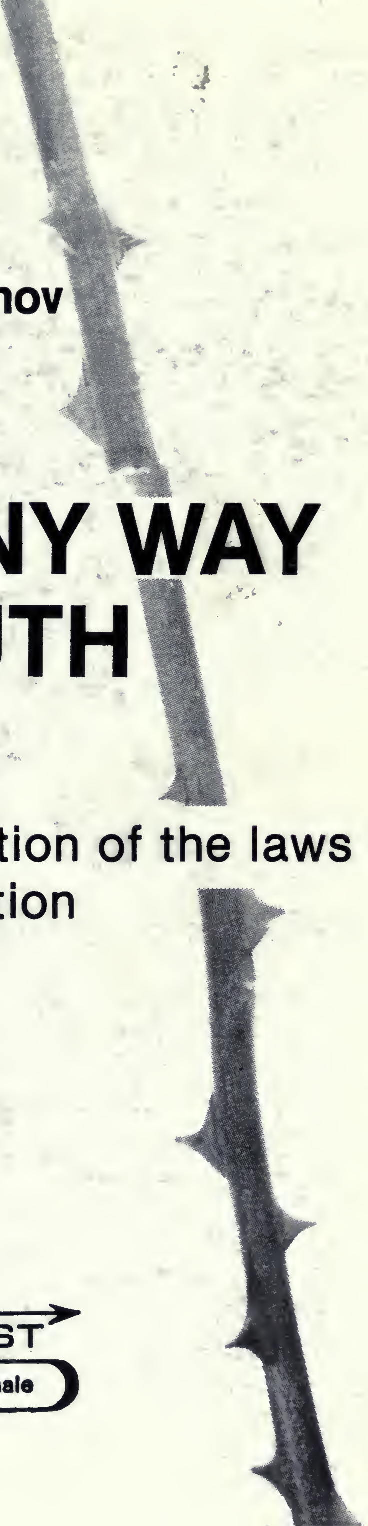


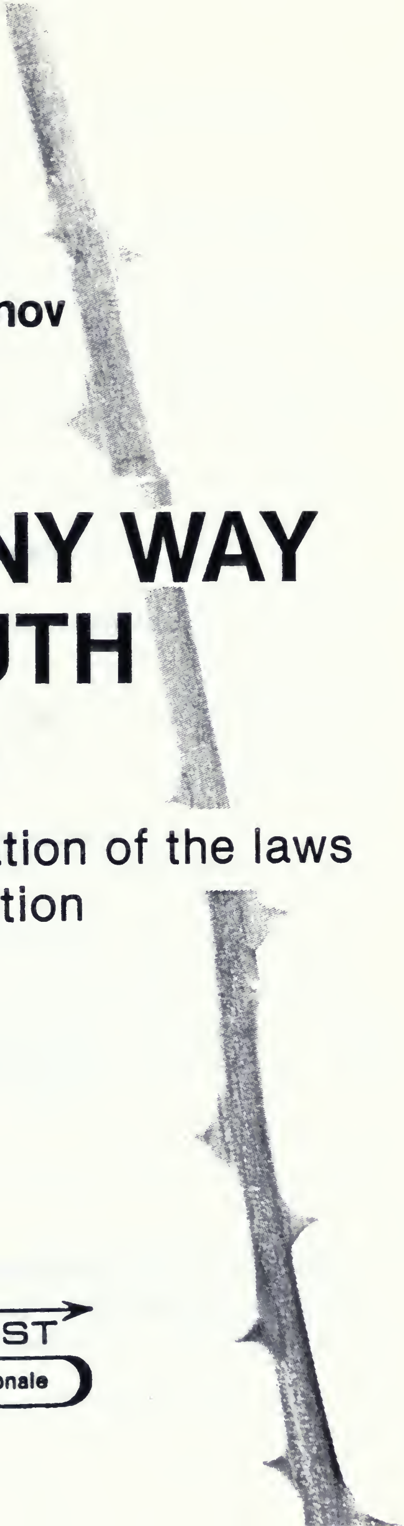
Stefan Marinov

THE THORNY WAY OF TRUTH

Part IX

Documents on the violation of the laws of conservation

EST-OVEST
Editrice Internazionale



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IL PROFETA Ê L'UNICO CHE NON IMPAZZISCE
PARLANDO AL VENTO.

- ГОВНОТО ТРЯБВА ДА Е НЕЩО МНОГО СЛАДКО.
- ЧИ КАК ТАКА?
- ЕМИ ГЛЕДАЙ МУХИТЕ КАК СА ГО НАКАЦАЛИ И ГО СМУЧАТ.

Разговор чут на конференцията "Physical
Interpretations of Relativity Theory",
Imperial College, London, September 1988.

МНОГИЕ ВЕЩИ НАМ НЕПОНЯТНЫ НЕ ПОТОМУ, ЧТО НАШИ
ПОНЯТИЯ СЛАБЫ, НО ПОТОМУ, ЧТО СИИ ВЕЩИ НЕ
ВХОДЯТ В КРУГ НАШИХ ПОНЯТИЙ.

Козьма Прутков

CHE COS'Ê DUNQUE IL TEMPO? - SE NESSUNO ME LO
DOMANDA, LO SO. SE DEVO SPIEGARLO A QUALCUNO,
NON LO SO.

Sant'Agostino

ПОБЕДИТЕЛЬ-ФАРАОН, ДЛЯ ПУЩЕГО УНИЖЕНИЯ, ЕЩЕ И
ВПРЯГ ПЛЕННОГО ЦАРЯ СОСЕДНЕЙ ЗЕМЛИ В СВОЮ
КОЛЕСНИЦУ ВМЕСТО КОНЯ.
- О ЧЕМ ТЫ ЗАДУМАЛСЯ? - СПРОСИЛ ЦАРЯ ФАРАОН.
- О КОЛЕСЕ, - ОТВЕТИЛ ПЛЕННИК. - ТА ЕГО ЧАСТЬ,
ЧТО СВЕРКАЕТ НА СОЛНЦЕ, ВСКОРЕ УТОНЕТ В ДОРОЖНОЙ
ГРЯЗИ, А ТА, ЧТО СЕЙЧАС ПОГРУЖЕНА В ГРЯЗЬ, СНОВА
ЗАСВЕРКАЕТ НА СОЛНЦЕ.

НИ ОДНО ДОБРОЕ ДЕЛО НЕ ОСТАЕТСЯ БЕЗНАКАЗАННЫМ.

TOUTE VUE DES CHOSES QUI N'EST PAS ÊTRANGE
EST FAUSSE.

Paul Valêry

МАЛО ЛИ ЧТО МОЖНО В КНИЖКЕ НАМОЛОТЬ.

B. B.

THE WAY IN WHICH TODAY'S PHYSICS TREATS THE UNCONVENIENT EXPERIMENTS.

By the courtesy of "Physics Today"

PREFACE

> В нашия живот са възможни само
> две трагедии. Едната - когато
> не стигнеш това, което гониш,
> другата, когато го стигнеш.
> Втората е по-лошата, това е истинската трагедия.
>
> Оскар Уайлд
>
> А ако си хукнал подир вятъра,
> и вземеш че го догониш. Тогава,
> Оскарик, какви ще ги дъвчеме?
>
> Мадам Батърфлайд

The ninth volume of THE THORNY WAY OF TRUTH is my ninth symphony!

Here I present the machine VENETIN COLIU (IL NICOLINO DI VENETO) which is so simple and has such a huge perpetuum mobile effect, that its realization is a question, if not of days, of weeks, but not of months or years.

In the following pages I give a detailed report on the VENETIN COLIU machines which have been built by Cavalli and Vianello in Treviso and by me in Graz. The reader can find the whole necessary experimental description and the relevant theoretical explanation, and thus can build the self-running machine alone.

Of course, I am sure that nobody will consider seriously my report, as everybody will say: "It is not possible that a perpetuum mobile can be realized in such a simple manner."

When I presented in 1986 the MAMIN COLIU machine in NATURE and NEW SCIENTIST, paying atrocious sums to publish its description as advertisement, I was sure that nobody will try to build this machine and to see its no-braking effect (because of the lack of money I could not build MAMIN COLIU with a closed energetic circle and after six attempts - see TWT-III - I gave up). Now, publishing in TWT-IX the description of VENETIN COLIU, I am sure again that nobody will try to see its self-accelerating effect.

Cavalli and Vianello said to me: "Stefano, do not publish the description and the explanation of the effect, as other persons will try to build the self-running machine and will perhaps appear before us in the public."

Proceeding from my long-year experience, I said to them: "The best way to keep a BIG discovery in secret is to publish it. Nobody believes in a big discovery, moreover if it can bring also BIG money."

And when Cavalli and Vianello looked at me with puzzling eyes, I narrated to them the following story:

Once the Persian caliph left his palace in the very early morning hours when the whole capital of his huge empire slept profoundly. He crossed the market, filled during the day by shouting men, but now completely desert and silent. The caliph took out from his pocket three of his most precious diamonds, threw them in the mud and returned to the palace without being seen by somebody.

The next day, at the same early hours, he went again to the same place of the market and looked about the diamonds. He could not find them in the mud where he has thrown them the day before. But after searching shortly around, he stumbled at the one diamond a couple of paces to the left, at the other a couple of paces to the right, and finally he revealed the third one sunk in a cow shit. Putting the diamonds again in his pocket, the caliph said to himself: Many people have seen the diamonds during the day. They have taken them in the hands, looked at their gleaming faces and after saying "a diamond?

here? in the mud? - Impossible!", they have thrown them again. And somebody, perhaps, has become angry and has hurled the diamond in the cow shit.

....

I had to prepare this volume in a haste. As I had not enough material, I reproduce here all my physics papers which have not been published in the previous volumes (I mean only the PUBLISHED papers).

All the papers are of the domain of space-time physics. With these papers (and with a dozen of other papers which still are not published) I restored in the seventies and in the early eighties the absolute Newtonian space-time concepts and showed the fallacy of Einstein's theory of relativity.

Certainly many persons have read or perused these papers, but surely all of them have said to themselves: "What? Refutation of Einstein? By a certain dark Bulgarian groom? - Impossible!"

И със статиите са си избърсали задника.

Graz, 29 March 1991, Good Friday   Stefan MARINOV

SCIENTIFIC PAPERS

THE PERPETUUM MOBILE "IL NICOLINO DI VENETO" (VENETIN COLIU)

Stefan Marinov

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A-8010 Graz, Austria

Abstract. The two variations of the electromagnetic generator "Il Nicolino di Veneto" (Venetin Coliu) are presented which I have recently constructed. The idea for this machine was suggested by my friends Manuele Cavalli and Bruno Vianello (Treviso, Italy) and for this reason I called the machine "Il Nicolino di Veneto", as Veneto is the Nothern Italian province where the town Treviso is situated. This machine, on the other hand, has many common features with the generator Mamin Coliu and I call it also with the Bulgarian translation of "Nicolino di Veneto" which is "VENETIN COLIU".

The substantial difference between MAMIN COLIU and VENETIN COLIU is the following: MAMIN COLIU is a generator without electromagnetic braking effect, while VENETIN COLIU has, so to say, a *reversed* electromagnetic braking effect, namely when induced electric energy is produced by VENETIN COLIU, it *accelerates* its rotation.

Thus there are now in the world the following three different classes of electromagnetic generators:

a) The rotation of any conventional generator is *braked* when induced electric energy is produced by it, i.e., a conventional generator has an electromagnetic *braking* effect (*normal Lenz effect*).

b) The rotation of MAMIN COLIU is *not braked* when induced electric energy is produced by it, i.e., MAMIN COLIU has *no* electromagnetic braking effect (*no Lenz effect*).

c) The rotation of VENETIN COLIU is *accelerated* when induced electric energy is produced by it, i.e., VENENTIN COLIU has an electromagnetic *accelerating* effect (*anomalous, or anti-, Lenz effect*).

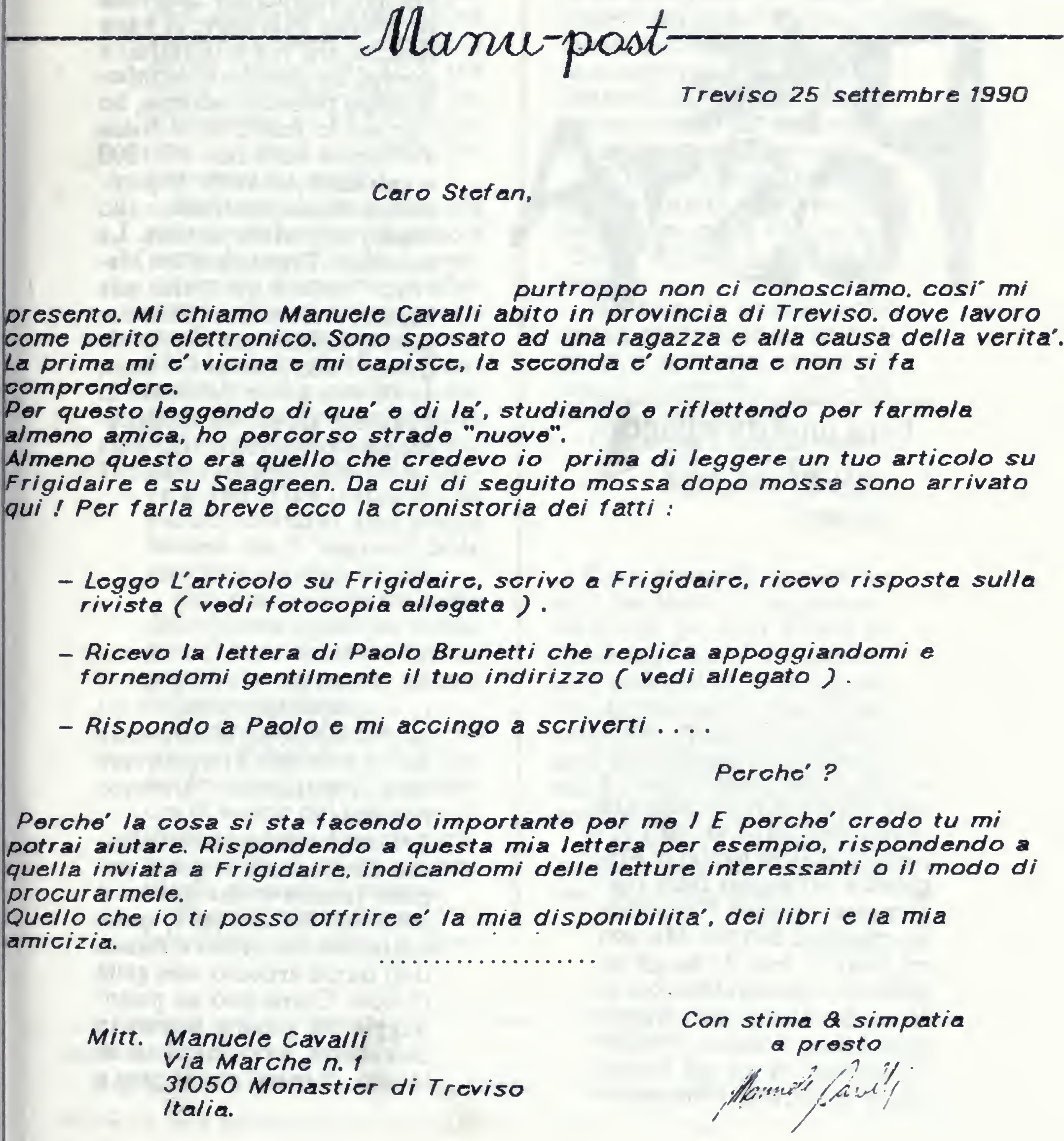
In MAMIN COLIU the magnetic flux flowing through a coil is changed by changing the mutual positions of *permanent magnets* and inducing electric current in the coil; however the magnetic field of this induced current has no mechanical action on the moving permanent magnets.

In VENETIN COLIU the magnetic flux flowing through a coil is changed by changing the mutual positions of pole shoes of *soft iron* and inducing electric current in the coil; at *lower* rotation, when the current induced in the coil is almost "in phase" with the induced tension, its magnetic field brakes mechanically the rotation of the moving pole shoes, but at *higher* rotation, when the current induced in the coil goes "out of phase" with respect to the induced tension (i.e., appears with a delay), its magnetic field accelerates mechanically the rotation of the moving pole shoes. At a certain rotational velocity VENETIN COLIU behaves as MAMIN COLIU, i.e, it has neither braking nor accelerating effect.

The accelerating power in the two variations of VENETIN COLIU which I have constructed is still less than the mechanical friction power and the energetic circle can be not closed to run the machine eternally. The construction of an eternally rotating machine (perpetuum mobile) is only a question of money and, as the reader can see by reading this report, the sum which I need is comically low.

1. HISTORICAL NOTES

After returning from a trip to Bulgaria (where I examined the plasma generator of Cyril Chukanov), I found a letter from Italy in my post. The beginning of the letter, in which Signor Manuele Cavalli presented himself and described the way on which he has heard of me and has found my address, was the follwoing:



Manu-post

Treviso 25 settembre 1990

Caro Stefan,

purtroppo non ci conosciamo, cosi' mi presento. Mi chiamo Manuele Cavalli abito in provincia di Treviso, dove lavoro come perito elettronico. Sono sposato ad una ragazza e alla causa della verita'. La prima mi e' vicina e mi capisce, la seconda e' lontana e non si fa comprendere.
Per questo leggendo di qua' e di la', studiando e riflettendo per farmela almeno amica, ho percorso strade "nuove".
Almeno questo era quello che credevo io prima di leggere un tuo articolo su Frigidaire e su Seagreen. Da cui di seguito mossa dopo mossa sono arrivato qui ! Per farla breve ecco la cronistoria dei fatti :

- *Leggo L'articolo su Frigidaire, scrivo a Frigidaire, ricevo risposta sulla rivista (vedi fotocopia allegata) .*
- *Ricevo la lettera di Paolo Brunetti che replica appoggiandomi e fornendomi gentilmente il tuo indirizzo (vedi allegato) .*
- *Rispondo a Paolo e mi accingo a scriverti . . . .*

Perche' ?

Perche' la cosa si sta facendo importante per me ! E perche' credo tu mi potrai aiutare. Rispondendo a questa mia lettera per esempio, rispondendo a quella inviata a Frigidaire, indicandomi delle letture interessanti o il modo di procurarmele.
Quello che io ti posso offrire e' la mia disponibilita', dei libri e la mia amicizia.

. . . .

Con stima & simpatia
a presto

Mitt. Manuele Cavalli
Via Marche n. 1
31050 Monastier di Treviso
Italia.

And here is the letter which Sign. Cavalli has written to Vincenzo Sparagna, the editor of the Italian monthly FRIGIDAIRE, where Cavalli has read my papers "Violation of the laws of conservation of momentum, angular momentum and energy" (see TWT-VI, p. 322) and "On the present status of physics" (see TWT-VII, p. 227):

POSTA

Una partita aperta tra E2 ed E4

Boh! non so, comunque l'importante è che lo facciate! Sono paurosamente interessato a tutto ciò che è verità pura. Gli spunti colti dagli articoli apparsi da qualche tempo su **Frigidaire**, mi hanno fatto raggiungere e solcare l'impetuoso mare del dubbio. Ma non mi basta. Il fatto è che gli argomenti e le considerazioni di **Boscoli e Monti**, caro **Sparagna**, hanno ricalcato e ordinato sentieri da me già battuti, anche se in modi meno specialistici, istintivamente appunto. Quando poi nel numero di novembre è apparsa l'intervista di **Stefan Marinov**, il vaso non ha più retto la fatidica goccia. Da qualche anno infatti, dopo ricerche estreme, ho iniziato lo studio della fisica sviluppata dalla fine del 1800 e agli inizi del 1900. In particolare mi sono interessato allo studio dell'elettrostatica. La macchina Testatica di cui Marinov parla è qui nella mia mente, ancora non perfettamente definita ma potenzialmente funzionante. Or bene, se da una parte l'articolo in questione mi sprona energicamente a proseguire, dall'altra mi inibisce la tranquillità

Io, purtroppo, non ho il piacere di conoscere Marinov e lui non ha il piacere di conoscere me! Ma credo di non avere torto, reputandolo "Davvero non male!...".

E credetemi quando definisco una persona in questi termini la mia stima per lui è massima. Sembra però, anche dalle foto sornione a fianco dell'inizio articolo, che gatta ci covi. Come può un personaggio del genere, entrare in una stanza, avvicinarsi ad un tavolo, chinarsi con il naso a pochi centimetri da un PERPETUUMMOBILE, e non assorbirne l'anima, il principio della sua essenza.

Pur non reputandomi un buon osservatore scientifico, io stesso credo avrei saputo intuire di più. Non vorrei entrare in particolari tecnici, però il nome della macchina stessa fà pensare al connubio di due teconologie TES- (da Tesla, con il suo famoso trasformatore) e -TATICA (dal tipo di energia utilizzata, l'elettrostatica appunto).

Nell'articolo invece si parla solo di condensatori di piccola e grande capacità. Non credo inoltre sia necessario un laboratorio ben attrezzato per riprodurre questo tipo di macchina, visto che **Paul Baumann** lavorò in carcere! E ancora. Credendo pure io nella logica intuitiva e nell'ispirazione piuttosto che nella logica scientifica (retaggio di pseudo-cultura), non posso credere che il "segreto" della macchina sia tanto occulto.

Non riesco a digerire molte delle frasette (quasi per sadico gioco) tecnicamente incongruenti che appannano un così brillante argomento.

Carissimo **Marinov**, dolcissimo **Frigidaire** volete farmi dormire? (perdo preziose ore di sonno nel tentativo di risolvere questa dannata partita a scacchi, di cui mi sembra, stiamo giocando il centro).

Che cosa volete da me? Volete darmi una mano, o devo fare da solo?

Un pò meno notizie sensazionalistiche e un pò più di precisione!

È come se io vi dicessi che al momento stò cercando di sviluppare un motore elettrostatico a cilindri, su modello di un'altro Padre, F. Luscla e non vi spiegassi come mai questa machina è autoeccitante e come penso di poter realizzare il trasformatore di Tesla necessario per innescarne il funzionamento perpetuo.

Vi prego quindi, fatemi capire se volete seminare per raccogliere o per dare aria ai "Semi!". (Come si dice qui nel veneto).

Ho sempre creduto che questa partita iniziata da Seagreen e di cui voi ora avete il tratto, sia partita da E2-E4. Giochi aperti quindi!

Con stima e fiducia vostro

Manuele Cavalli,
Treviso

Caro Manuele, quello che so è che Marinov sta lavorando e così gli altri. Come un fiume inghiottito dal deserto dell'imbecillità contemporanea la ricerca va avanti, ma sottoterra. Quando sgorgherà sarà una cascata resa purissima dal lungo filtraggio nelle profondità oscure del fango.

A presto, comunque, altri enigmi e qualche risposta ai tuoi angosciosi quesiti.

V.S.

I answered with a letter of the 3 October 1990, expressing my consent for scientific cooperation.

Then Cavalli wrote me a very long letter of the 21 October, of which I cite here the following part concerning his interest in a further development of my machine MAMIN COLIU, so that the energetic circle can be eventually closed and the machine run as a perpetuum mobile:

> Ho comunque un certa liberta' di movimento, se posso esserti utile conta pure su di me. Potrei se ti interessa portare avanti i tuoi esperimenti con la tua macchina MAMIN COLIU, ad esempio, risolvendo quei problemi tecnici ed economici (di cui parlavi nell'articolo su Seagreen) che ti hanno impedito di giungere ad un risultato definitivo. Potrei fare delle ricerche per te, o cercare qualcuno che ti possa aiutare; avrei anche la possibilita' di creare un banca dati di riferimento e di scambio per tutti quelli che come te e me fanno ricerche.

I answered with a letter of the 7 November in which I wrote that I can bring to Italy one of the MAMIN COLIU models to demonstrate the non-braking effect. If Sign. Cavalli should be convinced that it indeed is a non-braking generator, then he can develop further the machine and eventually close the energetic circle. Here is a part of my letter:

> Posso portare un modello della mia macchina MAMIN COLIU (simile alla quella fotografata nel SEAGREEN). Ne ho fatto 6 modelli, porterò l'ultimo, anche se e troppo pesante, quasi 15 chili. Lo porterò nel caso che vorreste fare un settimo modello. La macchina PRODUCE energia dal niente. Arrivo a ottenere una tensione d'uscita abbastanza alta, ma non riesco a ottenere una corrente alta, dunque una potentza alta. Ci sono problemi solamente TECNOLOGICI e FINANZIARI. Nella MAMIN COLIU TUTTO È CHIARO! Secondo me ci vogliono 10,000,000 lire per farla e il VOSTRO lavoro. Io potrei avvanzare 1,000,000. Poi voi dovete decidere, anche cercare qualche sponsor, se avete degli amici.

In the middle of November I visited Cavalli for two days in his house in Monastier di Treviso (a small village in the subburbs of Treviso) bringing the sixth model of MAMIN COLIU (see it on p. 94 of TWT-III). I learned his charming wife Lucia and he introduced to me some of his friends interested in "alternative energetics". With two of his friends, Alberto and Maurizio, we visited Paolo Brunetti in Bologna who offered to all of us a splendid dinner.

Cavalli's friend who was at the most interested in the "perpetuum mobile" problems was Signor Bruno Vianello of Roncade, another small subburb of Treviso.

After spending two fine days in the beautiful Cavalli's house, I left MAMIN COLIU in his and Vianello's hands and with a package of the 20th November I dispatched them additionally some pieces from Graz.

On the 6 December Cavalli sent me a telefax. As the text was badly received, I retype it here, giving, because of its importance, also its English translation and reproducing only the designs of the three figures of which the most important is Fig. 3 which, as a matter of fact, became then the machine "Il Nicolino di Veneto". The graph beneath the figures represents the dependence of the tension produced by the coil as a function of time. The rapid change of the voltage from positive to negative occurs exactly at the moment when the moving pole shoes pass in front of the stationary pole shoes.

fig. 1

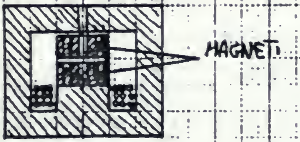
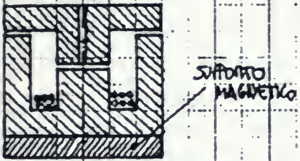


fig. 2



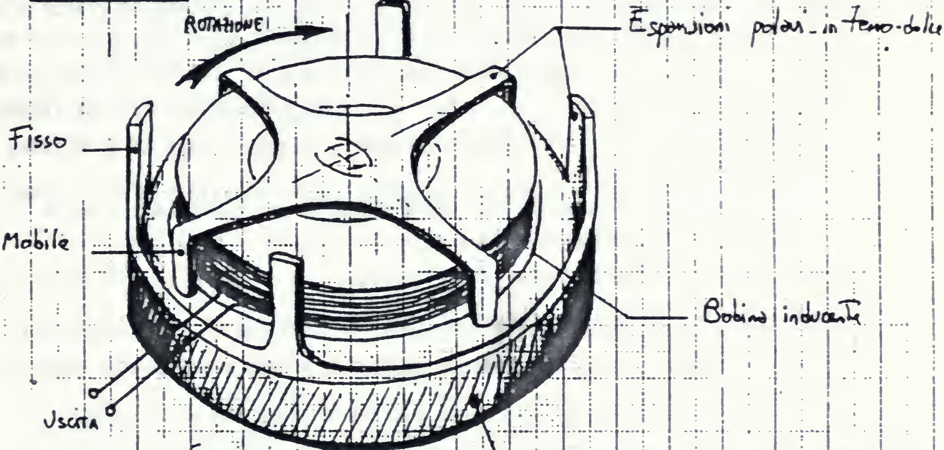
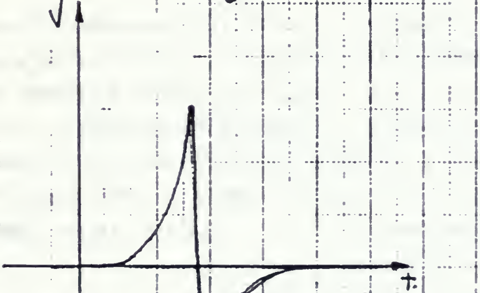


Fig. 3



Caratteristiche elettriche della bobina:

$R_{bobina} = 1100\ \Omega$

Filo di rame smaltato da 0,10 mm

Rilevamenti a vuoto :

1500 Giri/min → 9,2 Volt. ≃ } A.C.
→ 3,3 mA ≃ }

N.B. Aspetto una Tua opinione a questo →

Cavalli's fax thus was the following:

Caro Stefano,

in breve, sei mesi dopo aver letto il tuo articolo su Seagreen, avevo sintetizzato il concetto utilizzato per la MAMIN COLIU definendola un generatore che non funziona come motore. A questo punto mi sono guardato un po' intorno alla ricercha di qualche cosa di simile. Ho trovato proprio nel contesto del mio lavoro un generatore particolare che ti disegno nel foglio che segue. Si tratta di un generatore magnetico realizzato fissando una bobina su di un supporto formato da una calamita anellare e da un'espansione polare a forma di corona. Per chiudere le linee del campo magnetico si fa ruotare sopra a questo sistema un rotore a stella. Quando le espansioni polari delle due corone (fissa e mobile) sono una di fronte all'altra le linee del campo sono cortocircuitate e il flusso ê massimo, poi decresce rapidamente quando le espansioni si allontanano. Dopo aver realizzato, insieme con l'amico Bruno, un supporto adeguato, ho potuto fare delle misure. Ed ecco le sorprese!!!

(Il generatore sopra descritto viene fatto girare con un motorino in corrente continua che chiamerô M_1.)

ASSORBIMENTO M_1 CON BOBINA GENERATORE A VUOTO $I_1 = 91$ mA, $U_1 = 3$ V, DC

ASSORBIMENTO M_1 CON BOBINA GENERATORE IN CORTOCIRCUITO $I_1' = 89$ mA, $U_1 = 3$ V, DC

ASSORBIMENTO M_1 CON BOBINA GENERATORE COLLEGATA A TESTER. $I_1' = 89$ mA, $U_1 = 3$ V, DC

Nell'ultimo caso ho rilevato anche le grandezze in uscita alla bobina:

RILEVAMENTO $I_2 = 13.2$ mA, $U_2 = 1.6$ V, AC

Come potrai notare dai dati, quando io applico un carico alla macchina, ottengo una diminuzione dell'energia richiesta per farla ruotare. Ho provato anche ad alimentare con corrente continua la bobina mentre la macchina girava. A secondo della polaritâ con cui alimentavo la bobina ottengo un aumento o un abbassamento della corrente assorbita dalla macchina per la sua rotazione. Dalle prove fatte sembra che quando viene fornita alla bobina una corrente che genera un campo magnetico che coincide con quello del magnete permanente, si ottiene una diminuzione della corrente richiesta per il movimento.

In FIG. 1 - MAMIN COLIU (Tua proposta in sintesi).

In FIG. 2 - MAMIN COLIU NUOVO (Mia proposta in sintesi).

In FIG. 3 - Rappresentazione globale della macchina.

TRANSLATION:

Dear Stefan,

in brief, six months after having read your article in SEAGREEN, I synthesized the concept of MAMIN COLIU, defining it as a generator which cannot function as a motor. At this point, I looked around for finding something similar. I found in the domain of my own work (Cavalli is electrician in a car service - S.M.) a special generator which I design in the following sheet. This is a magnetic generator realized by fixing a coil over a support formed by a ring magnet and pole shoes in form of a crown. For closing the lines of the magnetic field, a rotor in form of a star rotates above. When the pole shoes of the two crowns (fixed and rotating) are in front of each other, the lines of the field are shortcircuited and the flux is maximum; the latter decreases rapidly when the pole shows go away from each other. After having built, together with our friend Bruno, an adequate support, I could do measurements. And here is the surprise!!!

(The generator above described is rotated by a small motor of direct current which I shall call M_1.)

INPUT M_1 WITH OPEN GENERATOR'S COIL $I_1 = 91$ mA, $U_1 = 3$ V, DC

INPUT M_1 WITH SHORTCIRCUITED GENERATOR'S COIL $I_1' = 89$ mA, $U_1 = 3$ V, DC

INPUT M_1 WITH GENERATOR'S COIL CONNECTED TO AMMETER $I_1' = 89$ mA, $U_1 = 3$ V, DC

In the last case I measured also the output of the coil:

OUTPUT $I_2 = 13.2$ mA, $U_2 = 1.6$ V, AC

As you can conclude from the data, when I apply a load to the machine, I obtain a diminishion of the requested energy for rotating it.

I tried also to feed the coil by direct current when the machine rotates. Correspondingly to the polarity with which I feeded the coil, I obtained an increase or decrease of the current consumed by the machine for maintaining its rotation. It seems that when the coil is feeded by current which generates a magnetic field which coincides with that of the permanent magnet, the current needed for the rotation decreases.

In FIG. 1 - MAMIN COLIU (Your proposal in synthesis).

In FIG. 2 - NEW MAMIN COLIU (My proposal in synthesis).

In FIG. 3 - Global presentation of the machine.

Now I shall interrupt for a while the historical notes and I shall give my explanation of the physical reasons which lead to the strange effect observed in Cavalli's machine which I shall call further "Il Nicolino di Veneto" (VENETIN COLIU).

2. EXPLANATION OF THE ANTI-LENZ EFFECT IN VENETIN COLIU

In Fig. 1 is presented the over-all view of VENETIN COLIU and in Fig. 2 its schematical diagram:

1-1' is a support of soft iron,

2-2' is a ring permanent magnet,

3-3' is the coil in which alternating tension is induced.

4-4' are the fixed pole shoes of soft iron,

5-5' are the moving pole shoes of soft iron,

6 is the axle of the rotating pole shoes of soft iron, too.

When the moving pole shoes 5-5' of the rotating "star" are not in front of the fixed pole shoes 4-4' of the stationary "crown", a considerable part of the lines of magnetic flux generated by the permanent ring magnet 2-2' closes through air without going through the cross-section of the coil 3-3'. When the moving pole shoes are in front of the fixed ones, some part of the lines of magnetic flux follows the way 2(N)-4-5-6-1-2(S) and crosses the plane of the coil. Thus when the moving pole shoes approach the fixed ones, the magnetic flux through the coil increases; when the former are in front of the latter this flux is maximum; and when these go apart this flux decreases.

Consequently an electric tension will be induced in the coil's windings. If the coil is shortcircuited, according to the Lenz rule, the induced current will have such a direction that the magnetic flux generated by it must be opposite to the <u>change</u> of the initial flux. Thus when the moving pole shoes approach the fixed ones, the coil will become a magnet with a north pole up and south pole down. This will lead to the result that, with respect to the situation when there is no current in the coil, less lines of

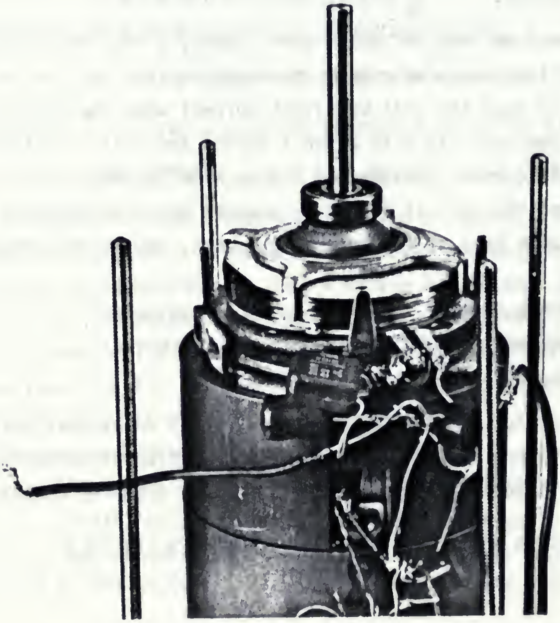


Fig. 1. - Over-all view of VENETIN COLIU which is one of the ten generators in the machine constructed by Marinov (see the over-all view of the whole machine in the next pages).

magnetic flux will follow the way 2(N)-4-5-6-1-2(S), as certain lines will be shortcircuited by the magnetic flux of the coil. Consequently, at short circuited coil, the fixed pole shoes will attract the moving ones with <u>less</u> force than in the case where the coil should be open.

On the opposite, when the moving pole shoes go away from the fixed ones, the latter will attract the former, at closed coil, with <u>bigger</u> force than in the case where the coil should be open.

Thus if the coil is shortcircuited, the rotation of the machine will be braked when induced electric power will be produced.

This is the picture of a conventional generator and this effect can be observed at <u>low velocities</u> also in VENETIN COLIU (<u>normal Lenz effect</u>). Cavalli has not mentioned this effect in his fax, but he could also observe it in his machine.

With the increase of the rotational velocity, at a certain <u>critical velocity</u>, the input power driving the motor remains the same at open and closed coil (<u>no Lenz effect</u>). And at <u>high velocities</u> the input power decreases at closed coil (<u>anti-Lenz effect</u>).

The explanation of the "anti-Lenz behaviour" of VENETIN COLIU is childishly simple:

The coil has a certain ohmic resistance R and a certain inductive resistance ωL, where ω is the angular frequency of the current going through the coil and L is its inductance (I shall suppose that the tension is sinusoidal function of time, although this is not exactly the case in VENETIN COLIU - see the graph in Cavalli's fax). The impedance of the coil is

$$Z = (R^2 + \omega^2 L^2)^{1/2} \quad (1)$$

and

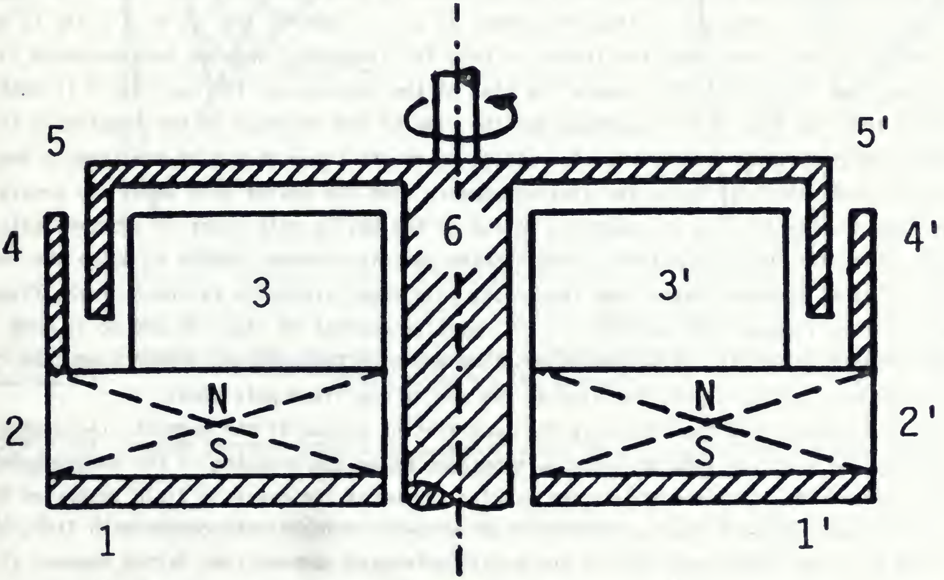


Fig. 2. Diagram of the generator VENETIN COLIU.

$$\phi = \arccos(R/Z) \tag{2}$$

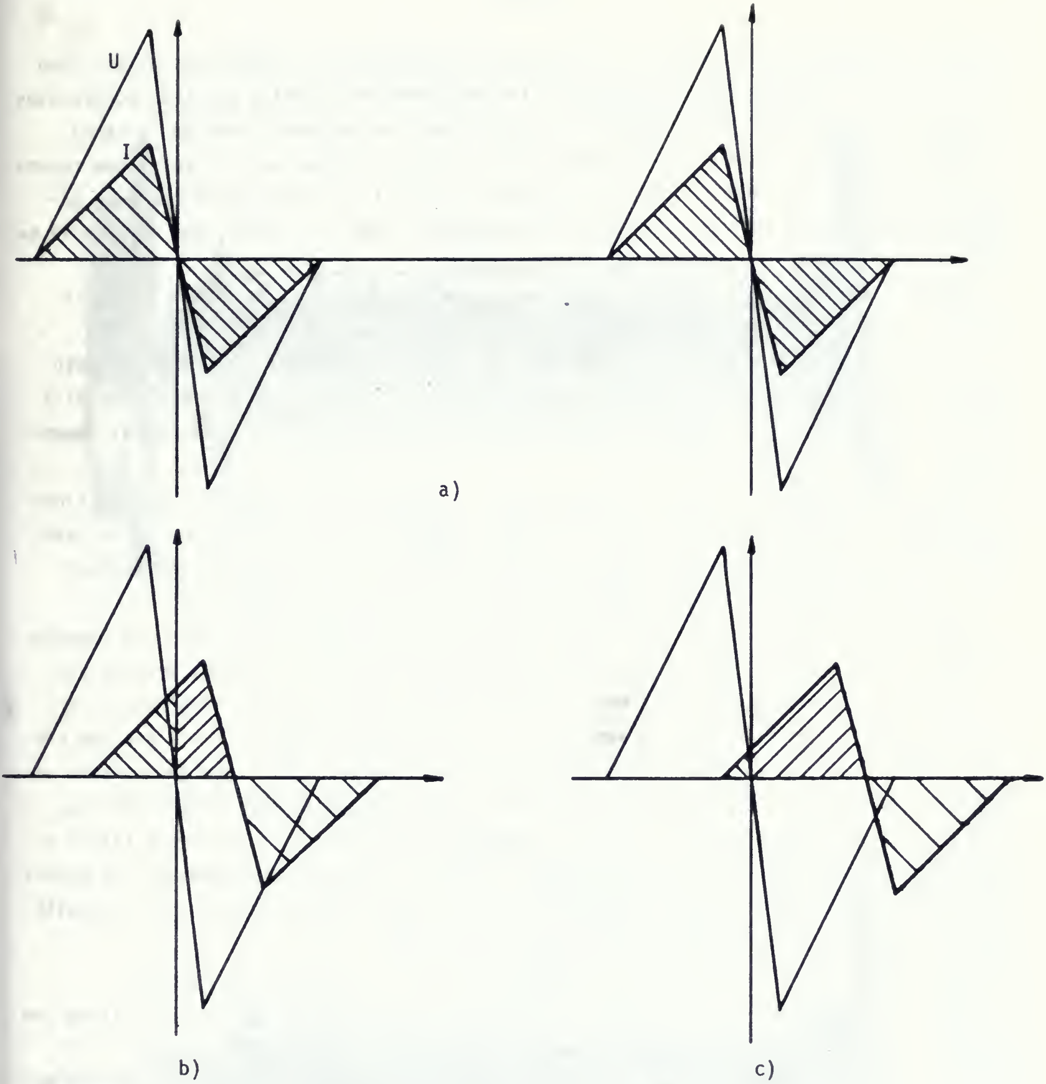
is the phase angle showing the angular delay in radians with which the maximum of the current in the coil appears after the appearance of the maximum of the tension. If T is the period of the induced tension, then $\Delta t = (\phi/2\pi)T = \phi/\omega$ is the time after which the maximum of the current appears after the maximum of the tension.

At lower rotational velocities we can accept $\omega L \ll R$. In such a case the current appears simultaneously with the tension and VENETIN COLIU works as a conventional generator. With the increase of the rotational velocity, a part of the current which generates north pole in the coil up in fig. 2 appears when the moving pole shoes go away from the fixed pole shoes. As this current decreases the attraction between the pole shoes, its action is not opposing the driving torque of the motor but supporting it.

At the critical velocity the braking and accelerating torques become equal and the machine shows zero Lenz effect. With further increase of the angular velocity, the accelerating torque becomes stronger than the braking torque and the machine becomes self-accelerating.

The correlation in time between tension and current in VENETIN COLIU is presented in fig. 3. In fig. 3a there are presented two "bursts" of induced tension and respective induced current at $\phi = 0$ for two consequent approaches-separations of the moving and stationary pole shoes. As the latter are very slim and the distance between every two consequent pole shoes is considerable, for the predominant part of the time there is no induced tension in the coil, as for the predominant part of the time the magnetic flux through the coil remains quite the same. In fig. 3b there is presented only one "burst" of induced tension and respective induced current at $\phi = \pi/4$ and in fig. 3c at $\phi = \pi/2$ (I have to emphasize once more that the theory is true for sinusoidal induced tension which is not the case in VENETIN COLIU where the time of the increase of the positive U is much bigger than the time of its decrease and the time of the increase of the negative U is much shorter than the time of its decrease). As in the cases 3b and 3c the induced negative current (which is below the x-axis) appears when the moving pole shoes are pretty far from the fixed ones, its magnetic action on the moving pole shoes is substantially weaker than the magnetic action of the induced positive current (which is above the x-axis), as the latter appears always when the moving pole shoes are quite in front of the fixed ones. For this reason the hatching of the negative current in figs. 3b and 3c is done not so dense as in fig. 3a where the positive and negative currents appear symmetric with respect to the conjunction line of the moving and fixed pole shoes.

At a certain rotational velocity the accelerating torque of the magnetic field generated by the positive induced current, appearing after the crossing of the conjunction line, becomes equal to the sum of the braking torques of the magnetic field generated by the positive induced current, appearing before the crossing of the conjunction line, and of the magnetic field generated by the negative induced current (the latter appears always after the crossing of the conjunction line). For this rotational velocity there is



a)

b)

c)

▧ induced current generating magnetic field which brakes the motion of the magnet inducing the current

▨ induced current generating magnetic field which accelerates the motion of the magnet inducing the current

Fig. 3. - Time correlation between tension, U, and current, I, in VENETIN COLIU:

a) $\phi = 0^0$, a case appearing when $R \gg \omega L$, i.e., for low rotation,

b) $\phi = 45^0$, a case appearing when $R = \omega L$, i.e., for higher rotation,

c) $\phi = 90^0$, a case appearing when $R \ll \omega L$, i.e., for very high rotation.

neither braking nor acceleration of the machine as a whole. For velocities higher than this critical velocity, the net torque of the positive and negative currents accelerates the machine as a whole (if assuming, of course, that the mechanic friction is zero).

This is the whole "puzzle" with VENETIN COLIU and Dr. Maddox can present a new conundrum on the pages of NATURE, although for every logically thinking child there is nothing puzzling in Dr. Maddox' first conundrum (NATURE, **346**, 103, 1990) and there will be nothing puzzling in his eventual second conundrum.

One will say that this effect must exist in any direct current generator. Yes, IT EXISTS! - Why then it was not observed until now? - For two reasons:

1) The generator must have an abrupt change of the induced "positive" tension into "negative" tension, as this is the case with VENETIN COLIU (see the graph in Cavalli's fax). In almost all d.c. generators used by mankind the tension has a sinusoidal dependence.

2) The effect appears when cosϕ becomes much less than unity. However then the flowing current is pretty low. The best effect will appear at cosϕ = 0, but in such a case, at final ohmic resistance, as is the case in any generator in our world, the induced current will be zero. Thus cosϕ must be neither too high nor too low.

Obviously, the first person in the world who has realized this situation was Manuele Cavalli. Perhaps other people have also observed such an effect, but they were blind.

The most comical aspect in the whole story is that Cavalli has not constructed an original machine. He has taken an ignition coil which can be found in every benzine car (it activates the high voltage for generating the spark which ignates the gas mixture after the compression) and has done the most simple energetic measurements considering this coil as a power generator. The Bosch company has produced millions and millions of such ignition coils but none of the engineers who have developed and examined the models has noticed that these ignition coils violate the energy conservation law and that with their help a perfect perpetuum mobile may be constructed.

Now I shall explain the effect which Cavalli reported at the end of his fax.

Cavalli has observed that when the coil was feeded by constant current generating the same magnetic field as the permanent ring magnet, the motor needed less power for its rotation. Indeed, in such a case the magnetic flux of the coil "binds" a part of the magnetic flux generated by the permanent magnet. Thus less lines of the magnetic flux will follow the way 2(N)-4-5-6-1-2(S) and the attraction between the fixed and moving pole shoes will be less. In such a case the eddy currents induced in the pole shoes during the rotation will be weaker and their braking effect will be less (the eddy currents have always a normal Lenz effect). The friction due to the eddy currents in VENETIN COLIU has very important NEGATIVE influence and I shall come to this topic later, as this was one of the reasons hampering me to run my first VENETIN COLIU machine (see figs. 4 and 5) as a perpetuum mobile.

Cavalli has further observed that when the coil was feeded by constant current genera-

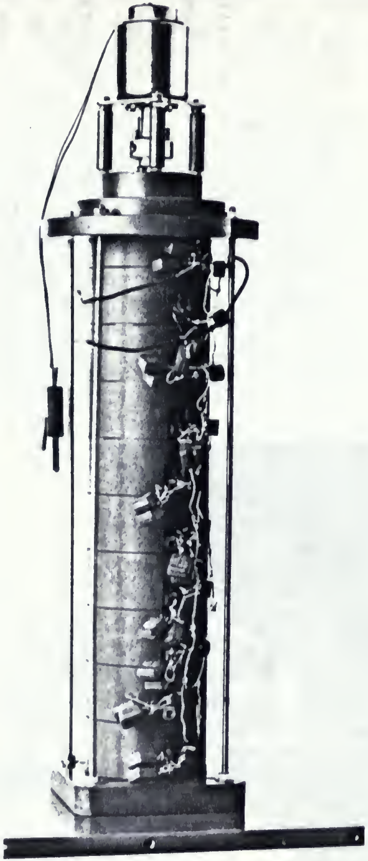


Fig. 4. - The first VENETIN COLIU machine constructed by Marinov in January 1991. The d.c. motor on the top drives ten Bosch a.c. generators.

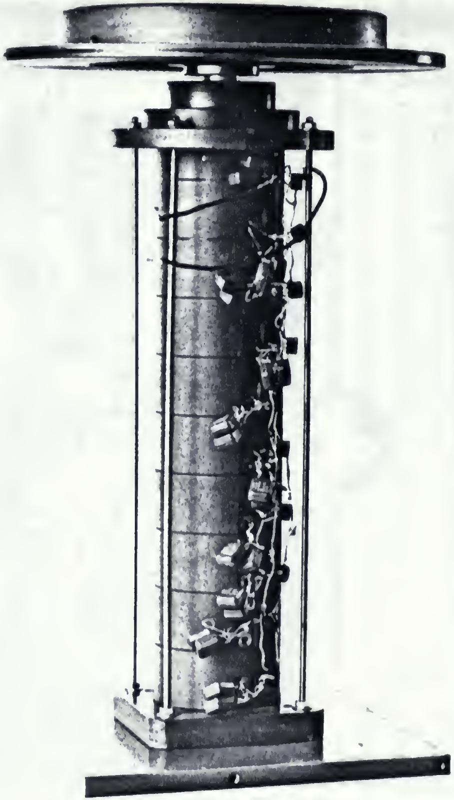


Fig. 5. - The same machine as in fig. 4, where the driving motor sets in motion a fly-wheel, so that all losses are reduced to a minimum.

ting magnetic field opposite to the field of the permanent ring magnet, the motor needed more power for its rotation. Oppositely to the first case, now the magnetic flux of the coil "repels" a part of the magnetic flux generated by the permanent magnet which instead to go through the "air" of the coil will follow the way 2(N)-4-5-6-1-2(S) through the "iron" and the attraction between the fixed and moving pole shoes will be bigger. Now the eddy currents appearing in the pole shoes during the rotation will be stronger and the braking effect will be bigger.

At the end I shall calculate the input and output powers of Cavalli's machine in which he has taken only one Bosch generator (see the figures in Cavalli's fax):

Input power at open generator's coil: $P_1 = I_1U_1 = 273$ mW.

Input power at short-circuited generator's coil: $P_1' = I_1'U_1 = 267$ mW.

Output of the short-circuited coil (ohmic heat):

a) For the coil of the Bosch generator which has a wire of diameter of 0.1 mm and resistance R = 1100 Ω (see the figures on the sheet with the drawings in Cavalli's fax): $P_2 = I_2U_2 = 3.3\times9.2 = 30$ mW.

b) For a new wound coil with greater diameter of the wire and resistance 52 Ω (see the figures in the text of Cavalli's fax): $P_2 = I_2U_2 = 13.2\times1.6 = 21$ mW.

Thus when the output of the generator was $P_2 = 30$ mW (respectively, $P_2 = 21$ mW), the input to the driving motor instead to increase has decreased with $\Delta P_1 = P_1' - P_1 = - 6$ mW.

I shall show later that when the cross section of the copper in the coil is the same, the output must be the same and is thus independent of the thickness (and consequently of the number of turns) of the coil's wire. Cavalli's VENETIN COLIU machine with four generators is shown in fig. 6.

Fig. 6. The machine VENETIN COLIU constructed by Cavalli in December 1991 with four generators which have been taken from the Italian car Alfa Romeo Giulia and are produced by the German compagny Bosch under Bosch production number 1237011030. I have bought from Bosch in Würzburg one such generator for DM 35. The time of delivery was one day.

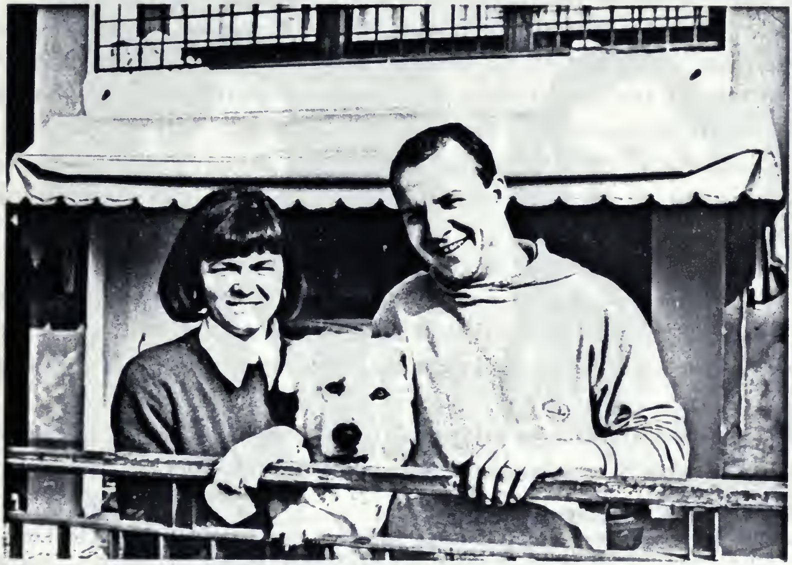


Fig. 7. - Lucia and Manuele Cavalli with the bitch Judith in front of their house in Monastier di Treviso.

3. FURTHER HISTORICAL NOTES

On the 9 December 1990 I flaw for a week to Leningrad to take part at a conference on non-conventional energetics and to meet the organizers (Parshin, Tolchelnikova) of the anti-relativity conference which has to take place in Leningrad in September 1991. After returning, I went to Treviso (on the 21 -24 December) to see the self-accelerating effect with my own eyes. Cavalli, Vianello and I decided to develop further the machine together and any of us took the obligation to cover 1/3 part of all future investments. The self-running machine will be then presented to the world as result of our common work.

As there were difficulties in finding many Bosch ignition generators in Italy and in Austria, the decision was taken that during my trip to Germany I shall buy there 10 such generators which will be then mounted on a common axle, so that the energy produced from nothing should be increased.

I was invited for the New Year (from 28 December to the 4 January) to take part, together with Eike Müller, at a conference in the Burg Rothenfels, near Würzburg, where I delivered lectures on the violation of the laws of conservation. At the concluding "merry evening" a big "perpetuum mobile" was granted to me whose parts were: a pan, a pot, bottles, cups, an orange, and other similar things tied together by many strings which oscillated at swing.

I bought in Würzburg the 10 Bosch ignition generators and returning to Graz constructed my first VENETIN COLIU machine (see figs. 1, 4 and 5). The report on this first machine is presented in section 4.

As I could not close the energetic circle in this first machine, I brought it to Treviso (14 - 19 January 1991), so that all three of us could do measurements on it and take a decision how to built the next machine. This time I was guest in Bruno's house where his beautiful Michela seduced us with temptingly covered tables.

I built the second VENETIC COLIU machine at the end of January and at the beginning of February. The report on the second machine, where the energetic circle again could be not closed, is given in section 5.

I brought my second VENETIN COLIU machine to Treviso on the 2 March 1991.

After going for a couple of days to visit Monti and Brunetti in Bologna and Bartocci in Perugia for discussing the organization of our conference "WHAT PHYSICS FOR THE NEXT CENTURY?", which has to meet in Ischia at the end of May 1991, I returned on the 9 March to Treviso.

We decided that the third machine will be built by Cavalli and Vianello in Treviso. I left for this machine the strong Neodymium magnets from MAMIN COLIU and took the latter with me again back to Graz.

The third machine has a very simple design in which our previous investigations have been taken into account. I am firmly convinced that the third machine will be selfrunning.

Fig. 8. - Michela and Bruno Vianello in front of their house in Roncade (Treviso).

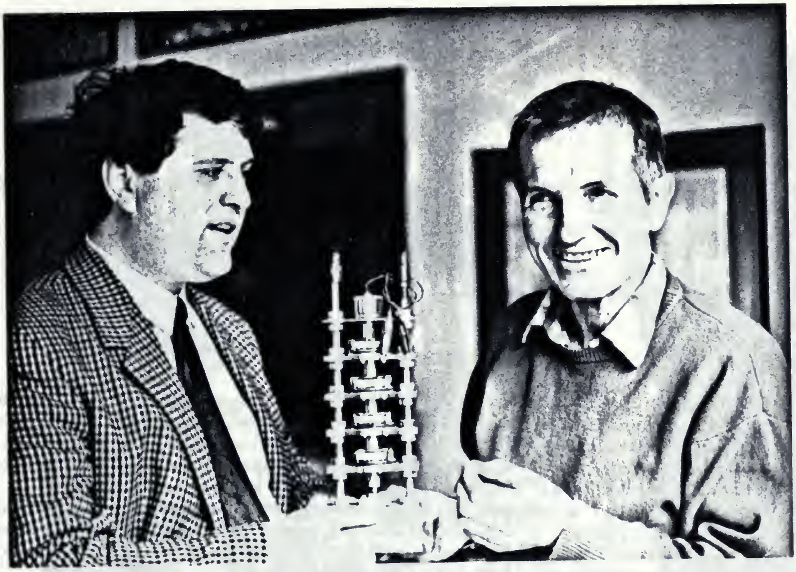


Fig.9. - Vianello and Marinov with the VENETIN COLIU machine built by Cavalli and Vianello.

Fig. 10. - Lucia and Manuele with the second VENETIN COLIU machine.

In Treviso all three of us signed the following protocol for sealing our colaboration:

Treviso, 10 marzo 1991

CONVENZIONE

I SOTTOSCRITTI:

Vianello Bruno nato a Roncade il 12.2.61 ivi residente in Via S. Rocco, 58

Cavalli Manuele nato a Biella il 10.12.61 residente a Monastier Via Marche, 1

Marinow Stefan nato a Sofia il 1.2.1931 residente a Graz Via Morellenfeldgasse, 16

PREMESSO

A seguito di un incontro svoltosi a casa del sig. Cavalli e promosso dallo stesso, i sottoscritti: Stefan Marinow, Manuele Cavalli, Bruno Vianello sono successivamente interessati allo sviluppo sia teorico che sperimentale di un nuovo sistema energetico che prevede la produzione di energia senza richiedere trasformazioni di altre fonti energetiche esterne al sistema stesso.
Tali sviluppi scientifici e tecnologici, coordinati successivamente dai tre, hanno portato allo sviluppo e costruzione di numerose apparecchiature; grazie a queste si sono raggiunti dei risultati che mettono in discussione teorie e principi fondamentali della fisica moderna.
La strada che bisogna percorrere per realizzare questa nuova fonte di energia, prevede iniziative economiche considerevoli, svolte in laboratori attrezzati per ricerche piu profonde e dettagliate.

CONVENGONO

di scrivere un libro-relazione (TVT-IX) dove vengono descritti i nuovi fenomeni scoperti e di spedire una copia di questo libro al "Comitato Nobel di Fisica" di Stoccolma, al fine di tutelare storicamente la scoperta e di metterla a disposizione dei grossi laboratori di fisica mondiale e a tutti quei ricercatori che volessero studiare questa nuova fonte potenziale di energia.
Si riconosce fin d'ora ai sottoscritti in maniera equa il diritto storico di esclusiva della scoperta scientifica.
I sottoscritti si impegnano singolarmente e collettivamente a dar corso a successivi studi e sviluppi. Risultati futuri conseguenti a questa ricerca saranno concordamente riconosciuti ad ognuno in maniera equa.
La presente covenzione ha validita' illimitata, con la presente i sottoscritti si impegnano personalmente all'attuazione del presente accordo, ai fini della miglior riuscita dell'iniziativa.

letto, confermato e sottoscritto

Treviso, li 10 marzo 1991

....

Manuele Cavalli
....

S. Marinov
....

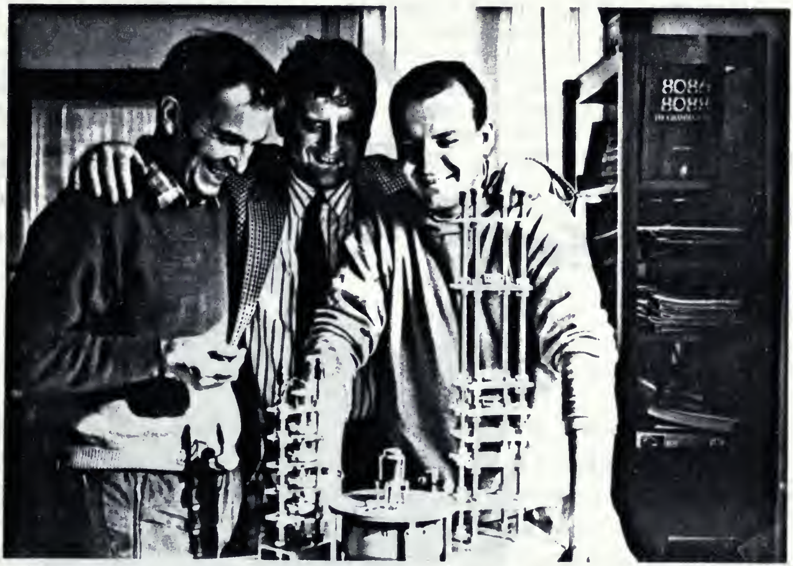


Fig. 11. - Marinov, Vianello and Cavalli with the two machines built by Cavalli and Vianello (the second one is not finished) and the second machine built by Marinov.

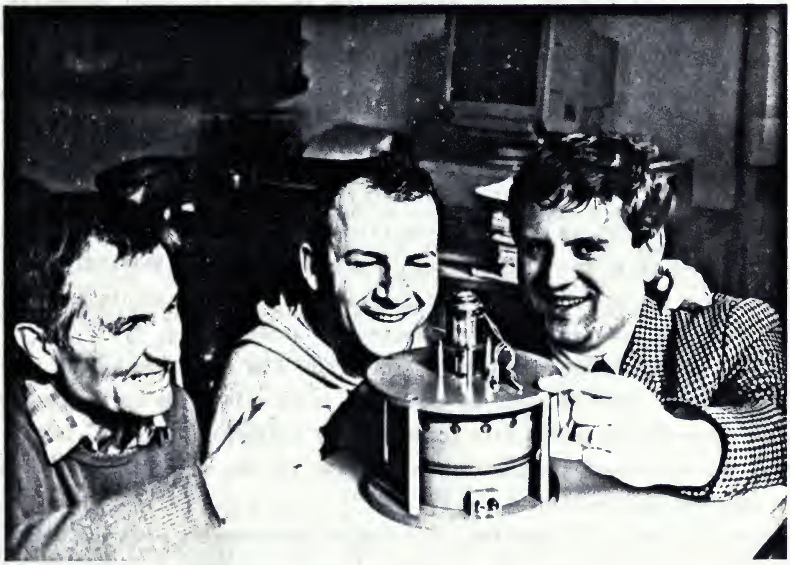


Fig. 12. - Marinov, Cavalli and Vianello with the second VENETIN COLIU machine.

Fig. 13. - The first VENETIN COLIU machine with the big fly-wheel resembled a little man with a gypsy hat. This was also one of the reasons to call the whole machine IL NICOLINO DI VENETO. The fly-wheel had this form as my mechanician occasionally found a piece of plastic of such a form. Holding the piccolo Nicolino in my hands, I had perhaps the same feeling as the shoemaker Giapetto holding the wooden Pinocchio. I am looking about the day when the slim Nicolino, too, will begin to move by his own force.

4. THE FIRST VENETIN COLIU MACHINE

Thus the first VENETIN COLIU machine (figs. 1, 2, 4, 5, 13, 14, 15, 16) constructed by me consisted of 10 Bosch generators (production number 1237011030) mounted on a common axle one above the other. The predominant part of the measurements has been done when the driving motor rotated the axle directly, as shown in fig. 4.

The a.c. output of every single generator could be rectified by own two-way rectifier, and then all d.c. outputs could be connected in parallel. The coil of every generator could be connected in series with condensers of different capacity. In the photographs one sees the rectifiers and the condensers (two for any generator which could be connected in parallel and in series).

In table 1 there are given the input-output measurements when the coils of the original Bosch generators (see later) have been used and no condensers have been introduced.

TABLE 1. - Input-output measurements with VENETIN COLIU - I, with rectification, with original Bosch coils, without condensers

Tension applied to the motor	Current consumed by the motor		Power consumed by the motor		Increase of the consumed power	Tension induced in the generator	Current flowing in the generator	Power produced by the generator
	at open circuit	at closed circuit	at open circuit	at closed circuit				
U_m (V)	I_m (mA)	I'_m (mA)	P_m (mW)	P'_m (mW)	ΔP_m (mW)	U_g (V)	I_g (mA)	P_g (mW)
10	61	65	610	650	+ 40	10	15	150
20	68	68	1360	1360	0	18	21	378
30	79	76	2370	2280	- 90	25	26	650

The resistance of every Bosch coil was R = 1100 Ω and the inductivity was L = 2 H. The wire's diameter was estimated to be 0.1 mm, but I have not measured it exactly.

When rectification was not used and the energetic measurements were done on every single generator's coil, summing then them up, the produced power increased with about 10%. The reason is that on every rectfier a part of the induced tension is lost (about 0.7 V). The a.c. tension induced in every coil was about 30% of the d.c. tension produced by all coils when connected in parallel. For sinusoidal induced tension the a.c. tension had to be equal to the d.c. tension, but this was not the case in our coils.

If we should assume that the cross-section of the copper in the coils does not depend on the number of the windings, we shall have the following relation between the resistances of two coils, the one of which has n_1 windings and the other n_2 windings

$$R_2 = (n_2/n_1)^2 R_1. \tag{3}$$

To verify relation (3), imagnine two coils with the same rectangular cross-section, the one of which has $n_1 = 1$ windings and the other $n_2 = 4$ windings. According to formula (3) we have $R_2 = 16R_1$. On the other hand, if we denote by R the middle radius of the coil and by r_1 and r_2 ($r_1 = 2r_2$) the diameters of the wires in the first and second cases ($R \gg r_1$), we shall have, denoting by ρ the specific resistance of the copper (i.e., the resistance of a wire with unit length and unit cross-section),

$$R_1 = \rho 2\pi R/\pi r_1^2 = 2\rho R/r_1^2, \qquad R_2 = 4\rho 2\pi R/\pi r_2^2 = 16(2\rho R/r_1^2) = (n_2/n_1)^2 R_1. \tag{4}$$

On the other hand, as

$$r_1^2/r_2^2 = n_2/n_1, \tag{5}$$

we shall have

$$R_2 = (r_1/r_2)^4 R_1. \tag{6}$$

The current flowing in the first coil, for $\omega L_{1,2} \ll R_{1,2}$, is

$$I_1 = U_1/R_1, \tag{7}$$

and in the second coil is

$$I_2 = U_2/R_2 = (n_2/n_1)U_1/(n_2/n_1)^2R_1 = (n_1/n_2)I_1. \quad (8)$$

Thus the total current flowing through the cross-sections of the two coils is the <u>same</u>

$$(I_{tot})_1 = n_1I_1, \qquad (I_{tot})_2 = n_2I_1 = n_1I_1. \quad (9)$$

The ways to increase the output power, which would lead also to an increase of the self-accelerating power, when the input power remains the same, were the following:

1. To increase the generated tension. This could be done
   a) by increasing the strength of the generator's ring magnets,
   b) by increasing the number of the fixed and rotating pole shoes.
2. To increase the generated current. This could be done
   a) by increasing the cross-section of the coils.

I was unable to introduce the changes 1a and 1b, but there were certain limits in which I could introduce the change 2a.

First I wound additional windings on the Bosch coils and I filled the whole still available space, as one can see in fig. 14 (in the original Bosch coils the outer diameter of the coil is less than the diameter of the holder). In this way 300 additional windings of wire of diameter 0.22 mm could be wound. Then I replaced all other nine

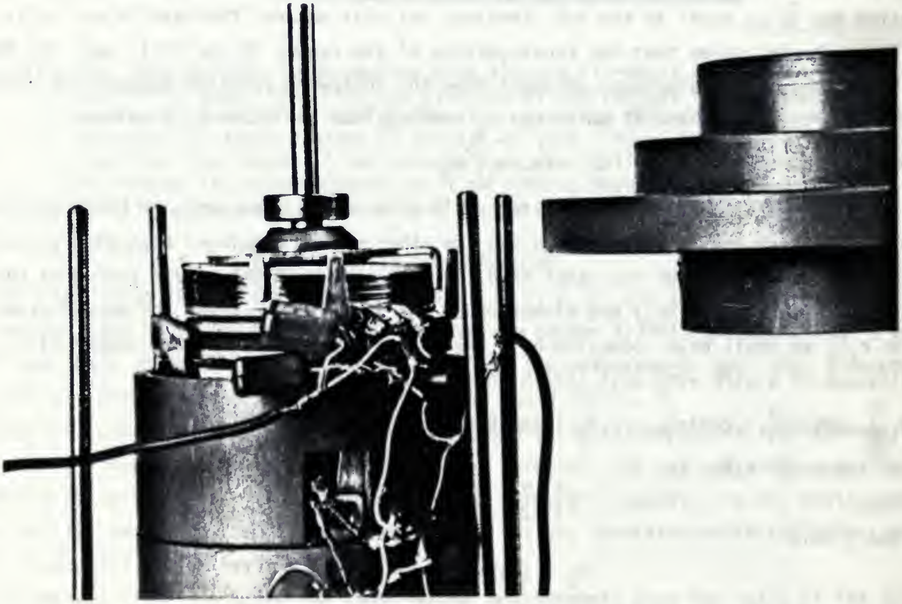


Fig. 14. - One of the Bosch generators (the tenth in VENETIN COLIU - I) with the original Bosch coil on which additional windings were wound.

coils by coils wound without holders. The new nine coils had about 3000 windings each of wire of diameter 0.22 mm, resistance about 400 Ω and inductance about 1 H.

The inductance of a singular circular loop, that has a radius R and is made of wire of radius r, is (see W. T. Scott, The Physics of Electricity and Magnetism, John Wiley, 1966, p. 361)

$$L = \mu_0 R\{\ln(8R/r) - 7/4\}, \tag{10}$$

where μ_0 is the magnetic constant.

The calculation of the inductance of a ring coil with n windings is rather complicated, but the following approximate formula can be in many cases used

$$L = \mu_0 \pi R^2 n^2/H, \tag{11}$$

where R is the outer radius of the circular coil, H is its height and n is the number of the windings.

Thus if there are two coils with the same geometry, respectively, with n_1 and n_2 windings, the relation between their inductances will be similar to relation (3), namely

$$L_2 = (n_2/n_1)^2 L_1. \tag{12}$$

Thus, taking into account formulas (3) and (12), we see that the phase angles of these two coils will be equal (see formulas (2) and (1))

$$\cos\phi_2 = R_2/(R_2^2 + \omega^2 L_2^2)^{1/2} = R_1/(R_1^2 + \omega^2 L_1^2)^{1/2} = \cos\phi_1. \tag{13}$$

In table 2 there are given the input-output measurements when the new coils with a bigger cross-section have been used and no condensers have been introduced.

TABLE 2. - Input-output measurements with VENETIN COLIU - I, with rectification, with new generator coils, without condensers

Tension applied to the motor	Current consumed by the motor		Power consumed by the motor		Increase of the consumed power	Tension induced in the generator	Current flowing in the generator	Power produced by the generator
	at open circuit	at closed circuit	at open circuit	at closed circuit				
U_m (V)	I_m (mA)	I'_m (mA)	P_m (mW)	P'_m (mW)	ΔP_m (mW)	U_g (V)	I_g (mA)	P_g (mW)
10	61	63	610	630	+ 20	14	17	235
20	68	66	1360	1320	- 40	25	23	575
30	79	74	2370	2220	- 150	35	27	945

Considering tables 1 and 2 we see that at low rotational velocities (U_m = 10 V) the power consumed by the motor increased when the generators' coils were short-circuited. At higher rotational velocities (U_m = 30 V) the power consumed by the generator decreased when the generators' coils were short-circuited. This is the self-accelerating effect of the machine VENETIN COLIU.

Another way for increasing the current in the coils was to put the machine at lower temperature where the specific resistance of the copper is lower. I did measurements at about -20^0 putting VENETIN COLIU - I on my balcony in the cold winter nights. An increase in the current was observed and the produced by the generator power did increase. But also the power consumed by the motor did increase. The relative increase of the consumed power was even greater than the relative increase of the produced power. I could not establish whether the consumed power increased because at the lower temperatures the eddy currents (see later) in the pole shoes increased or the friction in the ball-bearings increased because of thermal deformations. Anyway I abandoned this way for increasing the produced power.

Finally, to increase the current in the generators, I put condensers in series with every generator's coil. In table 3 there are given the input-output measurements when condensers with capacitance C = 1.4 μF have been put.

TABLE 3. - Input-output measurements with VENETIN COLIU - I, with rectification, with new generator coils, with condensers

Tension applied to the motor	Current consumed by the motor		Power consumed by the motor		Increase of the consumed power	Tension induced in the generator	Current flowing in the generator	Power produced by the generator
	at open circuit	at closed circuit	at open circuit	at closed circuit				
U_m (V)	I_m (mA)	I'_m (mA)	P_m (mW)	P'_m (mW)	ΔP_m (mW)	U_g (V)	I_g (mA)	P_g (mW)
10	61	72	610	720	+ 90	10	21	210
20	68	74	1360	1480	+ 120	20	34	680
30	79	78	2370	2340	- 30	26	47	1222

At the availability of a condenser with capacitance C, the impedance of the coil will be given not by formula (1) but by the following formula

$$Z = \{R^2 + (\omega L - 1/\omega C)^2\}^{1/2}, \tag{14}$$

and the phase angle between the tension and the current (see formula (2)) will be smalle if assuming that $2\omega L > 1/\omega C$.

Thus we see that now the self-acclerating effect is smaller, but, because of the higher currents flowing in the coils, the produced power is bigger.

First my intension was to try to extract a part of the power produced by the generator and to apply this power to the driving motor, searching in this way to close the energetic circle. Then I abandoned this trend for the following reasons:

1. When extracting power from the machine, the produced power decreased (the highest power is produced when short-circuiting the coils). Respectively, also the self-accelerating power decreased, as the current flowing in the coils was lower.
2. Any transformation of energy involves inevitable losses.

Thus I decided to search for a way in which the self-accelerating power will overwhelm the friction power of the machine and in this way to bring it to eternal motion.

For this aim I substituted the driving motor by a fly-wheel (fig. 15). The driving motor sets this fly-wheel in motion and then the motor is removed, so that only the friction power in the ball-bearings (and in the air) remains to be overwhelmed by the self-accelerating power.

The big fly-wheel had, of course, a considerable friction. To diminish this friction, I put a ring magnet under the fly-wheel (in fig. 13 one sees clearly the ring excavation in which this ring magnet was fixed) and a similar ring magnet was fixed to the upper part of the machine, facing the magnet fixed to the wheel with the homonymous pole, so that the weight of the fly-wheel (and the weight of the axle with the rotating "crowns" fixed to it) was balanced by the magnetic repulsive forces of these two ring magnets. This improvement, however, could not diminish substantially the friction and was then abandoned.

Then I substituted the big fly-wheel by a smaller one (fig. 16) which was substantially lighter and produced a smaller friction.

However, then I noticed that besides the mechanical friction there is also a <u>magnetic friction</u>, due to the eddy currents induced in the rotating and fixed pole shoes. Exact measurements of this magnetic friction could be done if I could take away only the ring

Fig. 15. - The first VENETIN COLIU machine with the big fly-wheel.

magnet of the generator's coils (item 2-2' in fig. 2) but this was impossible (better to say, difficult) to be done and I made measurements taking away all fixed parts of the generator (items 1-1', 2-2', 3-3' and 4-4'). The measurements showed that the magnetic friction power due to the eddy currents induced in the pole shoes is about one half part of the whole power consumed by the driving motor. Thus I concluded that all my endeavours to reduce the mechanical friction were vain, as the magnetic friction due to the eddy currents always remained.

As mentioned above, the mechanical friction consisted of friction in the ball-bearings and in the air. Cavalli has put his machine in vacuum and noticed that the consumption of the motor diminished with about 10%.

After realizing that the magnetic friction in the Bosch generators always remains, the decision was taken (at my visit in Treviso on the 14 - 19 January) to construct a machine without iron parts, where the magnetic flux will be led only through ferrites where eddy currents do not appear (see the next section).

Here I shall also mention the following important experiments:

When (see fig. 3) only the positive half-waves of the current were let to flow (i.e., these current waves which appear because of the induction during the time in which the moving pole shoes approach the fixed ones) and the negative half-waves were blocked by a rectifier, the power consumption of the motor decreased. However, when only the nega-

Fig. 16. The first VENETIN COLIU machine with the small fly-wheel.

tive current pulses were let to flow and the positive current pulses were blocked by a rectifier, the power consumption of the motor increased.

This effect can be immediately explained by the help of fig. 3, as we have established that only the positive current pulses call forth a self-accelerating effect (better to say, the last parts of the positive current pulses).

Finally the fact (see tables 1, 2, 3) that at high rotational velocities the rotation is supported when the coils are short-circuited and at low rotational velocities it is braked, was observed in the following very simple and sure way:

After having brought the big fly-wheel to a certain rotational velocity, at which the current produced by the generator was 27 mA (see table 2), I registered the moments at which the current decreased with 1 mA, and noticed the differences between two such consequent moments. Then I did the same when the coils remained open.

TABLE 4. - VENETIN COLIU - I "driven" by the big fly-wheel. Moments at which the current in the generator attains integer values at closed and open circuit

Current (mA)	Closed circuit		Open circuit	
	Moments	Their difference	Moments	Their difference
27	$0^m\ 00^s$		$0^m\ 00^s$	
		15^s		14^s
26	$0^m\ 15^s$		$0^m\ 14^s$	
		17^s		14^s
25	$0^m\ 32^s$		$0^m\ 28^s$	
		14^s		13^s
24	$0^m\ 46^s$		$0^m\ 41^s$	
		13^s		13^s
23	$0^m\ 59^s$		$0^m\ 54^s$	
		13^s		12^s
22	$1^m\ 12^s$		$1^m\ 06^s$	
		12^s		11^s
21	$1^m\ 24^s$		$1^m\ 17^s$	
		11^s		11^s
20	$1^m\ 35^s$		$1^m\ 28^s$	
		53^s		52^s
15	$2^m\ 28^s$		$2^m\ 20^s$	
		49^s		52^s
10	$3^m\ 17^s$		$3^m\ 12^s$	
		51^s		58^s
5	$4^m\ 08^s$		$4^m\ 10^s$	
		58^s		67^s
0	$5^m\ 06^s$		$5^m\ 17^s$	

As table 4 shows, at high velocities the time intervals at closed generator circuit were longer and at low rotational velocities the time intervals at open generator circuit were longer, as it really must be as at high velocities the machine is self-accelerating and at low velocities braking.

The first moments (at closed circuit) could be registered easily, as the amperemeter was the whole time percoursed by current, while the second moments (at open circuit) were registered by closing quickly the circuit with the amperemeter. This short-circuiting, obviously, marred to a certain extent the measurement.

5. THE SECOND VENETIN COLIU MACHINE

In the second VENETIN COLIU machine the magnetic flux was led always through ferrites and the magnetic friction due to the Foucault currents was reduced to zero.

The drawing of VENETIN COLIU - II is given in fig. 17 and the photographs in figs. 18, 19 and 20. By looking at these figures and at fig. 2, one understands how the machine is constructed and which is its function.

The absence of magnetic friction was demonstrated in the most pure way by looking at the current consumed by the d.c. motor (at a definite driving tension), first when the ring magnet was put in the machine and second when it was taken out. There was no change in the current in these two cases.

Measurements have been also done by setting the machine in rotation with a certain speed by the help of a motor which rubbed the circumference of the rotor (similarly as in figs. 15 and 16) and then measuring the cost down times. With and without the ring magnet these times were equal.

However VENETIN COLIU - II showed a much smaller self-accelerating effect than VENETIN COLIU - I. My explanation is the following:

VENETIN COLIU - I has a very sharp change from positive induced tension to negative induced tension when the moving pole shoes cross the conjunction line (see the graph in Cavalli's fax of the 6 December), because the pole shoes are VERY SLIM. Meanwhile the tension induced in VENETIN COLIU - II was almost sinusoidal (the pole shoes had pretty large faces).

To obtain a self-aceelerating effect in VENETIN COLIU - II, I had to make $\cos\phi$ very small, i.e., I had to run the machine at very high velocities. But at $\cos\phi$ very small the induced current was very feeble and the self-accelerating effect very feeble. As a matter of fact the current in VENETIN COLIU - II increased for an increase of the rotation from zero to about 1 rev/sec; further increase of the rotational velocity did not increase the current. Meanwhile the current in MAMIN COLIU - I always increased with the rotational velocity (of course, at higher velocities this increase was weaker). The difference between the first and second machines is to be explained by the fact that the first machine had higher R and lower L.

When respective condenser was inserted in the circuit of MAMIN COLIU - II, the current became bigger but, as $\cos\phi$ became bigger, too, the effect on the rotor was no more self-accelerating but braking.

When the driving tension of the d.c. motor was 30 V, the tension produced by the coil with $R = 413\Omega$ was 70 V and the tension produced by the coil with $R = 17\Omega$ was 8 V.

After doing many experiments with VENETIN COLIU - II, which for saving space I do not describehere, the decision was taken to build VENETIN COLIU - III which will combine the

□ plastic (PVC)

▨ ferrite

☒ coil

⊠ ring magnet

Two induction coils have been used with the following characteristics:

a) R = 413Ω, L = 4.4 H.

b) R = 17Ω, L = 0.05 H.

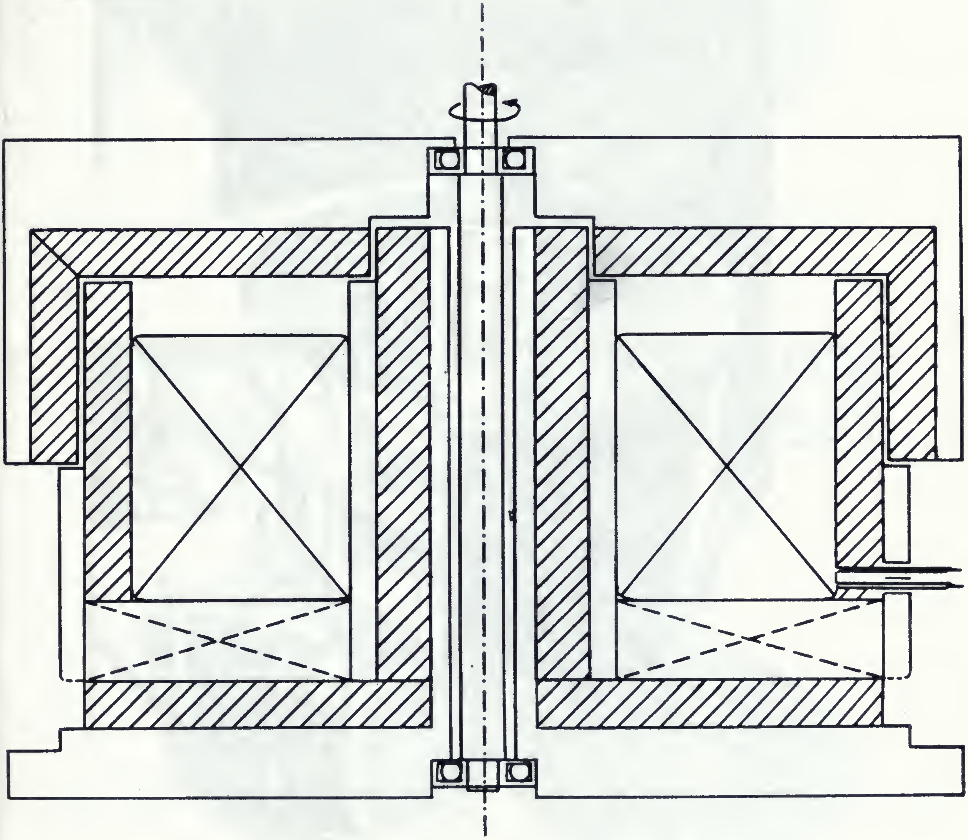


Fig. 17. - Diagram of the second VENETIC COLIU machine. The diameter of the rotor is 18 cm.

positive characteristics of VENETIN COLIU I and II and will exclude their negative aspects.

Now Cavalli and Vianello are trying to build VENETIN COLIU - III. If they will fail, I shall do it. VENETIN COLIU will be not abandoned as MAMIN COLIU was abandoned, because the self-accelerating effect is HUGE!

Fig. 18. - The second VENETIN COLIU machine constructed by Marinov in February 1991. The d.c. motor on the top drives the rotor.

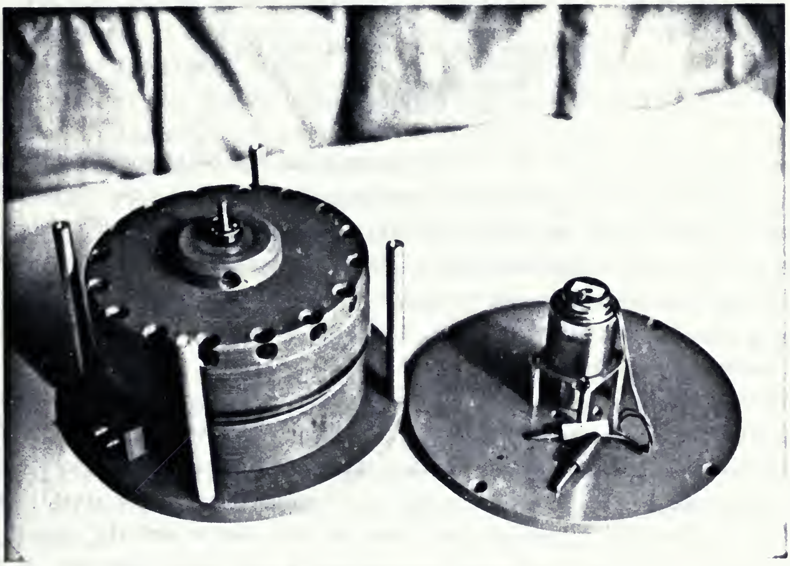


Fig. 19. - The second VENETIN COLIU machine with the top desk taken out.

Fig. 20. - The second VENETIC COLIU machine with the rotor taken out.

THE LENINGRAD DISSIDENT CONFERENCE

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On the 10-14 December 1990 in Leningrad took place the conference "Practical and theoretical problems of non-traditional energetics" organized by the society "Znanie" (Knowledge) of the Russian Socialist Federative Soviet Republic, with a scientific secretary Dr. Petr Gerassimovich Guziukin. The conference was attended by some 150 professors, doctors of science and researchers in scientific institutions, industry and schools from the whole Soviet Union. I was the only attendant from abroad, although some 200 invitations have been sent to the "West".

The difference between the "Western" conferences on non-traditional energetics and the Leningrad conference was colossal. The researchers constructing their machines by violating the first and second thermodynamic laws and the "actio-reactio" law of Newton are considered in the "West" as cranks and no scientists of the establishment attend their conferences. I noticed that when "established scientists" appear at such confrences, they do it incognito and never present a report nor take part in the discussions. When such established scientists search for more information in private conversations, they give always their private addresses. Meanwhile the Russian conference on "alternative physics" was attended if not by scientists of the "first echelon", but surely by such ones of the "second and third echelons".

It is not possible for me to inform the reader about all reports, as before the opening of the conference such have been presented 63. Some of the reports dedicated to "wind energetics", to "bio-energetics", to the "technology of economic energetics" etc. did not enter into conflict with established physical theories. I shall concentrate my attention only to the non-traditional aspects of this conference on non-traditional energetics.

All scientists who spoke on space-time problems (Peshchevitsky, Vogel, Sekerin, Parshin, Fefelov, Matveev, Smulsky, etc.) were pronounced anti-relativists. Highly interesting was the historic report of E. P. Kolokolov on the fight between absolutists and relativists in the Soviet Union in the last 70 years which was crowned by the victory of the relativists. Now the relativists try to present the absolutists (Prof. A. K. Timiriazev, Prof. V. F. Mitkevich, Prof. N. P. Kasterin, etc.) as "Lysenkoists", i.e., as pseudo-scientists, who could not win the game, as all persons who built the atomic and nuclear bombs (Kurchatov, Tamm, Sakharov, Zeldovich, Alexandrov, etc.) were relativists. Although the primitive and borned minds of Jdanovs and Stalins were rather on the side of the absolutists, as their concepts are more simple, clear and near to the "child's intuition", after the "ultimatum" presented to Beria: "If you wish to have the bomb, catch away the anti-relativists", any criticism on Einstein's theory disappeared from the physical and philosophical literature.

The presidium of the Soviet Academy of Sciences took a decision that "no encroachment on the theory of relativity is to be tolerated". P. L. Kapiza (Nobel prize winner) wrote ("Experiment, theory, praxis" (in Russian), Moscow, 1974, p. 201): "The editorial board of the JOURNAL OF EXPERIMENTAL AND THEORETICAL PHYSICS (the leading Soviet physical journal - S.M.) does not even examines papers criticizing the theory of relativity as obviously anti-scientific."

As all in a totalitarian state becomes grotesque, the only place where the contributions of the absolutists have been examined was the psychiatric clinic. Kolokolov cited V. A. Bronstein ("Discourses on cosmos and hypotheses" (in Russian), Moscow, 1968, p. 198): "There is a considerable group of hypotheses-maniacs (the word is constructed similarly to the word "klepto-maniac" - S.M.) who are specialized on the disproof of the theory of relativity. It is interesting to note that the scientific institutions help in revealing the psychopaths-paranoics who address these institutions with their 'discoveries'. So only in the year 1966 the Division of General and Applied Physics of the Soviet Academy of Sciences helped the physicians to reveal 24 paranoics." And Kolokolov added: "Lysenko could only dream of having such a power against his adversaries."

Let me add that in 1967 I was sentenced by the Bulgarian Court to compulsory treatment in a psychiatric clinic for my political and scientific paranoia. In the accusation for compulsary treatment in 1974 remained only the scientific paranoia, as in these years a Helsinki wind has begun to blow and it became uncomfartable to sentence me for political paranoia.

But now the situation in the Soviet Union is completely different. As the political power there became shaky, also the "scientific bosses" feel not sure in their seats.

I shall cite here two interventions at the yearly plenary meeting of the Soviet Academy of Sciences in 1990:

Academician A. D. Alexandrov: We must defend the Academy of attacks. Take the journal "Science in Siberia" (where articles of Peshchevitsky and Smulsky have been published - S.M.). Because of ignorance, articles against the theory of relativity have been published there. Via such printed organs (vehicles) we set the science under strokes. Another example. "The Literary Journal" published an interview with Prof. A. A. Denissov, who, according to my knowledge, is, it seems, a president of the commission on ethics in the Soviet Supreme of USSR. This interview is a blatant analphabetism and mischief. It shows that the professor does not understand at all the theory of relativity, about which he speaks. Moreover, he refers to L. D. Landau as to his predecessor. He speculates too much on the topic of pluralism and the encounter of opinions. But how can one not understand that a pluralism in the common sense cannot be in science; it can be there only encounter of opinions based on different treatment of the facts. There is a body of knowledge in science, and the dispute whether two plus two are four is there senseless. The fact that "The Literary Journal" has published this interview and that the person who has given it is at a high position gives rise to concern. And I have not heard that the deputies at the Soviet Supreme from the Academy of Sciences have presented protests against such interventions (we have elected from the Academy, for example, V. L. Ginsburg who, I hope, understands the theory of relativity). This is a precedent which provokes new defamation of science. The situation is in any case difficult. One hears from everywhere: the scientists are guilty for all. Our scope is to strengthen a high authority of science.

Academician V. L. Ginsburg: Indeed, Prof. Denissov, who is an enemy of the theory of relativity, was elected for president of the Commision on ethics. When I have been invited to become a member of this Commission, I declined the invitation, by learning that Prof. Denissov will be the head. I informed the ruling body of the Soviet Supreme that it is inadmissable to elect as a president of the Commission on ethics a man who, in a certain sense, is an enemy of science and stays on anti-scientific positions. It will be a great luck if Prof. Denissov will act in ethics not as incompetently as he acts in science. But at the present time there are few grounds for optimism. Read the interview of Denissov in "The Literary Journal"; it is unacceptable from a moral point of view.

I spent an evening with Prof. Denissov in his appartment in Leningrad. Prof. Denissov, whose booklet "The myths of the theory of relativity" has been sold in a couple of days in thousands of copies, reacted extremely calmly to the attacks of the "academicians": "Let them shout, said he. By their shouting they will bring the wolf in the fold."

At the end of the conference a suggestion to the Ministery of education was voted unanimously for excluding the theory of relativity from the program of the Soviet colleges.

Let us now go over to the machines. The most interesting of the reports was of Dr. Albert Victorovich Seregodsky of the Central Aerological Laboratory in Moscow who reported on his perpetual motion machine of second kind. The thermal machine is already constructed and delivers a mechanical power of 18 kW (many of the conference attendants have seen it in action). The energy is taken from a heater and there is no cooler. The machine has no valves and works with a mixture of nitrogene in a gas form and propane in saturated steam form. The "secret" is the following: The time of expansion endures much longer than the time of compression. During the expansion, the propane, after cooling, deposites partly as a liquid. During the compression the propane is compressed predominantly in its liquid form and the mechanical work for the compression is lower than the mechanical work delivered by the expansion. Thus the surface on the p-v diagram encircled by the lines which are neither adiabates nor isotherms becomes positive and the machine delivers mechanical work (the p-v diagram gives the dependence between the pressure, p, and the volume, v, of the gas mixture in the cylinder).

I saw that there are many common features between the machine of Serogodsky and the machine of the Austrian inventor Doczekal who died shortly after WWII. Doczekal worked with a dual-steam mixture of water and benzole.

Now Bernhard Schaeffer from Berlin tries to reconstruct Doczekal's machine. He has heard that I have seen Serogodsky and at the middle of January phoned me from Berlin. "In March I shall have also a running perpetual motion machine of second kind" said to me Schaeffer.

Dr. Anatoly Pavlovich Smirnov, one of the presidents of the conference (he has invited Serogodsky), pointed to the wide horizons which stay before these physicists and engineers who are without blinkers. Dr. Smirnov organized for me a visit at the laboratory of Prof. V. A. Lihachov of the Leningrad University (the Physics Department of the University is some 30 km far from Leningrad). Prof. Lihachov demonstrated his thermodynamic machines working on the effect "memory of the metals" which consists in the following: A specially treated titanium is elastic up to a certain temperature and one can make a spring of a pretty thick wire, having thus considerable elastic potential energy. By overpassing a certain critical temperature by only 0.2^{0}, the metal becomes plastic and loses its potential elastic energy. If diminishing the temperature again below the critical one, the metal "remembers" that it was a spring and when restituting its initial form can deliver mechanical work. Using this effect (which is known since many years), Prof. Lihachov has constructed thermal machines with considerable mechanical output. Now there are in construction 20,000 water pumps with power of 1 kW for the dry regions in Soviet Asia which will work on the temperature difference of two water recepients: the one under the sun and the other in shaddow. In practice the temperature difference will be maintained much bigger than 0.2^{0}, as it is difficult to maintain stabilized such a small temperature difference. But the important aspect of Prof. Lihachov's machines is that they work with a "heater" and "cooler" having quite the same temperature and they are surely perpetual motion machines of second kind. I think that they are also perpetual motion machines of first kind, as Prof. Lihachov has not measured exactly whether the lost heat power is equal to the delivered mechanical power. According to me, the lost heat power is minimal.

Because of the lack of space, I shall mention of the numerous more or less amazing machines only the magnetic "ball bearing" demonstrated by one of the speakers (his report was not announced in the program and I forget his name). If one puts a ball of soft iron in a strong ring magnet having thicknes about 2/3 of the ball's diameter and a hole with about 0,5 mm larger, the former remains "suspended" in the air. Connecting two such "suspended" balls by an axle, the speaker constructed a "ball bearing" practically without friction. Certain people to whom I narrated about this "ball bearing", told me that it must be known, however I do not know that some company produces and sells such ball-bearings.

The theoretical calculations, as well as the measurements with a Hall sond, have shown that at four points pretty near to the system of ring magnet and magnetizable sphere the magnetic intensity becomes equal to zero.

Finally I should like to inform the reader about a perpetuum mobile reported by Dr. A. F. Ryhlov which can be constructed by any child: Take a cup filled with pure water. Pin a needle in a rubber and put them in the cup, so that some small part of the needle goes out of the water and pour a small drop of oil on the needle, so that it spreads around the latter without touching the borders of the cup. Cut then an isosceles triangle (basis 1-2 mm, height 4-5 mm) of a very thin metal or plastic foil (thickness of microns) and put it on the water, so that one of the big corners touches the periphery of the oil spot. Because of the difference of the pressure due to the Brownian hits of the water molecules, the triangle will begin to rotate eternally around the oil spot with his basis ahead, with a velocity of some 10 cm/hour.

My intervention was dedicated to the machines constructed by me which violate the angular momentum and energy conservation laws, and I presented the 30 minutes film on the machine TESTATIKA and the religious community METHERNITHA in Switzerland. The interest which the film raised among the attendants was enormous.

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EXPERIMENTUM CRUCIS FOR THE PROOF OF THE SPACE-TIME ABSOLUTENESS

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A crucial experiment which will verify the "special" space-time absoluteness is proposed. This experiment consists in the establishment of the zero transverse light Doppler effect.

Let us have a light source and an observer noving with respect to each other with velocity v. ccording to the spatial theory of relativity ach the relation which exists between the emited light frequency ν_0 and the observed frequency s the following

$$= \nu_0 \cdot \frac{(1 - v^2/c^2)^{1/2}}{1 - (v/c) \cdot \cos\theta} , \quad \nu = \nu_0 \cdot \frac{1 + (v/c) \cdot \cos\theta_0}{(1 - v^2/c^2)^{1/2}} \tag{1}$$

here θ is the angle between the line connecting ource with observer and the direction of their elative velocity measured by the observer, θ_0 s the same angle measured by the source and c s the velocity of light.

According to our physical theory [1], grounded n the notions of absolute space and time, θ can e considered also as the absolute angle between he source-observer line and the direction of the elative velocity at the moment of observation nd θ_0 as the same angle at the moment of emission. According to our theory the dependence etween the emitted and observed frequencies n the middle angle $\theta_m = \frac{1}{2}(\theta + \theta_0)$ at the middle noment when the light is emitted but not yet observed is the following

$$\nu = \nu_0 \left[\frac{1 + (v/c) \cdot \cos\theta_m}{1 - (v/c) \cdot \cos\theta_m}\right]^{1/2} . \tag{2}$$

None of the experiments performed till now concerning the measurement of the light Doppler ffects of second order [2, 3] contradicts formulas 1) and (2). We must note that the "rotor" experiments [2] (where either θ or θ_0 is equal to $\frac{1}{2}\pi$) give what is called by us the post-traverse ($\theta = \frac{1}{2}\pi$) or ante-traverse ($\theta_0 = \frac{1}{2}\pi$) Doppler effects; all "rotor" experiments will give zero effect if the light frequency would be of the same order of magnitude as the number of revolutions per second of the "rotor". We assert that the true transverse, or what is called by us the traverse ($\theta_m = \frac{1}{2}\pi$), Doppler effect must be analysed with the aid of formula (2) and not of formulas (1). So we predict that the following experiment will verify formula (2) and show the insufficiency of formulas (1) or, better to say, the incorrect interpretation of formulas (1) by the special theory of relativity.

As a moving light source are to be used H_2-ions in a canal-ray tube of Dempster type (narrow velocity band) according to fig. 1. The ions are produced in an hydrogen arc between the heater H and the perforated electrodes E and E'. Between E and E' the ions are accelerated by an electric field, thus forming the beam S, proceeding with constant velocity and representing

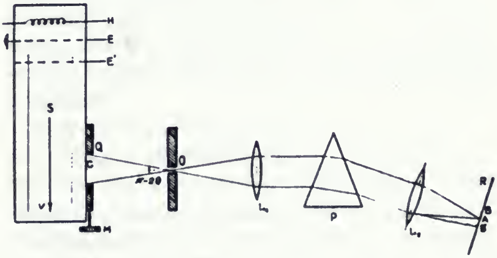

Fig. 1. Scheme of the experiment for the establishment of the zero transverse light Doppler effect.

the moving source. The light emitted by the excited ions passing through the large slit Q illuminates the narrow spectroscope slit O that represents the observer at rest. From the spectroscope are shown the focusing lenses L_1 and L_2, the refracting prism P and the screen R over which one can observe the corresponding spectrum.

If the source is at rest ($v \ll c$) the light of a certain emission line, say H_β, will be focused at the point A on screen R. If the velocity of the ions is comparable with that of light ($v \approx 10^{-2} \times c$) and the angle under which one can see the moving ions from the spectroscope slit O is $\pi - 2\theta$, than the "width" of the lines of emission due to the light Doppler effect will be $\Delta\nu = 2\nu_0(v/c)\cos\theta$.

According to our theory (formula (2)) the widened emission line will illuminate the spot BB' the center of which (if the line OC is perpendicular to the velocity v) must be at point A, when according to the Einstein theory (use the first formula (1) because there is the case of an observer at rest) this center must be shifted to the "red end" with respect to point A over a "distance" $\Delta\nu_{sh} = \frac{1}{2} \cdot \nu_0 \cdot v^2/c^2$.

Thus the gist of the proposed experiment consists in the following. Manipulating with the micrometer M (with the help of which one changes the angle between the line OC and the velocity of the ions v) and with the voltage applied between E and E' (with the help of which one changes v), such a position of the slit Q is to be found at which the increase of the voltage does not lead to a shift of the center of the light spot on screen R; if one can find such a position our "absolute" formula (2) is valid, if one can not find such a position Einstein's "relative" formulas (1) are valid.

In our opinion the realization of this experiments is easier than of that one performed by Ives in the late thirties [3], where the longitudinal light Doppler effect of second order was measured. In our opinion only the experiment proposed here can be considered as an experimentum crucis for the proof of the space-time absoluteness (or relativity) because only for the true transverse (for the traverse) light Doppler effect the relative and the absolute theories lead to different results.

Further the experiment proposed will indirect show that the "rotor" experiments [2] must give zero effect when the frequency of the emitted light and the number of revolutions per second of the "rotor" will be comparable. (We must note that the realization of the "rotor" experiment under this condition could be considered at the present state of technique only as a challenge to the experimentators.) Thus the conclusion could be made that the acceleration of the source does not cause a frequency shift, as is the case when the source is placed at a point with gravitational potential different from the gravitational potential of the observer, and this conclusion will in a certain extent undermine the principle of equivalence.

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CONCERNING THE EXPERIMENTUM CRUCIS FOR THE PROOF OF THE SPACE-TIME ABSOLUTENESS

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It is shown that the experiment proposed by us in another paper for the measurement of the transverse light Doppler effect can not be considered as an experimentum crucis between special relativity and our absolute space-time theory in which the Lorentz transformation takes its legitimate place. A modification of the socalled "rotor" experiment is proposed which can serve as an experimentum crucis between both theories.

In [1] we have proposed an experiment which acording to our previous prediction would serve as an experimentum crucis between the theory of relativity and our absolute space-time theory. Until today this experiment was not carried out. However, as we shall how in this paper, it could not serve as an experimentum crucis between both theories, because our revious assertion that in this experiment the two heories predict different results is not true.

Let us have a light source and an observer moving ith respect to each other with velocity v. Proceeding om the absolute (Newtonian) conceptions, the ollowing relations between the emitted light frequency ν_0 and the observed frequency can easily be found:

$$= \frac{\nu_0}{\sqrt{1 - (v^2/c^2)\sin^2\theta_0} - (v/c)\cos\theta_0} \tag{1}$$

$$= \nu_0 \sqrt{1 - (v^2/c^2)\sin^2\theta} + (v/c)\cos\theta$$

here c is the velocity of light; θ_0 is the angle between he line connecting source with observer and the direcon of their relative velocity at the moment of obseration, which we call the emission angle, since this is he angle between the velocity of the source (or the pposite velocity of the observer) and the wave vector f the emitted light; θ is the same angle at the moment f emission, which we call the observation angle, since his is the angle between the velocity of the source or the opposite velocity of the observer) and the ave vector of the observed light.

In [1] are given the relations between ν_0 and ν obtained on the grounds of the Lorentz transformation; there the same notations are used but in the second paragraph is written erroneously θ instead of θ_0 and vice versa.

For the ante-traverse ($\theta_0 = \pi/2$) and post-traverse ($\theta = \pi/2$) Doppler effects the absolute formulas (1) and the relativistic formulas (1) in [1] give exactly the same results. For the longitudinal effect ($\theta_0 = \theta = 0$) formulas (1) give

$$\nu = \frac{\nu_0}{1 - v/c}, \quad \nu = \nu_0 \left(1 + \frac{v}{c}\right), \tag{2}$$

i.e., two different results, while the relativistic formulas (1) in [1] give the unique result

$$\nu = \nu_0 \left(1 + \frac{v}{c} + \frac{1}{2}\frac{v^2}{c^2}\right), \tag{3}$$

which represents the geometrical (or arithmetical) mean of the results (2), since the longitudinal effect is the unique case where the emission and observation angles coincide and the observed frequency calculated with the help of the first and second formulas (1) must be the same.

If we want to find the relation between ν_0 and ν in dependence on the middle angle $\theta_m = \frac{1}{2}(\theta + \theta_0)$ which the source-observer line makes with the mutual velocity at the mean moment between emission and observation, we have to take the geometrical mean of formulas (1) or of formulas (1) in [1], where we have to put $\theta_0 = \theta = \theta_m$, and we obtain [1]

$$\nu = \nu_0 \left\{ \frac{1 + (v/c)\cos\theta_m}{1 - (v/c)\cos\theta_m} \right\}^{1/2} \tag{4}$$

For $\theta_m = \pi/2$ we called the Doppler effect traverse.

In [1] was proposed an experiment which according to our erroneous assertion was to present a realization of the traverse Doppler.effect. As a matter of fact when the source-observer line is perpendicular to the mutual velocity at the moment of emission we have $\theta = \pi/2$, $\cos\theta_0 = -v/c$, and there is a post-traverse effect. In this case for the mean angle we have $\cos\theta_m = -\frac{1}{2} v/c$. The traverse Doppler effect ($\theta_m = \pi/2$) can be realized when $\cos\theta = \frac{1}{2} v/c$ and $\cos\theta_0 = -\frac{1}{2} v/c$. Hence in fig. 1 in [1] for any velocity v we have to put slit Q in such a position, that the angle between the line CO, determining the direction of the central observed photons, and the velocity of the ions must be equal to arccos $v/2c$. Thus for any different voltage applied to the electrodes in this figure we have to search for different position of the slit Q at which the center of the light spot over the screen will not move.

It is important to note here that our absolute space-time theory uses the Lorentz transformation and we also work with two different sets of mathematical apparatus – the nonrelativistic and the relativistic. However, according to our opinion, they do not contradict each other and the nonrelativistic apparatus is not be considered only as a limiting case of the relativistic when $c \to \infty$. According to our conceptions, the physical reality (even at high velocities of the material points) is to be described with the help of both of them. A very important conclusion of our theory is that for the transverse problems (i.e., when the motion of the material points is perpendicular to the distance between them) both sets of apparatus lead to the same results. The transverse Doppler effect, which was examined here theoretically and for which the experiment described in [1] can give an experimental verification, shows the significance of our approach. As the reader saw, for the treatment of the transverse Doppler effect one has to use exclusively the brain of an 18-th century man.

Now we shall propose another experiment based on the Doppler effect which could serve as an *experimentum crucis* between our absolute space-time theory and the theory of relativity.

According to the special [2] and general theory of relativity [3] the relation which exists between the emitted frequency ν_0 and the observed frequency ν in the "rotor" experiment if the following

$$\nu = \nu_0 \cdot \left[\frac{1 - v_E^2/c^2}{1 - v_A^2/c^2} \right]^{1/2} \tag{5}$$

where v_E is the velocity of the source (the emitter) an v_A is the velocity of the observer (the absorber).

We shall not enter into discussion (as it is to be found in [2]) whether this formula can be obtained with the apparatus of special or general relativity. We shall only show that according to the absolute space-time theory formula (5) does not correspond to the reality.

If the observer is put at a distance R from the cente of rotation and the source at the half of this distance, one should obtain from formula (5)

$$\frac{\nu - \nu_0}{\nu_0} = \frac{1}{2} \frac{v_A^2 - v_E^2}{c^2} = \frac{3}{8} \frac{\Omega^2 R^2}{c^2} , \tag{6}$$

where Ω is the angular velocity of the "rotor",

According to the absolute space-time theory the Doppler effect depends only on the relative velocity between source and observer (measured in an inertial frame of reference) and we have to use only the formulas given in this paper (and in [1]), where we have to put for the relative velocity $v = v_A - v_E$. -Hence instead of [6] we predict that the observed frequency will be

$$\frac{\nu - \nu_0}{v_0} = \frac{1}{2} \frac{(v_A - v_E)^2}{c^2} = \frac{1}{8} \frac{\Omega^2 R^2}{c^2} , \tag{7}$$

sice for $v_A > v_E$ the "rotor" experiment gives a post-traverse effect (i.e., the observation angle θ is equal to $\pi/2$).

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HOW TO MEASURE THE EARTH'S VELOCITY WITH RESPECT TO ABSOLUTE SPACE

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In our absolute space-time theory the time dilation is treated as an absolute phenomenon and it appears as a result of the motion of the material systems with respect to absolute space. Hence, comparing the courses of two atomic clocks put at two antipodal points of the equator (which in the different hours of the day move with different velocities with respect to the absolute space), one can establish the velocity of the Earth as a whole.

We define the absolute space as that frame of refernce in which the kinetic energy of the considered *isolated* material system is a minimum. Obviously the enter of mass of an isolated material system rests in he absolute space.

According to our absolute space-time theory [1], if wo clocks (which when being together show always xactly the same readings on their clock-faces) move vith velocities v_1 and v_2 with respect to the absolute pace and at a given initial moment their readings vere equal to zero, then to any reading n_1 of the first lock a reading n_2 of the second clock will correspond nd the relation between them will be

$$\frac{n_1}{(1-v_1^2/c^2)^{1/2}} = \frac{n_2}{(1-v_2^2/c^2)^{1/2}}\,, \tag{1}$$

vhere c is the velocity of light.

Let us suppose that the Sun system is an isolated naterial system and let us have two clocks put at two ntipodal points of the equator. When for the first lock it is noon and for the second midnight, their elocities with respect to the absolute space (during he solstices!) will be

$$v_1 = v_0 - v, \quad v_2 = v_0 + v, \tag{2}$$

vhile when for the first clock it is sunset and for the econd sunrise, their velocities with respect to the absolute space will be

$$v_1 = v_2 = (v_0^2 + v^2)^{1/2}, \tag{3}$$

vhere v_0 = 30 km/sec is the orbital velocity of the Earth and v = 0.46 km/sec is the linear rotational velocity of the equatorial points.

It can be seen easily that when the Sun sets or rises for our clocks their rates will be the same. However when for the first clock it is noon and for the second midnight, the night-clock will go at a slower rate and with an accuracy of second order in $1/c$ we shall have

$$\Delta n/n = 2\ v_0 \cdot v/c^2, \tag{4}$$

where $\Delta n = n_1 - n_2$ and $n \approx n_1 \approx n_2$. Substituting here the suitable numerical values, we obtain $\Delta n/n = 3 \times 10^{-10}$. Taking into account [2] that the portable cesium beam clocks show the time with an accuracy $\Delta n/n \approx \pm 10^{-13}$, we see how high will be the precision with which this experiment can be performed.

Since the Sun system is not isolated, then, obviously, there is a possibility to establish the velocity of the Earth with respect to the center of our Galaxy or even to the center of the Universe. Comparing the readings of the two equatorial antipodal clocks during the different hours of the day and during the different days of the year, we can find the exact value of the velocity of the Sun system in the Universe and the inclination of the Earth's axis with respect to the ecliptic.

The experiment proposed here can be considered as an experimentum crucis between Einstein's theory of relativity and our absolute space-time theory, because its result would reject the basic principle of relativity, according to which there is no physical possibility to establish the inertial motion of a given material system, performing measurements only within this system.

Our experiment resolves also the twin paradox, showing that the time dilation is not a relative phenomenon, as special relativity asserts, but an absolute phenomenon. The experiment reported in ref. [3] is still "explained" by general relativity [4]. Our experiment could not be explained by general relativity. Special relativity gives for it two answers excluding each other, namely: working in the reference frame attached to the Earth, one concludes that all clocks on the equator go with the same rate; working in the frame attached to the Sun, one comes to the conclusions stated above by our absolute theory.

We use the occasion to correct an error which has appeared in our recent article [5]. The last words in thi article are to be read as follows: " . . . since for $\upsilon_A > \upsilon_E$ the "rotor" experiment gives an ante-travers effect (i.e., the emission angle θ_0 is equal to $\frac{1}{2}\pi$)."

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KANTOR'S SECOND-ORDER DOPPLER-EFFECT EXPERIMENT TREATED BY THE ABSOLUTE SPACE-TIME THEORY

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It is shown that the second-order Doppler-effect experiment proposed recently by Kantor must give the same result within an accuracy of second order in v/c, when treated by the nonrelativistic and relativistic mathematical apparatus, in contradiction to Kantor's conclusions.

Kantor has proposed [1] the following experiment: A light source S and an observer O′ are at rest; between them a plane parallel thin plate of a transparent medium moves with velocity v. Kantor asserts that in this experiment according to the Einstein-Doppler formulas the emitted frequency ν_0 and the observed frequency ν' must be equal, while according to the "etherless classical photon kinematics" it must be

$$\nu' = \nu_0(1-v^2/c^2)\,, \tag{1}$$

where c is the velocity of light.

Our absolute space-time theory asserts [2, 3] that the nonrelativistic mathematical apparatus (based on the Galilean transformation) and the relativistic mathematical apparatus (based on the Lorentz transformation) represent two peculiar sisters but in no way two rivals and that both apparatus must be used in parallel also when considering material systems moving with velocities comparable with c. In our manuscript [3] we show that for *all* light kinematical experiments both apparatus lead to the same formulas not only within an accuracy of first order in v/c (as it is commonly assumed) but also within an accuracy of second order in v/c (as nobody believes).

Now we shall show that for the Kantor's experiment both apparatus, indeed, lead to identical results within an accuracy of second order in v/c.

Let us suppose (fig. 1) that a photon is emitted by the source S when the position of the transparent plate is P_{em}, that it crosses the plate when the position of the latter is P_{cr} and that it reaches the observer O′ when the position of the plate is P_{ob}. Plotting the line AB perpendicularly to the plate through the point $O_0 = S'$, where the photon crosses the plate, we can easily establish that the triangles SAO_0 and $O'BS'$, as well as SAO and $O'BS'_0$ are similar. Hence the emission, θ_0, and observation, θ, angles [2] at the first phase (i.e., emission by S, observation by P) are correspondingly supplemental for the observation, θ', and emission, θ'_0, angles [2] at the second phase (i.e., emission by P and observation by O′).

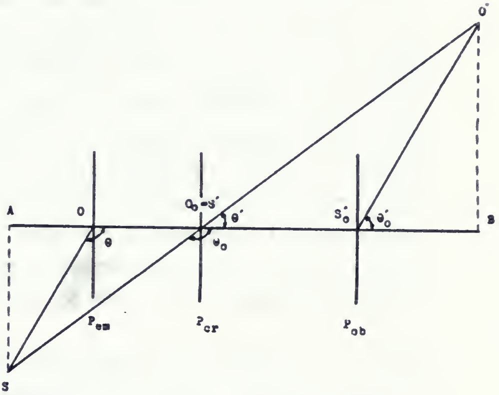

Fig. 1. Kantor's experiment.

Thus using the nonrelativistic formulas (1) from [2] and denoting by ν the observed (and then reemitted by the plate) frequency, we shall have

$$\nu = \frac{\nu_0}{\sqrt{1-(v^2/c^2)\sin^2\theta_0}-(v/c)\cos\theta_0}\,,$$

$$\nu' = \nu(\sqrt{1-(v^2/c^2)\sin^2\theta'}+(v/c)\cos\theta')\,. \tag{2}$$

Since $\theta' = \pi - \theta_0$, we obtain $\nu' = \nu_0$.

We use the occasion to correct the last part of our recent paper [2]. Our absolute space-time theory (as we shall show this in a long future research paper) leads for the experiment considered in [2] also to formula (6) and not to formulas (7), as stated there erroneously.

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THE VELOCITY OF LIGHT IS DIRECTION DEPENDENT*)

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Performing the so-called by us "coupled-mirrors" experiment, we have established that velocity of light measured along a given track on the earth's surface is different during the different hours of the day.

In the last decades the Einstein postulate about the constancy of light velocity along all directions in any inertial frame of reference has gained such a large popularity that for a great part of the physicists this problem is closed as, say, the problem about the impossibility to construct a perpetuum mobile. However, until now an experimental proof of this Einstein postulate within first order accuracy in v/c does not exist. The historical Michelson experiment, favouring the constant light velocity dogma, gives an accuracy of second order in v/c, but the effects of first order, as a matter of fact, are there unobservable. And we must emphasize that the null effects of second order (which, according to us, are connected with the Einstein-Lorentz time dilation, considered by our theory as an absolute phenomenon [1]) cannot be treated as a decisive proof of the "first-order-constancy" of light velocity. On the other hand, the historical Harress-Sagnac-Pogany experiment has shown that velocity of light in a non-inertially moving frame of reference is direction dependent and this dependence is of first order in v/c.

Recently we have performed an experiment which offers the possibility to establish whether the velocity of light is direction dependent also in an inertial frame of reference. This so-called by us "coupled-mirrors" experiment, although too crude in its first performance, can be considered, according to our firm opinion based on the absolute space-time theory elaborated by us in the last years [2], as the first experimental disproof of the Einstein constant light velocity dogma and of his principle of relativity.

In [3] the opinion is defended that until now a first-order in v/c experiment for the establishment of the light velocity direction dependence in an inertial frame of reference is neither proposed nor it is shown that such an experiment cannot be invented at all. In this report we show that a first-order in v/c experiment can be not only theoretically proposed, but such an experiment was performed and it has favoured the anti-relativistic dogma for the direction dependence of light velocity.

For the sake of simplicity and better visualization, we shall perform the necessary calculation for the adjustment presented in fig. 1.

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*) Editorial note: The idea of the experiment seems to be of some interest, notwithstanding the author's experimental results are too crude to be convincing.

Let us have two disks driven always **exactly** with the same phase difference (imagine the wheels of a bicycle). On each disk two antipodal facets are cut and the one is made a mirror, while the other and the rest of the disk's rim are not light reflecting. The distance between both disks, called further rotating mirrors RM_1 and RM_2, is *d*. Intensive light from the source S_1 (respectively, S_2) is reflected by the semi-transparent mirror M_1 (resp., M_2) and, after passing through the semi-transparent mirror N_1 (resp., N_2), is incident on the mirror facet of RM_1 (resp., RM_2).

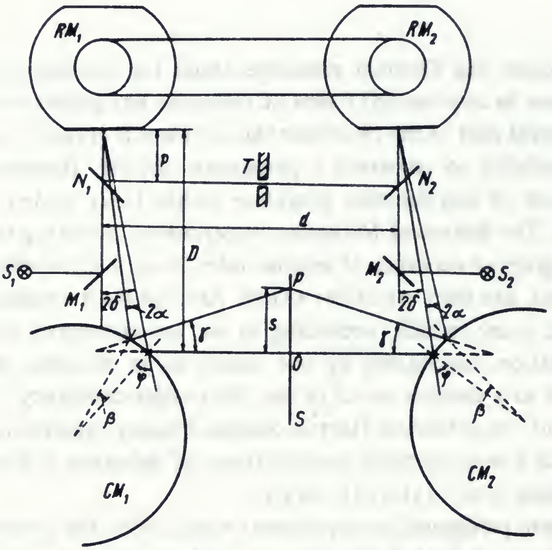

Fig. 1. The "coupled-mirrors" experiment.

The light beam reflected further by the semi-transparent mirrors N_1 and N_2 (resp., N_2 and N_1), whose distance from the rotating mirrors is *p*, is incident on the mirror facet of RM_2 (resp., RM_1). If the rotating mirrors are at rest, the light beam reflected further by the cylindrical mirror CM_2 (resp., CM_1) will illuminate screen S from the right (from the left) at an arbitrary point. The light path from the rotating mirrors to the cylindrical mirrors is *D* and from the cylindrical mirrors to the screen is $d/2$.

If the rotating mirrors are put in motion, then, because of the slit T, only the light which is reflected by RM_1 (resp., by RM_2) when the latter is perpendicular to the incident beam will reach RM_2 (resp., RM_1). However, for the time spent by light to cover distance $d + 2p$, the facet of RM_2 (resp., RM_1) which is parallel (an exact parallelism is not necessary!) to the corresponding facet of RM_1 (resp., RM_2) will rotate by a certain angle $\delta = 1/c\,(d + 2p)\,\Omega$, where Ω is the angular velocity of the rotating mirrors.

Let us now suppose that light velocity along the direction from RM_1 to RM_2 (which we shall call "direct") is $c - v$ and along the direction from RM_2 to RM_1 (which we shall call "opposite") is $c + v$. In such a case during the time in which the light pulse reflected by RM_1 will reach RM_2 the latter will rotate to an angle $\delta + \alpha$, while during the time in which the light pulse reflected by RM_2 will reach RM_1 the latter will rotate to an angle $\delta - \alpha$, and we shall have

$$\delta \pm \alpha = \left(\frac{d}{c \mp v} + \frac{2p}{c}\right)\Omega \,, \tag{1}$$

from where (assuming $v \ll c$) we get $\alpha = \Omega dv/c^2$.

Our apparatus takes part in the diurnal rotation of the earth and in 24 hours it will make all possible angles with the component of the absolute earth's velocity in the plane determined by the different positions of the apparatus durnig the day; this component we shall call further absolute earth's velocity and designate by v.

Let us suppose that the "ether" conception (defended by our absolute space-time theory) is valid and let us denote the unit vector along the "direct" direction by $\boldsymbol{n}$.

Let us first suppose that $\boldsymbol{n}$ is perpendicular to $\boldsymbol{v}$ and let us adjust so the cylindrical mirrors that the chopped light beams will illuminate the same point O on the screen S. Now, if $\boldsymbol{n}$ will become parallel to $\boldsymbol{v}$, both light beams will illuminate point P and for the distance s between O and P we shall have (suppose $\varphi \cong \pi/4$)

$$s = \gamma \frac{d}{2} + 2\alpha D \,, \tag{2}$$

where $\gamma = 2(\alpha + \beta)$ and $\beta = 2\alpha(D/R) \sec \varphi$; angles β, γ and φ are shown in the figure and R is the radius of the cylindrical mirrors. Thus we should have

$$s = \frac{\Omega}{c^2} d^2 v \left[1 + 2D\left(\frac{1}{d} + \frac{\sec \varphi}{R}\right)\right]. \tag{3}$$

If we take $\Omega = 900$ rad/sec $\cong 143$ rev/sec, $d = 10$ m, $v = 100$ km/sec, $D = 5$ m, $\varphi = \pi/4$, and $R = \sqrt{2}/0{\cdot}098 \cong 14$ cm, we obtain $s = 0{\cdot}01$ mm.

The establishment of velocity v is to be performed as follows: In regular intervals of time during a whole day we maintain such a rotational velocity Ω that the chopped light beam from the left would illuminate always point O. Then the light beam from the right will illuminate point O when $\boldsymbol{n} \perp \boldsymbol{v}$; it will be displaced over a distance $2s$ upwards when $\boldsymbol{n} \uparrow\uparrow \boldsymbol{v}$ and over the same distance downwards when $\boldsymbol{n} \uparrow\downarrow \boldsymbol{v}$.

In our factual adjustment both rotating disks were fixed on a common shaft because the most important requirement of the "coupled-mirrors" experiment is the ensuring of equal phase difference between both rotating mirrors during the earth's rotation. As light sources two He–Ne lasers were used. We used three cylindrical mirrors for any beam and such a combination of cylindrical mirrors which encreases enormously the "arm" of a light beam is called by us the "cylindrical mirrors indicator". The cylindrical mirrors indicator has shown its effectiveness because of the use of light beams generated by lasers. The light spots were observed over two different screens because in our factual experiment both rotating mirrors lie in two different parallel planes. According to the calculation for our real adjustment it must be $s = 0{\cdot}62$ mm for $v = 100$ km/sec. This displacement is large enough to be reliably registered. However the nonconstancy of the cylindrical mirrors radii and the trembling of the images were too considerable and our experiment could not lead to an accurate quantitative measurement of v. The observed displacement was maximum 3 ± 2 hours after midnight and after noon and corresponded to a velocity $v = 130 \pm 100$ km/sec, the "direct" direction being that one after midnight. The distance between both rotating mirrors was $d = 7{\cdot}2$ m, the radius of the cylindrical mirrors was $R = 8$ cm, and the velocity of rotation of the shaft taken from an old torpedo-boat was $\Omega/(2\pi) = 80$ rev/sec. The azimuth of the apparatus was 84^0 and the observations were performed in July – August in Sofia.

The error of ± 100 km/sec was established in the following manner: An observer maintains during 2 – 3 minutes one of the light spots in a given position adjusting by hand a corresponding tension of a dc electromotor which drives the shaft. Another observer registers the diapason of trembling of the other light spot which was normally 2 – 3 mm. If this diapason is $\Delta s = 2{\cdot}48$ mm, then (see fig. 1) the fluctuation error is ± 100 km/sec.

As a matter of fact we observed over the screen not a light spot but only a boundary line between a more bright and a more dark fields. This boundary line was the image of one end of the slit T. Because of the diffraction the boundary line between the dark and bright fields was not enough sharp. This was the reason that even when there is not a trembling of the light spot (the rotating mirrors are at rest) one registers the position of this boundary line with an uncertainty of about 1 mm.

The room was not temperature-controlled. However it is easy to see that the temperature changes of the whole room have not influence on the result, because the appearing effects (a change of the shaft's length, a change of the diameters of the cylindrical mirrors, a change of the refractive index of the semi-transparent mirrors) lead ot results which compensate each other. It is worth to note here that the temperature change of the diameters of the cylindrical mirrors CM_1 and CM_2 in fig. 1 leads to shifts of both light spots over the screen S which cannot be compensated changing the rotational velocity, while one easily concludes that in our real adjustment (where the symmetry over the corresponding cylindrical mirrors is complete!) also the results of this temperature effect are compensated with a change of the rotational velocity. Of course it is clear that if there will be a temperature change only for one part of the apparatus, this can be neither eliminated nor established.

We cannot give an estimation of the non-constancy of the cylindrical mirrors radii and the irregularity of the mirrors' surfaces which can lead to considerable errors. To elliminate this sort of errors we have performed the measurement choosing in the different days different position O which is to be illuminated on the screen steadily by the one of the light beams. In the time from 25-th July to 23-rd August we have performed 17 whole-day measurements (with interruption of 3–4 hours for a sleep) but during the greater deal of time the author operated alone on both screens that has diminished the accuracy.

We must declare that the technique used in our experiment is far beneath the possibilities of the contemporaneous technology and we appeal to the interested scientists to repeat this experiment on a higher technical level. The play is worth the candles. If other experimentalists should establish that no positive effect can be seen, then the "coupled-mirrors" experiment will represent the first experiment in the history of physics by whose help the Einstein constant light velocity dogma is being proved involving first-order in v/c effects. Our firm conviction, however, is that this time the theory of relativity should not be granted with an experimental support coming from the hands of an absolutist, as it was the case so many times in the last 70 years.

If one puts the "coupled-mirrors" apparatus on a rotating platform, then one has not to await for the earth's rotation and the measurement can be performed in a couple of minutes. If such a platform has three degrees of freedom, one can measure all three components of the absolute earth's velocity.

Obviously, the result of the "coupled-mirrors" experiment will agitate the whole physical world. This experiment will require an urgent correction of the official (generally called "relativistic") space-time conceptions. As a matter of fact, after its performance by several scientists who should claim a positive effect, nobody would further doubt that theoretical physics has to return to the old and simple Newtonian conceptions about absolute space and time, introducing there only our absolute time dilation dogma [1].

However we have to emphasize that the "coupled-mirrors" experiment could have been performed even by Foucault in the midst of the XIX-th century. As a matter of fact, it represents only a modification of his method for the measurement of light velocity with the help of the "rotating mirror". And we must add that with the help of the "coupled-mirrors" experiment one can establish the absolute earth's velocity with an absolute accuracy higher than the accuracy which the Foucault's experiment offers, because in our experiment the displacement of the light spot is proportional to v, while in the Foucault's experiment this displacement is proportional to c, and c is about thousand times larger than v. Thus we are surprised, indeed, that Michelson, the king of the exactitude, has not performed the "coupled-mirrors" experiment and has overseen its magnificent first-order in v/c possibilities.

I am indebted for help, aid and counsels to Dr. M. MEDAREVA, Dr. R. RADKOV, I. IVANOV (Sofia), Captain T. TODOROV (Varna) and first of all for a material support to my brother N. MARINOV (Sydney).

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Velocity of Light in a Moving Medium According to the Absolute Space-Time Theory

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Abstract

Proceeding from our absolute space-time conceptions and applying the 'hitch-hiker' model (so-called by us) for the propagation of light in a medium, we obtain the general formula for the light velocity in a moving medium including terms of second order in v/c. This formula is identified with that one obtained by proceeding from the Lorentz transformation.

What is light? What is the mechanism of propagation of light?—Despite the high level to which science has been developed in the last century, there has not been a firm and clear answer to these questions.

Now two substantially different models of light are common in physics and, although excluding each other, many phenomena are explained by the one model, many by the other and many by both. These models are:

(1) The corpuscular (Newton's) model.
(2) The wave (Huyghens') model.

In our absolute space-time theory we use only the corpuscular model. We introduce the notion of the 'period' of a photon (i.e., of any light corpuscle) as follows: The period T is the time for which a given photon is emitted or absorbed, or the time for which we can assert with certainty that a photon propagating with velocity c in vacuum (with respect to the reference frame used) and crossing a given surface has indeed crossed this surface. The quality ν inverse to the period is called the frequency.

Since there is a certain time T during which the photon is emitted, we can imagine it as an 'arrow' or as a 'machine-gun burst' with length $\lambda = cT$, called the wavelength. Now the following question arises: When the source moves with a certain velocity v in the reference frame used, would the 'arrow' (or the single bullets of the 'burst') move with a velocity different from c? According to the answer given to this question there are possibly two different models:

(a) The 'arrow' (Ritz') model, according to which the photon moves with a velocity representing the vector sum of **v** and **c**, while the wavelength remains constant.
(b) The 'burst' (Marinov's) model, according to which the photon moves always with velocity c and only the wavelength (i.e., the distances between the single bullets of the 'burst') change.

For the mechanism of propagation of light in a medium we use the 'hitch-hiker' model (so-called by us). According to this model the photon is a hitch-hiker walking with velocity c and the molecules (the atoms) of the medium are cars driving with velocity v ($c > v$). Since the walker would be tired if he walked all the time (then his velocity will be the highest!), he takes any mth car on the road (we suppose that the distance between the cars are the same) and rests there a definite time (if he drove all the time his velocity will be the lowest!). If $v \ll c$, then the mean velocity of the hitch-hiker will be $c_m = c/n$, where $1/n$ is that part of the time during which, on average, the hitch-hiker walks and $1-(1/n)$ is that part of the time which the hitch-hiker spends in the cars.

Now using this model for the propagation of the photons in a medium, we shall calculate their velocity when the medium moves with respect to the observer. The factor n is called the refractive index of the medium; c is the velocity of light in vacuum and $c_m = c/n$ is the velocity of light in the medium when it is at rest with respect to the observer. In the same manner as the hitch-hiker takes a rest in any mth car, so the photon is 'absorbed' by any mth molecule which it meets on its way and there is a definite time after which the photon is again 're-emitted'.

Let us suppose first that the medium rests in the frame of reference used and that the light propagating with velocity c/n makes an angle θ' with the x-axis (Fig. 1). As supposed previously, any photon, on average, moves $1/n$th part of the time and $[1-(1/n)]$th part of the time rests absorbed by the molecules.

Let us then suppose that the medium moves with velocity v along the x-axis only during this time when the photon is absorbed by some molecule and let us suppose that during the time between the re-emission and next absorption the medium is at rest. If we consider the path of the photon between two successive absorptions, then this path could be presented by the broken line ABC in Fig. 1. Supposing that the time between two successive absorptions is chosen for a unit of time, i.e., that

$$\frac{AB}{v} + \frac{BC}{c} = 1 \tag{1}$$

we shall have

$$AB = \left(1 - \frac{1}{n}\right).v, \qquad BC = c/n \tag{2}$$

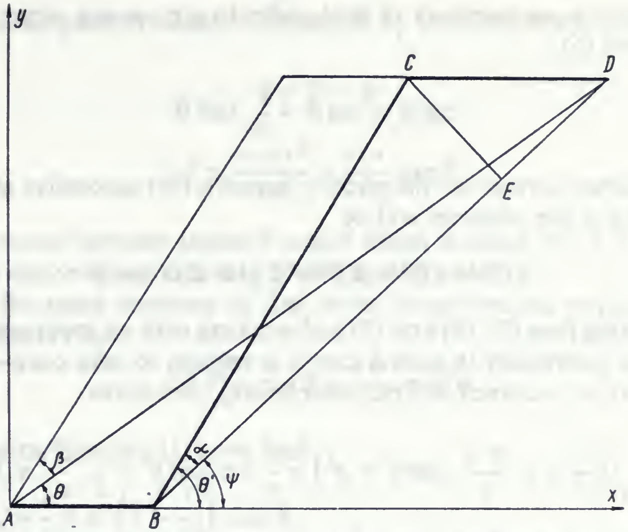

Figure 1.—The paths of a photon moving in a medium with respect to the rest and moving frames.

If now we suppose that the medium moves with velocity v during the whole time, then the next (mth) molecule will be caught not at point C but at point D, where the distance CD is covered by this molecule in the time in which the photon covers distance BD, i.e.,

$$CD = v/n \tag{3}$$

Thus now the distance covered by the photon between two successive re-emission and absorption will be not BC but

$$BD = BE + ED = \sqrt{\left(\frac{c^2}{n^2} - \frac{v^2}{n^2}.\sin^2\psi\right)} + \frac{v}{n}.\cos\psi \tag{4}$$

where

$$\psi = \theta' - \alpha \tag{5}$$

is the angle between the 'free path' of the photon and the x-axis with respect to the observer, while θ' is the angle between the 'free path' of the photon and the x-axis with respect to the medium, and

$$\alpha = \arcsin\frac{CE}{BC} \cong \frac{v/n}{c/n}.\sin\psi \cong \frac{v}{c}.\sin\theta' \tag{6}$$

is the difference between these two angles which is small and, as we shall see further, it is enough to consider it with an accuracy of first order in v/c.

Within the same accuracy of first order in v/c we can write, having in mind (5) and (6),

$$\cos\psi = \cos\theta' + \frac{v}{c}.\sin^2\theta' \tag{7}$$

The distance covered by the photon between two successive absorptions with respect to the observer will be

$$AD^2 = AB^2 + BD^2 + 2.AB.BD.\cos\psi \tag{8}$$

Substituting here (2), (4) and (7) and working with an accuracy of second order in v/c (obviously in such a case it is enough to take $\cos\psi$—and thus also α—with an accuracy of first order in v/c), we obtain

$$AD = \sqrt{\left(\frac{c^2}{n^2} + 2.\frac{v.c}{n}.\cos\theta' + v^2\right)} = \frac{c}{n} + v.\cos\theta' + \frac{1}{2}.\frac{v^2}{c}.n.\sin^2\theta' \tag{9}$$

To obtain the mean velocity of the photon with respect to the observer we have to divide the distance AD by the time for which the broken line ABD is covered. This time, taken with an accuracy of second order in v/c, is

$$\begin{aligned} t_m &= \frac{AB}{v} + \frac{BD}{c} = \frac{AB}{v} + \frac{\sqrt{(BC^2 - CE^2)} + DE}{c} \\ &= \frac{AB}{v} + \frac{BC}{c} - \frac{1}{2}.\frac{CD^2}{BC}.\frac{\sin^2\psi}{c} + \frac{CD}{c}.\cos\psi \\ &= 1 + \frac{v}{c.n}.\cos\theta' + \frac{1}{2}.\frac{v^2}{c^2.n}.\sin^2\theta' \end{aligned} \tag{10}$$

where we have used (1), (2), (3) and (7).

Thus for the mean velocity of the photon in the moving medium measured by the observer at rest we get, with an accuracy of second order in v/c,

$$\begin{aligned} c_m = \frac{AD}{t_m} &= \frac{c}{n} + v.\left(1 - \frac{1}{n^2}\right).\cos\theta' \\ &- \frac{v^2}{c.n}.\left(1 - \frac{1}{n^2}\right).\cos^2\theta' + \frac{1}{2}.\frac{v^2.n}{c}.\left(1 - \frac{1}{n^2}\right).\sin^2\theta' \end{aligned} \tag{11}$$

The factor

$$\kappa = 1 - \frac{1}{n^2} \tag{12}$$

is called the Fresnel's drag coefficient.

If we want to introduce the angle θ between the x-axis and the average velocity of the photon which is measured by the observer at rest, we shall have

$$\theta = \theta' - \beta \tag{13}$$

where

$$\beta \cong \frac{v.\sin\theta}{c/n} = \frac{v.n}{c}.\sin\theta \tag{14}$$

is the difference between angles θ' and θ which is small and it is enough to consider it only with an accuracy of first order in v/c.

Within the same accuracy of first order in v/c we can write, having in mind (13) and (14),

$$\cos\theta' = \cos\theta - \frac{v.n}{c}.\sin^2\theta \tag{15}$$

Substituting this into (11), we find

$$\begin{aligned} c_m = \frac{c}{n} + v.\left(1 - \frac{1}{n^2}\right).\cos\theta \\ - \frac{v^2}{c.n}.\left(1 - \frac{1}{n^2}\right).\cos^2\theta - \frac{1}{2}.\frac{v^2}{c}.n.\left(1 - \frac{1}{n^2}\right).\sin^2\theta \end{aligned} \tag{16}$$

For $\theta = \theta' = 0$ formulaes (11) and (16) give

$$c_m = \frac{c}{n} + v.\left(1 - \frac{1}{n^2}\right) - \frac{v^2}{c.n}.\left(1 - \frac{1}{n^2}\right) \tag{17}$$

For $\theta = \pi/2$, $\theta' = (\pi/2) + [(v.n)/c]$ formulae (11) and (16) give

$$c_m = \frac{c}{n} - \frac{1}{2}.\frac{v^2}{c}.n.\left(1 - \frac{1}{n^2}\right) \tag{18}$$

Exactly the same results can be obtained when proceeding from the Lorentz transformation formulae for velocity which run (see, for example, Møller (1955))

$$v_x = \frac{v'_x + V}{1 + \frac{v'_x.V}{c^2}}, \qquad v_y = \frac{v'_y\sqrt{1 - V^2/c^2}}{1 + \frac{v'_x.V}{c^2}} \tag{19}$$

where v'_x, v'_y are the velocity components of a material point in the moving frame of reference and v_x, v_y are the velocity components of the same point in the rest frame, supposing that the moving frame proceeds with velocity V along the x-axis of the rest frame and their axes are respectively parallel.

Putting in (19)

$$v'_x = \frac{c}{n}.\cos\theta', \qquad v'_y = \frac{c}{n}.\sin\theta', \qquad V = v \tag{20}$$

and working with an accuracy of second order in v/c, we obtain for $\sqrt{(v_x^2+v_y^2)}$ exactly formula (11).

For the components of the velocity the identity is only within the first order in v/c. Indeed, if we use in the equations

$$c_m . \cos\theta = v_x, \qquad c_m . \sin\theta = v_y \tag{21}$$

formulae (11), (15), (19) and (20), then we see that only the terms of zero and first order in v/c are identical on both sides of these equations.

Formula (17) was proved experimentally within an accuracy of first order in v/c first by Fizeau (1851). An experimental proof of this formula within an accuracy of second order in v/c is still not made and at the present state of technique such an experiment is to be considered only as a challenge to the experimentors.

This experiment, sketched briefly, will appear as follows: Let us use the Michelson interferometer and let us put a liquid with refractive index n in one of its arms whose length is L. We should observe a certain interference picture. Let us then set the liquid in motion with velocity v along the arm L. Now if we use formula (17), we should easily obtain, when the liquid is in motion, the light beam proceeding along arm L, there and back, and returning to the semi-transparent mirror of the interferometer with a time delay

$$t = \frac{L}{c_m^+} + \frac{L}{c_m^-} - \frac{2.L}{c/n} = \frac{2.L.v^2}{c^3} .n.(n^2-1) \tag{22}$$

However, even before performing this experiment, we can make the following conclusion: Since the Lorentz transformation formulae have shown their validity in many different experiments, then the identity of the results obtained, on the one hand, proceeding from our absolute space-time conceptions and from the 'hitch-hiker' model for the propagation of light in a medium and, on the other hand, from the Lorentz transformation formulae, is very strong support for

(a) our absolute space-time theory, which defends the assertion that the non-relativistic and relativistic mathematical apparatus (i.e., the Galilean and Lorentz transformations) are not contradictory (at least within an accuracy of second order in v/c), thus an absolute space-time does exist, and

(b) our 'hitch-hiker' model for the propagation of light in material media.

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The Experimental Verification of the Absolute Space-Time Theory—I

The Fundamental Conception of the Absolute Space-Time Theory

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Abstract

The fundamental postulate of our theory is the constancy of light velocity only with respect to absolute space. This postulate was proved right by our recently performed 'coupled-mirrors' experiment (Marinov, 1974). In the present paper it is shown that the so-called (by us) Newtonian and Einsteinian time synchronisations lead respectively to the Galilean and Lorentz transformations. Both types of synchronisation can be practically realised, hence both corresponding transformations describe the physical reality at low as well as at high velocities of the material points. The conception that the Einstein time dilation is an absolute phenomenon and the Lorentz length contraction a fiction is defended.

1. *Introduction*

Our absolute space-time theory (Marinov, in preparation) finds its *experimentum crucis* in the 'coupled-mirrors' experiment recently performed by us (Marinov, 1974). This experiment has undoubtedly shown that the Einstein principle of relativity is invalid and that the hypothetical motionless 'luminiferous ether' of the nineteenth century in which light propagates with velocity c in all directions is a physical reality which we call absolute space.

After the development of the 'coupled-mirrors' experiment, theoretical physics has to thoroughly revise the fundamental space-time concepts defended by conventional physical theory, whose important basis is the theory of relativity, and in many aspects return to the old Newtonian absolute conception.

However, we must emphasise that we also work with the Lorentz transformation and do not reject it. Hence, almost all formulae of conventional physical theory find a place in absolute space-time theory, thus the revision of the mathematical apparatus is very limited.

In this paper we shall expound our basic space-time concept and we shall show how we arrive at the following two very important conclusions:

(a) The Einstein time dilation is an absolute phenomenon (as supposed by Lorentz) and not a relative phenomenon (as supposed by Einstein).

(b) The Lorentz length contraction is pure fiction, i.e., it is neither an absolute phenomenon (as supposed by Lorentz) nor a relative phenomenon (as supposed by Einstein).

2. *Newtonian and Einsteinian Time Synchronisations*

According to our theory light propagates with velocity *c* along all directions only in absolute space. The definition of absolute space is given in Marinov (1972). Since our 'coupled-mirrors' experiment has not yet given a reliable quantitative value for the absolute earth velocity, and since the astronomers also cannot offer such a reliable value, we shall assume that absolute space is that in which the centre of mass of our Galaxy rests.

It is well known that physics is geometry plus time. Hence any physicist must start with the problem of how time is to be measured.

We shall suppose that we have a clock which operates at the same rate as 'die Räder an der grossen Weltenuhr', i.e., that this clock performs a periodical motion with exactly equal periods. If we want to have at some other place of the used reference frame another 'daughter' clock which would show the same time as our 'mother' clock, i.e., whose pointers show at any *absolute moment* the same reading on its clock-face as the pointers of the 'mother' clock, then we have two possibilities of realizing this:

(a) Between the 'mother' and 'daughter' clocks we place a long *rigid* shaft which is rotating at a constant angular velocity determined, say, by the 'mother' clock. Let us have two cog-wheels on both ends of the shaft and let us number any two cogs which lie against each other on the opposite ends of a given shaft's generation. Let us now suppose that at the beginning of any time interval chosen as a time unit a definite cog of the first cog-wheel comes in touch with the 'mother' clock. If the pointers of the 'daughter' clock show the reading which is 'communicated' by the corresponding cog of the second cog-wheel when it makes contact with the 'daughter' clock, then we say that a Newtonian time synchronisation is maintained between both clocks.

(b) From the 'mother' clock we send a light signal at the beginning of any time interval chosen as a time unit. If the pointers of the 'daughter' clock show the reading which the light signal has 'communicated', plus the time r/c, where r is the distance between both clocks, then we say that an Einsteinian time synchronisation is maintained between both clocks.

When introducing the Einsteinian time synchronisation we make the *assumption* that light propagates with a velocity which has the same numerical value along all directions in *any* inertial frame of reference, i.e., in any frame which moves with a constant velocity with respect to absolute space.

If our 'mother' and 'daughter' clocks rest in absolute space, then their Newtonian and Einsteinian time synchronisations lead to the same result, i.e., two 'daughter' clocks placed at the same space point and synchronised respectively in Newtonian and Einsteinian manner will show the same reading on their clock-face. However, if our clocks move with a certain velocity in absolute space, then two such 'daughter' clocks will show different readings, and from this variance, with the help of r and c, one could determine the component V of the unknown absolute velocity along the line connecting the 'mother' clock to both 'daughter' clocks. This is due to the fact that velocity of light in a frame moving with velocity V in absolute space is equal to $c - V$ along a direction parallel to V and to $c + V$ along a direction antiparallel to V.

In our 'coupled-mirrors' experiment (Marinov, 1974) we have realised for the first time in the history of physics a combination of the Newtonian and Einsteinian time synchronisations and this gave us the possibility of determining the absolute earth velocity.

3. *The Galilean and Lorentz Transformations*

If we have two frames of reference moving with respect to each other, i.e., moving with different velocities respectively to absolute space, then the use of the Newtonian and Einsteinian synchronisations would lead to two different types of transformation formulae for the elements of motion of a given material point whose motion is considered in both frames. The Newtonian synchronisation leads to the Galilean transformation formulae and the Einsteinian synchronisation leads to the Lorentz transformation formulae.

We shall first deduce the Galilean transformation.

Let us have (Fig. 1) two frames K and K' between which there is the case

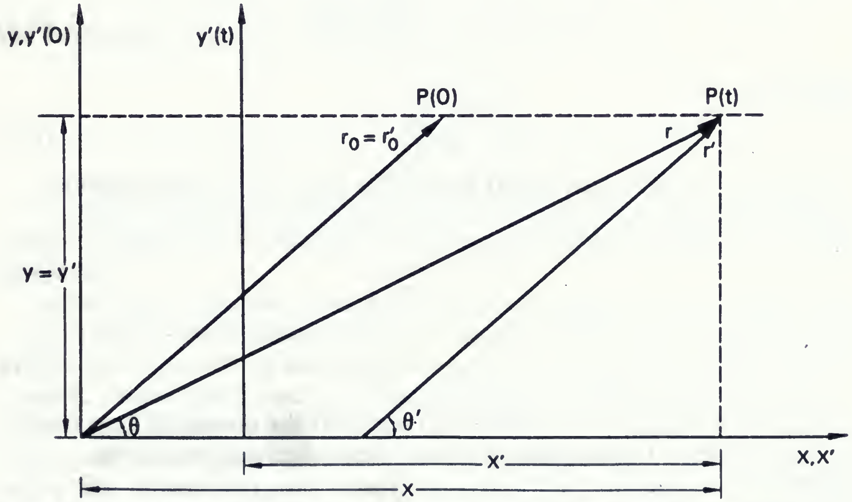

Figure 1.–Two space frames moving with respect to each other, the transformation between being a special one.

of a special transformation, i.e., at the initial zero moment both frames have coincided and frame K' proceeds with velocity V along the positive direction of the x-axis of frame K (or frame K proceeds with the same velocity along the negative direction of the x'-axis of frame K'). For the sake of simplicity we have shown a two-dimensional case in Fig. 1.

Let point P be at rest in K'. For the initial zero moment, $t_0 = t'_0 = 0$, the radius vectors $\mathbf{r}_0$ and $\mathbf{r}'_0$ of point P in both frames are equal. For an arbitrary moment t (to which in frame K' the moment t' corresponds) the radius vectors of point P in frames K and K' are respectively $\mathbf{r}$ and $\mathbf{r}'$ $(= \mathbf{r}'_0)$. It is obvious that the y- and z-components of $\mathbf{r}$ and $\mathbf{r}'$ are equal, i.e.,

$$y = y', \qquad z = z' \tag{3.1}$$

Only the x-components are different at any different moment. To find the transformation formulae for the x-components let us assume that at the initial zero moment we send a photon from the common frames' origin to the projection of point P on the x-axes. When the Newtonian time synchronisation is used we should find that this photon reaches the projection of P at the moments

$$t = \frac{x}{c}, \qquad t' = \frac{x'}{c - V} \tag{3.2}$$

respectively, if we assume that frame K is attached to absolute space, or at the moments

$$t = \frac{x}{c + V}, \qquad t' = \frac{x'}{c} \tag{3.3}$$

if we assume that frame K' is attached to absolute space.

In both cases it must be

$$\frac{x}{c} = \frac{x'}{c - V}, \qquad \frac{x}{c + V} = \frac{x'}{c} \tag{3.4}$$

respectively, i.e.,

$$t = t' \tag{3.5}$$

From (3.2) and (3.5), as well as from (3.3) and (3.5), we immediately obtain

$$x = x' + V \,.\, t' \tag{3.6}$$

and

$$x' = x - V \,.\, t \tag{3.7}$$

Formulae (3.6), (3.7), (3.1) and (3.5) represent the special Galilean transformation which is the mathematical basis of so-called non-relativistic mechanics.

Let us now deduce the Lorentz transformation. For this purpose the

Einsteinian time synchronisation must be used, and instead of formulae (3.2) and (3.3) we should consider, in both cases,

$$t = \frac{x}{c}, \qquad t' = \frac{x'}{c} \tag{3.8}$$

We see that when the Einsteinian synchronisation is used the couples of formulae (3.2) and (3.3) must be replaced by the unique couple (3.8). Thus we have also to replace both formulae (3.4) by a unique formula. This is done by multiplying formulae (3.4) and taking the square root giving

$$x \,.\, \sqrt{\left(1 - \frac{V}{c}\right)} = x' \,.\, \sqrt{\left(1 + \frac{V}{c}\right)} \tag{3.9}$$

From here, using the second formula (3.8), we get

$$x = \frac{x' + V \,.\, t'}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} \tag{3.10}$$

and using the first formula (3.8) we get

$$x' = \frac{x - V \,.\, t}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} \tag{3.11}$$

Substituting (3.10) into (3.11) we obtain

$$t = \frac{t' + x' \,.\, V/c^2}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} \tag{3.12}$$

and substituting (3.11) into (3.10) we obtain

$$t' = \frac{t - x \,.\, V/c^2}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} \tag{3.13}$$

Formulae (3.10), (3.11), (3.1), (3.12), and (3.13) represent the special Lorentz transformation which is the mathematical basis of so-called relativistic mechanics.

At the given deduction of the Lorentz transformation the moments t and t' (for which we have obtained the transformation formulae) are such that a photon sent at the initial zero moment, $t_0 = t'_0 = 0$, from the origins of frames K and K', along their x-axes, just reaches the projections of point P on the x-axes at the moment t (or t').

We shall now suppose the most general case where t and t' are arbitrary. In such a case we send a photon from the origin of the moving frame K' at some initial moment $t_0 \neq 0$ (or $t'_0 \neq 0$) and it reaches the projection of point P on the

x-axes at the arbitrary moment t (or t'). In this general case, if we suppose that the rest frame K is attached to absolute space, we shall have, on the grounds of formulae (3.10), (3.11), (3.12), and (3.13),

$$x - x_0 = \frac{x' + V.(t' - t'_0)}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}}, \qquad t - t_0 = \frac{t' - t'_0 + \frac{x'.V}{c^2}}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}}$$

$$x' = \frac{x - x_0 - V.(t - t_0)}{\left(1 - \frac{V^2}{c^2}\right)}, \qquad t' - t'_0 = \frac{t - t_0 - \frac{(x - x_0).V}{c^2}}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} \tag{3.14}$$

where x_0 is the x-coordinate of the origin O' of frame K' at the moment t_0 (or t'_0) when the 'photon-runner' is sent from O' along the x-axes; this photon reaches the projection x (or x') of point P at the moment t (or t'). Hence

$$x_0 = V.t_0 \tag{3.15}$$

If we further assume

$$t'_0 = t_0 . \sqrt{\left(1 - \frac{V^2}{c^2}\right)} \tag{3.16}$$

then formulae (3.14) reduce to formulae (3.10), (3.11), (3.12), and (3.13).

This assumption (namely, that time goes at a slower rate according to relation (3.15) in any frame moving at velocity V with respect to absolute space) is fundamental in our absolute space-time theory and is called the *absolute time dilation.* We can consider this assumption as a result of the Lorentz transformation, because if we place into (3.12) $x' = 0$, we obtain

$$t' = t . \sqrt{\left(1 - \frac{V^2}{c^2}\right)} \tag{3.17}$$

The opposite assumption (which would follow from (3.13) if we insert $x = 0$) cannot be made because only frame K' (together with the attached K'-clock) can be considered moving with respect to absolute space, but evidently we can *not* make the symmetric opposite assumption that absolute space (together with the attached K-clock reading absolute time) moves with respect to frame K'.

However, we must emphasise that relation (3.17) is not an absolute logical result of the Lorentz transformation because the existence of absolute space *is not imprinted* in the Lorentz transformation formulae which have an absolutely symmetric character from a *mathematical viewpoint*. As a matter of fact, the special theory of relativity, which works with the Lorentz transformation, does not come to the conclusion that the time dilation is an absolute phenomenon and has endeavoured (despite the resistance of the healthy mind of several generations of physicists) to treat the time dilation as a relative phenomenon.

In Section 6 we give further motivations in favour of our absolute time dilation dogma. Other motivations will be given in future papers which are being prepared for printing.

We shall also need the formulae for our so-called restricted Lorentz transformation. The restricted transformation has the same character as the special one, with the unique difference that the relative velocity V is not parallel to the x-axes of frames K and K' but has an arbitrary direction. The formulae for the restricted Lorentz transformation can easily be obtained if we consider the radius vector $\mathbf{r}$ of an arbitrary point P as a sum of its vector components $\mathbf{r}_{\parallel}$ and $\mathbf{r}_{\perp}$, which are respectively parallel and perpendicular to $\mathbf{V}$, and if we apply the special Lorentz transformation to $\mathbf{r}_{\parallel}$ and $\mathbf{r}_{\perp}$. We therefore obtain

$$\begin{aligned} \mathbf{r} &= \mathbf{r}' + \left\{ \left(\frac{1}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} - 1 \right) . \frac{\mathbf{r}' . \mathbf{V}}{V^2} + \frac{t'}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} \right\} . \mathbf{V} \\ t &= \frac{1}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} . \left(t' + \frac{\mathbf{r}' . \mathbf{V}}{c^2} \right) \end{aligned} \qquad (3.18)$$

and the parallel inverse formulae if we should express $\mathbf{r}'$ and t' by $\mathbf{r}$ and t.

In conclusion, we can say that the Galilean and Lorentz transformations represent two *different* mathematical implements which are used for the description of the *same* physical reality, i.e., they represent two slightly different images of the same object. We do not agree with the conventional opinion that the Galilean transformation represents only a limited case of the Lorentz transformation when $V \ll c$. We defend the assertion that the Galilean transformation is also to be used when high velocity material systems are considered. The difference between these two transformations is determined only by the different character of synchronisation of clocks remote in space.

4. *Space Intervals in Non-Relativistic Mechanics*

Let us take a rod which is at rest in the used reference frame. We can measure its length (i.e., the space interval between both ends), with the help of a standard length, during a specific time, the duration of which is of no importance.

However, if this rod moves in the used reference frame, then we cannot proceed in such a manner. We now have to register the 'track' which the rod would leave for a certain time interval. After measuring this 'track', which represents a 'rod at rest' in the used frame, we can calculate the true length of the moving rod if we know its velocity and the duration of the corresponding time interval. Of course, if the time interval is insignificantly short, then it is not necessary to make such a correction over the measured 'track'.

As an example let us measure the length of a train which moves with velocity v. If we run a certain time t with a velocity c ($c > v$), parallel with the train from the last carriage to the locomotive, we shall cover a distance

$$r = r_0 + v \, . \, t \tag{4.1}$$

where r_0 is the length of the train, which could be measured when resting at the station.

Both ends of distance r can be marked by us relative to the ground (relative to the railway), and, having these two scores, we can measure distance r during specific long time-interval.

But we can run with velocity c on the top of the carriages (as we have seen many times in the movies) and, throwing two stones, mark the 'track' with respect to the railway.

In the first case, i.e., when our velocity c is taken with respect to the ground, we shall have

$$t = \frac{r}{c} \tag{4.2}$$

and, in the second case, i.e., when our velocity c is taken with respect to the train, we shall have

$$t = \frac{r_0}{c} \tag{4.3}$$

Substituting (4.2) and (4.3) into (4.1), we obtain, respectively

$$r = \frac{r_0}{1 - \frac{v}{c}}, \qquad r = r_0 \, . \left(1 + \frac{v}{c}\right) \tag{4.4}$$

We note that these two relations differ within second-order terms of v/c. This is a result of the two different assumptions concerning velocity c, namely that in the first case c is the velocity of the 'runner' with respect to the ground, and in the second case c is the velocity of the 'runner' with respect to the train. If in the first formula of (4.4) we put $c + v$ instead of c, we should obtain the second formula of (4.4), and if in the second formula we put $c - v$ instead of c, we should obtain the first formula.

Let us now consider the most general case, where the velocity of the moving rod is not parallel to its length (see Fig. 2). Similar results could be obtained if we want to know the distance between a point q, moving with an arbitrary velocity v, and a point P_0 which rests in the used reference frame.

There are two possibilities of measuring the length of the moving rod P_0Q_0, or the distance between the rest point P_0 and the moving point q when the latter crosses the space point Q_0:

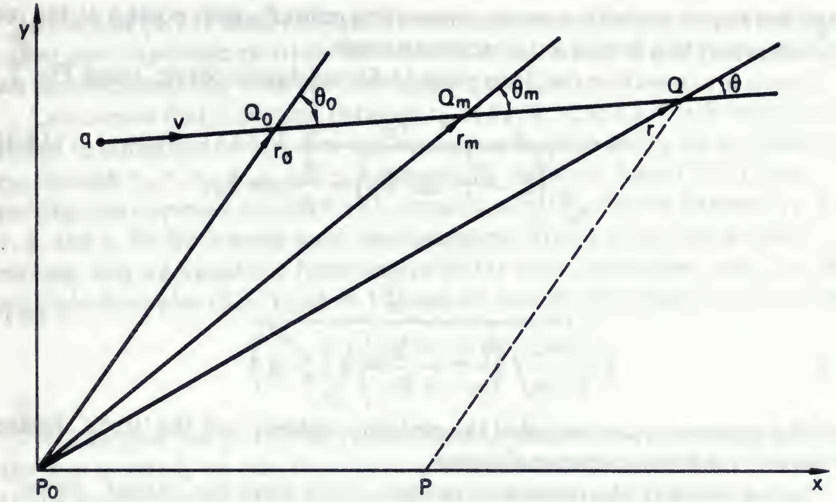

Figure 2.– A 'photon-runner' going 'there' or 'back'.

(a) either to start from point q (when it crosses Q_0) at the moment t_0, which we shall call the *emission moment*, and covering with velocity c the distance $r_0 = Q_0P_0$ to arrive at point P_0 at the moment

$$t = t_0 + \frac{r_0}{c} \tag{4.5}$$

which we shall call *reception moment*;

(b) or to start from point P_0 at the emission moment t_0 and covering with velocity c the distance $r = P_0Q$ to catch point q (when it crosses Q) at the reception moment

$$t = t_0 + \frac{r}{c} \tag{4.6}$$

We have to use the relation

$$\mathbf{r} = \mathbf{r}_0 + \mathbf{v}.(t - t_0) \tag{4.7}$$

If into this equation we first place (4.5), we should obtain, using Fig. 2,

$$r = r_0 . \sqrt{\left(1 + 2.\frac{v}{c}.\cos\theta_0 + \frac{v^2}{c^2}\right)} \tag{4.8}$$

or

$$r = r_0 . \left(\sqrt{\left(1 - \frac{v^2}{c^2}.\sin^2\theta\right)} + \frac{v}{c}.\cos\theta\right) \tag{4.9}$$

where θ_0 is the angle between v and $\mathbf{r}_0$ (the vector connecting point P_0 with point q at the emission moment) and is called the *emission angle*, while θ is the angle between **v** and **r** (the vector connecting point P_0 with point q at the reception moment) and is called the *reception angle.*

If now into equation (4.7) we place (4.6), we should obtain, using Fig. 2,

$$r = \frac{r_0}{\sqrt{\left(1 - \frac{v^2}{c^2} . \sin^2 \theta_0\right)} - \frac{v}{c} . \cos \theta_0} \tag{4.10}$$

or

$$r = \frac{r_0}{\sqrt{\left(1 - 2 . \frac{v}{c} . \cos \theta + \frac{v^2}{c^2}\right)}} \tag{4.11}$$

The distance r_0 can be called the *emission distance* and the 'track' distance r can be called the *reception distance.*

Let us now find the relation between r_0 and r when the 'runner' covers, with velocity c, some *middle distance* r_m, starting at the emission moment t_0 from Q_m (or from P_0) and arriving at the reception moment

$$t = t_0 + \frac{r_m}{c} \tag{4.12}$$

at P_0 (or at Q_m).

We can now write (see Fig. 2)

$$\frac{r_m}{c} = \frac{r . \cos \theta - r_0 . \cos \theta_0}{v} \tag{4.13}$$

When the 'runner' covers distance r_0 between the emission and observation moments, it is

$$\frac{r_0}{c} = \frac{r . \cos \theta - r_0 . \cos \theta_0}{v} \tag{4.14}$$

from where

$$r = r_0 . \frac{v/c + \cos \theta_0}{\cos \theta} \tag{4.15}$$

and when the 'runner' covers distance r between the emission and reception moments, it is

$$\frac{r}{c} = \frac{r . \cos \theta - r_0 . \cos \theta_0}{v} \tag{4.16}$$

from where

$$r = r_0 . \frac{\cos \theta_0}{\cos \theta - v/c} \tag{4.17}$$

Relations (4.15) and (4.17) differ within second-order terms v/c and can be called non-relativistic relations between r_0, r, θ_0, θ, v, and c because, until now, we have worked only with the Newtonian concept.

Let us now find a relation between r_0, r, θ_0, θ, v, and c which would correspond to condition (4.13). For this reason we have to define an expression for r_m through r_0, r, θ_0, θ, v, and c, substantially different from (4.13), and, putting this expression into (4.13), obtain a suitable relation between r_0, r, θ_0, θ, v, and c. We have made many mathematical efforts to do this, without success, and we found the following to be the most reasonable path: Let us multiply formulae (4.15) and (4.17) and let us take the square root: we obtain

$$r = r_0 \, . \sqrt{\left(\frac{v/c + \cos\theta_0}{\cos\theta - v/c} \, . \, \frac{\cos\theta_0}{\cos\theta}\right)} \tag{4.18}$$

We can now call (4.18) the relativistic expression between r and r_0, because the way in which we pass from both non-relativistic formulae (4.15) and (4.17) to the unique formula (4.18) is similar to how we passed from both non-relativistic formulae (3.4) to the unique relativistic formula (3.9). However, the mathematical essence of relation (4.18) is now *very transparent and clear from a non-relativistic point of view*, because it is obvious that relation (4.18) corresponds to the case where the 'runner' covers some middle distance r_m between the emission and reception moments.

From Fig. 2 we have

$$\frac{r_0}{r} = \frac{\sin\theta}{\sin\theta_0} \tag{4.19}$$

and from (4.18) and (4.19) we obtain the following relations between the angles θ_0 and θ

$$\cos\theta = \frac{\cos\theta_0 + v/c}{1 + \dfrac{v}{c} . \cos\theta_0}, \qquad \cos\theta_0 = \frac{\cos\theta - v/c}{1 - \dfrac{v}{c} . \cos\theta} \tag{4.20}$$

From formulae (4.19) and (4.20) we find

$$r = r_0 \, . \frac{1 + \dfrac{v}{c} . \cos\theta_0}{\sqrt{\left(1 - \dfrac{v^2}{c^2}\right)}}, \qquad r = r_0 \, . \frac{\sqrt{\left(1 - \dfrac{v^2}{c^2}\right)}}{1 - \dfrac{v}{c} . \cos\theta} \tag{4.21}$$

from where

$$r = r_0 \, . \sqrt{\left(\frac{1 + \dfrac{v}{c} . \cos\theta_0}{1 - \dfrac{v}{c} . \cos\theta}\right)} \tag{4.22}$$

From (4.21) we get

$$\left(1+\frac{v}{c}.\cos\theta_0\right).\left(1-\frac{v}{c}.\cos\theta\right)=1-\frac{v^2}{c^2} \qquad (4.23)$$

Since it is approximately

$$\cos\theta_0=\cos\theta_m+a, \qquad \cos\theta=\cos\theta_m-a \qquad (4.24)$$

where a is a positive or negative quantity and θ_m is the angle between **v** and $\mathbf{r}_m$ (the vector connecting point P_0 with point q at the *middle moment* t_m between the emission and reception moments), which is called the *middle angle*, then we can write (4.22) approximately in the form

$$r=r_0.\sqrt{\left(\frac{1+\frac{v}{c}.\cos\theta_m}{1-\frac{v}{c}.\cos\theta_m}\right)} \qquad (4.25)$$

We must emphasise that formulae (4.21) are *identical*, while formulae (4.8) and (4.9), on the one hand, and formulae (4.10) and (4.11), on the other hand, are *different*. So for the longitudinal case $\theta_0=\theta=0$, instead of the two formulae (4.4), obtained when proceeding, respectively from formulae (4.10) and (4.11) and formulae (4.8) and (4.9), we obtain the unique formula

$$r=r_0.\sqrt{\left(\frac{1+v/c}{1-v/c}\right)} \qquad (4.26)$$

when proceeding from formulae (4.21).

However, it is important to note that for the transverse case $\theta_0=\pi/2$ formulae (4.21), (4.10) and (4.8)—the last within an accuracy of second order in v/c—give the same result:

$$r=\frac{r_0}{\sqrt{\left(1-\frac{v^2}{c^2}\right)}} \qquad (4.27)$$

and for the transverse case $\theta=\pi/2$ formulae (4.21), (4.9) and (4.11)—the last within an accuracy of second order in v/c—again give the same result:

$$r=r_0.\sqrt{\left(1-\frac{v^2}{c^2}\right)} \qquad (4.28)$$

Thus the difference between the non-relativistic formulae (4.8), (4.9), (4.10) and (4.11) and the relativistic formulae (4.21) is not so drastic.

It is clear that the problem, which formulae correspond better to reality—the non-relativistic or the relativistic—cannot be posed. These slightly different formulae correspond to slightly different conditions under which the 'runner' covers with velocity c the distance between points P_0 and q, and they all correspond to reality.

However, when the 'runner' is a photon, then, as nature shows (this can be seen in the Michèlson–Morley experiment and in the longitudinal Doppler effect experiments), the relativistic formulae (4.21) correspond to reality and the non-relativistic formulae do not. Thus we have to assume that during the emission and reception moments the 'photon-runner' covers the middle distance with velocity c. In our opinion, this conclusion, as a matter of fact, is a result of the absolute time dilation dogma.

Let us now suppose that the reference frame in Fig. 2 is attached to absolute space and thus point q moves with velocity v in absolute space. If we denote by c_0 the velocity of the 'photon-runner' with respect to point q, then instead of formula (4.5) we have to write the following one

$$t = t_0 + \frac{r_0}{c_0} \tag{4.29}$$

and now formulas (4.6) and (4.29) will be valid *together*. In this case we can immediately obtain from formulas (4.21), (4.6), and (4.29)

$$c_0 = c \cdot \frac{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}{1 + \frac{v}{c} \cdot \cos\theta_0} = c \cdot \frac{1 - \frac{v}{c} \cdot \cos\theta}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} \tag{4.30}$$

Those are the formulas for the velocity of light in a moving frame of reference in relativistic mechanics, according to our absolute space-time conceptions.

The same formulas can be also obtained when proceeding from the Lorentz transformation. Let us suppose that frame K in Fig. 1 is at rest in absolute space and frame K' is the moving one. If the 'photon-runner' is sent from the coinciding origins of K and K' at the initial zero moment, $t_0 = t'_0 = 0$, and if it catches point P respectively at the moments t and t', we should have (see (3.8))

$$\frac{r}{t} = c \qquad \frac{r'}{t'} = c \tag{4.31}$$

i.e., the velocity of light in both frames has the same numerical value when time in these frames is not the same but is to be transformed according to the Lorentz transformation formulas. However if we should measure the velocity of light in both frames in the *same absolute time*, we have to write

$$\frac{r}{t} = c, \qquad \frac{r'}{t} = c_0 \tag{4.32}$$

Substituting t from the second formula (3.18) into the second formula (4.32), we get, keeping in mind the second relation (4.31),

$$c_0 = \frac{r'}{t} = \frac{r'}{t'} \cdot \frac{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}}{1 + \frac{\vec{r}' \cdot \vec{V}}{t' \cdot c^2}} = c \cdot \frac{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}}{1 + \frac{V}{c} \cdot \cos\theta'} \qquad (4.33)$$

Obviously, we can express $\vec{r}'$ through $\vec{r}$ and t according to the formula inverse to the first formula (3.18) and use the first relation (4.31). The calculation in this case is more complicated and we obtain

$$c_0 = \frac{r'}{t} = \frac{\sqrt{(\vec{r}'^2)}}{t} = \frac{r}{t} \cdot \frac{1 - \frac{\vec{r} \cdot \vec{V}}{t \cdot c^2}}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} = c \cdot \frac{1 - \frac{V}{c} \cdot \cos\theta}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} \qquad (4.34)$$

5. *Space Intervals in Relativistic Mechanics*

In this section we proceed from the Lorentz transformation formulae and intend to show to which results they lead concerning the space interval between two points moving with velocity V together, or one with respect to the other. When referring to a 'rod', we will also have in mind the second case.

Let us consider the problem about the length of a 'rod', using first the *Einsteinian time synchronisation*. Hence the measurement of the length of a 'rod' is to be performed by sending a light signal from one of its ends to the other. Then the distance between both scores left in the rest frame K is to be measured and the real length (distance), if we know the relation V/c, calculated.

Let us have a 'rod' which has an arbitrary position in frame K' (use Fig. 1) and let us find its 'track' in frame K. We proceed from formulae (3.10) and (3.1) and build the differences $x_2 - x_1, y_2 - y_1, z_2 - z_1$, where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the scores left in frame K when a light signal is sent at the moment t_1 (t'_1) from one end of the 'rod' to its other end, which is covered by the signal at the moment t_2 (t'_2). Let us square these differences and add, respectively, their left and right sides. Taking the square root from the equation obtained, and substituting there

$$t'_2 - t'_1 = \frac{1}{c} \cdot \sqrt{[(x'_2 - x'_1)^2 + (y'_2 - y'_1)^2 + (z'_2 - z'_1)^2]} = \frac{r'}{c} = \frac{r_0}{c} \qquad (5.1)$$

we obtain the following relation (cf. (4.21))

$$r = r_0 \,.\, \frac{1 + \frac{V}{c} \,.\, \cos\theta_0}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} = r_0 \,.\, \frac{1 + \frac{\mathbf{n}_0 \,.\, \mathbf{V}}{c}}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} \tag{5.2}$$

where we have used the notation

$$\frac{x_2' - x_1'}{r'} = \cos\theta' = \cos\theta_0 \tag{5.3}$$

and $\mathbf{n}' = \mathbf{n}_0$ is the unit vector pointing from the initial to the final end of the 'rod' in frame K'.

In the same way, proceeding from formula (3.11) and the inverse formulae (3.1) and using the condition

$$t_2 - t_1 = \frac{1}{c} \,.\, \sqrt{[(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2]} = \frac{r}{c} \tag{5.4}$$

we obtain the following relation (cf. (4.21))

$$r_0 = r \,.\, \frac{1 - \frac{V}{c} \,.\, \cos\theta}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} = r \,.\, \frac{1 - \frac{\mathbf{n} \,.\, \mathbf{V}}{c}}{\sqrt{\left(1 - \frac{V^2}{c^2}\right)}} \tag{5.5}$$

where we have used the notation

$$\frac{x_2 - x_1}{r} = \cos\theta \tag{5.6}$$

and n is the unit vector pointing from the initial to the final end of the 'track' of our 'rod' in frame K.

Relations (5.2) and (5.5) can also be obtained, proceeding from the formulae for the restricted Lorentz transformation.

Indeed, proceeding from the first formula (3.18), let us build the difference $\mathbf{r}_2 - \mathbf{r}_1$, where $\mathbf{r}_1$ and $\mathbf{r}_2$ are the radius vectors of the scores left in frame K when a light signal is sent at the moment t_1 (t_1') from one end of our 'rod' to its other end which is covered by the signal at the moment t_2 (t_2'). Squaring both sides of the equation obtained, taking the square root, using the notations

$$\mathbf{r}_2 - \mathbf{r}_1 = r \,.\, \mathbf{n}, \qquad \mathbf{r}_2' - \mathbf{r}_1' = r' \,.\, \mathbf{n}' = r_0 \,.\, \mathbf{n}_0 \tag{5.7}$$

and introducing the conditions

$$t_2 - t_1 = \frac{r}{c}, \qquad t_2' - t_1' = \frac{r'}{c} = \frac{r_0}{c} \tag{5.8}$$

we obtain formula (5.2).

In a similar way, proceeding from the inverse formula to (3.18), we can obtain formula (5.5).

We shall now write formulae (5.2) and (5.5) in different notations.

Let us consider again the point q proceeding with an arbitrary velocity **v** in the rest frame of reference K (see Fig. 3 and compare it with Fig. 2). When q crosses the space point Q' a light signal (a 'photon-runner') is sent towards point P, which we shall call the reference point. This light signal, covering distance r', reaches P at the moment t, called the *observation moment*, when q crosses point Q. At this very moment a light signal is sent from P which, covering distance r'', catches q when it crosses point Q''.

The moment

$$t' = t - \frac{r'}{c} \tag{5.9}$$

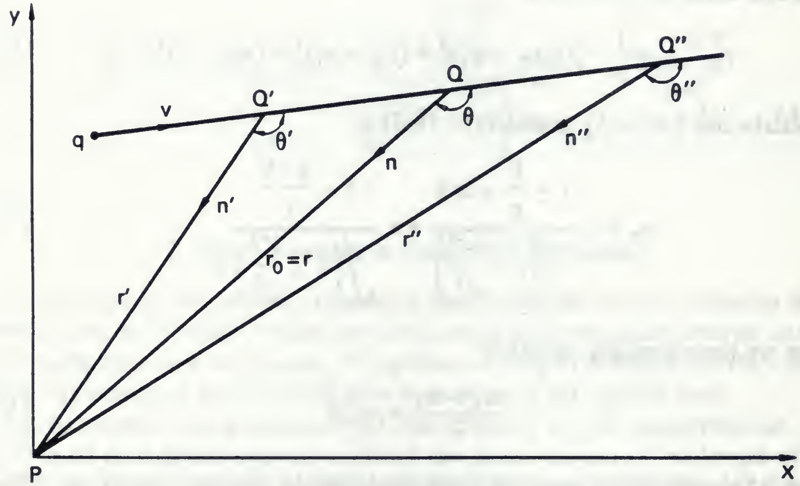

Figure 3.—A 'photon-runner' going 'there' and 'back'.

at which a light signal is sent from q when it crosses point Q' is called the *advanced moment*.

The moment

$$t'' = t + \frac{r''}{c} \tag{5.10}$$

at which a light signal sent from P reaches q when it crosses point Q'', is called the *retarded moment*.

Slightly different values for the advanced and retarded moments should be obtained if in formulae (5.9) and (5.10) we write r_0 instead of r' and r''.

We call r', r'', and r_0, respectively, the *advanced, retarded*, and *observation distances*.

When comparing Fig. 3 with Fig. 2 we must take into account that the triangle Q_0P_0Q corresponds *either* to the triangle $Q'PQ$ *or* to the triangle

QPQ″. Take also into account that in Fig. 2 the radius vectors $\mathbf{r}_0$ and $\mathbf{r}$ (i.e., the unit vectors $\mathbf{n}_0$ and $\mathbf{n}$) point from the rest point P to the moving point q, while in Fig. 3 the unit vectors $\mathbf{n}'$, $\mathbf{n}$, and $\mathbf{n}''$ point from the moving point q to the rest point P. We also see immediately that if the emission moment is the advanced moment, then the reception moment is the observation moment, and if the emission moment is the observation moment, then the reception moment is the retarded moment.

Thus, writing in formula (5.2)

$$r = r_0, \qquad r_0 = r', \qquad \mathbf{n}_0 = -\mathbf{n}', \qquad \theta_0 = \theta', \qquad \mathbf{V} = \mathbf{v} \tag{5.11}$$

and writing in formula (5.5)

$$r_0 = r_0, \qquad r = r'', \qquad \mathbf{n} = -\mathbf{n}'', \qquad \theta = \theta'', \qquad \mathbf{V} = \mathbf{v} \tag{5.12}$$

we obtain, respectively,

$$\begin{aligned} r_0 &= r' . \frac{1 - \dfrac{\mathbf{n}' . \mathbf{v}}{c}}{\sqrt{\left(1 - \dfrac{v^2}{c^2}\right)}} = r' . \frac{1 - \dfrac{v}{c} . \cos\theta'}{\sqrt{\left(1 - \dfrac{v^2}{c^2}\right)}} \\ r_0 &= r'' . \frac{1 + \dfrac{\mathbf{n}'' . \mathbf{v}}{c}}{\sqrt{\left(1 - \dfrac{v^2}{c^2}\right)}} = r'' . \frac{1 + \dfrac{v}{c} . \cos\theta''}{\sqrt{\left(1 - \dfrac{v^2}{c^2}\right)}} \end{aligned} \tag{5.13}$$

Let us now consider the problem about the length of a ‘rod’ using *Newtonian time synchronisation*. Hence the length of a given ‘rod’ moving in frame K with velocity $\mathbf{v}$ is to be established, registering the scores which both its ends leave in frame K at a given absolute moment.

We must emphasise that according to our absolute space-time conception, at a given moment the ‘rod’ has the *same length* in any frame of reference. However, if we use Newtonian time synchronisation in the Lorentz transformation formulae, then a certain peculiarity appears which will now be analysed.

The ‘momentary’ length of a ‘rod’ will be called the *distance* between both its ends and will be denoted

$$r = \sqrt{[(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2]} \tag{5.14}$$

where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of both ends of the ‘rod’ which are registered in frame K at the same moment

$$t_1 = t_2 = t \tag{5.15}$$

If we compare (5.14) with (5.4), we must take into account that in (5.4) r is the ‘track’ distance left by the ‘rod’ in frame K during a definite time interval $t_2 - t_1$, while r in (5.14) is a ‘momentary track’ left by the ‘rod’ in K at a given instant.

Let us now write the length of this ‘rod’ in frame K'. Supposing that the ‘rod’ rests in K', we shall have

$$r' = r_0 = \sqrt{[(x'_2 - x'_1)^2 + (y'_2 - y'_1)^2 + (z'_2 - z'_1)^2]} \tag{5.16}$$

where (x'_1, y'_1, z'_1) and (x'_2, y'_2, z'_2) are the coordinates of both ends of the ‘rod’ which are registered in frame K'. Since the ‘rod’ rests in K', then these coordinates concern every moment there.

Using formula (3.11) and the inverse formulae (3.1) into (5.16), and remembering condition (5.15), we find

$$r_0 = \frac{1}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} . \sqrt{\left\{(x_2 - x_1)^2 + \left(1 - \frac{v^2}{c^2}\right) . [(y_2 - y_1)^2 + (z_2 - z_1)^2]\right\}} \tag{5.17}$$

If we use here notations (5.6) and (5.14) we get

$$r_0 = r . \frac{\sqrt{\left(1 - \frac{v^2}{c^2} . \sin^2\theta\right)}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} \tag{5.18}$$

where θ is the angle between the line along which the ‘rod’ lies and its velocity.

We call r_0 the *proper distance* of the moving ‘rod’.

For $\theta = \pi/2$ we obtain

$$r_0 = r \tag{5.19}$$

and for $\theta = 0$ we obtain

$$r_0 = \frac{r}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} \tag{5.20}$$

According to our absolute conception the difference between the distance r and the proper distance r_0 is *not* a result of some physical length contraction (commonly called the Lorentz contraction). This is a result of the interference of the two slightly different mathematical apparatus–the non-relativistic and the relativistic.

Indeed, using Fig. 3 and performing a purely non-relativistic calculation, we shall have

$$r' - \frac{r'}{c} . v . \cos\theta' = \sqrt{\left[r^2 - \left(\frac{r'}{c} . v . \sin\theta'\right)^2\right]} \tag{5.21}$$

But according to the law of sines it is

$$\frac{r'}{\sin(\pi - \theta)} = \frac{r}{\sin\theta'} \tag{5.22}$$

so that we can write (5.21) in the form

$$r = r' . \frac{1 - \frac{v}{c} . \cos \theta'}{\sqrt{\left(1 - \frac{v^2}{c^2} . \sin^2 \theta\right)}} \qquad (5.23)$$

This formula, and the first formula (5.13) lead immediately to relation (5.18).

We must emphasise that when writing equation (5.21) we have assumed that the 'photon-runner' covers the emission (i.e., the advanced) distance. If we should assume that the 'photon-runner' covers the reception (i.e., observation) distance, another relation between r_0 and r can be obtained which will lead to a 'length dilation'.

Hence we must look to the distance r as a 'non-relativistic' observation distance and to the proper distance r_0 as a 'relativistic' observation distance. These two distances are connected by relation (5.18). This permanent contradiction between the distance r and the proper distance r_0 appears, not as a result of some peculiar property of space and time, which the theory of relativity has tried to introduce into physics, despite the resistance of the healthy human mind, but as a result of the fact that in non-relativistic mechanics we assume that between the moments of emission and reception the 'photon-runner' covers either the emission or the reception distances, while in relativistic mechanics we assume that the 'photon-runner' covers the middle distance. We shall repeat (see the end of Section 4), in the basis of this contradiction lies the absolute time dilation.

6. *Time Intervals*

Let us have (Fig. 4) two so-called light clocks, one of which (clock A) is at rest in the used reference frame attached to absolute space and the other (clock B) performing a rotational motion in such a manner that its 'arm' always remains perpendicular to the linear velocity of rotation.

If clocks A and B have the same 'arms' they will go exactly at the same rate when being at rest, i.e., two photon packages left together, say, from their left mirrors, will reach the mirrors at the same time.

However, if clock B performs the above-mentioned rotational motion, its photon package will always arrive, with a specific time delay, later than the corresponding photon package in clock A. Indeed, the photon packages have to cover the distance $2 . r_0$ between two reflections in clock A and the distance

$$2 . r = \frac{2 . r_0}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}} \qquad (6.1)$$

in clock B, where r_0 is the length of the light clock's 'arm'.

This formula can be obtained from the first formula of (4.21)–or from formulae (4.8) and (4.10)–at the condition $\theta_0 = \pi/2$, as well as from the second formula of (4.21)–or from formulae (4.9) and (4.11)–at the condition $\cos\theta = v/c$ (see Fig. 4).

Thus if we choose the unit of time as the time between two successive reflections of a photon package in a light clock with a given 'arm' r_0, then the light clock A will have

$$n_0 = \frac{2 . r_0}{c} \tag{6.2}$$

absolute seconds in a unit of time.

The light clock B will also have n_0 absolute seconds in a unit of time when being at rest and

$$n = \frac{2 . r}{c} = \frac{2 . r_0}{c . \sqrt{\left(1 - \frac{v^2}{c^2}\right)}} \tag{6.3}$$

absolute seconds in a unit of time when being in motion.

From (6.2) and (6.3) we draw the conclusion that clock B goes at a slower rate and if, for a certain absolute time interval, say for one revolution of clock B, the reading of clock A is t A-time-units, then the reading of clock B will be

$$t_0 = t . \sqrt{\left(1 - \frac{v^2}{c^2}\right)} \tag{6.4}$$

B-time-units, since it is $t_0/t = n_0/n$. We call t *time interval* and t_0 *proper time interval.*

This deduction of the time dilation has an entirely non-relativistic character. It is clear from Fig. 4 that clock B moves with respect to absolute space and clock A is at rest. In the opposite case we have to assume that the whole world rotates about clock B; obviously, this is nonsense.

In Fig. 4 the motion of clock B is non-inertial during the whole period of separation from clock A. We shall now show that we will also obtain the same effect of time dilation when the motion of clock B is inertial during the predominant part of the separation time.

Indeed, let us have (Fig. 5) a light clock A, which is at rest in absolute space, and an identical light clock B which passes near it (at point b) with velocity v. Until the point b' the light clock B moves inertially with the same velocity v. From point b' to point b'' its velocity reduces to zero, and from point b'' to point b' its velocity increases again to v however oppositely directed. Clock B then begins to move inertially and, with this velocity v, again passes near clock A.

Now assuming that the time of non-inertial motion is insignificantly short with respect to the time of its inertial motion, we can obtain, in a purely non-

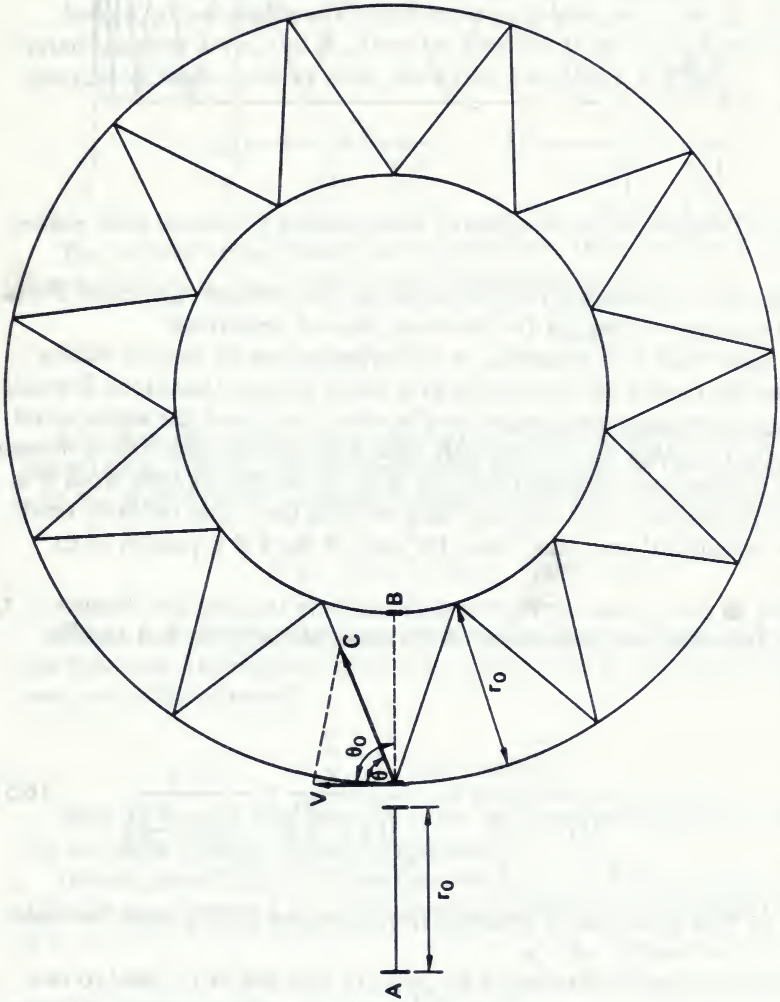

Figure 4.–Two light clocks, the second of which performs a circular motion.

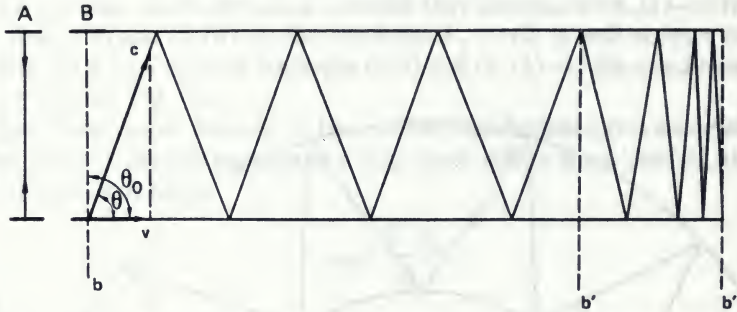

Figure 5.—Two light clocks, the second of which performs a 'there and back' motion.

relativistic way, the relation (6.4) between the time reading t_0 of clock *B* and the time reading *t* of clock *A* for the whole time of separation.

Here again clock *B* is in motion; in the opposite case we have to assume that when the mutual velocity of clocks *A* and *B* change, then clock *B* would not change its velocity with respect to the whole world but the whole world would have to change its velocity with respect to clock *B*; again this is nonsense.

Until now we have supposed that the 'arm' of the moving light clock *B* is always perpendicular to its velocity. Now we shall show that the same result could be obtained if we assume that the 'arm' of clock *B* is parallel to its velocity.

Indeed, in such a case the photon packages have to cover the distance $2 \,.\, r_0$ between two successive reflections on the same mirror in clock *A* and the distance

$$2 \,.\, r = r_0 \,.\, \frac{1 + \dfrac{v}{c}}{\sqrt{\left(1 - \dfrac{v^2}{c^2}\right)}} + r_0 \,.\, \frac{1 - \dfrac{v}{c}}{\sqrt{\left(1 - \dfrac{v^2}{c^2}\right)}} = \frac{2 \,.\, r_0}{\sqrt{\left(1 - \dfrac{v^2}{c^2}\right)}} \qquad (6.5)$$

in clock *B*. This result can be obtained from formulae (4.21) under the conditions $\theta_0 = \theta = 0$ and $\theta_0 = \theta = \pi$.

The non-relativistic relations (4.8), (4.9), (4.10), and (4.11) lead to two formula with different terms of second order in v/c, whose geometrical mean gives the result (6.5).

Thus we have shown that any light clock moving arbitrarily with respect to absolute space goes at a slower rate than an identical light clock which rests in absolute space; the relation between their readings for a definite absolute interval of time is given by formula (6.4).

We can generalise this conclusion and assume that the time of any clock (i.e., of *any material system*) which moves with respect to absolute space advances with a slower rate than absolute time. We suppose that this close connection between the light clock and any other clock (i.e., any other periodic process) is due to the empirical fact that the velocity of light is a universal constant which gives the numerical tie between space and time.

We record here that the results obtained in this section immediately give the explanation of the historical Michelson-Morley experiment.

Indeed, if the lengths of the mutually perpendicular 'arms' in the Michelson interferometer are r_0 and R_0, then the absolute time intervals spent by two photon packages to cover these 'arms' there and back will be

$$\Delta t = \frac{2 . r_0}{c . \sqrt{\left(1 - \frac{v^2}{c^2}\right)}}, \qquad \Delta T = \frac{2 . R_0}{c . \sqrt{\left(1 - \frac{v^2}{c^2}\right)}} \tag{6.6}$$

The corresponding proper time intervals, i.e., those which will be read on a clock attached to the interferometer, will be (see (6.4))

$$\Delta t_0 = \frac{2 . r_0}{c}, \qquad \Delta T_0 = \frac{2 . R_0}{c} \tag{6.7}$$

For their difference, which calls forth an eventual shift in the interference fringes when rotating the interferometer with respect to the absolute velocity v of the interferometer or when changing the velocity v, we obtain

$$\Delta t_0 - \Delta T_0 = \frac{2}{c} . (r_0 - R_0) = \text{const.} \tag{6.8}$$

Hence, not only the Michelson-Morley experiment (where $r_0 = R_0$), but also the Kennedy-Thorndike experiment (where $r_0 \neq R_0$) must give zero results, as was practically observed.

7. *Some Results*

With the help of formulae (5.13) we can immediately obtain expressions for the so-called Liénard-Wiechert potentials.

Indeed, according to our absolute conception, the electromagnetic 4-potential of a point charge q at a reference point distant r (see formula (5.14)) from it is

$$\overleftrightarrow{A} = \frac{q}{c} . \frac{\overleftrightarrow{v}_0}{r_0} \tag{7.1}$$

$$\overleftrightarrow{v}_0 = (\vec{v}_0, i . \bar{v}_0) = \left(\frac{\vec{v}}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}, i . \frac{c}{\sqrt{\left(1 - \frac{v^2}{c^2}\right)}}\right) \tag{7.2}$$

is the proper 4-velocity of the charge, $\vec{v}$ is its velocity at a given moment of observation

and r_0 (see formula (5.17)) is the proper distance between charge and reference point at this very moment; i is the imaginary unit; with the sign $\leftrightarrow$ we denote a 4-vector, with the sign $\rightarrow$ its space part and with the sign $-$ its time part.

Substituting formulae (5.13) into (7.1), we obtain the electromagnetic 4-potential of the charge q in the form of Liénard–Wiechert

$$\overleftrightarrow{A} = \frac{q}{c} . \frac{\overleftrightarrow{v}}{r' . \left(1 - \frac{\vec{n}' . \vec{v}}{c}\right)}, \qquad \overleftrightarrow{A} = \frac{q}{c} . \frac{\overleftrightarrow{v}}{r'' . \left(1 + \frac{\vec{n}'' . v}{c}\right)} \qquad (7.3)$$

where $\overleftrightarrow{v} = (\vec{v}, i . c)$ is the 4-velocity of the charge, r' is the advanced distance and r'' is the retarded distance.

In our absolute space-time theory we do not introduce drastic differences between electricity and gravitation. All formulae with which we work are identical if the electric charges are replaced by masses and the inverse electric constant (which in the system CGS is equal to unity) by the gravitational constant taken with a negative sign.

Hence on the basis of (7.1) we obtain that the gravitational potential of a point mass m, moving with velocity $\vec{v}$ with respect to the reference point distant r from it, is to be presented in the form

$$\phi = -\frac{k^2 . m}{r_0 . \sqrt{\left(1 - \frac{v^2}{c^2}\right)}} \qquad (7.4)$$

where k^2 is the gravitational constant and r_0 the proper distance.

The gravitational energy of mass m and a mass M which rests at the reference point will be $U = M . \phi$. Using this form for the gravitational energy we obtain (in Part IV of our manuscript (Marinov, in preparation) dedicated to gravitation):

(a) For the perihelion displacement of the planets a result which represents half of the result given by general relativity.

(b) For the angular deflection of a light beam passing near the sun a result which represents half of the result given by general relativity.

(c) For the gravitational frequency shift (the so-called 'red shift') a result which is the same as that given by general relativity.

In our opinion the experimental check of the first two results is not sufficiently reliable, so it is impossible to decide whose predictions best correspond to reality. As a decisive *experimentum crucis* in favour of our theory we now consider only the 'coupled-mirrors' experiment (Marinov, 1975).

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A RELIABLE EXPERIMENT FOR THE PROOF OF THE SPACE-TIME ABSOLUTENESS

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A realizable modification of the historical Harress experiment is proposed which shows that the velocity of light is direction dependent in any frame moving with respect to absolute space.

Recently [1] we have performed the (so-called by us) "coupled-mirrors" experiment which offers the possibility of measuring the absolute earth's velocity in a laboratory. However, because of the high measuring error, the result obtained in this first realization is too crude to be directly convincing.

In this paper we shall propose a realizable experiment which can with a very high accuracy show that our "coupled-mirrors" experiment must give a positive result. Let us have (fig. 1) a disk along whose rim the mirrors $M_1, \ldots, M_k$ are placed close enough to each other. Light emitted by the source S_A (or S_B) passes through the semi-transparent mirror M_A (M_B) and through the high-frequency operating shutter Sh_A (Sh_B). The chopped light reflects by the mirrors $M_1, \ldots, M_k$, passes through the shutter Sh_B (Sh_A) and, being reflected by the semi-transparent mirror M_B (M_A), is observed by the observer O_A (O_B). The shutters operate with the same chopping frequency, f, being driven by the common resonator Res put at the center of the disk. Thus the shutters operate synchronously at rest as well as at motion of the disk. This synchronism is to be understood in the most simple and natural Newtonian manner. As a matter of fact, since the distances between the common resonator and the shutters which the electromagnetic signals have to cover are equal (with respect to the disk but also with respect to absolute space!), then it is obvious that the shutters always will be opened and closed together.

Let us suppose first that the disk is at rest and let us denote by d the light path between both shutters. At the condition that $n = (d/c) \cdot f$ is an integer (or an integer plus $\frac{1}{2}$) both observers will register a maximum (minimum) photonian flux. If now we put the disk in rotation in a clock-wise direction, then the observer O_A will register a maximum photonian flux at the condition that $n_A = (d/c) \cdot f \cdot (1 + v/c)$ is an integer, while the observer O_B will register a maximum photonian flux at the condition that $n_B = (d/c) \cdot f \cdot (1 - v/c)$ is an integer.

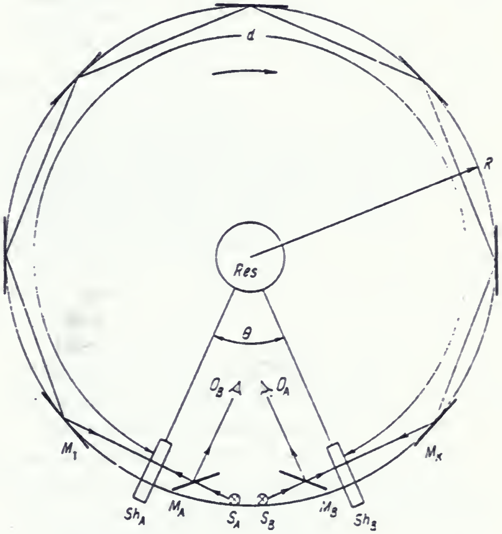

Fig. 1. The "coupled-shutters on a rotating disk" experiment.

If d and v are given and f changes, then both observers consequently should register "equal" or "opposite" pictures, i.e., say, "O_A and O_B together see maximum light", or "O_A sees maximum light when O_B sees minimum light". Indeed, we have

$$n_A = n_B \cdot \frac{c + v}{c - v} \approx n_B + 2 \cdot \frac{v}{c} \cdot n = n_B + \Delta n . \qquad (1)$$

Thus if $\Delta n = 2\cdot d\cdot v\cdot f/c^2$ is an integer the observers O_A and O_B should register "equal" pictures and if Δn is equal to an integer plus 1/2, the observers O_A and O_B should register "equal" pictures and if Δn is equal to an integer plus 1/2, the observers O_A and O_B should register "opposite" pictures.

If the angle θ is almost equal to 2π and the radius of the disk R is very large, then we can consider the motion of the coupled shutters as inertial. It is obvious that (at given d and f) the effect registered depends only on the velocity v and *not* on the centrifugal acceleration (which for large radius of the disk tends to zero). Thus if the system of both shutters and the resonator is replaced by two cog-wheels fixed on a common rigid shaft droven by a motor, then the effect will remain the same. Just such is the essence of our "coupled-mirrors" experiment. Anyone who can not find inner forces to agree that a Newtonian time synchronization is realized in the "coupled-mirrors" experiment has to perform the "coupled-shutters on a rotating disk" experiment with θ very near to 2π. This can be practically realized if one takes as a rotating disk the earth and puts the common resonator at the pole. As shutters two Kerr cells can be taken separated by a short distance d (about 100 km) along the equator (say, on the peaks of two mountains). As light sources lasers can be taken. The commanding signals can be sent from the pole to the shutters by the help of several retranslation stations. The equality of the ways to both shutters is to be determined by the "echo" radar technique. However it is easy to see that *an absolute equality of these ways is by no means necessary.*

For $v = 0.45$ km/s (that is approximately the linear rotational velocity of the earth's equator) and d = 100 km one should have $\Delta n \approx 0$ for f low, $\Delta n = 1/2$ for $f = 5 \times 10^8$ Hz, $\Delta n = 1$ for $f = 10^9$ Hz, and so on. Thus changing the commanding frequency in this range one should change the pictures registered by both observers from "equal" to "opposite", again to "equal", and so on, and the linear rotational velocity of the earth's equator can be measured using the direction dependence of light velocity.

Remark. The anonymous referee has suggested we should clearly note which must be the prediction given by the theory of relativity to the "coupled-mirrors on a rotating disk" experiment. At the present time the situation in the camp of the relativists is the following: There is a part of them (a minority) which asserts that the result of the Harress experiment can be explained in the domain of special relativity and there is another part (a majority) which asserts that the result of the Harress experiment (where the motion is not inertial) can be obtained only with the apparatus of general relativity. Thus according to the largest part of the relativists even the result of the Harress experiment (which was performed 60 years ago!) can be not explained by special relativity. Thus, we think, this is a task of an authoritative Einstein's disciple to predict the result of the "coupled-shutters on a rotating disk" experiment (where the motion is quasi-inertial) and we can mention only the following:

If a relativist says that the result of the Harress experiment must be just the one as was practically established, he must mean that the result of the "coupled-shutters on a rotating disk" experiment must be this one as predicted by us. However if a relativist says this, he must mean that the result of the "coupled-mirrors" experiment must be this one as predicted (and practical established) by us. However if a relativist says this, he is not more a relativist, but becomes an absolutist denying the principle of relativity. (An analogue: If a lady says "no", she means "may be"; if a lady says "may be", she means "yes"; however if a lady says "yes", this is not a lady.)

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The Second-Order Effects in the "Rotating Disk" Experiment

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Abstract

We find the second-order in v/c effects in the four different modifications of the "rotating disk" experiment whose first-order effects have been analyzed and the experimental results obtained by us reported in another paper. The differences between our absolute space-time theory and the Newtonian ether theory are within effects of second order in v/c. We propose experiments for the measurement of the second-order effects on the "rotating disk" that can be considered as *experimenta crucis* between both theories.

1. *Introduction*

We have dedicated earlier papers to the analysis of the first-order in v/c effects in the "rotating disk" experiment (Marinov, 1975a, 1976a, 1976b). In Marinov (1976a) we give the account of the disrupted "rotating disk" experiment and in Marinov (1976b) of the Harress–Marinov and Harress–Fizeau experiments, performed recently by us. All these experiments, as well as the "coupled-mirrors" experiment (Marinov, 1974b, 1976c), with whose help we have measured for the first time in history the Earth's absolute velocity, show that the velocity of light is direction dependent in any frame moving with respect to absolute space. Within effects of first order in v/c this dependence is the same as that predicted by the Newtonian ether theory.

However, our absolute space-time theory (Marinov, 1975b) leads to effects of second order in v/c that differ from those predicted by the ether theory. In this paper we shall show which are the second-order effects in the "rotating disk" experiment according to our conceptions. Before tackling this problem we shall find by the help of our "hitch-hiker" model (Marinov, 1974a) the velocity of light in a medium that rests in absolute space if this velocity is measured in a frame (i.e., by an observer) moving with respect to absolute space.

2. *Velocity of Light in a Medium at Rest Measured by a Moving Observer*

In Marinov (1974a) we have found the velocity of light in a medium that moves at velocity v in absolute space measured by an observer who is at rest. Now we shall find the velocity of light in a medium that rests in absolute space measured by an observer who moves at velocity v. The theory of relativity cannot make such a distinction because for this theory only the relative velocity between the medium and the observer is of importance. Our absolute space-time theory can pose this problem and resolve it, and, as we have experimentally established (Marinov, 1976b), experience has splendidly verified our predictions.

Thus let there be (see Figure 1) a medium with refractive index n that is at rest in absolute space and in which light propagates along a direction that makes an angle θ with the x axis of a frame K attached to absolute space. Let another frame K' move at velocity v along the positive direction of the x axis of K and assume that the x axes of both frames are collinear and the y axes parallel.

We choose as a time unit the time between two successive absorptions of a photon on the molecules of the medium. At such a choice of the time unit a photon propagating along the direction AF in the rest frame K is "hitched" $(1 - 1/n)$th part of the time unit onto a molecule that rests at point A and $(1/n)$th part of the time unit moves along the line AF until it is "hitched" again onto another molecule, which rests at point F (see Marinov, 1974a).

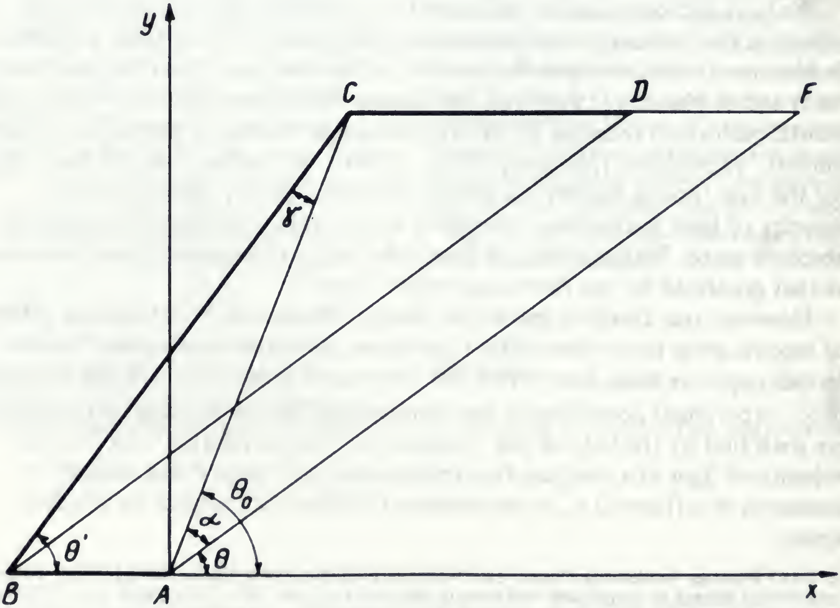

Fig. 1. The paths of a photon proceeding in a medium that rests in absolute space with respect to the rest and moving frames.

In the moving frame K' we shall have the following picture: During the time in which the photon is "hitched" it will cover the distance AB with velocity v and during the time in which the photon propagates with velocity c in absolute space it will cover distance BC in K' (at an angle θ' to the x' axis) with a velocity (measured on a clock that rests in K'!) (Marinov, 1976c)

$$c_0' = \frac{c}{1 + (v/c) \cos\theta'} \tag{2.1}$$

since during the time in which the photon has covered the broken line ABC in frame K' the molecule that rests at point F in absolute space has covered distance FC in K' with velocity v. We call (Marinov, 1976c) c_0' the proper relative light velocity. The mean proper relative light velocity in frame K' (i.e., the average light velocity measured in K' by the help of a clock that rests there) will make an angle θ_0 with the x' axis and have magnitude

$$c_{0m}' = AC = (AB^2 + BC^2 - 2AB \cdot BC \cos\theta')^{1/2} \tag{2.2}$$

since the time between two successive absorptions of the photon is taken equal to unity.

Substituting into (2.2)

$$AB = v(1 - 1/n), \qquad BC = \frac{c}{1 + (v/c) \cos\theta'} \frac{1}{n} \tag{2.3}$$

and working within an accuracy of second order in v/c, we obtain

$$c_{0m}' = \frac{c}{n} - v \cos\theta' + \frac{v^2}{cn} \cos^2\theta' + \frac{1}{2} \frac{v^2}{c} n \left(1 - \frac{1}{n}\right)^2 \sin^2\theta' \tag{2.4}$$

The angle that the observer should measure between the direction of propagation of light and the x' axis in frame K' is θ_0. Thus, substituting into (2.4)

$$\theta' = \theta_0 - \gamma \tag{2.5}$$

where γ is a small angle and, as we shall see further, within the necessary accuracy we can take

$$\sin\gamma = \frac{AB \sin\theta'}{AC} \cong \frac{v}{c} (n - 1) \sin\theta' \cong \frac{v}{c} (n - 1) \sin\theta_0 \tag{2.6}$$

we obtain

$$c_{0m}' = \frac{c}{n} - v \cos\theta_0 + \frac{v^2}{cn} \cos^2\theta_0 - \frac{1}{2} \frac{v^2}{c} n \left(1 - \frac{1}{n^2}\right) \sin^2\theta_0 \tag{2.7}$$

The angle between the x axis and the direction of propagation of light which should be measured in frame K is θ. Thus, substituting into (2.7)

$$\theta_0 = \theta + \alpha \tag{2.8}$$

where α is a small angle and, as we shall see further, within the necessary accuracy we can take

$$\sin \alpha = \frac{CF \sin \theta}{AC} \cong \frac{v}{c} n \sin \theta \tag{2.9}$$

we obtain

$$c'_{0m} = \frac{c}{n} - v \cos \theta + \frac{v^2}{cn} \cos^2\theta + \frac{1}{2}\frac{v^2}{c} n \left(1 + \frac{1}{n^2}\right) \sin^2\theta \tag{2.10}$$

If $n = 1$, it will be $c'_{0m} = c'_0$, so that formula (2.7) reduces to the following one (for $n = 1$ it is $\theta_0 = \theta'$):

$$c'_0 = c - v \cos \theta' + (v^2/c) \cos^2\theta' \tag{2.11}$$

and formula (2.10) reduces to the following one:

$$c'_0 = c - v \cos \theta + v^2/c \tag{2.12}$$

which coincide within an accuracy of second order in v/c, respectively, with the first and second formulas for the proper relative light velocity in a frame moving at velocity v in absolute space (Marinov, 1976c)

$$c'_0 = \frac{c}{1 + (v/c) \cos \theta'} = c\, \frac{1 - (v/c) \cos \theta}{1 - v^2/c^2} \tag{2.13}$$

For $\theta = \theta_0 = 0$, formulas (2.7) and (2.10) give

$$c'_{0m} = \frac{c}{n} - v + \frac{v^2}{cn} \tag{2.14}$$

For $\theta = \pi/2$, $\theta_0 = \pi/2 + (v/c)n$, formulas (2.7) and (2.10) give

$$c'_{0m} = \frac{c}{n} + \frac{1}{2}\,\frac{v^2}{c} n \left(1 + \frac{1}{n^2}\right) \tag{2.15}$$

We recall (Marinov, 1976c) that c'_0 is the proper relative light velocity, i.e., c'_0 is the light velocity in the moving frame measured by the help of a clock which is attached to the moving frame. The absolute relative light velocity, called for short relative light velocity, is the same quantity, but measured by the help of a clock that is attached to absolute space, and it is equal to

$$c' = c'_0 (1 - v^2/c^2)^{1/2} \tag{2.16}$$

Let us find now the velocity of light in a medium moving with respect to absolute space and measured in a frame attached to the medium.

Since in such a case $(1 - 1/n)$th part of the time unit the photon is "hitched" and does not move with respect to the moving frame K', then the "effective" velocity of the frame with respect to the trajectory of the "free" photon will be $(1/n)v$. Thus, according to formula (2.13), the proper velocity of the "free" photon with respect to K' will be

$$c'_0 = \frac{c}{1 + (v/cn)\cos\theta'} = c\,\frac{1 - (v/cn)\cos\theta}{1 - (v^2/c^2n^2)} \tag{2.17}$$

With this velocity the photon moves only $(1/n)$th part of the time unit, so that the mean proper velocity with respect to K' will be

$$c'_{0m} = \frac{1}{n}c'_0 = \frac{c}{n}\,\frac{1}{1 + (v/cn)\cos\theta'} = \frac{c}{n}\,\frac{1 - (v/cn)\cos\theta}{1 - (v^2/c^2n^2)} \tag{2.18}$$

where θ' and θ are the angles between the direction of light propagation and the x axes, respectively, in the moving and rest frames.

This result can be obtained by the help of Figure 1 in Marinov (1974a). Let us note, however, that if we should use the notations given in Marinov (1974a), we should obtain the following expression for the mean velocity with respect to K':

$$c'_m = \frac{BC}{t_m} = \frac{c}{n}\,\frac{1}{1 + (v/cn)\cos\theta' + \frac{1}{2}(v^2/c^2n)\sin^2\theta'} \tag{2.19}$$

This formula gives the mean light velocity with respect to the moving frame K' measured in absolute time, i.e., the quantity [see (2.16)]

$$c'_m = c'_{0m}\,(1 - v^2/c^2)^{1/2} \tag{2.20}$$

The difference in the second-order terms in the formulas (2.19) and (2.20), substituting (2.18) into the latter, appears as a result of the fact that in obtaining (2.19) we have used only traditional Newtonian conceptions, while when obtaining (2.18) we have used formula (2.13) for the light velocity in a moving frame given by our absolute space-time theory, which is the true one. Thus only formulas (2.18) and (2.20) correspond to physical reality, while formula (2.19) corresponds to physical reality within the terms of first order in v/c.

3. *The Second-Order Effects in the Harress–Marinov, –Sagnac, –Fizeau, and –Pogany Experiments*

The measurement of the second-order effects in the "rotating disk" experiment is a technologically difficult problem, and in our laboratory we cannot cope with it. For this reason we shall propose such experiments without entering into the details of an eventual practical realization.

The setup for a measurement of the second-order effects in the "rotating disk" experiment is shown in Figure 2. A medium with refractive index n made

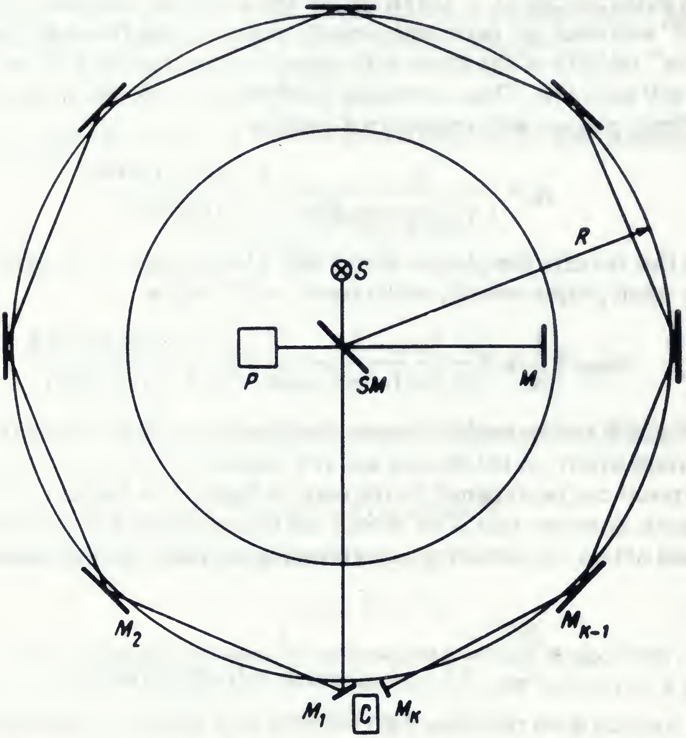

Fig. 2. The setup for the measurement of the second-order effects on the rotating disk.

in the form of a cylindrical ring (Marinov, 1976b) with outer radius R can rotate with the mirrors $M_1, M_2, \ldots, M_{k-1}, M_k$ or without them, or only the mirrors can rotate and the medium remain at rest. In the latter case medium with refractive index $n = 1$, i.e., vacuum (air) can be also taken. So there are four different possible combinations, as follows (see Marinov, 1976b):

1. The Harress-Marinov experiment, in which the medium is at rest and the mirrors rotate.
2. The Harress-Sagnac experiment, in which the medium is vacuum and the mirrors rotate.
3. The Harress-Fizeau experiment, in which the medium rotates and the mirrors are at rest.
4. The Harress-Pogany experiment, in which the medium rotates together with the mirrors.

Let us note that it will be very difficult to measure the second-order effects in the Harress-Marinov and Harress-Fizeau experiments, because there is a relative motion between mirrors and medium, so the performance of the Harress-Sagnac and Harress-Pogany experiments should be easier.

In Figure 2 S is a light source emitting coherent light, which is rigidly connected with the mirrors because the effect to be measured is too small and the use of a shutter that is governed by the rotating disk (Marinov, 1976b) would probably discredit the experiment. P is a photoresistor illuminated by interference light. It is put in one arm of a Wheatstone bridge, in whose other arm there is a variable resistor. We should assume that $M_1, M_2, \ldots, M_{k-1}, M_k$ are placed close enough to the rim of the medium's disk. Thus we can assume that the photons fly along the circumference of a circle and cover a path $d = 2\pi R$.

Let us suppose first that the disk is at rest. Light emitted by the source S is split by the semitransparent mirror SM into first and second beams. The first beam reflects on the mirror M and after refraction on SM illuminates P. The second beam reflects successively on $M_1, \ldots, M_k$ clockwise and on $M_k, \ldots, M_1$ counterclockwise and after reflection on SM illuminates P.

If now we set the disk in rotation, then the first beam should not change the time in which it will cover its path, because all the time it moves along the radius of the rotating disk, while the second beam should change its time with Δt. Now we shall calculate this time difference for the four different types of the "rotating disk" experiment.

Let us consider first the Harress–Marinov experiment. Using formulas (2.14) and (2.20) we find that the difference in the absolute times which the second beam should spend to cover its path in the cases of rest and rotation of the mirrors will be

$$\Delta t_{H\text{-}M} = \frac{d}{c_m'^{+}} + \frac{d}{c_m'^{-}} - \frac{2d}{c_m} = \frac{dv^2}{c^3} n(2n^2 - 1) \tag{3.1}$$

For $n = 1$, i.e., for the second-order effect in the Harress–Sagnac experiment we obtain

$$\Delta t_{H\text{-}S} = \frac{dv^2}{c^3} \tag{3.2}$$

It can easily be seen that for the first-order effects in the Harress–Marinov and Harress–Sagnac experiments we shall obtain the same formulas as in Marinov (1976b), where the calculation was made in a somewhat different way.

Let us now consider the Harress–Fizeau experiment. Using formula (17) from (Marinov, 1974a), we find that the difference in the absolute times which the second beam should spend to cover its path in the cases of rest and rotation of the medium will be

$$\Delta t_{H\text{-}P} = \frac{d}{c_m^{+}} + \frac{d}{c_m^{-}} - \frac{2d}{c_m} = \frac{2dv^2}{c^3}\, n(n^2 - 1) \tag{3.3}$$

And finally let us consider the Harress–Pogany experiment. Using formula (2.18) for $\theta' = \theta = 0$, and formula (2.20), we obtain

$$\Delta t_{H\text{-}P} = \frac{d}{c_m'^{+}} + \frac{d}{c_m'^{-}} - \frac{2d}{c_m} = \frac{dv^2}{c^3} n \tag{3.4}$$

From this formula for $n = 1$ we obtain again the second-order effect (3.2) in the Harress–Sagnac experiment.

4. *The Second-Order Effects in the "Rotating Disk" Experiment and the Absolute Time Dilation*

The second-order effects in the "rotating disk" experiment are very important for the understanding and for establishment of our absolute time dilation conception. Let us show this.

As is well known (see, for example, Marinov, 1975b), a light clock represents two mirrors placed in front of each other between which a light pulse goes "there and back." Instead of two mirrors we can have an arbitrary number. Of importance is only that a light pulse that leaves a given point, returns again to it, and repeats this cycle uninterruptedly. Thus our mirrors $M_1, M_2, \ldots, M_k, \ldots, M_2, M_1$ represent also a light clock.

Let the time that a light pulse spends covering the path d "there and back" be T when the mirrors are at rest. Thus $T = 2d/c$ is the rest period of our clock. When the mirrors are set in rotational motion with velocity $v = \Omega R$, where Ω is the angular velocity, the period of the light clock measured in absolute time, i.e., by the help of a clock that rests in absolute space, will be [see formulas (2.13) and (2.16)]

$$T_0 = \frac{d}{c'^+} + \frac{d}{c'^-} = \frac{2d}{c(1 - v^2/c^2)^{1/2}} = \frac{T}{(1 - v^2/c^2)^{1/2}} \tag{4.1}$$

while the same period measured in proper time, i.e., by the help of a clock that is attached to the rim of the moving disk, will be

$$T_{00} = \frac{d}{c_0'^+} + \frac{d}{c_0'^-} = \frac{2d}{c} = T \tag{4.2}$$

Thus the period of our light clock rotating with velocity v in absolute space, as the period of any proceeding as a whole with velocity v light clock (Marinov, 1975b), becomes longer, according to formula (4.1). We have called this effect the absolute kinematic time dilation. Let us note that to the absolute dynamic time dilation, i.e., to the dilation of the periods of light clocks placed near local concentrations of matter, we have dedicated our paper (Marinov, 1976d). Further, in the present paper we shall consider only the kinematic time dilation.

According to the tenth (high-velocity) axiom of our absolute space-time theory (Marinov, 1976c, 1976d), the time unit for any observer is determined by the period of a light clock that has the same "arm" for all observers. When the "arm" is $d = 150{,}000$ km, then this time unit is called a second. If the observer is at rest in absolute space, his second is called absolute. If the observer moves with certain velocity in absolute space, his second is called proper. Obviously, any proper second is larger then the absolute second and the relation is given by formula (4.1), where T_0 is the duration of the proper second in absolute time and T is the duration of the absolute second in absolute time. However this change in the duration of the period of a light clock, when being put in motion, can be established only comparing its period with a periodical process of a system that is at rest in absolute space (in general, which does not change its velocity when the light clock under investigation changes its velocity). If we should compare the period of the light clock considered with the periodical process of a system that all the time moves with the same velocity as the light clock, then no change can be registered, as follows from formula (4.2). This is due to the fact that the rhythm of *any* periodical process decreases according to formula (4.1) if the corresponding system is set in motion with velocity v.

All these assertions of our absolute space-time theory can be verified experimentally if one measures the second-order effect in the Harress–Sagnac experiment.

The second-order effect in the Harress–Sagnac experiment was treated by Burcev (1974), who has proposed also an experiment for its measurement. Burcev's proposal consists in the following: Let there by a number (≥ 3) of artificial satellites moving along the same circular trajectory round the Earth with a certain velocity v. If a radar pulse is emitted from the one of the satellites, then by means of reflections in the other satellites this radar pulse can be again received after having covered a closed path round the Earth, and the time of delay can be measured with high precision. If we suppose that the satellites are placed close enough to each other, then the trajectory of the radar wave can be assumed as circular and the gravitational potentials at all points crossed by the wave as equal. Thus any reference made by Burcev to Shapiro's experiment (Shapiro, 1968) [where the cover times of radar signals passing the *same* distance in regions with *different* gravitational potentials are measured—see Marinov (1976d)] is out of place, and we can treat Burcev's proposal by the help of our Figure 2, assuming that clock C (an atomic clock) is attached to the mirrors M_1 and M_k, so that the time in which a light pulse covers the path from M_1 to M_k, or from M_k to M_1, can be measured.

According to the Einstein theory of general relativity (Burcev, 1974; Landau and Lifshitz, 1955; Tonnelat, 1964) this time, respectively, for the "direct" (+) and "opposite" (−) pulse is

$$t_E^{\pm} = t \frac{1 \pm v/c}{(1 - v^2/c^2)^{1/2}} \tag{4.3}$$

where $t = d/c = 2\pi R/c$ is the time registered on the same clock if the disk is at rest.

According to the traditional Newtonian ether theory this time is

$$t_N^{\pm} = \frac{t}{1 \mp v/c} \tag{4.4}$$

According to our absolute space-time theory this time is [see formula (2.13)]

$$t_M^{\pm} = t_0^{\pm} = \frac{d}{c_0'^{\pm}} = t\left(1 \pm \frac{v}{c}\right) \tag{4.5}$$

If this time should be measured on a clock that rests in absolute space, it will be

$$t^{\pm} = \frac{d}{c'^{\pm}} = t\,\frac{1 \pm v/c}{(1 - v^2/c^2)^{1/2}} \tag{4.6}$$

When we have to measure the absolute time interval $t^{\pm}$ by the help of a clock that rests in absolute space, the problem arises about the time synchronization of spatially separated clocks. This problem is solved by us (theoretically and *practically*) by the help of a rotating rigid shaft. However, in the "rotating disk" experiment the problem about the time synchronization of spatially separated clocks can be eliminated if we choose an appropriate rotational velocity v, so that the light pulse, emitted by M_1 when it passes near the clock C, which is at rest, will arrive at M_k when M_k passes (after one or more revolutions) near C.

Let us note that Burcev (1974) wrongly writes formula (4.5) as corresponding to the Newtonian ether theory. In a letter to the author of 18 September 1974 he agreed that the true formula that must be written when proceeding from the traditional Newtonian theory is (4.4).

We have to add here that according to the majority of the relativists the "rotating disk" experiment can be treated only with the help of the mathematical apparatus of general relativity. However certain relativists (see, for example, Laue, 1955) assert that this can be done also by the apparatus of special relativity and perform suitable calculations making use of the Lorentz transformation.

Let us see what results the special relativity way leads to. Let us attach a moving frame K' to the rotating disk and a rest frame K to absolute space. Obviously, K' is not an inertial frame because at any moment its velocity changes its direction. However, the absolute value of the velocity remains constant and this makes it possible to use the Lorentz transformation formulas. For the initial event (sending of a light pulse from M_1) let us take $x_1' = 0$, $t_1' = 0$ and for the final event (arriving of the signal at M_k) $x_2' = d$, $t_2' = d/c$. Substituting these values into the Lorentz transformation formulas for time (see, for example, Marinov, 1975b) and subtracting the first formula thus obtained from the second, we obtain the result (4.6). Now this time is measured on a clock that is at rest. The time measured on a clock that is attached to the moving disk must be equal to $t' = d/c$, *both* for the "direct" and for the "opposite" pulses.

In Figure 3 we give the graphs of the relations t^+/t versus v/c drawn according to formulas (4.3)–(4.5). Thus an experiment such as the one proposed by Burcev can choose between these three rival theories. However, since the relativity theory was knocked out by our "coupled-mirrors" experiment (Marinov, 1976c), as well as by the disrupted "rotating disk"

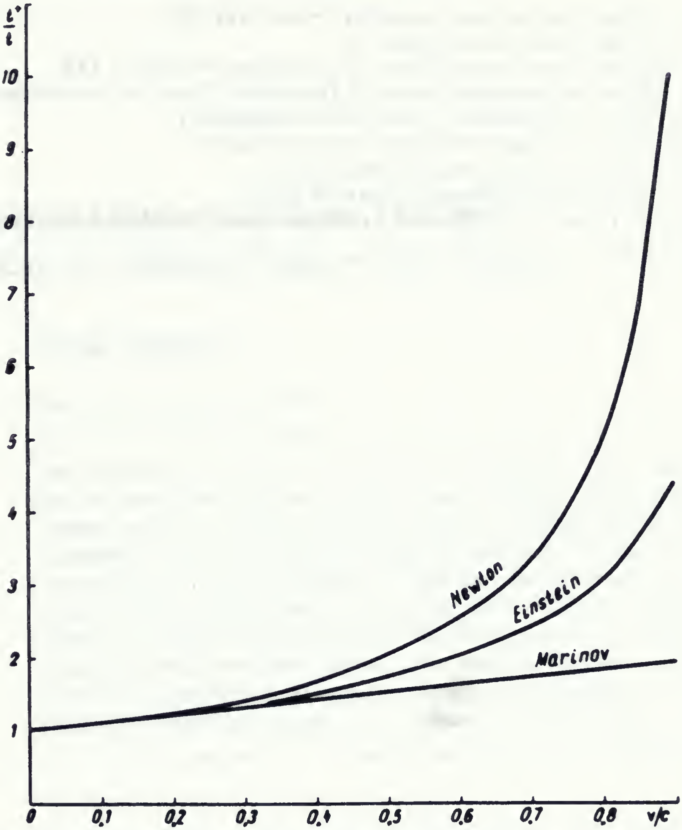

Fig. 3. The relative times in which the "direct" light pulse makes a whole revolution on the rotating disk, according to the theories of Newton, Einstein, and Marinov.

experiment (Marinov, 1976a), such a second-order experiment has to choose only between the Newtonian and our theories. Taking into account, however, that many second-order experiments (the Michelson–Morley experiment, the Ives–Stilwell experiment, and all experiments where the time dilation appears, i.e., the whole of high-velocity physics) have knocked out the traditional Newtonian ether theory, then the conclusion is to be drawn that at the present time only our absolute space-time theory corresponds to physical reality.

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Gravitational (Dynamic) Time Dilation According to Absolute Space–Time Theory

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Proceeding from our absolute space–time conceptions, we obtain the formula for the gravitational frequency shift in an extremely simple way. Using our "burst" model for photons, we show that the different rates of clocks placed in spatial regions with different gravitational potentials appear as a direct result of the gravitational frequency shift and the axiomatic assumption that at any space point the time unit is to be defined by light clocks with equal "arms," i.e., that at any space point the light velocity (in moving frames the "there-and-back" velocity) has the same numerical value c. *Considering the principle of equivalence, we come to the logical conclusion that the kinematic (Einstein–Lorentz) time dilation is an absolute phenomenon.*

1. THE GRAVITATIONAL FREQUENCY SHIFT

According to our absolute space–time theory,(1) the gravitational energy of two masses as registered in a frame of reference where the mass M is at rest is given by the formula

$$U = -\frac{k^2 mM}{r}\left(1 - \frac{v^2}{c^2}\right)^{-1/2} \tag{1}$$

where k^2 is the gravitational constant, r is the distance between both masses, $\mathbf{v}$ is the velocity of mass m, and c is the velocity of light.

The corresponding Lagrange equation of motion is

$$m\, d\mathbf{v}_0/dt = -\nabla U \tag{2}$$

where $\mathbf{v}_0 = \mathbf{v}(1 - v^2/c^2)^{-1/2}$ is the *proper velocity* of mass m.

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Forming the scalar product of both sides of (2) with $\mathbf{v} = d\mathbf{r}/dt$, we obtain

$$\frac{d}{dt}\left[mc^2\left(1-\frac{v^2}{c^2}\right)^{-1/2}\right] = \frac{d}{dt}\left[\frac{k^2mM}{r}\left(1-\frac{v^2}{c^2}\right)^{-1/2}\right] \tag{3}$$

or

$$\frac{de_0}{dt} = -\frac{d}{dt}\left(-\frac{k^2e_0E_0}{c^4r}\right) \tag{3'}$$

where e_0 and E_0 are the *proper energies* of the masses m and M. This equation shows that the change in time of the proper energy of mass m interacting with mass M is equal to the negative change in time of its gravitational energy.

If we start with Eq. (3′), then we need as a basis only the energy conservation law and the form of the gravitational energy of mass m given in formula (3′).

In addition, we must use the axiomatic assertion of our absolute space-time theory that the *energy* (or *rest energy*) $e = mc^2$ of any material point with mass m can be expressed by its *rest frequency* ν_r according to the relation $e = h\nu_r$, where h is the Planck constant. The *proper energy* $e_0 = e(1 - v^2/c^2)^{-1/2}$ is to be expressed by the *frequency* $\nu = \nu_r(1 - v^2/c^2)^{-1/2}$ of mass m according to the relation $e_0 = h\nu$. If the material point is a photon, then $m = 0$, $v = c$. The rest frequency of any photon is equal to zero; thus all photons have the same rest frequency, and only the frequencies of photons transferring different quantities of energy are different.

Substituting into (3′) the proper energy e_0 expressed through the frequency ν of the material point considered, we obtain

$$\nu_2 - \nu_1 = \frac{k^2M}{c^2}\left(\frac{\nu_2}{r_2} - \frac{\nu_1}{r_1}\right) = -\frac{1}{c^2}(\nu_2\Phi_2 - \nu_1\Phi_1) \tag{4}$$

or

$$\nu_1\left(1+\frac{\Phi_1}{c^2}\right) = \nu_2\left(1+\frac{\Phi_2}{c^2}\right) \tag{5}$$

where Φ_1 and Φ_2 are the gravitational potentials caused by mass M at the points of emission and reception, respectively, and ν_1 and ν_2 are the emission and reception frequencies of the photon.

For the case where the difference between the emitted and received frequencies is not large, we can write, on the right side of (4), $\nu_1 \cong \nu_2 \cong \nu_m$; and so we obtain

$$\nu_2 - \nu_1 = (\nu_m/c^2)(\Phi_1 - \Phi_2) \tag{6}$$

We call this effect (commonly known as the *red shift*) the gravitational (or *dynamic*) frequency shift. The frequency change of a photon emitted from a body which moves with respect to the receiver is called the Doppler (or *kinetic*) frequency shift.

2. THE RATE OF TIME IN A GRAVITATIONAL FIELD

Now we shall show that the gravitational light frequency shift considered together with the tenth axiom of our absolute space–time theory(2) leads to the conclusion that at points with different gravitational potentials time passes at different rates.

Here we shall briefly mention that the ten axioms, which represent the axiomatic basis of the classical (nonquantum) part of our theory, are: (1) Axiom for space. (2) Axiom for time. (3) Axiom for energy.[2] (4) Axiom for gravitational (i.e., first type of space) energy. (5) Axiom for electric (i.e., second type of space) energy. (6) Axiom for kinetic (i.e., time) energy. (7) Axiom for magretic (i.e., first type of space–time) energy. (8) Axiom for magnetic (i.e., second type of space–time) energy. (9) Axiom for conservation of energy. (10) Relativistic (i.e., high-velocity) axiom.

The tenth axiom reads: The material points called photons move with velocity c along all directions in absolute space and their velocity does not depend on their history. Light clocks with equal "arms" have the same rate in any frame, independent of the orientation of their "arms." At any point of any frame the time unit is to be defined by the period of light clocks with equal "arms," independent of the velocity of the frame and the local concentration of matter.

The crucial difference between the absolute space–time theory and relativity theory is the following: Our theory assumes that only the "there-and-back" velocity of light has the same numerical value at any point of any inertial frame, while the Einsteinian theory assumes that the "there" and "back" velocities separately have the same numerical value. As is shown in Ref. 1, in our theory for the unidirectional velocity of light we obtain the formula (4.30) of that paper, which was proved correct by our recent "coupled-mirrors" experiment.(3),[3]

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[2] In the third axiom we introduce axiomatically the relations $e = mc^2$ and $e = h\nu_r$. Thus in our theory the quantities mass and frequency are derivative. Only three physical quantities are undefined (i.e., axiomatically introduced): space (three-dimensional quantity), time, and energy.

[3] We note that now we are working on a repetition of the "coupled-mirrors" experiment in its so-called *interferometric* variant. According to preliminary estimations, we shall be able to measure the absolute Earth velocity with a measuring error less than 10 km/sec. In the old, so-called *deviative* variant of the "coupled-mirrors" experiment,(3) the fluctuation error alone was about 100 km/sec. The apparatus should be placed on a turntable and the whole measurement should last a couple of seconds, while in the first realization it lasted 24 hr. See Note Added in Proof on page 581.

Now we shall prove the assertion that at points with different gravitational potentials, time passes at different rates. Since now we are not interested in the *kinematic* aspect of the time dilation (i.e., the slowing of clocks moving with respect to absolute space), considered in Ref. 1, but only in the *dynamic* aspect of the time dilation (i.e., the slowing of clocks placed near local concentrations of matter), we shall work in a frame which is at rest in absolute space. Such a frame and the clocks attached to it are called *absolute* (better, *kinematically absolute*). The frames moving in absolute space and the clocks attached to such frames are called *proper* (better, *kinematically proper*). The clocks placed far enough from local concentrations of matter are called *dynamically absolute clocks*, while those placed near local concentrations of matter are called *dynamically proper clocks*. The regions between the galaxies (respectively, between the stars or between the planets) can be considered as situated far enough from local concentrations of matter.

Let us consider two points with gravitational potentials Φ_1 and Φ_2, supposing that a photon is emitted from the first point and received at the second. Since according to the tenth axiom the time units at these two points are defined by light clocks with equal "arms," the velocity of light at both points will have the same numerical value c, if measured by the help of two proper clocks placed respectively at the points of emission and reception. Thus we have

$$\nu_1\lambda_1 = c \qquad \text{and} \qquad \nu_2\lambda_2 = c \tag{7}$$

where ν_1 and ν_2 are the emitted and received frequencies, and λ_1 and λ_2 the corresponding wavelengths, of the photon.

Substituting (7) into (5), we obtain

$$\frac{\lambda_1}{1 + (\Phi_1/c^2)} = \frac{\lambda_2}{1 + (\Phi_2/c^2)} \tag{8}$$

Hence the wavelength of a photon becomes larger when it passes from a region with a stronger gravitational potential to a region with a weaker gravitational potential (i.e., when $|\Phi_1| > |\Phi_2|$). As follows from formula (5), for such a case, the frequency of the photon becomes lower.

Let us now assume that the velocities of the photon at the first and second points are v_1 and v_2, respectively, if measured with the help of an absolute clock. Then we shall examine the relation between λ_1, λ_2 and v_1, v_2, using our "burst" model[4] for photons.

For this purpose let us suppose that the gravitational potential changes from the emission to the reception point in a stepped form. The potential "steps" can be infinitely close to each other, but, for clarity, we shall assume the distances between them to be larger than the photon wavelength. Now, obviously, the rear bullet of the "burst," when passing the *i*th potential "step," will change its velocity from v_i to v_{i+1} always with a time delay $\Delta t_i = \lambda_i/v_i$ after the leading bullet, λ_i being the wavelength of the photon in the ith region. Thus the wavelength of the photon after crossing the ith potential "step" will be

$$\lambda_{i+1} = v_{i+1}\,\Delta t_i = (\lambda_i/v_i)\,v_{i+1} \tag{9}$$

If from the emission to the reception points there are n "steps," we have

$$\lambda_n = (\lambda_{n-1}/v_{n-1})\,v_n = (\lambda_1/v_1)\,v_n \tag{10}$$

This formula shows that λ_n can be different from λ_1 only if v_n is different from v_1. Thus, from (10) and (8), we obtain

$$\frac{v_1}{1 + (\Phi_1/c^2)} = \frac{v_2}{1 + (\Phi_2/c^2)} \tag{11}$$

Let us emphasize that, under the assumption of the "burst" model for photons, one cannot explain the wavelength change prescribed by formula (8) [thus also the frequency change prescribed by formula (5)] if one assumes that the velocity of light in regions with different gravitational potentials is equal when measured on a unique clock.

Since the absolute times of emission and reception of the "burst" (i.e., the *absolute periods* of the emitted and received photons) are, respectively, $T_1^{ab} = \lambda_1/v_1$ and $T_2^{ab} = \lambda_2/v_2$, we obtain, from (10),

$$T_1^{ab} = T_2^{ab} \tag{12}$$

The *proper periods* of the emitted and received photons are

$$T_1 = \lambda_1/c \qquad \text{and} \qquad T_2 = \lambda_2/c \tag{13}$$

From (13) and (8), taking into account (12), we come to the conclusion that if a time t_1, read on clock placed in a region with gravitational potential Φ_1, and a time t_2, read on a clock placed in a region with gravitational potential Φ_2, correspond to the same absolute time interval t^{ab}, then the relation between t_1 and t_2 is

$$\frac{t_1}{1 + (\Phi_1/c^2)} = \frac{t_2}{1 + (\Phi_2/c^2)} \tag{14}$$

Remark. Formula (6) and the analogous approximate formulas which can be deduced from (11) and (14) are obtained also in the theory of general relativity. However, our exact formulas (5), (11), and (14) differ from those found in general relativity (see, for example, Landau and Lifshitz[5]).

Thus our theory, as well as the theory of general relativity, leads to the following assertions:

1. The velocity of any photon measured at any space point by the help of a clock placed there (imagine for clarity a light clock) has the same numerical value c. An experimental confirmation of this *local constancy* of light velocity is furnished by the equal aberration constant for all celestial objects. Indeed, light coming from different celestial objects is emitted from space points with different gravitational potentials, and if the corresponding gravitational shifts in the frequencies are due to the different velocities with which the corresponding photons pass the observer, then the large "red shifts" observed for certain celestial objects (say, quasars) will lead to different aberration constants for these objects. Here we do not want to discuss the problem of absorption and reemission of light in the interstellar medium nor the problem of whether the large "red shifts" for quasars and distant galaxies have a Doppler character (as the majority of astronomers assert) or a gravitational character (as our absolute space–time theory asserts(2)).

2. The velocities v_1 and v_2 of photons that traverse two regions with different gravitational potentials are different if measured on a unique clock, the relation being given by formula (11). An experimental confirmation of this *relative changeability* of light velocity is furnished by the experiment of Shapiro.(6) Shapiro measured the time it took an electromagnetic signal, traveling back and forth, to cover definite well-known distances between the Earth an Venus, first when the Sun is far from the line connecting both planets and then when the Sun is near this line. In the second case the gravitational potential in the region crossed by the electromagnetic signal was stronger (i.e., its absolute value greater), and the light velocity (measured in both cases with the help of a clock placed at the same gravitational potential of the Earth) was lower.

3. The rates of two clocks placed at points with different gravitational potentials are different if measured by the help of a unique clock, the relation being given by formula (14). An experimental confirmation of this *gravitational time dilation* is furnished by the experiment of Hafele and Keating.(7) They flew atomic clocks in jet planes at different heights, where the gravitational potentials are different, and compared the readings before and after the flights with a stationary atomic clock left in Washington. The differences registered in the readings can be explained well enough by the kinematic and dynamic time dilations that appeared during the flights.

We shall not dwell on the experimental confirmations of formula (5), which for many years has offered an important tool for the observational exploration of the universe.

Let us consider a mass m ($m \neq 0$) which, having velocity v_1 in the region with gravitational potential Φ_1, acquires the velocity v_2 in the region with gravitational potential Φ_2 only as a result of the gravitational interaction between this mass and the masses producing the field. Proceeding from formula (3), we find

$$\frac{1 + (\Phi_1/c^2)}{[1 - (v_1^2/c^2)]^{1/2}} = \frac{1 + (\Phi_2/c^2)}{[1 - (v_2^2/c^2)]^{1/2}} \tag{15}$$

This is the energy conservation law for a point mass in a gravitational field according to our absolute space–time theory.

On the other hand, if two clocks move with velocities v_1 and v_2 with respect to absolute space, then, according to our theory,[2,8] the relation between their time rates is

$$\frac{t_1}{[1 - (v_1^2/c^2)]^{1/2}} = \frac{t_2}{[1 - (v_2^2/c^2)]^{1/2}} \tag{16}$$

Comparing formulas (14)–(16), we come to the following very important conclusion: If we want to change the rate of a given clock to a certain degree, we have to change either its velocity or its gravitational potential. In both cases we have to expend the same quantity of work. Here we must mention that we have to expend the same quantity of work in absolute value, since from (15) we obtain, within an accuracy of second order in $1/c$,

$$\tfrac{1}{2}mv_2^2 - \tfrac{1}{2}mv_1^2 = m\Phi_1 - m\Phi_2 \tag{17}$$

and the gravitational energy (together with the gravitational potential) is negative, while the kinetic energy is positive. This can be established also with the following reasoning: If we want to slow the rate of a given clock "kinematically," we have to enhance its absolute velocity, and thus to do *positive* work, while if we want to achieve this "dynamically," we have to transfer the clock from a point with a weaker gravitational potential to a point with a stronger gravitational potential, and thus to perform *negative* work.

This represents an interesting manifestation of the so-called principle of equivalence between inertial and gravitational masses.

On the other hand, since the different time rates of clocks placed at points with different gravitational potentials is, obviously, an absolute phenomenon, the foregoing conclusion gives us enough certitude to maintain that the different time rates of clocks moving with different velocities also represent an absolute phenomenon. This is one of our basic physical conceptions, which contradicts the special relativity conception about the relative character of the kinematic time dilation.

3. THE PRINCIPLE OF EQUIVALENCE

Since the masses of the material points are a measure of their kinetic energy as well as of the gravitational energy to which they contribute, the so-called *principle of equivalence* can be formulated, which asserts the following: Any gravitational field in a small region around a given space point can be replaced by a suitable noninertial frame of reference (and vice versa), so that the behavior of material points in an inertial frame of reference in the presence of a gravitational field would be indistinguishable from their behavior in a suitable noninertial frame without the gravitational field.

The principle of equivalence can be applied to solve many kinematic problems with dynamic methods. For this purpose we have to consider the noninertial kinematic problem in an inertial frame of reference under the introduction of the so-called pseudo-gravitational potentials. The *pseudo-gravitational potential* is a fictitious gravitational potential ascribed to the space occupied by a noninertially moving frame of reference in order to transform away this noninertial motion. The *pseudo-gravitational intensity* corresponding to this pseudo-gravitational potential equals the real acceleration of the noninertially moving masses in the part of space under consideration.

Thus, if the pseudo-gravitational potential at a given space point is Φ, then the pseudo-gravitational intensity will be

$$\mathbf{G} = -\nabla\Phi = \mathbf{u} \tag{18}$$

where $\mathbf{u}$ is the real acceleration of the masses, in a small region with radius vector $\mathbf{r}$, resulting from their noninertial motion with respect to absolute space.

Now we shall make a very interesting analysis of the kinematic time dilation with the aid of the principle of equivalence.

Any kinematic acceleration of a given material system (considered as a material point) which moves in a given inertial frame of reference can be decomposed into a tangential and a normal acceleration. First we shall consider the influence of the *normal acceleration* on the time dilation from a "pseudo-gravitational" point of view.

When the tangential acceleration is equal to zero and only the normal acceleration u exists, the system revolves with speed v in a circle with radius R such that

$$u = v^2/R = \Omega^2 R \tag{19}$$

where Ω is the angular velocity of the rotational motion.

Corresponding to the time t' read on a first clock which is at rest in absolute space (an absolute clock), a second clock moving with velocity v (a proper clock) will show a time t''; according to formula (16), for the difference $\Delta t = t'' - t'$ we obtain, within an accuracy of second order in v/c,

$$\Delta t/t = -\tfrac{1}{2}v^2/c^2 \tag{20}$$

where we have written $t \cong t' \cong t''$.

Let us take into account that during the time t the second clock has undergone the acceleration u. The difference between the pseudo-gravitational potentials at the space points along the circular trajectory of the second clock and the center of the circle, where the first clock rests, can be obtained from the following formula:

$$\Delta\Phi = \Phi'' - \Phi' = -\int_0^R \mathbf{G}\, d\mathbf{r} = -\Omega^2R^2/2 = -v^2/2 \tag{21}$$

where we have substituted **G** on the grounds of (18) and (19).

Substituting (21) into formula (14), we obtain a result identical with (20).

Thus the time dilation of a given clock due to its inertial motion at velocity v with respect to absolute space is exactly the same as the time dilation due to its noninertial motion in a circle with radius R and acceleration (19). But the inertial motion of a material system, when its velocity keeps a constant magnitude and direction, can be considered as a rotation in a circle with radius tending to infinity and with a normal acceleration tending to zero. So we arrive at the extremely important conclusion of our absolute space–time theory: The time dilation obtained if one proceeds, on the one hand, from the "inertial" formula (16) and, on the other hand, from the "noninertial" formula (14), with the help of the artificially introduced pseudo-gravitational potentials, is one and the same. Hence if we calculate the time dilation from an "inertial point of view," taking into account the different velocities of the systems, we must ignore their different normal accelerations; and if we calculate the time dilation from a "noninertial point of view," taking into account the different normal accelerations of the systems and making use of the pseudo-gravitational potentials, we must leave aside their different velocities.

Let us now study the influence of the *tangential acceleration* on the time dilation from a "pseudo-gravitational" point of view.

Consider a clock (called the second clock) moving with an arbitrary acceleration u collinear with its velocity. How does the time read on this proper clock compare with the time registered on an absolute clock (called the first) which rests in absolute space?

First we use the "inertial" approach. Consider a small time interval t

so short that over it the acceleration can be considered as constant. Then divide this time interval into small intervals $\delta t_1, \delta t_2, \ldots, \delta t_n$, in any of which we may consider the velocities as constant, equal to $v_1, v_2, \ldots, v_n$, where v_1 is the velocity at the beginning of the time interval δt_1, v_2 the velocity at the beginning of the time interval δt_2, and so on.

Now, using formula (16), we find that the time elapsed on the second clock will be

$$t'' = \sum_{i=1}^{n} \delta t_i' \left(1 - \frac{v_i^2}{c^2}\right)^{1/2} \tag{22}$$

and for the difference $\Delta t = t'' - t'$ we obtain, within an accuracy of second order in v/c, and writing $\delta t_i \cong \delta t_i' \cong \delta t_i''$,

$$\Delta t = -\frac{1}{2c^2} \sum_{i=1}^{n} \delta t_i \, v_i^2 \tag{23}$$

Let us now employ the "noninertial" approach, taking into account that during the time t the second clock has undergone the tangential acceleration u. The difference between the pseudo-gravitational potentials at the space points where the second clock was at the beginning and at the end of the time interval δt_i is

$$\begin{aligned} \delta\Phi_i &= -u\,\delta r_i = -\tfrac{1}{2}u(v_i + v_{i+1})\,\delta t_i \\ &= \tfrac{1}{2}(v_i - v_{i+1})(v_i + v_{i+1}) = \tfrac{1}{2}(v_i^2 - v_{i+1}^2) \end{aligned} \tag{24}$$

where δr_i is the distance covered in the time δt_i, and this formula is based on (18).

The result (23) for the difference between the readings of the moving and the stationary clocks is obtained under the assumption that, in the limit of small time intervals δt_i, the velocity of the moving clock changes instantaneously from v_i to v_{i+1}. Now we shall find the correction which is to be made when it is taken into account that during any of the time intervals δt_i the second clock has undergone the acceleration u. On the basis of formulas (14) and (24), assuming that δt_i are equal, i.e., $\delta t_i = \delta t$, we obtain, to within second order in $1/c$,

$$\Delta t_{\text{corr}} = \sum_{i=1}^{n-1} \delta t_i \frac{\delta\Phi_i}{c^2} = \frac{\delta t}{2} \sum_{i=1}^{n-1} (v_i^2 - v_{i+1}^2) = \frac{\delta t}{2}(v_1^2 - v_n^2) \tag{25}$$

Thus, when $\delta t \to 0$, we find $\Delta t_{\text{corr}} \to 0$.

Consequently we establish that the tangential accelerations do not influence the time rates of the clocks when use is made of the pseudo-gravitational potentials.

The analysis performed in this section has shown that the calculations of the time dilation from an "inertial" point of view, with the help of formula (16), and that from a "noninertial" point of view, with the help of formula (14), where the pseudo-gravitational potentials artificially introduced and the principle of equivalence are used, lead exactly to the same results. We have also seen that in the calculation of the time dilation from a "noninertial" point of view only the normal accelerations of the moving system need to be taken into account because the tangential accelerations have no influence.

Here we have to point out that the velocities of the material systems are different in the different inertial frames of reference. However, *the material systems have the same accelerations in all inertial frames of reference.* This conclusion leads immediately to the fundamental conception of our absolute space–time theory concerning the absolute character of the kinematic time dilation.

NOTE ADDED IN PROOF

We have successfully carried out the interferometric "coupled-mirrors" experiment. The absolute velocity of the Sun registered by us has magnitude $v = 303 \pm 20$ km/sec^{-1} and the equatorial coordinates of its apex are $\delta = -22.5° \pm 4°$, $\alpha = 14^h\ 17^m \pm\ 20^m$.

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A PURE EXPERIMENT TO ESTABLISH THAT THE VELOCITY OF LIGHT DOES NOT DEPEND ON THE VELOCITY OF THE SOURCE

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We propose an extremely pure experiment for the measurement in vacuum of the velocity of light emitted from a relativistically moving light source.

Since the Ritz' (ballistic) model of light propagation has still some scientific citizenship [1], we propose in this paper an experiment (called the "synchrotron" experiment) which can *directly* prove that the Ritz' model is not adequate to physical reality. We base our proposal on the experimental achievements of Kulikov et al. [2] and Bemporad et al. [3], who have observed reflection of light pulses on electrons revolving in synchrotrons.

Let us have (fig. 1.) a circular accelerator of electrons A. Short light pulses (packages of photons) are emitted by the emitter E in regular short intervals of time ΔT. These light pulses, after being reflected by the semi-transparent mirror M, pass through the slit S and reach the electrons revolving in the accelerator along the tangent to their trajectory. The photons, after being reflected by the electrons. turn back and passing through the semi-transparent mirror M are registered by the receiver R.

We can consider the revolving electrons (representing as a matter of fact a fast moving mirror) as a new source of radiation. Changing the velocity of the electrons, we change the velocity of this light source. If the velocity of light depends on the velocity of the source of radiation, then, with the increase of the velocity of the revolving electrons, the time for which the photons will cover the distance from the accelerator to mirror M will become shorter. Hence if we obtain electric pulses from the emitted and received light pulses and if we lead them to the electrodes of an eletronic oscillograph Osc, then on the screen we whould see the picture shown in the figure. Let the high peaks described by the electronic beam correspond to the emitted light pulses and the low peaks to the received pulses. If the velocity of light does not depend on the velocity of the source of radiation the distance between the high and low peaks will remain the same when increasing the velocity of the revolving electrons, while in the case of dependence this distance will change. Let us show this.

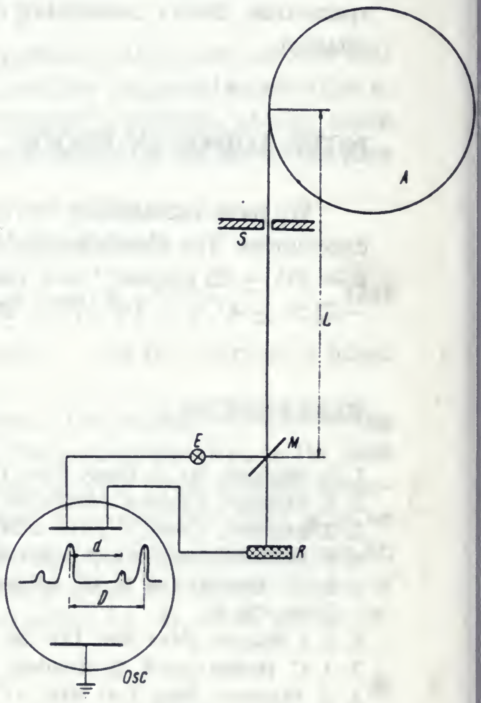

Fig. 1. The "synchrotron" experiment.

When the light pulses are emitted with time intervals ΔT after each other and D is the distance between them over the screen, it will be $D = k\Delta T$, where k is the constant of scanning.

Suppose that the velocity of the electrons in the accelerator is first v and then $v + \Delta v$. If the velocity of the source must be added geometrically to the velocity of light, then the velocity of the photons on the track from the accelerator to mirror M will be $c_1 = c + v$ in the first case and $c_2 = c + v + \Delta v$ in the second case.

Hence the time Δt with which the light pulses will come earlier to the receiver in the secons case will be (suppose, for simplicity's sake v, $\Delta v \ll c$)

$$\Delta t = \frac{L}{c_2} - \frac{L}{c_2} = \frac{L\Delta v}{(c+v)(c+v+\Delta v)} \cong \frac{L\Delta v}{c^2}\,, \qquad (1)$$

where L is the distance between the accelerator and mirror M.

If we denote by d the difference between the high and low peaks, then for their difference in the first and second cases we shall obtain $\Delta d = k\Delta t$. If we choose $\Delta T = 10^{-10}$ s, $L = 9$ m, $\Delta v = 10^6$ m/s, we obtain $\Delta t = \Delta T$, and thus $\Delta d = D$.

If the velocity of light does not depend on the velocity of the source, as our absolute space-time theory asserts, then it must be $\Delta d = 0$ for any increase of the electrons' velocity.

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Concerning Santos' Experiment to Test Special Relativity

Stefan Marinov[1]

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We show that the general light Doppler effect formula leads to an absolute null result in Santos' experiment. We point out that this experiment cannot be practically performed with the proposed Mössbauer effect technique. We emphasize that the relation between the emitted and received frequencies in the light Doppler effect is substantially different than the relation between the wavelengths.

Let us have (Fig. 1) a light source moving at velocity v (with respect to absolute space) which emits a photon at the position S' when an observer moving at velocity v_0 is at the position O'. Let this photon be received when source and observer are, respectively, at the positions S and O, supposing that the photon's wavelength is much shorter than the distance between source and observer. In Ref. 2, proceeding from our absolute spacetime

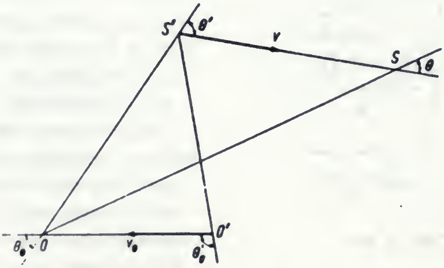

Fig. 1. Light Doppler effect for moving source and observer.

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theory, we have obtained the following relation between the emitted (ν) and received (ν_0) frequencies (the angles θ_0 and θ' are shown in the figure):

$$\nu_0 = \nu \frac{1 - v_0 \cos\theta_0/c}{1 + v\cos\theta'/c}\left(\frac{1 - v^2/c^2}{1 - v_0{}^2/c^2}\right)^{1/2} \tag{1}$$

Now, proceeding from this formula, we shall predict the result of Santos' experiment.(1) For this reason we have to suppose that only those photons that are emitted by the source (a γ-ray emitter) in a direction perpendicular to v can be received by the observer (a γ-ray absorber) when they travel along a direction perpendicular to v_0. Thus we have to put into (1) $\theta' = \pi/2$ and $\theta_0 = \pi/2$, obtaining, within an accuracy of second order in v/c,

$$\nu_0 = \nu[1 - (v^2 - v_0{}^2)/2c^2] \tag{2}$$

For $v = v_0$ we get $\nu_0 = \nu$.

It is very instructive to note that in this transverse Doppler effect experiment, where source and observer are moving with equal velocities, the result is the same at antiparallel and *parallel* directions of the velocities.

Now we shall show that, because of the *inevitable* appearance of first-order (in v/c) effects, Santos' experiment cannot be *practically* realized. Taking into account the transverse Doppler effect experiment considered by us in Refs. 2–4, we should suppose that between the disks of Santos rotating in opposite directions there is a shielding with length d and aperture b, assuming, for simplicity's sake, the trajectories of emitter and absorber are rectilinear and the shielding exactly perpendicular to them. Since the emitter and absorber are not point objects, then for the different emitting and receiving atoms we shall have

$$\theta' = \pi/2 \pm b/d, \qquad \theta_0 = \pi/2 \pm b/d \tag{3}$$

Putting this into (1) and assuming $v_0 = v$, we obtain $\Delta\nu = \nu_0 - \nu = \pm 2\nu v b/cd$. On the assumption of the Einstein time dilation under the condition that the relative velocity between the antiparallel moving source and observer is $2v$, the effect which Santos expects to register must be $\Delta\nu = 2\nu v^2/c^2$. Thus the requirement $b/d < v/c$ is to be satisfied. Supposing $v = 300$ m/sec, $d = 10$ cm, we obtain $b < 10^{-5}$ cm. Obviously, such an experiment cannot be practically realized.

It should be especially noted that in all "rotor" experiments(5,6) there is no relative motion between source and observer and no effects first order in v/c can appear.(2)

Let us emphasize that if the transverse Doppler effect experiment done with the help of electrically accelerated hydrogen ions(2–4) gives the result predicted by us, then Santos' experiment (considered as a thought experiment) must inevitably give a null result. Indeed, in our transverse Doppler effect experiment for any different velocity of the source we have to take another angle between the source–observer line and the velocity of the source if the same frequency ν (equal to the frequency emitted by the source at rest) is to be received by the observer. However, if at any different velocity of the source the observer will move with exactly the same, oppositely directed velocity, and the source–observer line is perpendicular to these two velocities, then the frequency received will always be the same. As a matter of fact, for moving source and observer at rest the Doppler effect will be post-traverse,(2–4) while for moving observer and source at rest the effect will be ante-traverse, so that for moving source and observer these two effects will cancel each other, producing a resultant null effect. Thus at certain position of the shielding, when the path of the photons interchanged between emitter and absorber will be exactly perpendicular to the trajectories of the latter, no change in the observed frequency can be registered at *any* velocity v of emitter and absorber, as long as they are identical.

It is to be noted that in Santos' experiment the shielding plays a very important role. As noted, if this shielding is at rest in the laboratory (being perpendicular to the trajectories of emitter and absorber), then the experiment gives a null result. If the shielding is attached to the absorber, there will be a post-traverse Doppler effect, and, at $v = v_0$, one will get $\nu_0 = \nu(1 - 2v^2/c^2)$. If the shielding is attached to the emitter, there will be an ante-traverse Doppler effect, and thus $\nu_0 = \nu(1 + 2v^2/c^2)$.

Santos claims that special relativity predicts a non-null result for his experiment, and thus it can serve as an *experimentum crucis* in favor of the Einstein or Lorentz conceptions. Rodrigues and Buonomano(7) have shown that, proceeding from the Lorentz transformations, a null result also is to be obtained. The analysis of these two authors is reasonable, and there is nothing strange in their absolute (null) result, since, as we have shown in Ref. 8, the Lorentz transformation can be (and is to be!) treated on the presumption of absolute space and time.

However, Rodrigues and Buonomano cite the following formula for the Doppler frequency shift in the case of moving source and observer, which is not true(7,9):

$$\nu_0 = \nu_s \frac{1 - v_0 \cos \theta_a/c}{1 - v_s \cos \theta_a/c} \left(\frac{1 - v_s^2/c^2}{1 - v_0^2/c^2}\right)^{1/2} \tag{4}$$

where ν_s and ν_0 are the emitted and received frequencies, v_s and v_0 are the velocities of source and observer, and θ_a (in Ref. 9 denoted by θ_p) is "the angle relative to the absolute frame."

According to our formula (1), the angles in the numerator and denominator of (4) are, in general, *not* equal. In the numerator is the angle between the direction of propagation of the photon and the velocity of the observer at the moment of reception (see our angle θ_0), while in the denominator is the angle between the direction of propagation of the photon and the velocity of the source at the moment of emission (see our angle $\pi - \theta'$). Let us note that formula (1) was first given by Lee and Ma.(10)

In formula (8) of Ref. 7, where the relation between the emitted and received wavelengths is given, the angles in the numerator and denominator are different (as they must be!). However, from the point of view of our absolute spacetime theory (which is to be considered in many aspects as a Lorentzian theory), the relation between the wavelengths is *completely different* from the relation between the frequencies. As we show in Ref. 2, the relation between the emitted (λ) and received (λ_0) wavelengths for the case shown in Fig. 1 is the following:

$$\lambda_0 = \lambda \frac{1 + v \cos \theta'/c}{(1 - v^2/c^2)^{1/2}} = \lambda \frac{(1 - v^2/c^2)^{1/2}}{1 - v \cos \theta/c} \tag{5}$$

Thus there is a change in the wavelength only if $v \neq 0$, i.e., only if the emitter moves with respect to absolute space. The motion of the receiver ($v_0 \neq 0$) does not lead to a change of the wavelength.

Formula (5) given by our absolute spacetime theory is of an *enormous theoretical and experimental significance*. Since our "coupled-mirrors" experiment(11) has shown that the velocity of light in a moving frame is anisotropic, then the motion of the observer cannot lead to a change of the wavelength, which is to be registered *always* with respect to absolute space.

In a paper that for two years we have been submitting (in vain) to different journals, we discuss the significance of formula (5), analyzing many performed (such as Bömmel's(12)) or proposed (such as Carnahan's(13)) experiments. Our analysis shows that formula (5) is adequate to describe physical reality. Instead of (5), special relativity posits a formula which can be obtained from (1) after replacing ν by c/λ and ν_0 by c/λ_0. Anyone who proceeds from the assumption of absolute space and time (as Rodrigues and Buonomano do) has to defend our formula (5) and not the Einsteinian one. This is an important problem, and if the spacetime specialists ignore it, the light Doppler effect will remain in darkness.

Final remark: The assertion of Rodrigues and Buonomano(7) that the result in Santos' experiment is null only when the distance between emitter and absorber is small (as they write, "when the distance between emission and absorption is small compared to the time of flight of the photon") is odd. According to formula (1), at any distance between emitter and absorber the result in Santos' experiment must be null.

NOTE ADDED IN PROOF

In Ref. 2, in parallel with formula (5), we also introduce the following relation between the emitted and received wavelengths

$$\lambda_0 = \lambda \frac{1 + \nwarrow \cos \theta'/c}{1 - \enclose{circle}{v}(v^2/c^2)} = \frac{\lambda}{1 - (v \cos \theta/c)} \tag{6}$$

The difference between formulas (5) and (6) is the following: In (5) it is not taken into account that when a periodic system (the source emitting photons) is set in motion with velocity v its period T increases according to the relation(8) $T_0 = T(1 - v^2/c^2)^{-1/2}$, while in formula (6) this absolute, *really existing*, time dilation is taken into account.

The difference between these two formulas becomes clear if we consider a light source and a mirror placed in front of it, which produce standing waves with length λ when at rest in absolute space. If setting the system in motion with velocity v, the length of the standing waves *remains the same*, as it can immediately be obtained from formula (6) for the "transverse" case, $\theta = \pi/2$, $\theta' = \pi/2 + v/c$, while this length becomes equal to $\lambda(1 - v^2/c^2)^{1/2}$, if working with formula (5). For the frequencies such difficulties do not appear, because the received frequency depends on the velocities both of source and observer, while the received wavelength depends only on the velocity of the source. Let us further note that *all* optical apparatus register frequencies; wavelengths can be measured *directly* only in a pattern of standing waves produced from the interference of coherent incident and reflected photons, whose wavelengths are different when the system moves in absolute space.

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Rotating Disk Experiments

Stefan Marinov[1]

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We consider the historic Harress–Sagnac experiment in the light of our absolute space–time theory, proposing two modifications, and we give an account of its recent practical performance. We show that the effect of the rotating disk experiment is a direct result of the light velocity's direction dependence and we point out that our recently performed coupled-mirrors experiment, with whose help for the first time we have measured the Earth's absolute velocity, can be considered as a logical result of the rotating disk experiment.

1. INTRODUCTION

A good formula is like a flour bag: however much you shake off, something always remains. The same can be said about a good experiment.

The rotating disk experiment of Harress(1,2) and Sagnac(3) was performed more than sixty years ago and repeated by Pogany(4) and Dufour and Prunier.(5) After the invention of the ring laser, Rosenthal(6) proposed to use the "Sagnac effect" for the measurement of very slow rotational velocities; later the so-called laser gyroscope was constructed, which has many different practical applications.(7)

Certain physicists (including Sagnac) have considered the rotating disk experiment as a confirmation of the light velocity's direction dependence and the existence of absolute space (see on this topic the note by Telegdi.(8)) Nevertheless, when today ballistic rockets can fly with the help of laser gyroscopes working on the Sagnac effect from the Soviet Union to the shores of America (and vice versa) and find their target to within 1km, physicists overwhelmingly assert that this effect is not due to an "aether wind." Thus, in order to explain the Sagnac effect without appeal to the aether wind assumption, thousands of pages have been written.

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We have established in practice by the help of the disrupted rotating disk experiment[9,10] that the velocity of light is direction dependent not only along a closed path over the Harress–Sagnac disk, but also along a straight line on this disk; and with the help of the coupled-mirrors experiment[11,12] we have measured the absolute veclocity of the Earth in our laboratory.

In this paper we give a report on the performance of two important modifications of the rotating disk experiment which support our absolute space–time conceptions; and then we show that the coupled-mirrors experiment can be considered as a logical modification of this fateful experiment.

Our absolute space–time theory proceeds from the aether model for light propagation and, within effects of first order in v/c, is identical with the traditional Newtonian theory. Since in this paper we shall consider only such effects, the whole analysis can be based on common Newtonian conceptions.

2. THEORY OF THE ROTATING DISK EXPERIMENT

Figure 1 presents our setup for the performance of the rotating disk experiment. A medium with refractive index n can rotate (in a clockwise

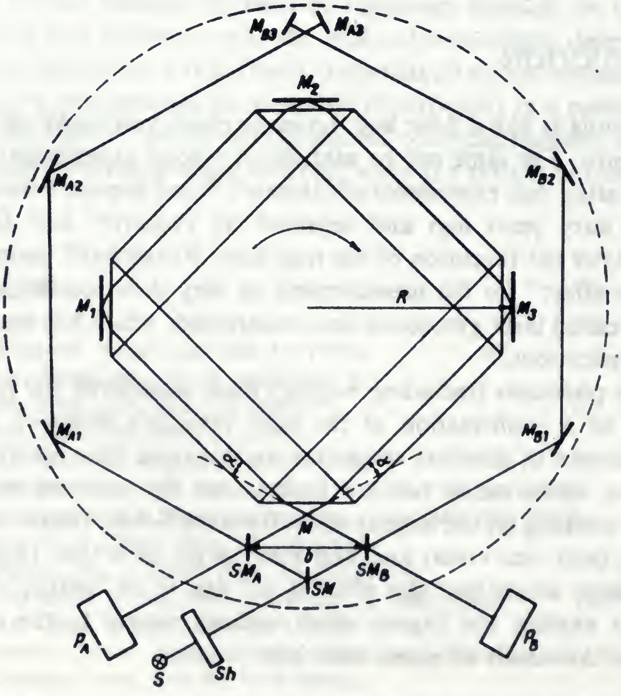

Fig. 1. Scheme of the rotating disk experiment in our version.

direction) with the semitransparent mirrors SM, SM_A, and SM_B and the mirrors M_1, M_2, M_3, M_{A1}, M_{A2}, M_{A3}, M_{B1}, M_{B2}, and M_{B3}, or without them; or only the mirrors can rotate and the medium can remain at rest. In the last case, a medium with refractive index $n = 1$, i.e., vacuum (air) also can be taken. So, four different combinations are possible, which we name as follows:

1. The *Harress–Sagnac experiment*, performed first by Sagnac,[3] in which the mirrors rotate and the medium is vacuum.

2. The *Harress–Pogany experiment*, performed first by Harress[1,2] and repeated very carefully by Pogany[4] in a slightly different arrangement, in which the mirrors rotate together with the medium.

3. The *Harress–Marinov experiment*, performed recently by us and reported further in this paper, in which the mirrors rotate and the medium is at rest. This experiment in a somewhat different arrangement was performed first by Dufour and Prunier,[13] and in their arrangement we call it the Harress–Dufour experiment.

4. The *Harress–Fizeau experiment*, performed first by Fizeau[14] in a substantially different arrangement (called the "water tube" experiment and repeated by Zeeman[15] with solid media), in which the medium rotates and the mirrors are at rest. Our performance of the Harress–Fizeau experiment, which is reported further in this paper, can be considered as original. Indeed, Post[16] writes (p. 484), "A rotational version of this (Fizeau's "water tube") experiment has apparently not yet been made. Such an experiment would not be altogether trivial because it could inform us about the extent to which the translational coefficient of drag can be extrapolated to cases of nonuniform motion."

In Fig. 1, S is a light source emitting coherent light; Sh is a shutter, which is governed by the rotating disk (the turnabout) and allows short light pulses (10^{-6} sec) to pass only at a strictly defined position of the disk when the diametrically opposite facets of the transparent medium are exactly parallel to the mirrors M_1, M_2, M_3. The area of the facets are small and the mirrors M_1, M_2, M_3 are placed near the medium. Thus we can assume that the photons travel between the single mirrors along the corresponding chords of a circle with radius R. P_A and P_B are two photoresistors put in both arms of a Wheatstone bridge. Always when the shutter Sh allows light to pass, the photoresistors are illuminated *uniformly* by interfered light. To explain the character of the interference, let us consider four photons that are emitted by S at the same moment and let us suppose that they cover the following paths:

First photon: $SM\text{-}SM_A\text{-}M_{A1}\text{-}M_{A2}\text{-}M_{A3}\text{-}M_{A2}\text{-}M_{A1}\text{-}SM_A\text{-}P_A$.
Second photon: $SM\text{-}SM_B\text{-}M_1\text{-}M_2\text{-}M_3\text{-}SM_A\text{-}P_A$.

Third photon: $SM\text{-}SM_B\text{-}M_{B1}\text{-}M_{B2}\text{-}M_{B3}\text{-}M_{B2}\text{-}M_{B1}\text{-}SM_B\text{-}P_B$.

Fourth photon: $SM\text{-}SM_A\text{-}M_3\text{-}M_2\text{-}M_1\text{-}SM_B\text{-}P_B$.

The first and the third photons cover the same paths for rest and motion of the mirrors. As a matter of fact, there are differences which are of second order in v/c, and we consider them in Ref. 17; however, as already said, in this paper we consider only effects of first order in v/c.

The second photon (which we shall call "direct") travels along the direction of rotation, and the fourth photon (which we shall call "opposite") travels against the direction of rotation. The differences in the optical paths of the first and second photons, on the one hand, and of the third and fourth photons, on the other hand, will change oppositely when chanigng the rotational velocity. Hence if, at certain angular velocity Ω_1 , the Wheatstone bridge is in equilibrium (this signifies that the difference of the differences in the optical paths of the first and second photons, on the one hand, and of the third and fourth photons, on the other hand, is equal to an integer number of wavelengths) and we change the rotational velocity, the bridge comes into greater and greater disequilibrium, passes through a state of maximum disequilibrium, and at certain angular velocity Ω_2 comes again into equilibrium. If the time spent by the second (or fourth) photon to cover its path at the angular velocity Ω_2 differs by Δt_A (or Δt_B) from the time spent at the angular velocity Ω_1 , and we introduce the notation $\Delta t = \Delta t_A + \Delta t_B$, then $\Delta = c\,\Delta t$ will be equal to the wavelength λ of the light.

Let us now find the expressions for Δt through the parameters of the device for the different types of rotating disk experiment, taking into account also the dispersion of the medium. We shall make the calculations, proceeding from the simple scheme of the rotating disk experiment given in Fig. 2. Here S is a light source, Sh a shutter governed by the turnabout, M is a semitransparent mirror where the light pulses separate into "direct" and "opposite," M_1 , M_2 , and M_3 are mirrors and O is an observer who registers the different interference pictures. In Fig. 1, to the semitransparent mirror M there corresponds a *point* M which can be considered as an effective point of separation.

First we shall consider the Harress–Marinov and Harress–Dufour experiments, whose schemes are given, respectively, in Figs. 2a and 2b. The deduction of the relevant formulas is given in Refs. 18 and 19; however, the calculations there are too cumbersome. We shall give simple deductions based on Newtonian conceptions, taking into account the dispersion of the medium.

We suppose that the mirrors in Fig. 2 rotate in a direct (clockwise) direction with angular velocity Ω relative to the medium, which is at rest with respect to absolute space. According to Fig. 3 (see also Figs. 2 and 1),

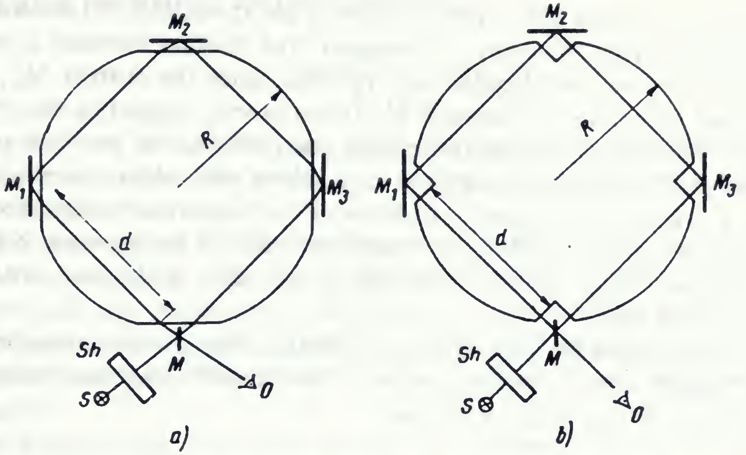

Fig. 2. The rotating disk experiment: (a) The Harress–Marinov variant, (b) the Harress–Dufour variant.

a "direct" photon (traveling along the direction of rotation), which separates from an "opposite" photon (traveling against the direction of rotation) on the semitransparent mirror M will reflect not at point M_1 (where it has to reflect when the mirrors are at rest), but at a point M_1', and thus in the case of rotation its path will be longer by

$$\Delta d = (\Omega R^2/c)\, n \tag{1}$$

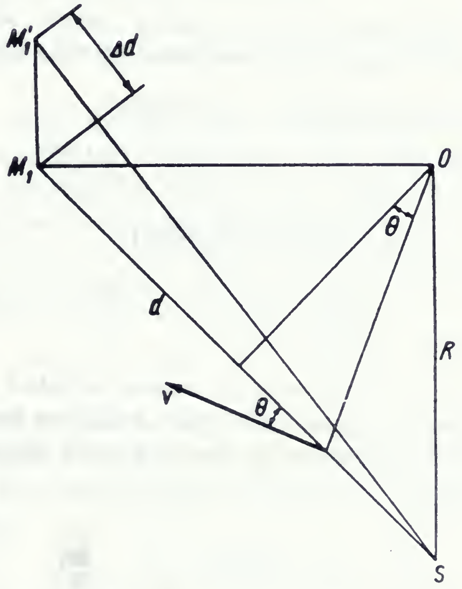

Fig. 3. Detail of the rotating disk experiment.

where $d = R\sqrt{2}$ is its path when the mirrors are at rest and R is the distance of the mirrors from the center of rotation. The relation between d and R given here is to be considered as approximate, since the mirrors M_1, M_2, and M_3 and the point of separation M are not exactly tangent to the circumference of the medium's disk and certain parts of the disk are "cut away." Here we shall consider an idealized case where this relation is exact (see Section 4, where the practical realization of this experiment is described).

When the mirrors rotate, an "opposite" photon has to cover between mirrors M and M_3 a distance which is Δd less than in the case where the mirrors are at rest.

Since mirror M (or mirrors SM_A and SM_B in Fig. 1) moves, then, because of the Doppler effect, the frequencies of the "direct" photons received by the molecules of the medium will be

$$\nu_0 = \nu\left(1 + 2\frac{v}{c}\cos\frac{\pi}{4}\right) = \nu\left(1 + \sqrt{2}\frac{\Omega R}{c}\right) \tag{2}$$

while the frequencies received by the "opposite" photons will remain the same.

Hence, if we take into account dispersion, the refractive index of the medium for the "direct" photons becomes

$$n^{+} = n(\nu_0) = n + \sqrt{2}\frac{\Omega R}{c}\nu\frac{dn}{d\nu} \tag{3}$$

Obviously, if the mirrors rotate, a "direct" photon will return to mirror M after an "opposite" photon with the following time delay:

(a) For the Harress–Marinov experiment,

$$\Delta t_{\mathrm{HM}} = 4\frac{d + \Delta d}{c/n^{+}} - 4\frac{d - \Delta d}{c/n} = 8\frac{\Omega R^2}{c^2}\left(n^2 + \nu\frac{dn}{d\nu}\right) \tag{4}$$

(b) For the Harress–Dufour experiment,

$$\Delta t_{\mathrm{HD}} = 4\left(\frac{d}{c/n^{+}} + \frac{\Delta d}{c}\right) - 4\left(\frac{d}{c/n} - \frac{\Delta d}{c}\right) = 8\frac{\Omega R^2}{c^2}\left(n + \nu\frac{dn}{d\nu}\right) \tag{5}$$

Thus if we rotate the disk with the mirrors attached to it first at angular velocity Ω_1 and then at angular velocity Ω_2, and if we denote $\Omega = \Omega_2 - \Omega_1$, we shall obtain for the difference in the light paths the following results:

(a) For the Harress–Marinov experiment,

$$\Delta_{\mathrm{HM}} = 8\frac{\Omega R^2}{c}\left(n^2 - \lambda\frac{dn}{d\lambda}\right) \tag{6}$$

(b) For the Harress–Dufour experiment,

$$\Delta_{\mathrm{HD}} = 8\frac{\Omega R^2}{c}\left(n - \lambda\frac{dn}{d\lambda}\right) \tag{7}$$

For the sake of simplicity we shall call the *common type* of rotating disk experiment, where the medium is at rest and the mirrors rotate, the Harress–Marinov experiment.

Let us now analyse the Harress–Fizeau experiment. It can be performed also in two somewhat different arrangements shown in Figs. 2a and 2b, which we shall call, respectively, the Harress–Fizeau–Marinov and Harress–Fizeau–Dufour experiments. To save time, we shall consider only the first one, which was practically realized by us, calling it the Harress–Fizeau experiment.

We suppose that the medium rotates in a direct (clockwise) direction with angular velocity Ω relative to the mirrors, which are at rest with respect to absolute space. Now, as can be seen from Fig. 3, the molecular velocity that makes an angle θ with the direction of propagation of the "direct" photons will have the magnitude

$$v = \frac{\sqrt{2}}{2}\frac{\Omega R}{\cos\theta} \tag{8}$$

Since the medium moves with respect to the mirrors, then, because of the Doppler effect, the frequencies of the "direct" and "opposite" photons received by the molecules will be, respectively,

$$\nu_0 = \nu\left(1 \mp \frac{v}{c}\cos\theta\right) = \nu\left(1 \mp \frac{\sqrt{2}}{2}\frac{\Omega R}{c}\right) \tag{9}$$

The molecules along the light path have different velocities; however, it is clear that the projections in the direction of light propagation, which are responsible for the Doppler effect, are equal. For this reason, all molecules of the medium will receive the frequencies (9).

Hence, if we take into account dispersion, the refractive indices for the "direct" and "opposite" photons become, respectively,

$$n^{\pm} = n(\nu_0) = n \mp \frac{\sqrt{2}}{2}\frac{\Omega R}{c}\nu\frac{dn}{d\nu} \tag{10}$$

Obviously, if the medium rotates, according to the well-known formula for the velocity of light in a moving medium (see, for example, Ref. 20), a "direct" photon will return to mirror M before an "opposite" photon with the time anticipation

$$\Delta t_{\mathrm{HF}} = \frac{4d}{c_m^-} - \frac{4d}{c_m^+} = 8\frac{\Omega R^2}{c^2}\left(n^2 + \nu\frac{dn}{d\nu} - 1\right) \tag{11}$$

Thus, if we rotate the disk with the medium attached to it first at angular velocity Ω_1 and then at angular velocity Ω_2, and if we denote $\Omega = \Omega_2 - \Omega_1$, we obtain for the difference in the light paths the value

$$\Delta_{\mathrm{HF}} = 8\,\frac{\Omega R^2}{c}\left(n^2 - \lambda\frac{dn}{d\lambda} - 1\right) \tag{12}$$

The formula for the Harress–Sagnac experiment is to be obtained from (4) or (5), putting $n = 1$:

$$\Delta t_{\mathrm{HS}} = 8\Omega R^2/c^2 \tag{13}$$

In the Harress–Pogany experiment the time delay with which a "direct" photon returns to mirror M after an "opposite" photon is equal to the difference in the time delays in the Harress–Marinov and Harress–Fizeau experiments. Thus, from formulas (4) and (11), we obtain

$$\Delta t_{\mathrm{HP}} = \Delta t_{\mathrm{HM}} - \Delta t_{\mathrm{HF}} = 8\Omega R^2/c^2 \tag{14}$$

The Harress–Pogany experiment can be immediately explained with the help of our "hitch-hiker" model for light propagation in a medium.(20) Indeed, its effect must be the same as the effect in the Harress–Sagnac experiment because in both of them the "direct" and "opposite" photons cover the same distances in absolute space as "free" photons. Obviously, the time in which both photons are "hitched" on the molecules of the medium are the same, so that in the Harress–Pogany experiment both photons return to mirror M a little bit later (than in the Harress–Sagnac experiment) but with the *same* time delay after each other.

Here we have to emphasize that, when calculating the effects in the Dufour variants of the Harress–Marinov and Harress–Fizeau experiments, one has, even in the limiting case, to take into account that parts of the medium's disk are "cut away." In the Harress–Dufour experiment these parts also produce some effect (there is a Harress–Sagnac effect), while in the Harress–Fizeau–Dufour experiment these parts do not produce any effect. Only after performing the suitable exact calculations can one find the effect in the Harress–Pogany experiment (performed with a medium in the Dufour form) according to formula (14).

We must turn the reader's attention to the fact that in the Harress–Marinov and Harress–Fizeau experiments there is the *same relative motion* between mirrors and medium. However, the results of these two experiments are substantially different because in the Harress–Marinov experiment the medium rests with respect to absolute space, while in the Harress–Fizeau experiment the mirrors rest with respect to absolute space.

For an illustration we note that if the Harress–Marinov experiment is performed at a pole with Ω equal and oppositely directed to the angular diurnal rotational velocity of the Earth, then the Harress–Fizeau experiment would be realized.

3. THE INERTIAL ROTATING DISK EXPERIMENT

The explanation of the rotating disk experiment given by the theory of relativity is full of contradictions. Certain relativists assert that this experiment can be explained only by the apparatus of general relativity because the motion there is not inertial (see, for example, Ref. 21). However, other relativists assert that this can be done also in the frame of special relativity and if one performs suitable calculations, making use of the Lorentz transformation.(22,23)

The mirrors M, M_1, M_2, and M_3 in Fig. 2 move with a normal acceleration when rotating. However, this normal acceleration is *not* decisive for the result of the experiment. Indeed, we propose the following modification of the Harress–Sagnac experiment (called by us the *inertial rotating disk experiment*), which will give the same result and where any noninertial motion is excluded.

Let (Fig. 4) mirrors M_1, M_2, and M_3 be at rest and let the semitransparent mirror S rotate with angular velocity Ω about some center C. We assume that when the semitransparent mirror S is vertical, then, over some small angle α, a "finger" reduces the rotational motion to a translational one with velocity $v = \Omega R$, where R is the radius of the rotational motion of S.

Let a light pulse fall over S and split into "direct" and "opposite" portions. If the semitransparent mirror S is at rest, then a certain interference picture will be observed produced by the "direct" and "opposite" photons after their unification. If now S is put in motion, then the interference picture will change because of the time delay with which the "direct" photons will return to S after the "opposite" photons, and this time delay will be given by formula (13).

Indeed, the time t in which the "direct" and "opposite" photons cover path $4d$ is equal to

$$t = \frac{4d}{c} = 4\sqrt{2}\,\frac{R}{c} \tag{15}$$

In this time the semitransparent mirror S will cover a distance

$$\Delta s = vt = 4\sqrt{2}\,\frac{\Omega R^2}{c} \tag{16}$$

between the positions S′ and S″.

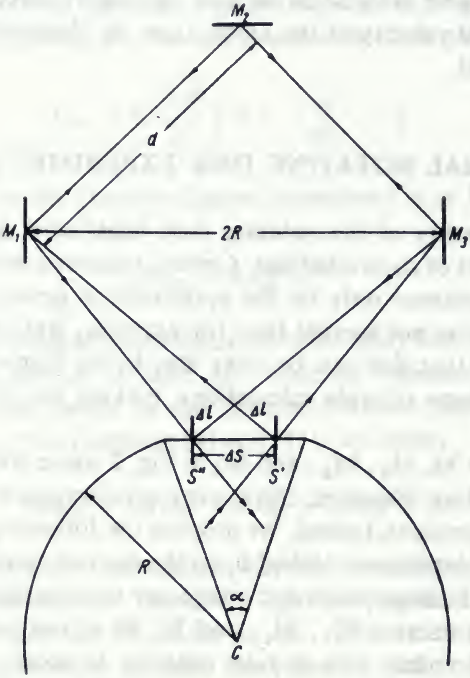

Fig. 4. The inertial rotating disk experiment.

If Δl is the difference between the paths of the "direct" and "opposite" photons when S is in motion and at rest, then the time with which the "direct" photons will come to the semitransparent mirror S after the "opposite" photons will be

$$\Delta t = 2\frac{\Delta l}{c} = \sqrt{2}\frac{\Delta s}{c} = 8\frac{\Omega R^2}{c^2} \tag{17}$$

4. PRACTICAL PERFORMANCE OF THE HARRESS–MARINOV AND HARRESS–FIZEAU EXPERIMENTS

We have carried out the Harress–Marinov and Harress–Fizeau experiments. Our scheme (Fig. 1) differs somewhat from the traditional scheme (Fig. 2) for the performance of the rotating disk experiment. The first difference consists in the following: In our realization the "direct" and "opposite" light pulses interfere with light pulses that always cover the same path. Thus the illuminations over the photoresistors P_A and P_B change oppositely, and we can use our convenient bridge method described in detail in Ref. 24. The second difference consists in the following: In Fig. 2, mirrors

M_1, M_2, and M_3 are tangent to the circumference of the medium; however, semitransparent mirror M is not tangent and cannot be placed close enough to the medium. In our realization the separation of the photons that will later interfere proceeds first at semitransparent mirror SM and then at semitransparent mirrors SM_A and SM_B, so that instead of mirror M, we have an *effective point of separation M* which can lie close enough to the circumference of the medium. Now, however, we have to take into consideration the difference in the light paths that appears along the contour $SM\text{-}SM_A\text{-}M\text{-}SM_B\text{-}SM$ when the mirrors rotate. Let us calculate the corresponding correction.

Denoting the distance between SM_A and SM_B by b, we obtain for the surface enclosed by this contour

$$S = \frac{b^2}{2} \cot\left(\frac{\pi}{4} + \alpha\right) = b^2 \frac{(2 - n^2)^{1/2}}{2n} \tag{18}$$

When the mirrors rotate with angular velocity Ω the second photon will rendezvous with the first photon on mirror SM_A with the following additional time anticipation:

$$\Delta t_{\text{add}} = \frac{S\Omega}{c^2} = \frac{\Omega b^2}{c^2} \frac{(2 - n^2)^{1/2}}{2n} \tag{19}$$

while the fourth photon will rendezvous with the third photon on mirror SM_B with the same time delay.

Hence in our realization we obtain the following difference in the light paths for the Harress–Marinov experiment:

$$\Delta_{\text{HM}} = 8 \frac{\Omega R^2}{c} \left(n^2 - \lambda \frac{dn}{d\lambda}\right) - \frac{\Omega b^2}{c} \frac{(2 - n^2)^{1/2}}{n} \tag{20}$$

As a medium we have taken distilled water in a metal vessel of the form shown in Fig. 1. Glass windows are put at the points where the light beams must cross the walls of the vessel. Glass windows also are put on the metallic interfaces that divide the square ring into compartments. Taking into account the thickness of the glass plates and their refractive index, we have put the mirrors M_1, M_2, and M_3 at such positions that the real light path (distance multiplied by refractive index) along the contour $M\text{-}M_1\text{-}M_2\text{-}M_3\text{-}M$ is exactly equal to the light path that would be covered if mirrors M_1, M_2, and M_3 had been *immersed* in water.

We have $n = 1.3317$ and $dn/d\lambda = -2.7 \times 10^{-5}\text{nm}^{-1}$, assuming $\delta n = 0$ and $\delta(dn/d\lambda) = 0$, for light of wavelength $\lambda = 632.8\text{nm}$ of the He–He laser used. Also, $R = 30.6 \pm 0.2$ cm and $b = 10.0$ cm, assuming $\delta b = 0$ and taking a large enough error $\delta R = \pm 0.2$ cm, which has to compensate also possible errors introduced in the measurement of the thickness of the glass plates and errors that could appear from the replacement of the real light path by an idealized light path only in water.

We have made the light paths of the first and second photons (as well as of the third and fourth photons) equal. However, since laser light with good coherence is used, this is by no means necessary and the light paths of the first and third photons can be substantially reduced.

The sensitivity of our bridge method is analyzed in more detail in Ref. 24. The maximum sensitivity occurs when the sum at rest of the differences in the light paths of the first and second photons and in the light paths of the third and fourth photons is $(2n + 1)\lambda/2$, and is(24) $\delta\Delta = \pm 2.5 \times 10^{-4}\lambda$. When this difference is $n\lambda$, the sensitivity falls to zero. We have not searched for a highest sensitivity by the help of a "tuner," as described in Ref. 24, and we have taken an average sensitivity $\delta\Delta = \pm 10^{-2}\lambda$. The tuner described in Ref. 24 can be used also for calibration during the run. However, in our method, where we change the rotational velocity until $\Delta = c\,\Delta t$ becomes equal to λ, *no* calibration need be made.

The number of revolutions per second of the disk $N = \Omega/2\pi$ is measured by a light stroboscopic cyclometer maintained automatically with precision $\delta N = \pm 0.02$ rev/sec. We rotated the disk first counterclockwise with angular velocity Ω_1 and then clockwise with angular velocity Ω_2, taking $\Omega = \frac{1}{2}(\Omega_1 + \Omega_2)$. We obtained $N = 22.68 \pm 0.04$ rev/sec for the Harress–Marinov experiment and $N = 50.60 \pm 0.04$ rev/sec for the Harress–Fizeau experiment. Putting the numerical values into formulas (20) and (12), we obtain

$$\begin{aligned} c_{\mathrm{HM}} &= (3.01 \pm 0.07) \times 10^8 \text{ m/sec} \\ c_{\mathrm{HF}} &= (2.97 \pm 0.07) \times 10^8 \text{ m/sec} \end{aligned} \tag{21}$$

where for δc we have taken the maximum measuring error.

The inertial rotating disk experiment can be carried out with our setup shown in Fig. 1 if one attaches only the semitransparent mirrors SM_A and SM_B to the rotating turnabout and leaves all other elements at rest.

5. THE COUPLED-MIRRORS EXPERIMENT

With the help of our deviative(11) and interferometric(12) coupled-mirrors experiments, for the first time in history, we have established the Earth's absolute motion by performing measurements in a laboratory. The Earth's absolute velocity on 12 July is $v = 279 \pm 20$ km/sec and its apex has equatorial coordinates $\alpha = 14^h 24^m \pm 20^m$, $\delta = -26° \pm 4°$. After the performance of this experiment physics has to return to Newtonian conceptions about absolute space–time and to the aether model of light propagation, which have been abondoned in the last 70 years as not corresponding to reality. According to our absolute space–time theory,(25) the unique new element that is to be introduced into the old Newtonian theory is only the *absolute* time dilation (including the axiomatic assumption that the rate of any light clock does not depend on the orientation of its "arm"). Thus the correction that 20th century high-velocity physics makes to classical (Newtonian) physical conceptions is very limited and, in our opinion, is no occasion at all to speak about some radical revolution.

It is interesting to note that the coupled-mirrors experiment is not a result of technological progress in experimental physics, nor of conceptual progress in theoretical physics. We are convinced that the coupled-mirrors experiment could have been performed by Foucault in the middle of the last century, since it represents only a modification of his method for the measurement of light velocity with the help of a rotating mirror.

Thus we are surprised, indeed, that Michelson did not perform the coupled-mirrors experiment and overlooked its magnificent first-order in v/c possibilities. And what should one say about the other generations of physicists coming after him?

Now we shall show that the coupled-mirrors experiment can be considered as a logical result of the rotating disk experiment. However, we shall not speak further about the coupled-mirrors (quasi-Foucault) experiment, but about the "coupled-shutters" (quasi-Fizeau) experiment, because methodologically the latter is simpler.

6. THE COUPLED-SHUTTERS EXPERIMENT

The coupled-shutters experiment represents only a modification of the historic Fizeau experiment for the measurement of the light velocity with the help of a rotating cog-wheel.

The principal scheme of the coupled-shutters experiment (proposed in a different arrangement by Dart(26)) can be seen in Fig. 5: We have two cog-wheels C_1 and C_2 fixed on a common shaft with length d, which is set in rotation by the electromotor EM. Intense light is emitted by the sources S_1 and S_2. After passing through the notches of the cog-wheels C_1 and C_2 (respectively, C_2 and C_1) this light is observed by the observers O_1 and O_2. We shall call the direction from S_1 to O_1 "direct" and that from S_2 to O_2 "opposite."

Suppose that the velocity of light in the direct and opposite directions has the same value, c. If both wheels have the same number of cogs placed respectively against each other (i.e., "cogs against cogs") and they are set in

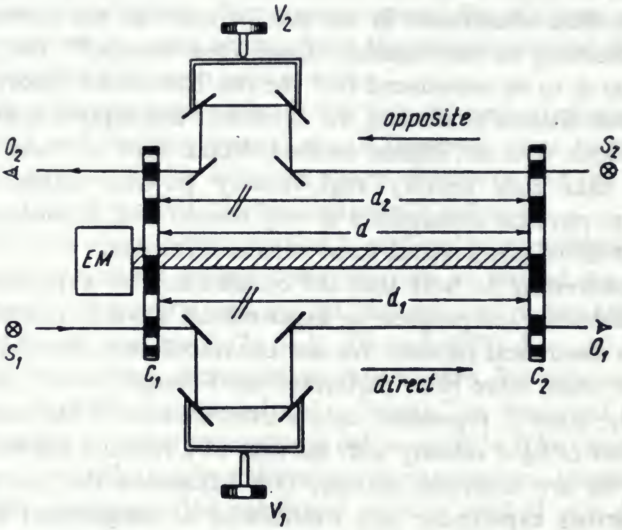

Fig. 5. Rigidly connected coupled shutters.

rotation, then the observers will establish maximum photon fluxes in the case where the distance d between the wheels is covered by light in the same time that the wheels are rotated an integer number of notches. If any of the wheels has p notches and makes N revolutions per second, the wheels will rotate $f = pN$ notches in a second. We call this number f the "frequency of chopping." Obviously the condition for observation of a maximum photon flux can be written $n = (d/c)f$, where n must be an integer.

With the help of the verniers V_1 and V_2 we can change the paths d_1 and d_2 of the light beams between both wheels. If the velocity of light in the direct and opposite directions is the same, then, obviously, O_1 and O_2 will observe maximum (or minimum) photon fluxes when $d_1 = d_2$.

Let us now suppose that the velocity of light is $c - v$ in the direct and $c + v$ in the opposite direction. The conditions for passing of the chopped direct and opposite beams will be

$$n_1 = \frac{d_1}{c - v} f, \qquad n_2 = \frac{d_2}{c + v} f \tag{22}$$

Since maximum photon fluxes can be observed by both observers when $n_1 = n_2$, this can be realized if

$$d_1 = d\left(1 - \frac{v}{c}\right), \qquad d_2 = d\left(1 + \frac{v}{c}\right) \tag{23}$$

or if

$$\Delta d = d_2 - d_1 = 2(d/c)\, v \tag{24}$$

Obviously, if we choose a lower chopping frequency, a longer shaft must be used. It is easy to see that the chopping frequency that can be achieved by a rotating cog-wheel requires a steel shaft so long that practically it cannot be constructed. Indeed, if we want to measure the absolute velocity v within an accuracy δv and we assume that the observers register the presence of light when $(1/n)$th part of the chopped light pulses passes through the "receiving" shutter, then the uncertainty in Δd will be

$$\delta(\Delta d) = 2\frac{1}{n}\frac{c}{2f} = \frac{c}{nf} \tag{25}$$

if both observers should place the verniers V_1 and V_2 in such positions that no light is to be registered by both of them. The factor 2 is taken in the nominator because there are two observers and the duration of the light pulse is one-half the duration of the chopping period. From formulas (24) and (25) we obtain $d = c^2/nf\,\delta v$. Putting $\delta v = 10$ km/sec, $n = 100$, $f = 5 \times 10^5$ Hz (this was the order of the chopping frequency that Fizeau used in the mid-19th century when measuring c), we get $d = 90$ km.

Since such a long steel shaft can not be made, the idea arises of using two independent cog-wheels not fixed on a common shaft but rotating with the same angular velocity.

For the sake of generality, we shall further speak not of two independently rotating cog-wheels but of two independently operating pairs of shutters (say, Kerr cells). Any pair of these shutters (Fig. 6) is driven by a common chopping mechanism, say, two resonators R_A and R_B.

Now the following two problems arise:

(a) How to maintain *equal* chopping frequencies of both pairs of shutters.

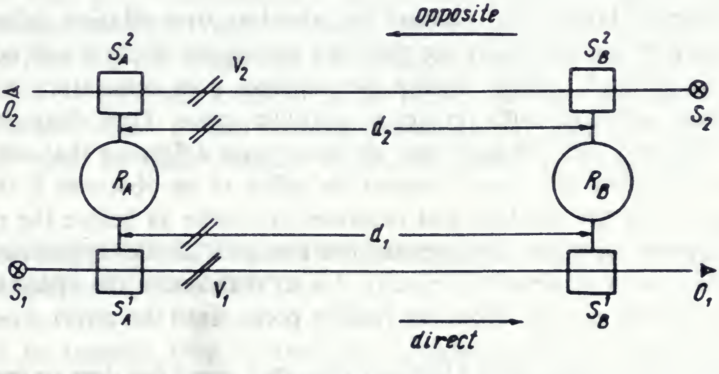

Fig. 6. Independent coupled shutters.

(b) How to maintain a phase difference between them equal to zero, i.e., how to ensure that both pairs of shutters will close and open *together*.

The first difficulty can be overcome if we use the same resonator for both pairs of shutters, which can be put near the shutters S_A , near the shutters S_B , or in the middle. However, if we transmit the signals for opening and closing of the shutters by an electric line, then a phase difference would appear between the pairs. It can be easily shown that the phase difference appearing at the motion of our apparatus in absolute space will exactly cancel the effect that we intend to observe.

Hence the resonators producing the chopping frequency must be independent. We have to take two good atomic clocks that produce the same chopping frequency or whose chopping frequencies are maintained equal, comparing them every now and then. The chopping frequency f_B of the resonator R_B can be maintained equal to the chopping frequency f_A of the resonator R_A if we tune f_B in such a manner that the "beating" of the light spot observed by O_2 will be reduced to zero.

When we use independent shutters, we cannot know the phase difference between them (i.e., we would have to know, when the first pair of shutters is opened, how far from opening is the second pair of shutters). Hence again we cannot measure the absolute velocity v.

However, as Dart has proposed,(26) we can rotate our apparatus with respect to absolute space. When the axis of the apparatus is perpendicular to v, we shall arrange the phase difference between both shutters such that both observers O_1 and O_2 would not see any light. If now the apparatus is put parallel to v, so that the direct direction will coincide with the direction of v, then some light will be seen by the observers; and only if we change the distances d_1 and d_2 , with the help of the verniers V_1 and V_2 to give a difference Δd according to formula (24), will no light be left to pass through both pairs of the coupled shutters.

However, taking into account the absolute time dilation defended by our theory,(25) we can easily see that this prediction of Dart will not correspond to reality.[2] Indeed, during the rotation both resonators will move at different velocities with respect to absolute space. Thus their time rates will be different and just such that the new phase difference that will appear after the rotation will *exactly* cancel the effect to be observed if the phase difference after the rotation had remained the same as before the rotation.

To prove this, let us suppose that the axis of the apparatus is first perpendicular to its absolute velocity. Let us then rotate the apparatus with angular velocity ω, say, about the middle point, until the direct direction of

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[2] In a letter to the author, dated 5 February 1975, Dart agreed that there are errors in his proposal.

the axis becomes parallel to v. Let the readings of two clocks (suppose, for simplicity, light clocks) attached to R_A and R_B be t_A', t_B' before the rotation and t_A'', t_B'' after the rotation. Let the proper times $t_A = t_A'' - t_A'$, $t_B = t_B'' - t_B'$ correspond to the same absolute time interval t. Because of the absolute time dilation, we have

$$t_A = \int_0^t (1 - v_A{}^2/c^2)^{1/2}\, dt, \qquad t_B = \int_0^t (1 - v_B{}^2/c^2)^{1/2}\, dt \tag{26}$$

where

$$\begin{aligned} v_A{}^2 &= v^2 + (\tfrac{1}{2}d\omega)^2 - vd\omega \cos \omega t \\ v_B{}^2 &= v^2 + (\tfrac{1}{2}d\omega)^2 + vd\omega \cos \omega t \end{aligned} \tag{27}$$

are the velocities of the resonators during the rotation of the apparatus.

If we work within an accuracy of second order in v/c, we obtain, after performing the integration, putting $\omega t = \pi/2$, and subtracting the second of formulas (26) from the first,

$$\Delta t = t_A - t_B = dv/c^2 \tag{28}$$

This formula shows that if before the rotation the phase difference between both pairs of shutters is equal to zero, then after the rotation the shutter $S_B{}^1$ will open with a delay Δt relative to the shutter $S_A{}^1$, while the shutter $S_A{}^2$ will open with the same anticipation relative to the shutter $S_B{}^2$. Thus for the same light paths, $d_1 = d_2$, minimum photon fluxes will pass through both coupled shutters.

Let us explain more clearly the difference between the independent shutters and the cog-wheels connected by a common rigid shaft. The relation between the absolute time and the proper times elapsed on two clocks moving with velocities v_A and v_B are given by formulas (26) only if these clocks are independent. If we consider both rotating cog-wheels as clocks, we do not have the right to use formulas (26) because the wheels are *rigidly* connected by a common shaft and there is a *unique* clock—the motor driving the shaft, which, if placed at the middle, does not change its velocity during the rotation. Thus, after the rotation, a change in the phase difference between both cog-wheels cannot occur. If such a change would appear, then after the rotation *the shaft must be found twisted*, which, obviously, is nonsensical.

7. CONNECTION BETWEEN THE ROTATING DISK AND COUPLED-MIRRORS EXPERIMENTS

Let us suppose (Fig. 7) that our coupled shutters, representing two cog-wheels fixed on a common shaft driven by the electromotor EM, are

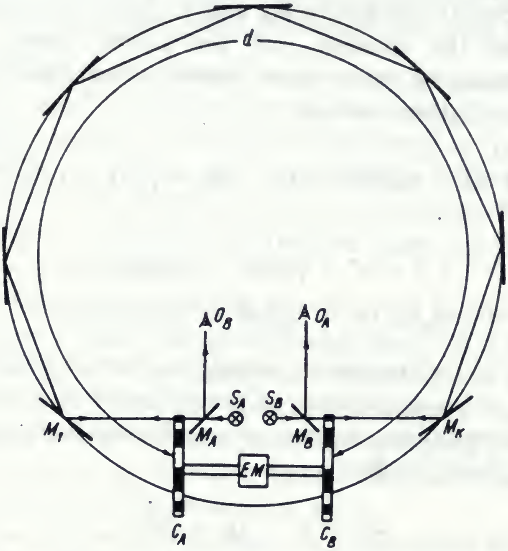

Fig. 7. Coupled shutters mounted on a rotating disk for d near $2\pi R$.

mounted on a rotating disk. Imagine that the distance between the wheels is much less than the circumference of the disk. The direct light beam emitted by the source S_A passes through the semitransparent mirror M_A and, after its chopping by the cog-wheel C_A and reflection by the mirrors M_1 ,..., M_k , arrives at the cog-wheel C_B . If $n = (d/c)f$, where n is an integer, d the path of the direct light beam between the cog-wheels C_A and C_B , and f the chopping frequency, then this chopped beam will pass through the cog-wheel C_B and, being reflected by the semitransparent mirror M_B , will be observed by the observer O_A . The same happens with the opposite light beam.

Let the disk be at rest. If we change the frequency of chopping, the observers O_A and O_B will register together maximum and minimum photon fluxes. However, if we set the disk in rotation, the observer O_A will register a maximum photon flux for the condition⁽¹⁰⁾

$$\frac{1}{f} n_A = \frac{d}{c} + \int_0^d \frac{\mathbf{v} \cdot d\mathbf{r}}{c^2} = \frac{d}{c}\left(1 + \frac{\Omega R}{c}\right) \tag{29}$$

where R is the radius of the disk, Ω is the angular velocity of rotation, $d\mathbf{r}$ is the differential element of the light path, and we have assumed that the mirrors M_1 ,..., M_k are close to each other, so that we can write $\mathbf{v} \cdot d\mathbf{r} = v\, dr$.

The observer O_B will register a maximum photon flux for

$$n_B = f \frac{d}{c}\left(1 - \frac{\Omega R}{c}\right) \tag{30}$$

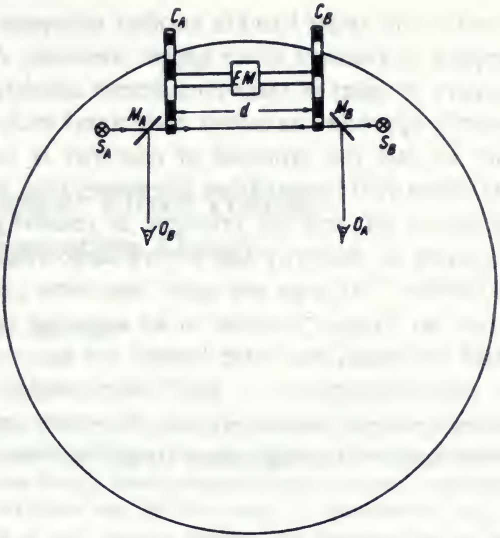

Fig. 8. Coupled shutters mounted on a rotating disk for d much less than $2\pi R$.

Suppose now that the distance d decreases gradually. Formulas (29) and (30), which describe the effect of this disrupted rotating disk experiment, will remain valid. Hence with such a gradually greater and greater disruption we shall come to the situation presented in Fig. 8, where the paths of both light beams are much smaller than the circumference of the disk. Now, for time intervals $t \gg 2\pi R/v = 2\pi/\Omega$ the motion of the coupled shutters can be considered as inertial, and thus we come to the coupled-shutters experiment analyzed in Section 6. Since any component of the Earth's absolute motion —the daily rotation about its axis, the yearly revolution about the Sun, the revolution about the galactic center of mass, etc.—represents some rotational motion, it follows that the coupled-shutters experiment must establish the resultant motion, which, as a matter of fact, we have revealed with the help of our coupled-mirrors experiment.(11,12)

8. CONCLUSIONS

The theoretical analysis and the practical performance of the rotating disk and coupled-mirrors experiments urgently compels the scientific community to recognize the reaccession to the throne of the aether conception and the decline of the principle of relativity. Nevertheless, we must be aware that almost all physical phenomena considered on the one hand in an absolute reference frame and on the other hand in another reference frame that moves inertially with respect to absolute space appear identical. As we have shown in a number of papers, in many of these phenomena *absolute effects do appear*, but they have exactly opposite characters and cancel each other in the final measurable result, so that the principle of relativity is valid there *de jure*. In all experiments where light propagation phenomena do not occur, *absolute effects do not appear at all*, and the principle of reiativity is valid *de facto*.

Thus the principle of relativity has a very large realm of validity, but this realm is not infinite. "All pigs are equal, but some pigs are more equal than others," wrote an English novelist in an amusing book. We can say: All intertial frames are equal, but some frames are more equal than others. However, in a contradistinction to the "more equal pigs," which, as experience has shown, are all equally swines, the more equal inertial frame attached to absolute space is the legitimate king of all inertial frames.

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The Light Doppler Effect Treated by Absolute Spacetime Theory

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We consider the light Doppler effect within the framework of our absolute spacetime theory, which proceeds from the aether conception for light propagation. We show that for the cases of "observer at rest, source moving" and "source at rest, observer moving" the formulas for the received frequency are the same, but the formulas for the wavelength are different. This is in a drastic contradiction with the formulas given by contemporary physics, which proceeds from the principle of relativity. Our recently performed "coupled-mirrors" experiments show that only our formulas can adequately describe physical reality. The experiment for the measurement of the transverse light Doppler effect proposed by us in another paper is reconsidered and we point out how it can be realized as a compensation experiment. The so-called "rotor" and "rotor–rotor" experiments are analyzed. We show why the rotor experiment carried out with the aim of establishing an aether drift has failed to give any positive result.

1. THEORETICAL CONSIDERATIONS

Following the performance of our deviative and interferometric "coupled-mirrors" experiments,$^{(1,2)}$ with whose help we measured the Earth's absolute velocity and disproved the principle of relativity, a description and explanation of all high-velocity phenomena in the light of the absolute spacetime conceptions is urgent. This paper is devoted to the light Doppler effect, which plays an important role in many physical phenomena. As will be shown, the interpretation of many aspects of this effect by conventional physics, based on Einstein's theory of relativity, does not correspond to physical reality.

The theory of the light Doppler effect will be elaborated using our "burst" model for photons, which is briefly described in Ref. 3, and the

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fundamental results of the absolute spacetime theory obtained in Ref. 4. Within effects of first order in v/c our model of light propagation, which we call the *Marinov aether* model, is the *same* as the conventional *Newton aether* model. However these two models differ in regard to effects of second order in v/c; the differences are considered by us in Ref. 5.

Let us recall that the light Doppler effect represents the frequency and wavelength shifts of photons, emitted from a source of radiation and received by an observer, due to the motion of source and observer with respect to absolute space.

1.1. Source and Observer at Rest

Let there be a source (emitter) of photons and an observer (receiver). The source can produce photons (an excited atom) or reflect them (a mirror). Let the source be at rest in absolute space. The *frequency* ν and the *wavelength* λ of any single photon, registered by an observer who is also at rest in absolute space, are connected with the proper energy(6) e_0 of the photon by the so-called de Broglie relations

$$\nu = e_0/h, \qquad \lambda = ch/e_0 \tag{1}$$

and thus

$$\nu\lambda = c \tag{2}$$

where h is the Planck constant and c the *absolute velocity of light*, i.e., the velocity of light with respect to absolute space, which is called briefly the *velocity of light*.

1.2. Source Moving, Observer at Rest

Suppose now (Fig. 1) that the observer is at rest in absolute space at the point O' and the light source moves with velocity v from the position S' where a photon is emitted to the position S where the source will be at the moment when the photon will be received by the observer. Suppose that the wavelength of the interchanged photon is much less than the distance between source and observer and, thus, the *emission* and *reception positions* of the source can be considered as points.

The distance between the emission and reception positions of the source is divided by the point S_m into two equal parts; thus the source will be at S_m at the midpoint in time between the moments of emission and reception. θ' is the emission angle, θ the reception angle, and θ_m the middle angle. We note that a certain freedom is inevitable when defining these angles, which leads to certain differences in the notations and in the formulas from those of our earlier papers.(7–9) Now, once and for all, we make the following

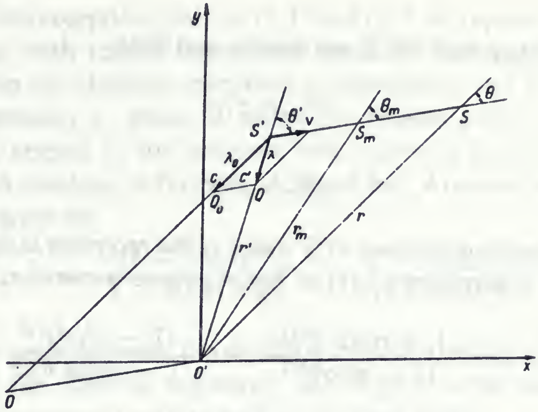

Fig. 1. Light Doppler effect in the case of a moving source (or of a moving observer).

stipulation: The *emission*, *reception*, and *middle angles* are subtended by the velocity of the moving object and the line connecting the object at rest with the moving object respectively at the emission, reception, and middle moments. We shall attach the subscript zero to the observed frequency and wavelength and *not* to the emitted ones, which will be written without any subscript. Primes will be attached to the initial (i.e., emission) distance, position, and angle, while the final (i.e., reception) distance, position, and angle will be written without any superscript.

When the source is moving, the observer at rest will *not* register the frequency ν and measure the wavelength λ that are registered and measured when the source is at rest, and which we call the *emitted frequency* and *wavelength*, but some other, in general different, quantities, ν_0, λ_0, which we call the *observed* (or *received*) *frequency* and *wavelength*.

If in Fig. 1 we represent the emitted wavelength λ by the segment $S'Q$, then, proceeding from our "burst" model,(3) we have to represent the observed wavelength λ_0 by the segment $S'Q_0$. Let us repeat that we consider only the case where the distance between source and observer is much larger than the wavelength of the interchanged photon, and on the figure we draw the wavelength so large only for the sake of clarity.

Since the photon moves in absolute space with velocity c, we shall have

$$\nu_0\lambda_0 = c \tag{3}$$

From (2) and (3) we obtain

$$\nu_0/\nu = \lambda/\lambda_0 \tag{4}$$

The triangles $S'Q_0Q$ and $O'SS'$ are similar and thus

$$\lambda/\lambda_0 = r'/r \tag{5}$$

so that

$$\nu_0/\nu = r'/r \tag{6}$$

where r' is the *emission distance* $O'S'$ and r is the *reception distance* $O'S$.

According to formulas (4.21) of Ref. 4 (where we write $r_0 = r'$, $\theta_0 = \theta'$),

$$r = r' \frac{1 + v(\cos\theta')/c}{(1 - v^2/c^2)^{1/2}} = r' \frac{(1 - v^2/c^2)^{1/2}}{1 - v(\cos\theta)/c} \tag{7}$$

Substituting this into (6) and (5), one finds

$$\nu_0 = \nu \frac{(1 - v^2/c^2)^{1/2}}{1 + v(\cos\theta')/c} = \nu \frac{1 - v(\cos\theta)/c}{(1 - v^2/c^2)^{1/2}} \tag{8}$$

$$\lambda_0 = \lambda \frac{1 + v(\cos\theta')/c}{(1 - v^2/c^2)^{1/2}} = \lambda \frac{(1 - v^2/c^2)^{1/2}}{1 - v(\cos\theta)/c} \tag{9}$$

If we wish to have the dependence between the emitted and received frequencies and wavelengths on the middle angle θ_m, we have to insert in (6) and (5) the formula (4.25) of Ref. 4; and so we obtain

$$\nu_0 = \nu \left(\frac{1 - v(\cos\theta_m)/c}{1 + v(\cos\theta_m)/c}\right)^{1/2}, \qquad \lambda_0 = \lambda \left(\frac{1 + v(\cos\theta_m)/c}{1 - v(\cos\theta_m)/c}\right)^{1/2} \tag{10}$$

This one can obtain also by multiplying both formulas (8) and both formulas (9), writing $\cos\theta' = \cos\theta_m + a$ and $\cos\theta = \cos\theta_m - a$, where a is an algebraic quantity.

For $\theta' = \theta = \theta_m = 0$ (or π), we call the Doppler effect *longitudinal.*

For $\theta' = \pi/2$, $\theta = \pi/2 - v/c$, $\theta_m = \pi/2 - v/2c$, we call the Doppler effect *post-traverse.*

For $\theta = \pi/2$, $\theta' = \pi/2 + v/c$, $\theta_m = \pi/2 + v/2c$, we call the Doppler effect *ante-traverse.*

For $\theta_m = \pi/2$, $\theta' = \pi/2 + v/2c$, $\theta = \pi/2 - v/2c$, we call the Doppler effect *traverse.*

The post-traverse, ante-traverse, and traverse Doppler effects are designated collectively by the common term *transverse* Doppler effect.

1.3. Source at Rest, Observer Moving

Suppose now (see again Fig. 1) that the source is at rest in absolute space at the point S' and the observer moves with velocity v from the emission position O' to the reception position O. If in Fig. 1 we represent the velocity c of the photons with respect to absolute space by the segment $S'Q_0$, then, proceeding from our absolute spacetime conceptions,⁽⁴⁾ we have to represent the observed velocity c', which is called the *relative velocity of light* and is measured with respect to the observer who moves in absolute space, by the segment $S'Q$. According to formula (4.30) of Ref. 4 (where we write $c_0 = c'$, $\theta_0 = \theta'$), it is given by

$$c' = c\,\frac{(1 - v^2/c^2)^{1/2}}{1 + v(\cos\theta')/c} = c\,\frac{1 - v(\cos\theta)/c}{(1 - v^2/c^2)^{1/2}} \tag{11}$$

where θ' is the angle between the direction of propagation of the photon and the velocity of the observer registered with respect to the observer, and θ is the same angle registered with respect to absolute space.

The relative light velocity c' is measured with the help of a clock at rest in absolute space, which reads *absolute time* and is called the *absolute clock*. If the relative light velocity is measured with the help of a clock attached to the moving observer, which reads *proper time* and is called the *proper clock*, we call it the *proper relative light velocity*; because of the absolute time dilation, it is given by

$$c_0' = \frac{c'}{(1 - v^2/c^2)^{1/2}} = \frac{c}{1 + v(\cos\theta')/c} = c\,\frac{1 - v(\cos\theta)/c}{1 - v^2/c^2} \tag{12}$$

If the absolute light velocity is measured in proper time, it is called the *proper absolute light velocity* (or, briefly, *proper light velocity*) and, because of the absolute time dilation, it is given by

$$c_0 = \frac{c}{(1 - v^2/c^2)^{1/2}} \tag{13}$$

Since the photon proceeds with respect to the moving observer with the relative velocity c', the relation between the observed frequency and wavelength will be

$$\nu_0\lambda_0 = c' \tag{14}$$

According to our "burst" model for photons, their wavelength can change only when the source moves with respect to absolute space. The motion of the observer with respect to absolute space leads only to a change in the velocity and frequency of the observed photons, but *not* to a change in their wavelengths. We have to emphasize that the wavelength is to be measured *always* with respect to absolute space, *even in the case of a moving observer*. The photon is a reality that exists *independently* of the observer, and the motion of the latter can exert *no* influence on the photon's wavelength, which is an immanent photon property. We have further to emphasize that a direct measurement of the wavelength cannot be performed. One can measure directly only the wavelength of standing waves, i.e., of "to and for" propagating photons, which interfere. All measurements of the wavelength of unidirectionally propagating photons are indirect. If one would accept that the motion of the observer leads to a change in the wavelength, then one is impelled to accept Einstein's dogma about the constancy of light velocity in any inertial frame, which, as we have experimentally shown, does not correspond to physical reality.

Thus, for the case of source at rest and a moving observer, we have

$$\lambda_0 = \lambda \tag{15}$$

From Eqs. (2), (14), and (15) we obtain

$$\nu_0/\nu = c'/c \tag{16}$$

Making use of formulas (11), we find

$$\nu_0 = \nu \frac{(1 - v^2/c^2)^{1/2}}{1 + v(\cos\theta')/c} = \nu \frac{1 - v(\cos\theta)/c}{(1 - v^2/c^2)^{1/2}} \tag{17}$$

Here again a formula analogous to (10) can be introduced, as well as the definitions for longitudinal and transverse Doppler effects.

1.4. Source and Observer Moving

Finally, suppose (Fig. 2) that the source moves with velocity v with respect to absolute space and the observer with velocity v_0, so that S' and O' are the emission positions of source and observer and S and O are their reception positions.

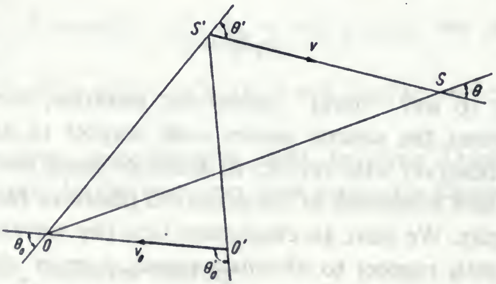

Fig. 2. Light Doppler effect in the case where both source and observer are moving.

We introduce two pairs of emission and reception angles: θ_0' and θ_0 are the emission and reception angles if the source is at rest at its emission position, while θ' and θ are the emission and reception angles if the observer is at rest at its reception position. For certain problems it is convenient to use the angles θ', θ_0, for others the angles θ_0', θ.

To find the relation between the emitted and received frequencies and wavelengths we proceed as follows: Suppose that the real source emits a photon and an imaginary observer is at rest at point O (the reception position of the real observer). The frequency and wavelength registered by this observer, called an intermediary, will be [use formulas (8) and (9)]

$$\nu_{\text{int}} = \nu \frac{(1 - v^2/c^2)^{1/2}}{1 + v(\cos\theta')/c} = \nu \frac{1 - v(\cos\theta)/c}{(1 - v^2/c^2)^{1/2}} \tag{18}$$

and

$$\lambda_{\text{int}} = \lambda \frac{1 + v(\cos\theta')/c}{(1 - v^2/c^2)^{1/2}} = \lambda \frac{(1 - v^2/c^2)^{1/2}}{1 - v(\cos\theta)/c} \tag{19}$$

If now an imaginary source is at rest at point S' (the emission position of the real source) and emits a photon with frequency ν_{int} and wavelength λ_{int}, then the frequency and wavelength registered by the real observer when he crosses point O will be [use formulas (17) and (15)]

$$\nu_0 = \nu_{\text{int}} \frac{(1 - v_0^2/c^2)^{1/2}}{1 + v_0(\cos\theta_0')/c} = \nu_{\text{int}} \frac{1 - v_0(\cos\theta_0)/c}{(1 - v_0^2/c^2)^{1/2}} \tag{20}$$

$$\lambda_0 = \lambda_{\text{int}} \tag{21}$$

Substituting (18) and (19) into (20) and (21), we obtain

$$\begin{aligned} \nu_0 &= \nu \frac{1 - v_0(\cos\theta_0)/c}{1 + v(\cos\theta')/c} \left(\frac{1 - v^2/c^2}{1 - v_0^2/c^2}\right)^{1/2} \\ &= \nu \frac{1 - v(\cos\theta)/c}{1 + v_0(\cos\theta_0')/c} \left(\frac{1 - v_0^2/c^2}{1 - v^2/c^2}\right)^{1/2} \end{aligned} \tag{22}$$

$$\lambda_0 = \lambda \frac{1 + v(\cos\theta')/c}{(1 - v^2/c^2)^{1/2}} = \lambda \frac{(1 - v^2/c^2)^{1/2}}{1 - v(\cos\theta)/c} \tag{23}$$

When $\mathbf{v}_0 = \mathbf{v}$, it means $\theta_0 = \pi - \theta'$, $\theta_0' = \pi - \theta$, and Eq. (22) reduces to

$$\nu_0 = \nu \tag{24}$$

while formulas (23) remain the same, so that

$$\nu_0 \lambda_0 = c' \tag{25}$$

c' being the relative light velocity with respect to source and observer. In this case θ is the angle between the direction opposite to that of light propagation and the velocity of source and observer registered with respect to both of them, while θ' is the same angle registered with respect to absolute space.

If the relative light velocity is measured in the proper time of the moving observer, it becomes

$$\nu_0\lambda_0 = c_0' \tag{26}$$

and formula (24) remains the same, while formulas (23) must be replaced by the following ones:

$$\lambda_0 = \lambda \frac{1 + v(\cos\theta')/c}{1 - v^2/c^2} = \frac{\lambda}{1 - v(\cos\theta)/c} \tag{27}$$

Equation (24) shows that if an observer moves with the same velocity as the light source, then the measurement of the received frequency can *never* give information about their absolute velocity. However, formula (27) shows that the measurement of the wavelength *can* give such information. These conclusions are of extreme importance. Let us note that, according to contemporary physics, which proceeds from the principle of relativity, a Doppler effect appears only when source and observer move with respect to one another. By contrast, we have shown that a Doppler effect appears also when source and observer move with the same velocity, to wit, the received wavelength is different from that which would be measured if source and observer were at rest in absolute space.

2. THE TRANSVERSE "CANAL RAY" EXPERIMENT

Let us now turn our attention to the experimental situation.

The longitudinal light Doppler effect of second order was measured by three groups.(10–12) According to the reports of all investigators, experiment well confirmed formula (8). However, as was shown by Kantor,(13) the accuracy of all these experiments is seriously in doubt.

In our opinion, with the present technical state of the art, we have to take the experiment proposed by us in Ref. 7 and reconsidered in Ref. 8 as a reliable experiment capable of establishing beyond doubt the existence of a light Doppler effect of second order when an *inertial* motion of the source is observed.

It is interesting to note that if one considers the state of experimental technique in the period prior to World War I, the conclusion can be drawn that the experiment proposed by us in 1970 could have been performed even at that time. Indeed (see the experimental arrangement in Fig. 3 and its description below), Stark,(14) who investigated the light Doppler effect in 1906, used accelerating voltages of about 10 kV, but, as he wrote, voltages as high as 60 kV could have been supplied. As a spectroscopic apparatus he used a Rowland grating with dispersion 1.64 nm on 1 mm for $\lambda = 500$ nm. Experimental equipment with optimal capabilities of the same order have been used by all investigators of the visible light Doppler effect of second order mentioned above. However, the realization of the longitudinal Doppler effect is very complicated, requiring measurements of distances between spectral lines with very high precision and additional calculations. We share the opinion of Kantor(13) that the available reports on the measurements of the longitudinal Doppler effect of second order must be viewed with considerable reservation.

Now we shall show that the experiment for the measurement of the transverse Doppler effect proposed by us can reliably be carried out, because it can be realized as a compensation experiment. Indeed, keeping in mind Refs. 7 and 8, we can perform this experiment as follows:

As a moving light source one should use ions in a canal-ray tube of the Dempster type according to Fig. 3. The ions are produced in the arc between the heater H and the perforated electrodes E and E'. Between E and E' the ions are accelerated by an electric field, thus forming the beam S. They proceed with a constant velocity and represent the moving source. The photons emitted by the excited ions, passing through the large slit Q, illuminate the narrow slit O, behind which there is a spectroscopic apparatus that gives a response only when photons are incident with frequency equal to the frequency ν emitted by the ions at rest. Let us emphasize that *any* indi-

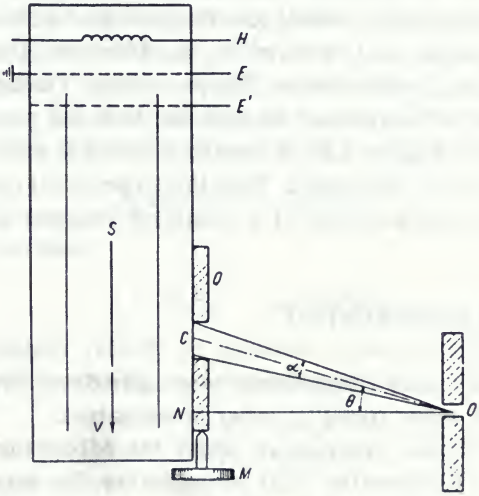

Fig. 3. The transverse canal ray experiment.

cator that registers light radiation is affected by the received frequency and *not* by the wavelength.

From Fig. 3 and from the formula (8) we see that photons will fall on the indicator with frequency

$$\nu_0 = \nu \frac{(1 - v^2/c^2)^{1/2}}{1 + (v/c)\cos(\frac{1}{2}\pi + \theta \pm \frac{1}{2}\alpha)} = \nu \left[1 + \frac{v}{c}\left(\theta \pm \frac{\alpha}{2}\right) - \frac{v^2}{2c^2}\right] \quad (28)$$

where θ is the angle between the perpendicular *ON* to the ionic beam and the line *OC* connecting slit *O* with the center of slit *Q*; α is the angle under which slit *Q* is to be seen from point *O*. If we choose $\alpha \ll \theta$, then we see that photons with frequency ν will fall on the indicator only when

$$\theta = \tfrac{1}{2}v/c \quad (29)$$

Hence the experiment is to be performed as follows: For any voltage applied to the electrodes, i.e., for any velocity v of the ions, we search for the position of slit *Q* at which the indicator will show the presence of photons with frequency ν. Then the theory will be proved right if a plot of $2\theta c$ vs. v gives a straight line of slope unity.

Recently a very reliable transverse light Doppler effect experiment has been performed.(15) In this experiment light was incident normally to a rapidly rotating mirror and the frequency of the reflected photons was compared with the frequency of the incident photons with the help of a Michelson interferometer. The authors registered no change in the frequency of the reflected photons. This result can immediately be explained by our theory. Indeed, for the photons received by the rotating mirror there is an ante-traverse Doppler effect, while for the photons "emitted" (i.e., reflected) by the rotating mirror and received by the observer (the Michelson interferometer) there is a post-traverse Doppler effect. The apparatus measures the resultant effect, which is null, because the ante and post-traverse Doppler effects cancel one another. Let us mention that the authors give the same explanation for the null final effect. Thus this experiment *cannot* be considered as showing directly the existence of a transverse Doppler effect.

3. THE ROTOR EXPERIMENT

The so-called "rotor" experiment was carried out first by Hay *et al.*(16) and then repeated many times by other investigators.

The scheme of this experiment, where the Mössbauer effect is used, is shown in Fig. 4. Radioactive ^{57}Co representing the source was put on a rotating wheel at a distance *R* from the center of rotation *C*. A thin ^{57}Fe

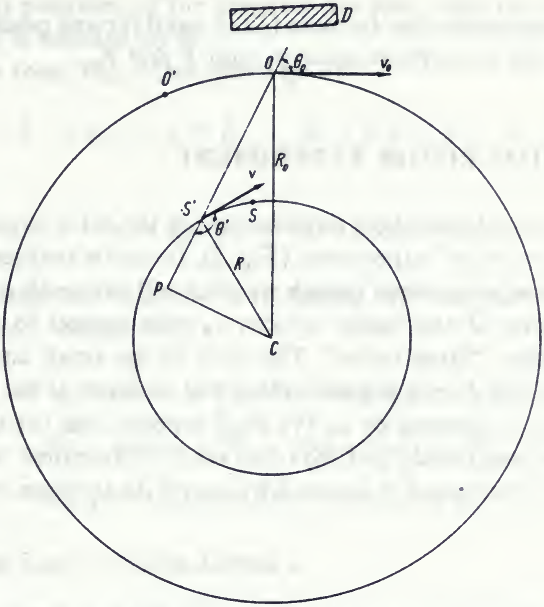

Fig. 4. The rotor experiment.

absorber representing the observer was put on the circumference of the rotating wheel at a distance R_0 from the center of rotation. A detector *D* at rest was used to measure the rate of passage through the absorber of photons emitted by the source. The transmission of the absorber was measured for various angular velocities. It was found to increase as the angular velocity increased, indicating a shift in the characteristic frequency of the absorber.

Since the line shape of the absorber at rest was known experimentally, the magnitude of the frequency could be established, and it was found to agree with the frequency shift calculated according to formula (22).

Indeed, from the triangles *OPC* and *S'PC* in Fig. 4 it follows that

$$R_0 \cos \theta_0 = -R \cos \theta' \tag{30}$$

Taking into account that

$$v = \Omega R, \qquad v_0 = \Omega R_0 \tag{31}$$

where Ω is the angular velocity of rotation, substituting relations (31) into (22), and keeping in mind (30), we obtain the relation

$$\nu_0 = \nu \left(\frac{1 - v^2/c^2}{1 - v_0{}^2/c^2} \right)^{1/2} \tag{32}$$

This was also the relation established experimentally.

Let us emphasize that formula (32) is valid for any position of source and observer on the circumferences with radii R and R_0.

4. THE ROTOR-ROTOR EXPERIMENT

Now we shall describe a modification of the rotor experiment, which we call the "rotor–rotor" experiment (Fig. 5). It can be realized when the center of the rotor just considered (which we shall call the small rotor) rotates at an angular velocity Ω and linear velocity v_0 with respect to some center, thus making another, "large rotor." The radii of the small and large rotors are denoted by r and R; the angular velocity of rotation of the small rotor about its own center is denoted by ω. We shall suppose that the source is placed at the tip of the small rotor and the observer is at its center. The linear velocity of rotation of the source is denoted by v_r and its absolute velocity by v. Thus we have

$$\mathbf{v} = \mathbf{v}_r + \mathbf{v}_0 \tag{33}$$

The angle between $\mathbf{v}_r$ and $\mathbf{v}$ is denoted by ψ and that between $\mathbf{R}$ and $\mathbf{r}$ by φ. The small angle between the observer's radii at the emission and reception moments is denoted by α, and the small angle under which the emission

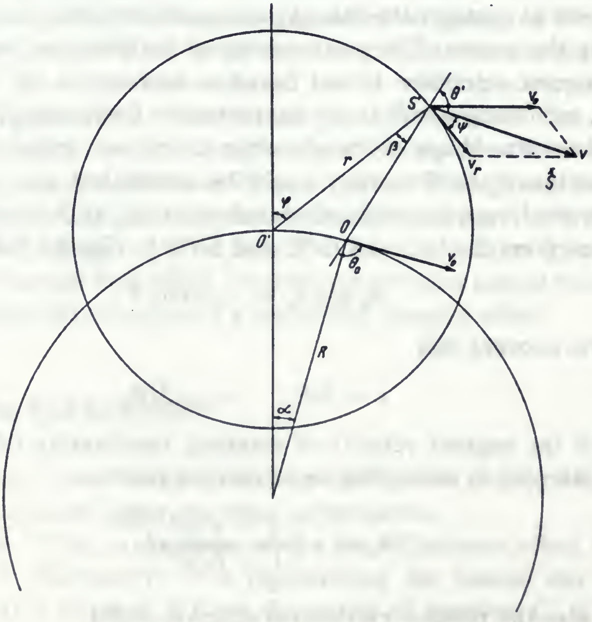

Fig. 5. The rotor–rotor experiment.

and reception positions of the observer are seen from the emission position of the source is denoted by β.

We have from Fig. 5 (see also Fig. 2)

$$\theta' = \pi/2 - \psi + \beta, \qquad \theta_0 = \pi/2 + \varphi - \alpha - \beta \tag{34}$$

with

$$\alpha = v_0 r/cR, \qquad \beta = (v_0/c)\cos\varphi \tag{35}$$

Substituting (35) into (34) and taking into account that α and β are small quantities, we can write

$$\cos\theta' = \sin\psi\cos\beta - \cos\psi\sin\beta = \sin\psi - (v_0/c)\cos\varphi\cos\psi \tag{36}$$

$$\begin{aligned}\cos\theta_0 &= -\sin\varphi\cos(\alpha+\beta) + \cos\varphi\sin(\alpha+\beta)\\ &= -\sin\varphi + (v_0/c)[(r/R) + \cos\varphi]\cos\varphi\end{aligned} \tag{37}$$

From the figure we have further

$$\sin\psi = v_0(\sin\varphi)/v, \qquad \cos\psi = (v_r + v_0\cos\varphi)/v \tag{38}$$

from which we get

$$v^2 = v_0^2 + v_r^2 + 2v_0 v_r\cos\varphi \tag{39}$$

Using the last four formulas in (22) and working within an accuracy of the second order in $1/c$, we obtain the relation

$$\nu_0 = \nu\left(1 - \frac{v_r^2}{2c^2} - \frac{v_0^2}{c^2}\frac{r}{R}\cos\varphi\right) \tag{40}$$

Taking into account that

$$r\omega/v_r = R\Omega/v_0 \tag{41}$$

one can write (40) in the form

$$\nu_0 = \nu\left(1 - \frac{v_r^2}{2c^2} - \frac{v_r v_0}{c^2}\frac{\Omega}{\omega}\cos\varphi\right) \tag{42}$$

This result can be confirmed by the "rotor–rotor" experiment proposed by us for the verification of the absolute formula (22).

However, we can show that formula (42) is already checked to a certain degree by experiment. Indeed, if we suppose $\Omega \ll \omega$, then Eq. (42) shows that with the help of the rotor experiment one cannot measure the absolute translational velocity v. Hence the suggestion of Ruderfer,(17) who predicts for such a case the same formula but without the factor Ω/ω (however, see Ref. 18) is based on an incorrect treatment of the light Doppler effect. Champeney *et al.*(19) and Turner and Hill(20) have performed experiments to check (42) written without the factor Ω/ω. The aim of Champeney *et al.* was to measure the Earth's rotational velocity (which is 310 m/sec on the 45° parallel). Experiment has shown that v_0 must be less than 1.6 ± 2.8 m/sec, and this result was treated as a new and better verification of the Einstein principle of relativity (with respect to the accuracy of the historical Michelson-Morley experiment).

It is clear that this conclusion is untenable. When we analyze Champeney's experiment with the help of (42), then we see that if $\Omega = 1.15 \times 10^{-5}$ rad/sec (the Earth's diurnal angular velocity), $\omega = 1.15 \times 10^{3}$ rad/sec (the rotor angular velocity), and $v_0 = 310$ m/sec, then $v_0\Omega/\omega = 3.1 \times 10^{-6}$ m/sec. This result is six orders lower than the accuracy of Champeney's experiment, and thus the diurnal velocity of the Earth cannot be detected by the Mössbauer technique of the rotor experiment. Since in nature all kinds of motions of celestial bodies are rotational, we can detect (at least theoretically!) any such motion, using the rotor, i.e., the rotor–rotor experiment, where the large rotor represents the rotation of the celestial body (about its rotational axis, about the primary, or about the galactic center).

A more detailed analysis of the rotor–rotor experiment gives us enough certainty to assert that absolute space does exist. We proceed to show this.

Let us suppose that in the discussed rotor–rotor experiment $r \ll R$. The unique difference from the case considered above is that now $\alpha = 0$, and we can successfully use Fig. 5. Substituting this zero value for α and the second formula of (35) into (36) and (37), we get

$$\cos\theta' = \sin\psi - (v_0/c)\cos\varphi\cos\psi \tag{43}$$

$$\cos\theta_0 = -\sin\varphi + (v_0/c)\cos^2\varphi \tag{44}$$

After the substitution of these two formulas and of formulas (38) into (22), we obtain

$$\nu_0 = \nu\left(\frac{1 - v^2/c^2}{1 - v_0{}^2/c^2}\right)^{1/2}\left(1 + \frac{v_r v_0}{c^2}\cos\varphi\right) \tag{45}$$

Substituting (39), we find within an accuracy of second order in $1/c$

$$\nu_0 = \nu\left(1 - \frac{v_r{}^2}{2c^2}\right) \tag{46}$$

If we attach two clocks respectively to the source and to the observer, then the relation between their reading t and t_0 for a *short enough* absolute time interval (in which we can assume that the source's absolute velocity v does not change substantially its direction and hence also magnitude) will be[4,21]

$$t = t_0 \left(\frac{1 - v^2/c^2}{1 - v_0{}^2/c^2} \right)^{1/2} \tag{47}$$

When the relation between the emitted and received frequencies is given by formula (32), then ν and ν_0 are exactly inversely proportional to the rates of the clocks attached respectively to the source and observer. Formula (32) shows that there is a post-traverse Doppler effect for the source and an ante-traverse effect for the observer. For its part, formula (45) shows that, besides the post- and ante-traverse effects (which are of second order in $1/c$), there is in the rotor–rotor experiment also a longitudinal effect (it is of first order in $1/c$, but since the angle involved is small, it becomes of second order in $1/c$). It is just this longitudinal effect that leads to the result that in the rotor–rotor experiment at $r \ll R$ the emitted and observed frequencies are not inversely proportional to the rates of the clocks attached, respectively, to source and observer. The frequencies ν and ν_0 are inversely proportional to these rates only when $\mathbf{v}$ and $\mathbf{v}_0$ are perpendicular to the line $S'O$ (the line connecting the emission position of the source with the reception position of the observer), or when the components of the source and observer velocities, respectively, at the emission and reception moments on the line $S'O$ are equal, i.e., when

$$v_0 \cos \theta_0 = -v \cos \theta' \tag{48}$$

As can be seen immediately from Fig. 5 (assuming there $\alpha \approx 0$), in the rotor–rotor experiment at $r \ll R$ the components of $\mathbf{v}$ and $\mathbf{v}_0$ on the line $S'O$ are not equal ($\mathbf{v}_r$ is not perpendicular to $S'O$, except for the case where $\mathbf{v}_r$ is perpendicular to $\mathbf{v}_0$).

These considerations give us the assurance to assert that in the rotor–rotor experiment at $r \ll R$ (i.e., when the small rotor moves inertially at velocity v with respect to absolute space) the clocks attached to the source and to the observer show (for a given short enough time interval) readings which are related as in Eq. (47).

Hence the existence of absolute space, which was experimentally established by our "coupled-mirrors" experiments,[1,2] can be anticipated when analyzing the rotor–rotor experiment.

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Comments on: "A Criticism of the 'Absolute Space-Time Theory'"

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A rebuttal is given of points of criticism raised by Z. Vrcelj against S. Marinov's absolute space-time theory.

I have already answered(3) the very interesting comments of Dr. Vrcelj on my absolute space-time theory.(1) To his present paper I should like to add also some short remarks (the items in my comments correspond to those of Dr. Vrcelj's in the preceding paper):

(i) The assertion of Dr. Vrcelj that the equation of motion will have the form (2) in my paper(2) only if the potential energy U is velocity-independent is correct. I give the equation of motion in the traditional Newtonian form (2) since the changes in the velocities of the material points lead to very small changes in their gravitational energy, and the changes in the velocities are determined exclusively by the changes in the distances between the material points. As a matter of fact, the *exact* equation is (3′) and its solution is given by Eq. (5); obviously, the solution of Eq. (2) must be given in the form (6). When solving the "Mercury problem," I proceed from the exact equation (3′), i.e., from the energy conservation law.

(ii) In my monograph,(4) I show that the astronomical observations where traditional absolutists expect absolute effects to be registered (as in the quasi-Roemer(4) and quasi-Doppler(4) experiments) must give *null* results according to my theory, because of the mutual annihilation of the absolute effects. Only the quasi-Bradley(4) experiment must, as Poincaré pointed out,

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give a positive result, i.e., the major axes of the aberration ellipses of stars situated near the apex of the Sun's absolute velocity must be 0".16 smaller than those of stars situated near the antiapex. This effect, although very small, can be registered with today's observational technique.

(iii) The right ascension of the Sun's absolute velocity registered with the help of the interferometric "coupled-mirrors" experiment(4) is $\alpha = 14^h\, 17^m \pm 20^m$. In Ref. 2, p. 581, in the preparation of the manuscript for the printer, a change was wrongly made from hours to degrees and time minutes to arc minutes. To the experimental data cited by Dr. Vrcelj I should like to add the following: (a) Vaucouleurs and Peters(5,6) measured the Sun's absolute velocity as 400 ± 200 km/sec toward $\alpha = 14^h \pm 2^h$, $\delta = -20° \pm 20°$; (b) Henry(6) measured the Earth's absolute velocity (the epoch of the year is not given) to be 320 ± 80 km/sec toward $\alpha = 10^h.5 \pm 4^h$, $\delta = -30° \pm 25°$. Let me especially point out that Dr. Vrcelj's correctly asserts that the astronomical "distant galaxies," "microwave radiation," and "cosmic ray" observations cannot be considered as a *direct* violation of the relativity principle, while my "coupled-mirrors" experiment violates this principle in the *most direct and unconditional way*. Nevertheless, Dr. Vrcelj concludes his item (iii) with the statement: "... when properly interpreted, the experiment cannot distinguish between special relativity and the absolute space–time theory" (see on this topic also Refs. 7 and 8). I should like to comment on this statement in detail.

I assert that with the "coupled-mirrors" experiment I measured the absolute velocity of my laboratory. However, as is clearly shown in Ref. 9, the "coupled-mirrors" experiment must give a positive result if the apparatus is mounted on a rotating disk, and many relativists agree with this conclusion (as was the case at the seminar organized for me by Prof. Speiser in the Louvaine-la-neuve University on the 27 October 1977). On the other hand, any terrestrial laboratory takes part in many rotational motions (daily rotation about the Earth's axis, yearly rotation around the Sun, rotation around the galactic center, and so on). Thus, say the relativists, with the "coupled-mirrors" experiment one measures, not the absolute velocity of the laboratory, but only its *resultant linear rotational velocity*, and the theory of relativity is saved since it manipulates only *inertial* (but not *rotational*) frames. Thus we come to a very amusing situation: During the last years I have been attacked with the claim that the effect in my "coupled-mirrors" experiment is due to thermic, seismic, and other causes; now I am attacked with the claim that, even if the effect, indeed, is due to a motion of the laboratory, this is not at all interesting because this motion is a certain rotational motion, a type of which was registered by Michelson, Gale, and Pearson in 1925. The problem is clear, but not a single relativist will make the effort to understand it and to accept the failure of the relativity principle. Michelson, Gale, and Pearson measured the diurnal *angular* velocity of their laboratory. But the effect measured by them included also the Earth's yearly *angular* velocity (which is 365 times smaller than the laboratory's diurnal angular velocity) and the Sun's galactic *angular* velocity (which is 200 millions times smaller than the Earth's yearly angular velocity). With the help of the "coupled-mirrors" apparatus I measured the vector sum of all these *linear* rotational velocities. But the Earth's yearly *linear* rotational velocity is 100 times greater than the laboratory's diurnal *linear* rotational velocity, and the Sun's galactic *linear* rotational velocity is ten times greater than the Earth's yearly *linear* rotational velocity. My results show that the Sun's galactic velocity includes also the rotation of our galaxy about the center of the cluster of galaxies, because the velocity established by me is not equal to the velocity of the Sun about the galactic center, which is known well enough from astronomical observations. This resultant linear rotational velocity I call the absolute velocity of the laboratory. Thus, I think that an authoritative relativist should state in the press: According to the theory of relativity, can this resultant *linear* rotational velocity be measured in a laboratory or not? If it can be measured, then, all right, there are no differences between special relativity and my absolute space–time theory. But why, then, almost three years after the performance of my interferometric "coupled-mirrors" experiment, can I not get my results published, having sent the paper to five different journals? And why have the referees of all these journals asserted: "How can one measure something which does not exist?"

(iv) The terminology of my absolute space–time theory is treated in Ref. 3.

(v) I *hypothetically* introduce the *magretic energy*, i.e., a gravitational analog to magnetic energy (here the copyeditor wrongly changed on p. 573 of Ref. 2 the term "magretic" to "magnetic"). Only experiment can show whether a magretic energy really exists, but at the present time I hardly see practical possibilities for the performance of relevant experiments. In my opinion the observation of the deflection of light beams touching the Sun's limb does not represent a pure experiment, because of the unknown refraction in the Sun's atmosphere. The relativistic perihelion displacement of Mercury cannot be experimentally estimated before knowing the Sun's quadrupole moment. The visual measurement of the Sun's oblateness cannot give relevant information for the quadrupole moment. Indeed, it can easily be shown that the oblateness of a liquid (or gaseous) sphere whose internal layers rotate with larger velocities than the external layers must be *smaller* (*not* larger, as commonly assumed) than the oblateness of a sphere rotating uniformly with the angular velocity of the external layer.

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THE EQUIVALENCE OF COMPTON AND DOPPLER EFFECTS

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Abstract

We show that the collision of photons and particles (electrons) with arbitrary velocities can entirely be explained as a Doppler effect, if the light Doppler-effect formulas are treated from an absolute point of view.

In (1) and (2) the equivalence between the Compton and Doppler effects is pointed out. However, in these papers (where one considers the Compton scattering on free electrons at rest) attention is paid only to the formal resemblance between the light Doppler-effect formulas and the formulas which can be obtained from the momentum and energy conservation laws applied to the elastic collisions of photons and particles. We shall show that the inner physical essence of this resemblance can easily be revealed. Besides, we shall consider the most general case of Compton scattering on moving particles where the Doppler essence of the Compton effect becomes more patent.

The momentum and energy conservation laws applied to the elastic collision of a photon and a particle with mass m are

$$\frac{m\underline{v}}{(1 - v^2/c^2)^{1/2}} + \frac{h\nu}{c}\underline{n} = \frac{m\underline{v}'}{(1 - v'^2/c^2)^{1/2}} + \frac{h\nu'}{c}\underline{n}' \qquad (1)$$

$$\frac{mc^2}{(1 - v^2/c^2)^{1/2}} + h\nu = \frac{mc^2}{(1 - v'^2/c^2)^{1/2}} + h\nu' \qquad (2)$$

where $\underline{v}$, $\underline{v}'$ are the velocities of the particle before and after the collision; ν, ν' are the frequencies and $\underline{n}$, $\underline{n}'$ are the directions of propagation of the photon before and after the collision.

Squaring both these equations and subtracting the first from the second, we obtain

$$\nu' = \nu \frac{1 - \frac{v}{c}\cos(\underline{v},\underline{n})}{1 - \frac{v'}{c}\cos(\underline{v}',\underline{n}')} \left(\frac{1 - v'^2/c^2}{1 - v^2/c^2}\right)^{1/2} \quad (3)$$

This is the dependence between the characteristics of the photon and of the particle before and after the collision in which only 3-dimensional invariants are involved. If we interchange the places of the different terms in equations (1) and (2) before squaring them, other formulas can be obtained for the description of the Compton effect where the cosines of other angles will appear.

The collision can be considered as "absorption" of the photon by the particle followed by an immediate "re-emission", i.e. as a reflection of the photon by the particle. The "absorbed" frequency of the photon will be denoted by ν_{int} (ν intermediary) and the "re-emitted" frequency (which can be received by an observer at rest) by ν'.

According to the light Doppler-effect formula for the case of a moving observer which involves the so-called reception angle (see formula (17) in (3)), we shall have

$$\nu_{int} = \nu \frac{1 - \frac{v}{c}\cos(\underline{v},\underline{n})}{(1 - v^2/c^2)^{1/2}} \quad (4)$$

since $\theta = (\underline{v},\underline{n})$ is the angle between the velocity of the observer (the hit particle) and the line connecting the source at rest with the moving observer at the moment of reception (i.e., the line which is along the direction of propagation of the incident photon).

According to the light Doppler-effect formula for the case of a moving source which involves the so-called emission angle (see formula (8) in (3)), we shall have

$$\nu' = \nu_{int} \frac{(1 - v'^2/c^2)^{1/2}}{1 + \frac{v}{c}\cos(\underline{v}', -\underline{n}')} \quad (5)$$

since $\theta' = (\underline{v}', -\underline{n}')$ is the angle between the velocity of the source and the line connecting the observer at rest and the moving source at the moment of emission (i.e. the line which is opposite to the direction of propagation of the reflected photon).

From the last two formulas we obtain the result (3).

We must emphasize that when the particle is elementary (for example, an electron) its mass cannot change and the "re-emission" must follow immediately after the "absorption", i.e. the photon will only be "reflected" by the particle. If the particle is compound (for example, an atom), its mass can change and the "re-emission" can follow a certain time after the absorption.

The Doppler-effect formulas give the relation between the frequencies of the emitted and received light when source and observer move with respect to one another. In the Compton effect source and observer are at rest. However between them there is a moving "mirror" (the particle) which, moreover, changes its velocity under the hit of the photon. Hence it is obvious that the relation to which the Doppler-effect formulas lead (where we are interested only in the mirror's velocity before and after the reflection of the photon) must be the same as the relation which can be obtained from the momentum and energy conservation laws.

Formulas (1) and (2) represent four relations for six unknown quantities: $\underline{v}'$, ν', $\underline{n}'$. Thus two of these quantities must be taken arbitrarily and they are determined by the unit vector $\underline{n}_r$ which is perpendicular to the "reflecting plane" of the moving mirror (Doppler treatment), or by the unit vector $\underline{n}'$ along the direction of propagation of the "re-emitted" photon (Compton treatment). Using the law of light reflection (the incident and reflected rays lie in the same plane with the perpendicular to the reflecting plane and make equal angles with it), we can find $\underline{n}_r$ when $\underline{n}$ and $\underline{n}'$ are given, or $\underline{n}'$ when $\underline{n}$ and $\underline{n}_r$ are given.

Thus the Compton scattering represents a Doppler effect where one observes relfection of light from a "mirror" which changes its velocity under the action of any single incident photon.

The experiments of Lebedev (4) on light pressure represent a Compton effect for a macroscopic body where the mirror changes its velocity under the action of many incident photons.

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THE ULTRASONIC "COUPLED-SHUTTERS" EXPERIMENT FOR MEASUREMENT OF THE EARTH'S ABSOLUTE VELOCITY

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Abstract

We propose a realizable experiment for establishing the light velocity's direction dependence in an inertially moving laboratory. In this experiment involving first-order in v/c effects a Newtonian time synchronization (Newtonian simultaneity) between spatially separated points is realized by the help of ultrasonic signals.

Silvertooth (1) stated that my "coupled-mirrors" experiment (2,3) with whose help for the first time in history I measured the Sun's absolute velocity in a laboratory is the unique "conceptually valid one ever published in the literature" (p. 543).

I share Silvertooth's opinion, since I show (3) that in all inertial high-velocity light kinematic experiments performed or proposed in the literature the eventual absolute effects which appear cancel each other in the resultant measurable effect. In (3) I show that absolute effects can be measured only if a combination of electromagnetic and mechanic phenomena is realized. For the mechanic phenomena the principle of relativity is valid, while for the light propagation (in general, for the electromagnetic) phenomena it is not valid. However, if an experiment involves only electromagnetic phenomena, the absolute effects, as a rule, cancel each other in the final result.

I wish to inform the scientific community that besides my "coupled-mirrors" experiment there is another one conceptually valid proposal for measurement of the absolute velocity of an inertially moving laboratory. It was made by Briscoe (4) in 1958 but, since presented as a patent, was discussed nowhere in the literature and as a matter of fact is unknown to the space-time specialists. Briscoe proposed the paralled transfer of light and sound signals. The propagation of sound is isotropic in any inertial frame, since this is a mechanical phenomenon, while the propagation of light is anisotropic, and, by comparing these two types of signal transfers, one can establish the absolute velocity of a laboratory.

In the present paper I give an account on Briscoe's ideas. However, analysing Briscoe's proposal, I established that the good thermal stabilization and the high factor of frequency multiplication from ultrasonic frequencies to short wave radio frequencies which are needed require a very sophisticated and pretentious set-up. Thus in the present paper I show how easily Briscoe's experiment can be performed in another variant which I call the ultrasonic "coupled-shutters" experiment, and where current equipment for hydrolocation is used. In this experiment the component v of the Earth's absolute velocity in the plane of the daily rotation of the implement's axis can be measured (as was the case in my deviative "coupled-mirrors" experiment ⁽²⁾).

Let us have (see Fig. 1 below) two electric high frequency operating shutters Sh_A, Sh_B, the distance between which is d. Behind the shutters there are the light sources S_A, S_B (lasers) and the observers O_A, O_B. The generator G produces electric pulses with period T (peak to peak time) which: (i) govern the shutter Sh_A, (ii) are applied to the emitter of ultrasonic waves E_A, (iii) are applied to the horizontal plates of the oscilloscope Osc. The ultrasonic pulses emitted by E_A with the same period T propagate through water at velocity V (thus their wavelength is $\lambda_s = VT$) and are received by the receiver R_B. After being transformed into electric pulses and amplified by the amplifier A_B, they: (i) are applied to the emitter of ultrasonic waves E_B, (ii) govern the shutter Sh_B. The ultrasonic pulses emitted by E_B propagate backwards in the water with the same velocity V

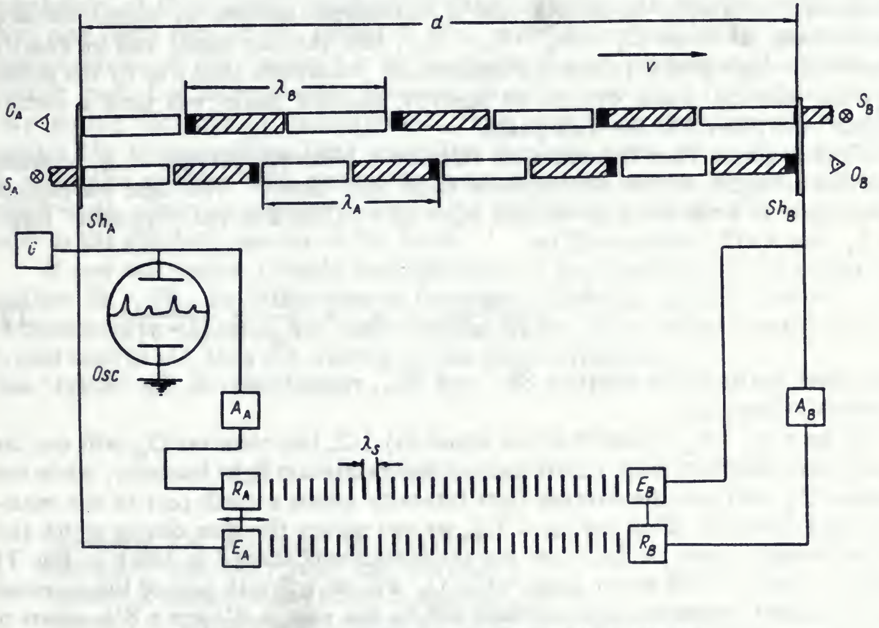

Figure 1. The ultrasonic "coupled-shutters" experiment.

and are received by the receiver R_A. After being transformed into electric pulses and amplified by the amplifier A_A, they are applied to the horizontal plates of the oscilloscope.

Suppose for simplicity the water homogeneous and the elements of the A-part (as well as of the B-part) too close to each other, so that the time in which the electric pulses cover the lines between shutters and ultrasonic emitter-receiver systems can be ignored. In such a case we can affirm that when on the screen of the oscilloscope the emitted pulses (the high ones) coincide with the received pulses (the low ones) there is a whole number of ultrasonic pulses along the track E_A - R_B - E_B - R_A. Moving the emitter-receiver E_A - R_A back and forth we can change the number of pulses on that track.

The propagation of sound is a mechanical phenomenon and, as said above, the principle of relativity holds good for it. Thus, by the help of sound signals, a Newtonian time synchronization between spatially separated points can be realized.

Suppose first that the absolute velocity of the laboratory (the Earth) is perpendicular to the axis d. The wavelengths of light in both directions will be $\lambda = cT$, and there will be

$$n = \frac{d}{\lambda} = \frac{d}{cT} \tag{1}$$

light pulses between the shutters Sh_A and Sh_B. Moving the emitter-receiver system E_A - R_A, we choose such a position that O_A and O_B should see an average light intensity. In such a case a half-integer number of sound waves is placed along the track E_A - R_B - E_B - R_A, and the low peaks will be exactly between the high peaks. In the real experiment, where the time lost by the pulses along the electric tracts cannot be ignored, the low peaks will have a certain position with respect to the high peaks.

Suppose now that the absolute velocity v becomes parallel to d, pointing from left to right, which direction we shall call "direct". The light wavelength in the "direct" direction will become $\lambda_A = (c - v)T$ and in the "opposite" direction $\lambda_B = (c + v)T$, so there will be

$$n_A = \frac{d}{\lambda_A} = \frac{d}{(c - v)T}, \qquad n_B = \frac{d}{\lambda_B} = \frac{d}{(c + v)T} \tag{2}$$

light pulses between the shutters Sh_A and Sh_B, respectively, in the "direct" and "opposite" directions.

If $\Delta n = n_A - n_B$ is less than (or equal to) 1/2, the observer O_B will see the average light intensity plus a Δnth part of the maximum light intensity, while the observer O_A will see the average light intensity minus a Δnth part of the maximum light intensity. Thus for $\Delta n < 1/2$, we can reduce the time during which the shutters remain open to ΔnT (see the small segments shaded in black in Fig. 1) obtaining that O_A will see no light, while O_B will see a $2\Delta n$th part of the nominal maximum light intensity. (Note: Such will be the case if $d/\lambda = n + 3/4$, where n is an integer; if $d/\lambda = n + 1/4$, all will be vice versa.)

From (2) we obtain

$$n_A = n_B \frac{c + v}{c - v} \cong n_B + 2\frac{v}{c}n = n_B + \Delta n \qquad (3)$$

and making use of (1) we get for the absolute velocity

$$v = \frac{c\Delta n}{2n} = \frac{c^2 T\Delta n}{2d} \qquad (4)$$

Taking f = 1/T = 0.3 MHz (this frequency is used in the hydrolocators of Soviet submarines), d = 50 km, we obtain for v = 300 km/s (3) $\Delta n = 0.1$.

In the actual experiment the water will not be homogeneous. Nevertheless, this is of no importance because the "direct" and "opposite" sound waves cross exactly the same way and the number of sound waves in the "direct" and "opposite" directions will be the same. However, as a result of different influences (temperature, density, currents, etc.), the water can change its sound conductive properties. This signifies that during the different moments different numbers of sound waves will be placed along the tract E_A - R_B - E_B - R_A, and the low peaks will "creep" with respect to the high peaks. Thus throughout the experiment, a corresponding shift of the emitter-receiver system E_A - R_A is to be performed and the low peaks are to be maintained at their initial positions. If the "creep" of the low peaks is conspicuous, the experiment is to be performed in winter time when the water is covered by ice and preserves its sound conductive properties for long enough. This experiment will be successful if the low peaks can be maintained at their initial positions a whole day with an inaccuracy much less than one Δnth part of the period T. For convenience and higher accuracy the compensation of the "creep" is to be made not in the ultrasonic but in the electric tract. Let us emphasize, however, that the "creep" is to be compensated only during the time of measurement. Thus only when the observers O_A, O_B register the corresponding light intensities the low peaks are to be maintained at a definite position with respect to the high peaks, namely at this position at which both observers register average light intensities when the axis is perpendicular to the absolute velocity of the Earth.

If one can realize a stable multiplication of the frequency f and govern the shutters Sh_A, Sh_B by this enhanced frequency, then the absolute velocity v can be measured by changing the multiplication factor and by using a method similar to that used in (5), thus not waiting for the Earth's rotation.

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A DECISIVE EXPERIMENT ESTABLISHING THE ABSOLUTE NATURE OF ELECTROMAGNETIC PHENOMENA

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Abstract

A crucial experiment is proposed which can show that the electromagnetic phenomena have an absolute character and the magnetic energy depends on the absolute velocities of the electric charges. This experiment is crucial if considered even only as a thought experiment.

Repeating our "coupled-mirrors" experiment (1) in its interferometric variant (2), we measured reliably enough the Earth's absolute velocity in a laboratory. Thus we disproved the principle of relativity and restored the "aether" model for light propagation.

We must emphasize that our absolute space-time theory defends the *corpuscular* model of light (3) and, after having restored the "aether" model for light propagation, we shall exert any effort to hamper an eventual revival of the wave model of light. Let us further note that light propagation has not entirely the well-known classical properties which we call *aether-Newtonian* (and according to which the Michelson-Morley experiment must give a positive result), but slightly different properties (the differences are in terms of second order in v/c) which we call *aether-Marinov.* The aether-Marinov character of light propagation is postulated by our tenth axion in (4) and considered in detail in (5).

Now the question to be answered is whether one has to restore also the "aether" model for the electromagnetic phenomena. Our firm opinion is that this should be done without fail, and in this paper we shall sketch an *experimentum crucis* which can favour the "aether" model. The realization of this experiment is difficult and probably impossible. Nevertheless, even considered as a thought experiment, it offers enough logical grounds for the acceptance of the absolute approach, according to which magnetism is not a "shadow" of electricity which appears in the eyes of the different inertially moving observers, but an absolute phenomenon depending on the velocities of the electric charges with respect to absolute space.

According to our conceptions [6,7], the theory of gravitation (called by us *gravimagretism*) can be obtained directly from the theory of electromagnetism if the electric charges of the material points are replaced by their proper masses and the inverse electric constant by the gravitational constant taken with a negative sign.

The fundamental equation of motion in electromagnetism (called by us the *Newton-Lorentz equation* [6]) is

$$\frac{d}{dt}(\underline{p}_o + \frac{q}{c}\underline{A}_e) = - \text{grad}\,(q\phi_e - \frac{q}{c}\underline{v}.\underline{A}_e), \tag{1}$$

where q is the electric charge of a material point with mass m which crosses with velocity $\underline{v}$ (thus has a proper momentum $\underline{p}_o = m\underline{v}(1 - v^2/c^2)^{-1/2}$) a given reference point where the electric and magnetic potentials are

$$\phi_e = \sum_{i=1}^{n} \frac{q_i}{\epsilon_o r_i}, \qquad \underline{A}_e = \sum_{i=1}^{n} \frac{q_i\,\underline{v}_i}{\epsilon_o c r_i}, \tag{2}$$

q_i being the charges of a system consisting of n material points, $\underline{v}_i$ their velocities, r_i their distances to the reference point and ϵ_o the electric constant.

The expression on the left side of (1) is called the *full kinetic force* and the expression on the right side — the *full potential force*. The quantity dp_o/dt is called the *kinetic force* and the quantity $-\text{grad}\,(q\phi_e)$ is called the *potential force*. We denote the kinetic force by $\underline{f}_o$, the full kinetic force by $\tilde{\underline{f}}_o$ the potential force by $\underline{F}$, and the full potential force by $\tilde{\underline{F}}$; when we wish especially to note that the interaction is electromagnetic, we put the subscript "e". The subscript "o" attached to the kinetic quantities signifies "proper", and thus $\underline{f}_o$ must be called the *proper* kinetic force; the kinetic force $\underline{f} = d\underline{p}/dt = m\,d\underline{v}/dt = m\underline{u}$ is called absolute.

When $d\underline{A}_e/dt = 0$, the kinetic force is equal to the full potential force. When $d\underline{A}_e/dt \neq 0$, equation (1) can be written in the form

$$\underline{f}_o \equiv \frac{d\underline{p}_o}{dt} = - q\,\text{grad}\,\phi_e - \frac{q}{c}\frac{\partial \underline{A}_e}{\partial t} + \frac{q}{c}\underline{v} \times \text{rot}\underline{A}_e \equiv \underline{F}_L \tag{3}$$

and the quantity $\underline{F}_L$ is called the *Lorentz potential force*. The Lorentz potential force is *not* a pure potential force because it cannot be obtained from the electromagnetic potentials taking only spatial derivatives.

The fundamental equation of motion in gravimagretism (called by us the *Newton-Marinov equation* [7]) can be obtained replacing in (1) the charge q by the proper mass $m_o = m(1 - v^2/c^2)^{-1/2}$ and the electromagnet potentials ϕ_e, $\underline{A}_e$ by the gravimagretic potentials ϕ_g, $\underline{A}_g$, which have the form (2), where q_i are to be replaced by m_{oi} and the inverse electric constant $1/\epsilon_o$ by the taken with a negative sign gravitational constant γ.

We shall now describe the "cauldron" experiment which can prove the adequacy to physical reality of the Newton-Lorentz and Newton-Marinov equations.

Let us have (Fig. 1) two homogeneous spheres with masses m and radii r, charged homogeneously with electric charges q, which can roll along the inner

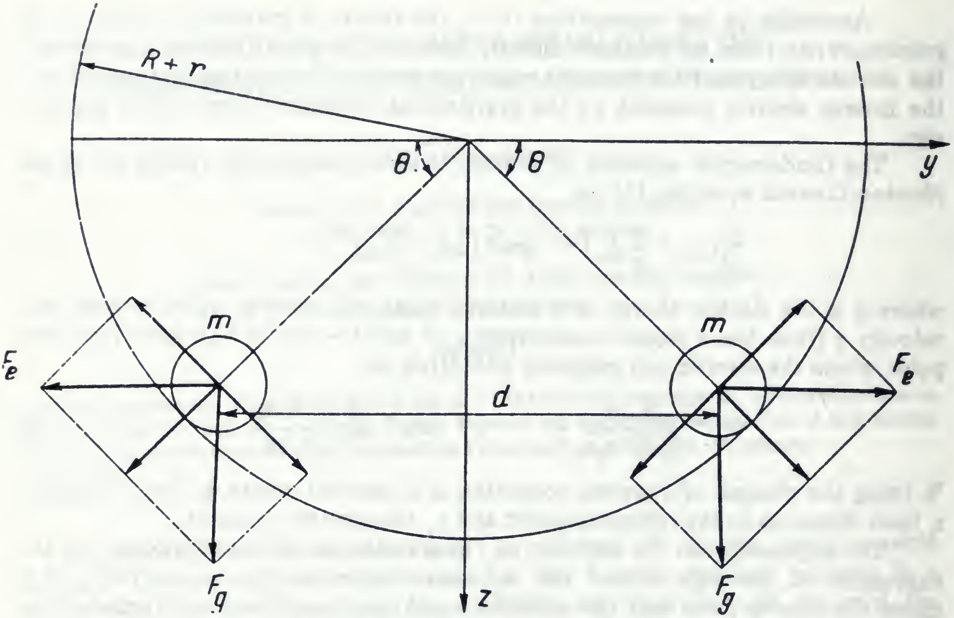

Figure 1. The "cauldron" experiment.

surface of a sphere (a "cauldron") with radius R + r. Let the x-axis (with unit vector $\underline{x}^o$) point behind the figure, the y-axis (with unit vector $\underline{y}^o$) to the right and the z-axis (with unit vector $\underline{z}^o$) downwards to the Earth's centre. The masses lie in the yz-plane and, for the sake of simplicity, we suppose that the absolute velocity of the laboratory is parallel to the xz-plane. If we do not take into account the mutual gravitational attraction between our masses and the attraction caused by the other celestial bodies, then, since the total time derivatives of the vector potentials will be equal to zero, the kinetic forces of our masses will be equal to the sum of:

a) The full potential force caused by the mutual electromagnetic interaction between the electric charges of the spheres

$$\underline{\widetilde{F}}_e = - q \,\mathrm{grad} \left(\frac{q}{\epsilon_o d} - \frac{qv^2}{\epsilon_o c^2 d}\right) = \pm \frac{q^2}{\epsilon_o d^2}\left(1 - \frac{v^2}{c^2}\right) \underline{y}^o = \pm \widetilde{F}_e \underline{y}^o , \tag{4}$$

where the sign "+" is for the force acting on the right mass, the sign "-" is for the force acting on the left mass, d is the distance between their centres and v is the absolute velocity of the laboratory.

b) The full potential force caused by the gravimagretic interaction with the Earth whose mass is M

$$\underline{\widetilde{F}}_g = m_o \,\mathrm{grad} \left(\gamma\frac{M_o}{D} - \gamma\frac{M_o v^2}{c^2 D}\right) = \gamma\frac{mM}{D^2}\underline{z}^o = \widetilde{F}_g \underline{z}^o , \tag{5}$$

where m_0 is the proper mass of any of the spheres, M_0 is the proper mass of the Earth and D is the distance between their centres (we ignore the rotational velocity of the Earth about its axis as small).

The masses will be in equilibrium at the condition

$$\widetilde{F}_g \cos\theta = \widetilde{F}_e \sin\theta, \qquad (6)$$

where θ is the angle between the horizontal plane and the radius pointing from the centre of the cauldron to any of the masses.

Suppose now that the velocity of the cauldron has changed with $\Delta v > 0$ because of the yearly motion of the Earth. The electromagnetic potential force will change and a new state of equilibrium will be installed, so that angle θ will change with $\Delta\theta > 0$ and distance d will change with $\Delta d = -2\Delta\theta R \sin\theta < 0$ (we ignore the change ΔD as very small with respect to D).

From (6) and the equation which we can write for the new state of equilibrium, we obtain within the necessary accuracy $\Delta\theta = (v\Delta v/c^2) \cot\theta$. Assuming the Earth's absolute velocity to be 300 km/s(2), we obtain a yearly variation about the state of equilibrium (for $\Delta v = \pm 30$ km/s and $\theta = \pi/4$) $\Delta\theta_{year} = \pm 10^{-7}$.

This experiment is difficult to realize. By the light lever of Jones (8), angles until 10^{-11} rad can be measured. However, there are difficulties in producing spheres (very likely one has to use electrets) which have to maintain a constant charge for a whole year.

Nevertheless, this experiment is extremely fruitful for theoretical physics as a thought experiment:

(1) It shows that magnetism is not a relative but an absolute phenomenon. Indeed, according to the principle of relativity, no variations about the state of equilibrium are to be observed when the absolute velocity of the apparatus changes. Note that the effect in the "cauldron" experiment depends not only on the change Δv of the absolute velocity — an effect depending on Δv is acceptable by the theory of relativity! — but also on the absolute velocity v itself.

(2) If the "relativists" consent that the electromagnetic force between two charges changes when they are set in motion (because of the appearing magnetic force), then the principle of relativity will automatically fail, if considering the "cauldron" experiment only as a thought experiment. Indeed, if we are on a ship sailing with velocity v in a canal, and we move our cauldron with velocity v (relatively to the ship) first towards the stern and then with the same velocity towards the prow, then an observer-relativist on the ship will conclude that the stern-bound and prow-bound states of equilibrium must be the same and different from the rest state of equilibrium when the cauldron is at rest with respect to the ship. However, another observer-relativist on the bank will conclude that all three states of equilibrium must be different (remember the "clocks-round-the-world" experiment of Hafele and Keating(9)). It is clear that the experiment can have a *unique* result as predicted by an observer-absolutist who is at rest in absolute space as this was also the case with the Hafele-Keating experiment. It is very instructive to compare the "cauldron" experiment with the "clocks-round-the-world" experiment. An effect in the Hafele-Keating experiment can be

measured only when the clocks make a closed trip round the Earth and thus the final effect depends only on the velocities of the clocks with respect to the Earth's centre. The effect in the "cauldron" experiment can be registered "*locally*". Thus the motion of the "cauldron" is to be referred neither to the Earth's centre nor to the Sun but to the centre of mass of the Universe, i.e. to absolute space.

(3) The "cauldron" experiment can throw abundant light over the law of gravitational interaction. If gravitation is a "Newtonian" analogue of electromagnetism, i.e. if there is a gravitational analogue to the magnetic energy and the *masses* are responsible for the gravimagretic interaction of the bodies, then no yearly variation will be observed. However, if gravitation is "Marinov" analogue of electromagnetism, i.e. if there is a gravitational analogue to the magnetic energy and the *proper masses* are responsible for the gravimagretic interaction of the bodies, then a yearly variation as described above will be observed. The same yearly variation will be observed also in the case if there is no gravitational analogue to the magnetic energy and the masses are responsible for the gravitational interaction of the bodies (as this was assumed by Newton).

Now we shall show why according to our absolute space-time theory the historical Trouton-Noble experiment⁽¹⁰⁾ must give a null result (as it was actually observed).

A simplified version of the Trouton-Noble experiment will be obtained if both charges in Fig. 1 will be connected by a rigid rod and suspended on an elastic spring at the middle point, so that they can oscillate in the horizontal plane. Trouton and Noble, as well as conventional physics (see, for example, ⁽¹¹⁾), assert that a rotational magnetic moment $M = q^2 v^2 \sin(2\theta)/2dc^2$ will appear, where θ is the angle between the absolute velocity of the laboratory and the line connecting both charges, which will lead to a torsion in the elastic string. This moment is large enough, so that its action can be registered during the daily rotation of the Earth when θ changes.

According to our theory no such moment does appear. Indeed, the full potential electromagnetic forces acting on both charges are equal and oppositely directed along the line connecting them (this is the assertion of the *Newton's full third law* introduced by us⁽¹²⁾). On the other hand during the rotation of the Earth it is $d\underline{A}_e/dt = 0$, because neither the velocities of the charges producing the magnetic potentials nor the distance between them change. Thus, according to formula (1), the kinetic forces of both charges are always equal and oppositely directed along the line connecting them and no rotational moment can appear.

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REPLY TO RUDERFER'S COMMENTS ON THE MARINOV PAPERS, Vol. 1, No. 3

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Thank you very much for your letter of 6 October 1978 and for issues of SST which I read with great interest and pleasure. I find the character of your journal extremely good and I am sure that very soon it will gain a good reputation among scientists. As I have already written you in my previous letter, I have only a fear of bad papers, and your policy to publish the criticisms of the referees and to give place for answering these criticisms, maybe, will be the best way to save the journal from "weeds".

I was very pleased to see all the formulas in my papers printed well and I must thank you for this, because, I am certain, this has caused you certain troubles. Also amazing is the speed with which you handle and print the papers. Congratulations and gratitudes.

I give apart my objections to the referee's opinions. These objections are rather long, but I treat there many important problems and they can be considered not only as an answer.

Let me inform you that the Nat. Sc. Found. (USA) has not awarded a grant to my proposal. The decision was taken on the grounds of referees' opinions. I presented my proposal for reconsideration from the Assistant Director for Physics, Mathematics and Astronomy (the first proposal was considered by the Physics Division). I received also a very kind letter "in the name of J. Carter", where a hope is expressed for a "positive solution of my problem by the NSF". Thus, I am still expecting. In the mean time I make many valuable contacts with different scientists and institutions.

In my objections are answered the critical remarks of the last referee. To save space I do not answer the remarks already published. There is expressed an opinion which is highly inconsistent, namely ". . .whether this experiment (Briscoe's experiment -S.M.) is realisable practically would appear highly doubtful in view of the very low velocity of sound (compared to that of light)". Whether the velocity is high or low is absolutely unimportant. Important is only the isotropy of the velocity. When giving my lecture in the Nat.B.Stand., I asked Dr. Luther to stand up and I made a Newtonian synchronization with him in the same manner as two duelents who go apart from a given point with the same speed, so that they have to turn their faces at the same moment and thus none of them would shoot earlier. Newtonian time synchronization can be made with any isotropically propagating signals.

I disagree with the criticisms of the referee. My objections are as follows:

1. *Briscoe's experiment.* T is the period of light, i.e. the time in which an observer motionless with respect to the laboratory (in the case considered, the Earth's surface) registers that the electric intensity of the light "wave" passes through two successive maxima (let us ignore here how this is to be measured practically). This period T is the *same* for the light propagating in "direct" (+) and "opposite" (-) directions, i.e. $T_+ = T_-$. Nowhere in his writings has Ives affirmed $T_+ \neq T_-$. Ives has assumed that the periods of "*clocks*" moving with *different velocities with respect to the aether* are *different;* this phenomenon, called "absolute time dilation" (the notion introduced first by Larmor in 1900), is accepted also in my absolute space-time theory, since it follows immediately from its 10th axiom (see S. Marinov, Found. Phys., 6, 571, 1976; Int. J. Theor. Phys., 13, 189, 1975).

The Michelson-Morley experiment has shown that the second-order in v/c effects *expected* by the traditional aether conceptions are null, but it says *nothing* about the first-order effects.

The referee asserts that the ultrasonic "coupled-shutters" experiment must give a null result. If the referee agrees that the velocities of light in "direct" and "opposite" directions are *different*, as this is supposed by Ives in all his papers, then the referee has to prove that the velocities of sound in "direct" and "opposite" directions are *not* the same. Experiments do not give evidence about direction dependence of sound velocity. The Harress-Sagnac "rotating disc" experiment has given a *positive* effect for *light*, but it must give a *null* effect for *sound.* One can object that a rotating disc experiment with sound is not made. This is a very easy experiment, but, I think, there is no necessity to do it because when one is in a plane sitting on a back-seat and speaking to a person on a fore-seat, the words go to and fro *for the same time* (but the smiles exchanged *do not*, if the absolute velocity of the plane is in the "direct" direction).

Ives has analysed a type of my "coupled-mirrors" experiment (the so-called "Fizeau's double toothed wheel" experiment) in J. Opt. Soc. Am., 29, 472, 1939. Ives was a "relative absolutist" (see New Scientist, 71, 662, 1976), i.e. he was a supporter of the aether model of light propagation *and* of the principle of relativity (the same were the conceptions of Poincare and Lorentz). To advocate null effect for the "Fizeau's double toothed wheel" experiment, Ives introduces ad hoc a twist of the rotating axis (I call this phenomenon the "Lorentz twist"). My "coupled-mirrors" experiment (see Stefan Marinov, Proceedings of the 8th International Conference on General Relativity and Gravitation, Canada, 1977, p.24) showed that a "Lorentz twist" does *not* exist. *Nowhere* in his writings has Ives analysed a type of Briscoe's experiment. To advocate null effect in this experiment, Ives (and any "relative absolutist) has to introduce certain assumptions ad hoc; such an assumption has to be pretty artificial, maybe of the kind that the velocity of sound in "direct" and "opposite" directions is $V_\pm = V(1 \mp v/c)$ where V is the velocity of sound in the medium when it rests in absolute space.

Ives is a very interesting author, although his mathematical speculations are extremely clumsy and cumbersome. In our fight for the restoration of absolute space-time, Ives' paper can definitely play a positive role. For this reason, I take an active part in the revival of his ideas culminating in the edition of *all* his papers dedicated to space-time problems. This well-edited book, with an addendum of the most important experimental papers on high-velocity light kinematics published in the last 60 years, can be obtained from me for $20.

2. *The "cauldron" experiment.* Until now, nobody nowhere has observed a "Lorentz contraction", i.e. a change in the dimensions of a rigid (?!) body moving with respect to the observer. According to my theory, the "Lorentz contraction" is a mathematical fiction (see S. Marinov, Int. J. Theor. Phys., 13, 189, 1975) resulting from the aether-Marinov character of light propagation (see S. Marinov, Eppur si muove, C.B.D.S. Bruxelles, 1977). I work with the Lorentz transformation treating it from an absolute point of view. In the Lorentz transformation velocity of light is absolute but time is relative; in reality, *velocity of light is relative* and *time is absolute*. The latter assumptions lead to the Marinov transformation (see Eppur si muove) which is to be considered as a companion of the Lorentz transformation, being entirely adequate to physical reality. Both transformations lead to the same results in all experiments. Let me emphasize here that the positive effect in my "coupled-mirrors" experiment is a logical result of the Lorentz transformation and the effect which I measured is the same as this calculated when proceeding from the Lorentz transformation.

3. *The equivalence of Comptom and Doppler effects.* In this paper I show that the "Compton effect" is not a certain "new" effect. This is a Doppler effect where the velocity of the mirror changes under the hit of any *single* photon. It is not clear whether the referee agrees with this statement. I spoke with many good physicists; all of them asserted: "The Compton effect is a Compton effect. This is a *special effect* which cannot be reduced to a Doppler effect".

In my theory the mass, m, is a constant independent of the velocity of the material point (body). Dependent on the velocity is the *proper* mass $m_o = m(1 - v^2/c^2)^{-½}$. The mass of an elementary particle (electron) *cannot* change, but the mass of a compound particle (atom) — which is also a microscopic body — can change if, for example, it absorbs a photon and becomes "excited". Even in my shortest papers, I give *exact* definitions of all introduced quantities and one makes wrong conclusions only because of inattentive reading. I consider this paper as one of the *most elegant* ever written by me, where one finds a perfect *experimental* confirmation of my treatment of the light Doppler effect (see S. Marinov, Found. Phys., 8, 637, 1978).

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The Coordinate Transformations of the Absolute Space–Time Theory

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In the light of our recently performed experiments, revealing the anisotropy of light velocity in any frame moving with respect to absolute space, we show that the Lorentz transformation, where the relativity of light velocity is given implicitly through the relativity of the time coordinates, must be treated from an absolute point of view if one seeks to preserve its adequacy to physical reality. Then we propose a new transformation (which is to be considered as a legitimate companion of the Lorentz transformation) wherein the relativity of light velocity is given explicitly and the time coordinates are absolute.

1. INTRODUCTION

After the performance of our "coupled-mirrors" experiment(1) and especially after its repetition in the so-called interferometric variant(2) no doubts can remain that the velocity of light is direction dependent (see also Refs. 3 and 4) and that absolute space is a reality practically detectable in a laboratory.

Thus, just at this very moment when mankind, after a heavy battle lasting several decades, has finally and definitely rejected the Newtonian absolute space–time conceptions and the aether model for light propagation, perfidious experiment produces a new puzzle which cannot be explained within the framework of modern high-velocity physics.

Are we on the threshold of a new dramatic crisis? Have we to revise once more our space–time conceptions? Have physicists of different orientations and erudition, philosophers, thinkers, and fiction writers to give birth to thousands of new papers and books?

Our definite answer is: No! Mankind has simply to return to the old,

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natural, simple, and clear Newtonian and nineteenth century conceptions. However, as the dialectical laws require, certain elements of the unsuccessful revolution always remain inscribed on the banners of the counter revolution which comes to replace the former. In a series of papers which are now in the press, we show which elements of modern high-velocity physics are to be introduced in the old Newtonian mathematical apparatus with the aim of obtaining a theory adequate to physical reality, which we have called the *absolute space–time theory.*

In the present paper we shall consider the problem of coordinate transformations in high-velocity physics, which, for historical reasons, we shall also call relativistic.

Before broaching this problem we must state that in absolute space–time theory we work only with three undefinable physical notions: (a) space, (b) time, and (c) energy (matter).

These three physical quantities cannot be defined at all and, appealing to the intuitive ideas of the reader, we can say only: (a) *Space* is that which extends. (b) *Time* is that which endures. (c) *Energy* is that which exists.

The points in space are called *material* (if their energy is different from zero) or *immaterial* (if their energy is equal to zero). The material points (i.e., the lumps of energy) can move in space. The space in which the energy of the whole world is at rest is called *absolute.* The space attached to a material system (i.e., a combination of material points) which moves with respect to absolute space is called *relative.* When all points of a material system move with the same velocity in absolute space this system is called *inertial* and the relative space attached to it is also called inertial.

Material points of an important class, called photons, propagate always with velocity c in absolute space. This assertion is hypothetical and represents the axiomatical basis of the so-called *aether model* for light propagation. We call this aether conception *Newtonian*, emphasizing in such a way that it has nothing in common with the wave model for light propagation. More details about our conception for light propagation can be found in Ref. 5.

Space intervals can be measured by rigid rods (i.e., material systems the distances between whose points do not change) and time intervals can be measured by so-called light clocks. Since the velocity of light in absolute space is a universal constant, the light clock represents the most accurate, exact, and *theoretically the most simple clock*.

2. THE LIGHT CLOCK

The light clock represents a light source and a mirror placed at a certain distance in front of it, called the "arm" of the clock. If this "arm" has *d* length units, then any photon (or short enough package of photons) will return to the light source, being reflected by the mirror, after

$$T = 2d/c \tag{1}$$

time units. The time interval T is called the period of the light clock.

A clock that rests in absolute space is called an *absolute clock* and a clock that moves with a certain velocity V is called a *proper clock*. Let us now establish the period of a proper light clock with "arm" *d*.

First we shall suppose that the "arm" is perpendicular to V and such a light clock will be called *transverse*. Denoting by $T_\perp'$ and $T_\perp''$ the times in which light covers the "arm" *d* of the transverse light clock "there" and "back," we have

$$c^2(T_\perp')^2 = d^2 + V^2(T_\perp')^2, \qquad c^2(T_\perp'')^2 = d^2 + V^2(T_\perp'')^2 \tag{2}$$

from which

$$T_\perp = T_\perp' + T_\perp'' = \frac{2d}{c(1 - V^2/c^2)^{1/2}} = \frac{T}{(1 - V^2/c^2)^{1/2}} \tag{3}$$

Then we shall suppose that the "arm" is parallel to V and such a light clock will be called *longitudinal*. Denoting by $T_\parallel'$ and $T_\parallel''$ the times in which light covers the "arm" *d* of the longitudinal light clock "there" and "back," we have (for the case where the source–mirror vector points along the same direction as the clock's velocity)

$$cT_\parallel' = d + VT_\parallel', \qquad cT_\parallel'' = d - VT_\parallel'' \tag{4}$$

from which

$$T_\parallel = T_\parallel' + T_\parallel'' = \frac{2d}{c(1 - V^2/c^2)} = \frac{T}{1 - V^2/c^2} \tag{5}$$

Hence we have the following conclusions:

(i) The rate of a proper light clock is different than the rate of an absolute clock.

(ii) The rate of a proper light clock depends on the orientation of its "arm" with respect to its velocity.

3. THE HIGH-VELOCITY AXIOM

The historic experiment of Michelson and Morley showed that the rate of a proper light clock does not depend on the orientation of its "arm."

Two hypotheses have been proposed for the explanation of this experimental fact, which contradicts the Newtonian aether conception:

(a) The Lorentz Hypothesis. Every rigid body contracts those of its dimensions that are parallel to its velocity by the factor $(1 - V^2/c^2)^{1/2}$. Hence the "arm" of the longitudinal light clock becomes $d_\parallel = d(1 - V^2/c^2)^{1/2}$, while the "arm" of the transverse clock remains $d_\perp = d$, and one obtains

$$T_\perp = T_\parallel = T/(1 - V^2/c^2)^{1/2} \tag{6}$$

(b) The Einstein Hypothesis. In every inertial relative space the velocity of light is isotropic and equal to c. Thus the period of any proper light clock will be given by formula (1).

Einstein rejected the Newtonian aether hypothesis *more radically than was demanded* by the Michelson–Morley experiment. This experiment only showed that the "there-and-back," i.e., *bidirectional*, light velocity is isotropic in any relative space, but it gives no information whether the "there" and "back," i.e., *unidirectional*, light velocities are also isotropic.

Einstein made the radical assumption about the unidirectional light velocity constancy, proceeding from the general principle of relativity, which asserts that there is no physical possibility for registering the motion of an inertial material system.

Before the performance of our "coupled-mirrors" experiment(1,2) there was no experiment contradicting the general (Einstein) principle of relativity and the hypothesis for the unidirectional light velocity constancy. But following its performance we have to revise Einstein's hypothesis, reject the general principle of relativity, and make it clear that from the Michelson–Morley experiment no such radical conclusion is to be drawn.

The axiomatical grounds of high-velocity (relativistic) physics is given by the tenth axiom of our absolute space–time theory,(6) which reads:

> The material points called photons move with velocity c along all directions in absolute space and their velocity does not depend on their history. Light clocks with equal "arms" have the same rate in any frame, independent of the orientation of their "arms." At any point of any frame the time unit is to be defined by the period of light clocks with equal "arms," independent of the velocity of the frame and the local concentration of matter.

Now proceeding from this axiom, we shall show which coordinate transformations we must have in high-velocity physics.

4. THE GALILEAN TRANSFORMATION

All transformations of the space and time coordinates which we consider are between a frame K attached to absolute space (called *absolute frame*) and a frame K' moving inertially with a velocity V (called *relative frame*). To avoid trivial constants we shall consider the so-called homogeneous transformation, i.e., we shall suppose that at the initial zero moment the origins of both frames coincide (see Fig. 1, where for simplicity's sake a two-dimensional case is presented).

Let us have a point P whose radius vector in K is $\mathbf{r}$ (called the *absolute radius vector*) and whose radius vector in K' is $\mathbf{r}'$ (called the *relative radius vector*). The radius vector of the origin of frame K' in frame K is $\mathbf{R}$ (called the *transient radius vector*). It is

$$\mathbf{R} = \mathbf{V}t = \mathbf{V}_0 t_0 \tag{7}$$

where t is the time read on a clock at rest in frame K (an absolute clock) and $\mathbf{V}$ is the velocity of frame K' measured on this clock, while t_0 is the time read on a clock at rest in K' (a proper clock) and $\mathbf{V}_0$ is the velocity of frame K' measured on this clock.

According to the traditional Newtonian conceptions we shall have

$$\mathbf{r}' = \mathbf{r} - \mathbf{V}t, \qquad \mathbf{r} = \mathbf{r}' + \mathbf{V}_0 t_0 \tag{8}$$

Adding these two equations, we obtain (7). If we assume that the clocks attached to K and K' read the same time, we have

$$t = t_0, \qquad \mathbf{V} \doteq \mathbf{V}_0 \tag{9}$$

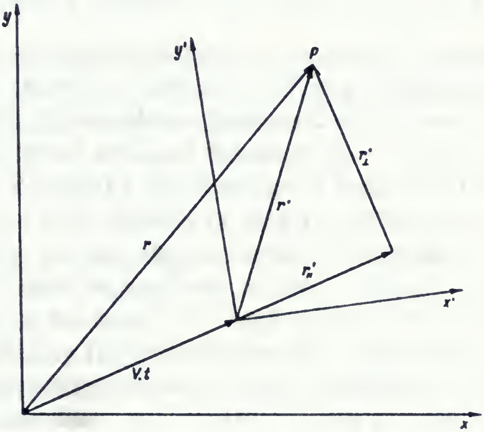

Fig. 1. A homogeneous transformation between two inertial frames of reference.

The first formula (8) represents the direct and the second formula (8) the inverse homogeneous *Galilean transformation* where the relations (9) are to be taken into account.

5. THE LORENTZ TRANSFORMATION

Now we shall search for a transformation of the space and time coordinates which will lead to the relation $T_\perp = T_\parallel$ between the periods of transverse and longitudinal light clocks, as required by our tenth axiom.

Let us decompose (Fig. 1) the radius vectors **r** and **r**′ into components $\mathbf{r}_\perp$, $\mathbf{r}_\perp'$ and $\mathbf{r}_\parallel$, $\mathbf{r}_\parallel'$, respectively, perpendicular and parallel to the direction of propagation of K'.

According to the traditional Newtonian conceptions we have

$$\mathbf{r}' = \mathbf{r}_\perp' + \mathbf{r}_\parallel' = \mathbf{r}_\perp + (\mathbf{r}_\parallel - \mathbf{V}t) = \mathbf{r} - \mathbf{V}t \qquad (10)$$

We can meet the requirement $T_\perp = T_\parallel$ of our tenth axiom if we take the parallel component of the relative radius vector contracted by the factor $(1 - V^2/c^2)^{1/2}$ when expressed by the coordinates in frame K, i.e., if we *axiomatically* assume as valid instead of the Newtonian relations

$$\mathbf{r}_\perp = \mathbf{r}_\perp', \qquad \mathbf{r}_\parallel - \mathbf{V}t = \mathbf{r}_\parallel' \qquad (11)$$

the "Lorentzian" relations

$$\mathbf{r}_\perp = \mathbf{r}_\perp', \qquad \mathbf{r}_\parallel - \mathbf{V}t = \mathbf{r}_\parallel'(1 - V^2/c^2)^{1/2} \qquad (12)$$

This "contraction" (when $\mathbf{r}_\parallel - \mathbf{V}t$ is expressed by $\mathbf{r}_\parallel'$) or "dilation" (when $\mathbf{r}_\parallel'$ is expressed by $\mathbf{r}_\parallel - \mathbf{V}t$) is neither a physical effect, as *supposed* by Lorentz, nor a result of measurement, as *obtained* by Einstein. According to our theory $\mathbf{r}_\parallel'$ and $\mathbf{r}_\parallel - \mathbf{V}t$ represent the *same* length (distance) between two material points which can be connected by a rigid rod or which can move with respect to one another, as well as between two non material points, taken at a given moment. (N.B. About lengths one can speak at a given moment only!) Thus $\mathbf{r}_\parallel'$ and $\mathbf{r}_\parallel - \mathbf{V}t$ are *equal* and we write the second relation (12) only because the velocity of light does *not* have an exact aether-Newtonian character. Making a transition from (11) to (12), we introduce a *blunt mathematical contradiction* into the traditional Newtonian mathematical apparatus. As we show in detail in Ref. 7, this mathematical contradiction remains in the formulas and we must state that after years of intensive mathematical speculations we have found no way to get rid of it. We ask the reader to pay due attention to this statement and not to blame our theory for mathematical imperfection. This imperfection exists in Nature itself. We must realize once and for all that light does not have an exact aether-Newtonian character of propagation, since its "there-and-back" velocity (in a frame moving in absolute space) is isotropic, while according to the *aether-Newtonian* conceptions it must be anisotropic. We have called this peculiarity in the propagation of light the *aether-Marinov* character of light propagation.

Thus, if we wish to meet the requirement $T_\perp = T_\parallel$, we have to write instead of relation (10) the following transformation of the radius vectors in frames K and K':

$$\mathbf{r}' = \mathbf{r}_\perp' + \mathbf{r}_\parallel' = \mathbf{r}_\perp + \frac{\mathbf{r}_\parallel - \mathbf{V}t}{(1 - V^2/c^2)^{1/2}} \tag{13}$$

This formula, written in such a manner that only the absolute radius vector $\mathbf{r}$ is represented, but not its transverse and longitudinal components $\mathbf{r}_\perp$, $\mathbf{r}_\parallel$, has the form

$$\mathbf{r}' = \mathbf{r} + \left\{\left[\frac{1}{(1 - V^2/c^2)^{1/2}} - 1\right]\frac{\mathbf{r}\cdot\mathbf{V}}{V^2} - \frac{t}{(1 - V^2/c^2)^{1/2}}\right\}\mathbf{V} \tag{14}$$

Let us now find the formula for the inverse transformation, i.e., from $\mathbf{r}'$ to $\mathbf{r}$. Here we have two possibilities:

(a) To assume that also in frame K' the velocity of light is isotropic and equal to c (the Lorentz way).

(b) To assume that the velocity of light is isotropic and equal to c only in frame K which is attached to absolute space (the Marinov way).

The Lorentz way leads to transformation of the time coordinates where the radius vectors should appear, i.e., to relative time coordinates, while the Marinov way leads to transformation of the time coordinates where the radius vectors should not appear, i.e., to absolute time coordinates.

Now we shall follow the first way and in Section 6 the second.

If the velocity of light in frame K' is *assumed* to be isotropic and equal to c, then assuming further that the velocity with which frame K moves with respect to K' (and measured on a clock attached to K') is equal and with opposite sign to the velocity V with which frame K' moves with respect to K (and measured on a clock attached to K), we can write (let us note that both these assumptions follow from the principle of relativity)

$$\mathbf{r} = \mathbf{r}' + \left\{\left[\frac{1}{(1 - V^2/c^2)^{1/2}} - 1\right]\frac{\mathbf{r}'\cdot\mathbf{V}}{V^2} + \frac{t'}{(1 - V^2/c^2)^{1/2}}\right\}\mathbf{V} \tag{15}$$

Adding formulas (14) and (15), we obtain

$$-\left[\frac{1}{(1 - V^2/c^2)^{1/2}} - 1\right]\frac{\mathbf{r}\cdot\mathbf{V}}{V^2} + \frac{t}{(1 - V^2/c^2)^{1/2}}$$
$$= \left[\frac{1}{(1 - V^2/c^2)^{1/2}} - 1\right]\frac{\mathbf{r}'\cdot\mathbf{V}}{V^2} + \frac{t'}{(1 - V^2/c^2)^{1/2}} \tag{16}$$

If in this formula we substitute **r**′ from (14), we obtain the transformation formula for time in which t' is expressed through t and **r**,

$$t' = \frac{t - \mathbf{r}\cdot\mathbf{V}/c^2}{(1 - V^2/c^2)^{1/2}} \tag{17}$$

On the other hand, if in formula (16) we substitute **r** from (15), we obtain the transformation formula for time in which t is expressed through t' and **r**′,

$$t = \frac{t' + \mathbf{r}'\cdot\mathbf{V}/c^2}{(1 - V^2/c^2)^{1/2}} \tag{18}$$

Formulas (14) and (17) represent the direct, and formulas (15) and (18) the inverse homogeneous *Lorentz transformation*. These formulas show that not only are the radius vectors **r** and **r**′ two different quantities, but also the time coordinates t and t' are two different quantities and are to be called the *absolute time coordinate* and the *relative time coordinate.*

Thus, as the time coordinates in the Lorentz transformation are relative quantities, the light velocity constancy in this transformation is only *apparent.* In Ref. 7 [see formulas (4.33) and (4.34) there] we show how, proceeding from the Lorentz transformation, one can obtain the expressions for the light velocity in any inertial frame which are adequate to physical reality. Hence, according to absolute space–time theory, the Einstein general principle of relativity is invalid and the Lorentz transformation is adequate to physical reality only if it is treated from our absolute point of view. Since Einstein treats the light velocity constancy as a physical fact and the general principle of relativity as a law of Nature, we consider the Lorentz transformation in the context of special relativity as inadequate to physical reality.

Note that we consider the Galilei limited principle of relativity as adequate to physical reality. This principle asserts that there is no mechanical physical phenomenon by whose help one can establish the inertial motion of a given material system. Hence for the mechanical phenomena any inertial relative space is isotropic.

For electromagnetic phenomena the principle of relativity does not hold good. Thus for the electromagnetic phenomena the inertial relative spaces are not isotropic.

However, as Minkowski has shown, if we consider a 4-space in which the three space coordinates in any inertial frame are unified with the corresponding time coordinate multiplied by c (and by the imaginary unit), then this 4-space turns out to be isotropic and homogeneous. As the Galilean transformations make a group in the 3-space, so the Lorentz transformations make a group in the 4-space. This is a great mathematical advantage and the four-dimensional mathematical apparatus developed by Minkowski has been an enormous help in the investigation of high-velocity physical phenomena.

In our absolute space–time theory we work intensively with the four-dimensional mathematical formalism of Minkowski, keeping always in mind that the fourth dimension is not a time axis, but a length axis along which the time coordinates are multiplied by the velocity of light, and here the apparent absoluteness of the light velocity is always connected with the relativity of the time coordinates. As a matter of fact, the time coordinates are absolute and light velocity relative, as in the Marinov transformation and as we have shown by the help of numerous experiments.(8)

We must note and emphasize that if experiments are set up where only electromagnetic phenomena are involved, then the principle of relativity apparently holds because of the mutual cancellation of the absolute effects that appear. This principle breaks down only for experiments where combined electromagnetic and mechanical phenomena are involved, as is the case with our "coupled-mirrors" experiment(1,2) and Briscoe's ultrasonic "coupled-transmitters" experiment.(9)

6. THE MARINOV TRANSFORMATION

To obtain a transformation of the space and time coordinates adequate to physical reality we shall proceed from our tenth axiom, noting that now we shall not take into account the influence of the gravitating masses on the rate of the light clocks, which problem was considered in Ref. 6.

Thus according to the tenth axiom:

(a) Light clocks with equal "arms" have the same rate, independent of the orientation of their "arms."

(b) In any frame the time unit is to be defined by the period of light clocks with equal "arms," independent of the velocity of the frame.

As we have shown in Section 2, the first assertion drastically contradicts the traditional Newtonian conceptions. The second assertion represents no such drastic contradiction, because in the framework of the traditional Newtonian space–time conceptions one can also define the time unit in any inertial frame by the period of light clocks with equal "arms." However, in the traditional Newtonian framework, the inconvenience exists that one has further to define that the "arms" of the light clocks must always make the same angle with the velocity of the inertial frame used—for example, their "arms" must be perpendicular to this velocity. In such a manner the absolute time dilation phenomenon will be introduced also into the traditional Newtonian theory. Thus, at first glance, it seems that the second assertion has not such a "natural" character as the first one and represents only a stipulation. However, it turns out that not only do the periods of light clocks become greater when they move with greater velocity in absolute space (we repeat, a phenomenon which exists also in the traditional Newtonian theory), but so do the periods of many other physical processes (the periods of atomic clocks, the mean lives of decaying elementary particles). So far there is no experimental evidence permitting one to assert that the period of any system (say, the period of a spring clock, the pulse of a man) becomes greater with the increase of its absolute velocity. This problem needs additional theoretical and experimental investigation. At any rate, we think the statement about the time dilation is to be considered not as a stipulation but as an axiomatical assertion alien to the traditional Newtonian theory.

Let us find first how the Galilean transformation formulas are to be written if one assumes that in any inertial frame the time unit is to be defined by the period of light clocks with equal "arms," supposing for definiteness that the "arms" of the light clocks must be always perpendicular to the absolute velocities of the frames.

The period of an absolute light clock with "arm" equal to d is given by formula (1). The period T_0 of a proper light clock with the same "arm" and which moves at velocity V (we repeat, V is assumed to be perpendicular to the "arm") will be given by formula (3), where we have to write $T_\perp = T_0$.

If (at an appropriate choice of d) we choose T as a time unit in frame K (called an *absolute second*) and T_0 as a time unit in frame K' (called a *proper second*), then it is clear that when between two events, t absolute seconds and t_0 proper seconds have elapsed, the relation between them will be

$$t_0/t = T/T_0 = (1 - V^2/c^2)^{1/2} \tag{19}$$

where T and T_0 are measured in the *same* time units (absolute or proper). Under this stipulation we shall obtain from (7) and (19)

$$\mathbf{V}_0 = \frac{\mathbf{V}}{(1 - V^2/c^2)^{1/2}}, \qquad \mathbf{V} = \frac{\mathbf{V}_0}{(1 - V_0{}^2/c^2)^{1/2}} \tag{20}$$

Formulas (8), to which we attach the relations (19) and (20), represent the direct and inverse homogeneous *relativistic Galilean transformation*.

In these formulas, $\mathbf{V}$ is the velocity of frame K' with respect to absolute space (i.e., to frame K) measured in absolute seconds (called the *absolute* *transient velocity*), $\mathbf{V}_0$ is the same velocity measured in proper seconds (called the *proper transient* velocity), and c is the velocity of light along the "arm" of the absolute clock measured in absolute seconds, as well as along the "arm" of the proper clock measured in proper seconds.

If, on proceeding from the traditional Newtonian conceptions, one would come to the result that a transverse and a longitudinal light clock would have the same rate, then a transformation of the space and time coordinates adequate to physical reality, at the assumption of the time dilation dogma, would be given by the relativistic Galilean transformation. However, the traditional Newtonian conceptions lead to the conclusion that a transverse and a longitudinal light clock have different rates (see Section 2). On the other hand, experiments (the historic Michelson–Morley experiment was the first) have shown that the rates of a transverse and a longitudinal light clock are equal. We have assumed this empirical fact as an axiomatical assertion, *without trying to explain why Nature is made in such a manner.* The introduction of this axiomatical (empirical) assertion into the Galilean transformation leads to the Marinov transformation.

This is to be done in the following manner: Exactly in the same way as in Section 5, we come to the conclusion that if we wish to meet the requirement of our tenth axiom about the independence of the light clock's rate on the orientation of the clock's "arm," the transformation between the radius vectors $\mathbf{r}$ and $\mathbf{r}'$ is to be written in the form (14). To obtain the inverse transformation we proceed from the formula [see (12)]

$$\mathbf{r} = \mathbf{r}_\perp + \mathbf{r}_\parallel = \mathbf{r}_\perp' + \mathbf{r}_\parallel'(1 - V^2/c^2)^{1/2} + \mathbf{V}t \qquad (21)$$

This formula, written in such a manner that only the relative radius vector $\mathbf{r}'$ is represented, but not its perpendicular and parallel components $\mathbf{r}_\perp'$ and $\mathbf{r}_\parallel'$, has the form

$$\mathbf{r} = \mathbf{r}' + \{[(1 - V^2/c^2)^{1/2} - 1]\mathbf{r}' \cdot \mathbf{V}/V^2 + t\}\mathbf{V} \qquad (22)$$

From formulas (14) and (22), in a manner similar to that used in Section 5, we obtain formula (19).

Let us combine formulas (14) and (19), and then formulas (22) and (19), expressing in both last formulas $\mathbf{V}$ through $\mathbf{V}_0$ according to the second relation (20):

$$\mathbf{r}' = \mathbf{r} + \left\{\left[\frac{1}{(1 - V^2/c^2)^{1/2}} - 1\right]\frac{\mathbf{r} \cdot \mathbf{V}}{V^2} - \frac{t}{(1 - V^2/c^2)^{1/2}}\right\} \mathbf{V} \qquad (23)$$

$$t_0 = t(1 - V^2/c^2)^{1/2}$$

$$\mathbf{r} = \mathbf{r}' + \left\{\left[\frac{1}{(1 + V_0^2/c^2)^{1/2}} - 1\right]\frac{\mathbf{r}' \cdot \mathbf{V}_0}{V_0^2} + t_0\right\} \mathbf{V}_0 \qquad (24)$$

$$t = t_0(1 + V_0^2/c^2)^{1/2}$$

Formulas (23) represent the direct, and formulas (24) the inverse, homogeneous *Marinov transformation.*

Let us now obtain the Marinov transformation formulas for velocities. Writing in the first formulas (23) and (24) $d\mathbf{r}$, dt, $d\mathbf{r}'$, dt_0 instead of $\mathbf{r}$, t, $\mathbf{r}'$, t_0, dividing them by dt, and introducing the notations $\mathbf{v} = d\mathbf{r}/dt$, $\mathbf{v}' = d\mathbf{r}'/dt$, we obtain

$$\mathbf{v}' = \mathbf{v} + \left\{\left[\frac{1}{(1 - V^2/c^2)^{1/2}} - 1\right]\frac{\mathbf{v}\cdot\mathbf{V}}{V^2} - \frac{1}{(1 - V^2/c^2)^{1/2}}\right\}\mathbf{V} \tag{25}$$

$$\mathbf{v} = \mathbf{v}' + \left\{\left[\left(1 - \frac{V^2}{c^2}\right)^{1/2} - 1\right]\frac{\mathbf{v}'\cdot\mathbf{V}}{V^2} + 1\right\}\mathbf{V} \tag{26}$$

The velocities $\mathbf{v}$ and $\mathbf{v}'$ are measured in absolute time. Thus v must be called the *absolute absolute velocity* (as a rule, the first adjective "absolute" will be omitted) and v' the *absolute relative velocity* (as a rule, the adjective "absolute" will be omitted). For this reason we have written in (26) the absolute transient velocity $\mathbf{V}$ and not the proper transient velocity $\mathbf{V}_0$. Formula (25) represents the direct and formula (26) the inverse Marinov transformation for velocities written in *absolute time.*

Writing in the first formulas (23) and (24) $d\mathbf{r}$, dt, $d\mathbf{r}'$, dt_0 instead of $\mathbf{r}$, t, $\mathbf{r}'$, t_0, dividing them by dt_0, and introducing the notations $\mathbf{v}_0 = d\mathbf{r}/dt_0$ for the *proper absolute velocity* and $\mathbf{v}_0' = d\mathbf{r}'/dt_0$ for the *proper relative velocity,* we can obtain the Marinov transformation for velocities written in *proper time.*

One also can write the transformation formulas for velocities in which the relative velocity is expressed in proper time and the absolute velocity in absolute time. This will be the Marinov transformation for velocities written in *mixed time.*

Now we shall write the transformation formulas for the velocities' magnitudes. Denoting the angle between $\mathbf{v}$ and $\mathbf{V}$ by θ and the angle between $\mathbf{v}'$ and $\mathbf{V}$ by θ', we can write formulas (25) and (26) in the following form, after having squared them:

$$(v')^2 = \frac{v^2[1 - V^2(\sin^2\theta)/c^2] - 2vV\cos\theta + V^2}{1 - V^2/c^2} \tag{27}$$

$$v^2 = (v')^2\,[1 - V^2(\cos^2\theta')/c^2] + 2v'V(\cos\theta')(1 - V^2/c^2)^{1/2} + V^2 \tag{28}$$

If we suppose $v = c$ and if we write $v' = c'$, where c' is the relative light velocity measured in absolute time, i.e., the absolute relative light velocity, then these two equations (the second after a solution of a quadratic equation with respect to v') give

$$c' = c\,\frac{1 - V(\cos\theta)/c}{(1 - V^2/c^2)^{1/2}} = c\,\frac{(1 - V^2/c^2)^{1/2}}{1 + V(\cos\theta')/c} \tag{29}$$

If we denote by c_0' the proper relative light velocity, then its connection with the absolute absolute light velocity c will be

$$c_0' = c\frac{1 - V(\cos\theta)/c}{1 - V^2/c^2} = \frac{c}{1 + V(\cos\theta')/c} \tag{30}$$

and its connection with the proper absolute light velocity

$$c_0 = \frac{c}{(1 - V^2/c^2)^{1/2}} \tag{31}$$

will be the same as that given by formula (29).

Note that the velocities with respect to the moving frame K' are called relative, while the clocks attached to K' are called proper. On the other hand, the velocities with respect to the rest frame K are called absolute and the clocks attached to K are also called absolute. To have in the second case a terminological difference similar to that in the first case we have considered calling the absolute clock and absolute time "universal." However, finally we decided to use a single word, even though this might sometimes lead to misunderstanding, because of the confusion in using too many different terms.

We designate the relative quantities by superscripts (primes) and the proper quantities by subscripts (zeros). For this reason, in the Lorentz transformation (where time is relative), we designate the relative time coordinates by superscripts (primes) and in the Marinov transformation (where time is absolute) we designate the proper time coordinates by subscripts (zeros).

The distances are always absolute. However, the aether-Marinov character of light propagation leads to the introduction of the notion "proper distance." The problem about the eternal contradiction between proper distances and distances is considered in detail in Ref. 7. Here we must again repeat that the absolute and proper time intervals are *physically different quantities*, while the difference between proper distances and distances is only a *contradictory mathematical result* which appears because of the aether-Marinov character of light propagation engendered by the bidirectional light velocity isotropy in any inertial frame.

7. GROUP PROPERTIES OF THE MARINOV TRANSFORMATION

After a due examination of the Marinov transformations, it can easily be established that they form a group. As the mathematical analysis in the general case is too cumbersome, we shall suppose, for simplicity's sake, that the velocities of the different frames and their x axes are parallel to the x axis of the rest (absolute) frame. Since in this simple case the y and z coordinates are subjected to an identical transformation, we shall ignore them.

From formulas (23) we obtain the following direct transformation between the coordinates (x, t) in the absolute frame K and the coordinates (x_2, t_2) in a proper frame K_2 moving with a velocity V_2 ($V_2 \gtrless 0$) along the positive direction of the x axis:

$$x_2 = (x - V_2 t)/(1 - V_2^2/c^2)^{1/2}, \qquad t_2 = t(1 - V_2^2/c^2)^{1/2} \tag{32}$$

The inverse transformation between the coordinates (x_1, t_1) in a proper frame K_1 moving with velocity V_1 ($V_1 \gtrless 0$) along the positive direction of the x axis of the rest frame K and the coordinates (x, t) in K, according to formulas (24) [see also formulas (20)], is

$$x = x_1 \left(1 - \frac{V_1^2}{c^2}\right)^{1/2} + \frac{V_1 t_1}{(1 - V_1^2/c^2)^{1/2}}, \qquad t = \frac{t_1}{(1 - V_1^2/c^2)^{1/2}} \tag{33}$$

where the velocities V_1 and V_2 are measured in absolute time.

Substituting formulas (33) into formulas (32), we can express the coordinates in frame K_2 through the coordinates in frame K_1:

$$\begin{aligned} x_2 &= x_1 \left(\frac{1 - V_1^2/c^2}{1 - V_2^2/c^2}\right)^{1/2} + t_1 \frac{V_1 - V_2}{(1 - V_1^2/c^2)^{1/2}(1 - V_2^2/c^2)^{1/2}} \\ t_2 &= t_1 \left(\frac{1 - V_2^2/c^2}{1 - V_1^2/c^2}\right)^{1/2} \end{aligned} \tag{34}$$

These formulas are absolutely symmetric with respect to the coordinates in both frames. Now we shall prove that these transformations form a group.

A set of transformations T_{12}, T_{23}, T_{34},... form a group if it has the following properties:

1. *Transitive property*: The product of two transformations of the set is equivalent to a member of the set, the product

$$T_{13} = T_{12} T_{23} \tag{35}$$

being defined as performing T_{12} and T_{23} successively.

If formulas (34) give a transformation T_{12}, a transformation T_{23} will have the same form in which the number 1 is replaced by 2 and the number 2 by 3. Substituting formulas (34) for the transformation T_{12} into the corresponding formulas for the transformation T_{23}, we obtain a transformation T_{13} which has the same form as (34) in which the number 2 is replaced by 3.

Thus the transitive property is proved. Let us mention here that the transitive property for the Lorentz and Galilean transformations can be proved only if one takes into account the corresponding transformation for velocities. The transitive property for the Marinov transformation is proved *directly*, i.e., without taking into account the transformation for velocities.

2. *Identity property*: The set includes one "identity" transformation T_{ii} whose product with any other member of the set leaves the latter unchanged. Thus

$$T_{12}T_{22} = T_{11}T_{12} = T_{12} \tag{36}$$

The identity form of the transformation (34) occurs for $V_1 = V_2$.

3. *Reciprocal property*: Every member of the set has a unique reciprocal (or inverse) which is also a member of the set. Thus the inverse of T_{12} is T_{21}, where T_{21} is a member of the set and

$$T_{12}T_{21} = T_{11} \tag{37}$$

The reciprocal of the transformation (34) can be obtained by writing the number 2 instead of 1 and vice versa.

4. *Associative property*: If three succeeding transformations are performed, then

$$T_{12}(T_{23}T_{34}) = (T_{12}T_{23})T_{34} \tag{38}$$

The associative property can easily be proved.

8. CONCLUSIONS

In the light of the experimental demonstration of the anisotropy of the unidirectional light velocity performed recently by us,(1–4) we have shown how the Lorentz transformation is to be treated from an absolute point of view, if one seeks to preserve its adequacy to physical reality. The seeming constancy of light velocity appearing in the Lorentz transformation is due to the introduction of space coordinates in the transformation formulas for time. In the Lorentz transformation the space as well as the time coordinates are relative quantities, while light velocity is an absolute quantity. We propose the Marinov transformation where the time coordinates are absolute quantities and light velocity is a relative quantity and we assert that this transformation is adequate to physical reality.

In Ref. 7 we have shown that the Einstein time synchronization leads to the Lorentz transformation, while the Newtonian time synchronization leads to the Galilean transformation. The second assertion is true only within an accuracy of first order in V/c. Within an accuracy of second order in V/c the Newtonian time synchronization leads to the Marinov transformation, and this is due to the aether-Marinov character of light propagation.

We have found difficulties in considering the Marinov transformation in a 4-space. In our opinion the Lorentz transformation is much more convenient and productive, so that the Marinov transformation only helps us when treating the Lorentz transformation from an absolute point of view, i.e., adequately to physical reality. We hope that future investigations will throw more light on the essence of the Lorentz and Marinov transformations, which are simply two companions.

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LETTER TO THE EDITOR

A proposed experiment to measure the one-way velocity of light

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Abstract. A simple experiment is proposed, with the aid of which it is suggested that the earth's absolute velocity may be measured.

The experimental arrangement is shown in figure 1.

EM is a motor rotating a shaft of length *d*. As we showed theoretically and experimentally (Marinov 1977), with a rotating axle one can realise a Newtonian time synchronisation (Marinov 1975), i.e. one can establish a *momentary* contact between two spatially separated events. The shaft has two mirrors on its ends, RM_1 and RM_2, called the rotating mirrors. Intense light emitted by the laser L is split by the semi-transparent mirror SM into two beams. In the following description the alternative route is shown in parentheses. The 'transmitted' ('reflected') beam passes through the semi-transparent mirror SM_1 (is reflected by mirror M and passes through the semi-transparent mirror SM_2) and is reflected by the rotating mirror RM_1 (RM_2); then it is reflected by the semi-transparent mirror SM_1 (SM_2) and, reflecting on the right-angled mirror M_0, strikes the photomultiplier PM_1 (PM_2) where the light pulse is transformed into an electric pulse. The outputs of the photomultipliers (*opposed* to one another) are applied to the horizontal plates of the oscilloscope Osc. One is interested only in the leading edge of the light (and electric) pulses, so that the duration of the pulses is of no importance. Only the *steepness* of the edges is important. Instead of pulses *reflected* by the rotating mirrors, with the help of the holes H_1, H_2 and the mirrors M_1, M_2, one can obtain pulses *cut* by the rotating shaft.

The display mechanism of the oscilloscope is triggered by one of the electric pulses. We shall assume that the pulses are trapezoidal, which can be achieved by limiting the electric outputs to a certain level. If the display time is longer than the duration of the pulses, then, in the general case when M_0 is not exactly at the mid point, or RM_1 and RM_2 are not exactly parallel, we shall see two oppositely oriented pulses on the screen. If the display time is shorter than the duration of the pulses, only one pulse will be seen on the screen. Moving the system M_0–PM_1–PM_2 to the left or right, we can make the leading edges of both pulses on the screen coincide in time. This signifies that the light pulses reflected from RM_1 and RM_2 reach M_0 at exactly the same moment.

The direction from SM_1 to SM_2 is called 'direct' and from SM_2 to SM_1 'opposite'. Let us suppose that the absolute velocity v of the laboratory is pointing in the 'direct' direction. In this case the velocity of the 'direct' light pulse will be $c+v$ and of the

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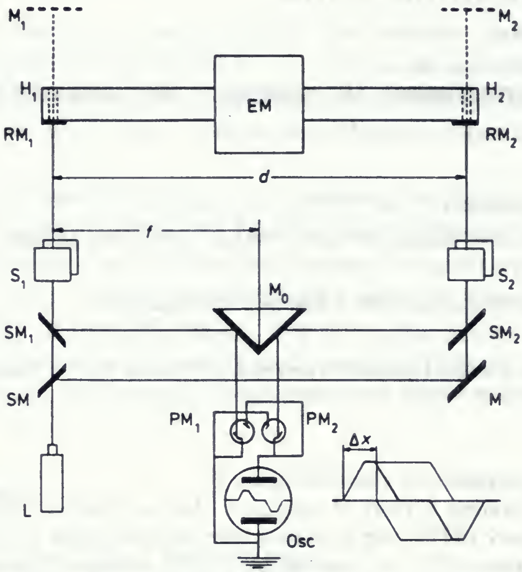

Figure 1. The oscilloscopic 'coupled mirrors' experiment.

'opposite' light pulse, $c+v$ (with respect to the laboratory). Thus, if we begin to rotate the whole apparatus (which is mounted on a horizontal rotating platform) two opposite pulses will appear on the screen; after a rotation through 180° (when the velocity of the 'direct' pulse will be $c \div v$ and of the 'opposite' pulse $c-v$) the pulses will be a maximum and after a rotation through 360° they will again disappear. If the constant of scanning is k s cm^{-1}, then the maximum distance Δx (see the figure) will correspond to a time difference $\Delta t = k\,\Delta x$, which can be expressed through the parameters of the apparatus as follows:

$$\Delta t = \frac{b}{c-v} - \frac{d-b}{c+v} - \left(\frac{b}{c+v} - \frac{d-b}{c-v}\right).$$

Thus, to first order, $\Delta t = 2dv/c^2$.

The shaft should then be rotated in the opposite direction and Δt re-established.

Assuming $v = 300$ km s^{-1} (Physics Today 1978) and taking $d = 1{\cdot}5$ m, we obtain $\Delta t = 10$ ps. Thus, if one could use an oscilloscope with horizontal time base 10 ps cm^{-1}, then, assuming that the inaccuracy of reading is 1/10th part of the scale, one will be able to measure the absolute velocity with an accuracy of 10%. Since the experiment does not depend upon coherence, d is only limited by mechanical constraints. If d is considerably larger, the necessity for such a high speed oscilloscope is relaxed. Higher accuracy will be achieved if one uses a dual beam oscilloscope.

In Marinov (1977) we give the method for establishing the absolute velocity of the laboratory and the equatorial coordinates of its apex from the measurements made during a day.

For more information concerning the technique of measurement see Biretta and Lang (1978) and the five references from the American Journal of Physics therein, where a similar technique is used for measuring the 'there-and-back' light velocity which is always c.

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THE EXPERIMENTAL MEASUREMENT OF THE ONE-WAY LIGHT VELOCITY AND ITS POSSIBILITIES FOR ABSOLUTE VELOCITY MEASUREMENT

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Abstract

I give the description of two simple variants of the "rotating axle" experiment which I have recently performed whereby the Earth's absolute velocity can be measured. The accuracy achieved has not permitted the effect of absolute motion to be observed, but I show how close to such observation this may be. With the second variant this experiment measures (for the first time) the one-way light velocity with an accuracy of 10%.

INTRODUCTION

In 1973, with the help of the deviative "coupled-mirrors" experiment, I measured an anisotropy in the velocity of light(1). In 1975/76, with the use of the interferometric "coupled-mirrors" experiment, I measured accurately enough the Sun's absolute velocity(2) to obtain the following(3): v = 303 ± 20 km/sec, equatorial coordinates of the apex $\alpha = 14^h\ 17^m \pm 20^m$, $\delta = -23° \pm 4°$.

At the present time the only other experiments which have given relatively reliable values for the Earth's absolute velocity are the measurements of the slight anisotropy in the cosmic background radiation. The figures obtained by Wilkinson and Corey, v = 320 ± 80 km/sec, $\alpha = 12^h \pm 1^h$, $\delta = -21° \pm 21°$ (the epoch is not given), are the closest to my results. The measurements of Wilkinson and Corey have been performed after my measurements and the account has been published after the publication of my results(4).

The "coupled-mirrors" experiments represent variants of the class of the "rotating axle" experiments. In my opinion, today the "rotating axle" experiments are the only ones with the help of which one can measure the Earth's absolute velocity in a laboratory. The "ultrasonic" experiments(5), the quasi-Bradley experiment(6), the "antipodal clocks" experiment(6), and the "cauldron" experiment(7) cannot give such an accuracy at the present state of the techniques.

All my efforts to publish a detailed account of my interferometric "coupled-mirrors" experiment when I was in Bulgaria and then when I relocated in the Western world have not given a positive result although I published the results of all my experiments in a monograph(6).

At the beginning of 1979 I performed in the Free University of Brussels two variants of the "rotating axle" experiment: (1) the oscilloscopic "coupled-shutters" experiment (see Figure 1 at the end of this article), and (2) the absolute and differential "coupled-shutters" experiment (Fig. 2).

Because of lack of money and technical support, the accuracy achieved with these two experiments was not enough to measure the absolute motion of the Earth. However the results obtained show how near to these absolute effects one can come with a relatively simple technique and in a very short time.

THE OSCILLOSCOPIC "COUPLED-SHUTTERS" EXPERIMENT

The proposal for the oscilloscopic "coupled-shutters" experiment is given in reference 8 for a slightly different variant. In the actual set up (Fig. 1), the light of two lasers is cut by two holes on the extremities of a rotating axle (distance between the holes d = 140 cm). The light pulses illuminate two photodiodes and the produced electric pulses go along cables to a double beam oscilloscope. Thus one measures not the one-way velocity of light in vacuum (in air) but the velocity of propagation of electric pulses in a cable. Because of the low linear velocity of the "shutters" and the inevitable degradation of the pulses in the oscilloscope, the leading edge of the pulses on the screen became quasi parallel when the necessary short time of scanning is switched on. Displacements of 10 ns of the leading edge of the pulses on the screen could be reliably registered, while the absolute velocity effect corresponds to 10 ps (when the circular platform from Fig. 1 is put on a turnabout and rotated through 360° — see reference 8). Thus I remained with three orders of magnitude from the absolute effect which is to be measured.

To obtain reliable results, one has to use either photomultipliers, as proposed in reference 8, or use trigger systems which produce short pulses (of the order of tens or hundreds of picoseconds) when the voltage of the pulses produced by the photodiodes reaches a definite level.

Since the differential "coupled-shutters" experiment has given more reliable results, the rest of this paper will describe this experiment.

THE ABSOLUTE "COUPLED-SHUTTERS" EXPERIMENT

The general description of the "coupled-shutters" experiment is given in reference 9. Here is described the variant of Fig. 2.

As can be seen from Fig. 2, the rotating axle has two discs with holes on the extremities. The distance from the centres of the holes to the centre of the axle is R = 9 cm. The distance between the extremities of the disc is d = 150 cm. The axle is driven by an electric motor which can rotate with a rate up to N = 200 rev/sec (measured by a digital cyclometer which can be seen in Fig. 1 on the left of the oscilloscope). A He-Ne laser is put on one side of the axle and a photodiode in front of it on the opposite side. With the ammeter one measures either the total current generated by the photodiode or the change in the current when increasing the rate of rotation of the axle.

One arranges the position of the laser and of the disc holes so that when the axle is at rest the light of the laser which passes through the near hole illuminates only a part (say, half) of the far hole. The axle is set in rotation and its rotational speed is increased gradually. Since the light pulses cut by the near holes have a transit time in order to reach the far holes, with the increase of the rate of rotation less and less light will pass through the far holes (when the distant holes "escape" from the light beam positions) and conversely more and more light will pass through the far holes (when the distant holes "enter" into the light beam positions).

The illumination at the different points of the light spot is not homogeneous — at the edges the illumination is lower and at the centre the most intense. For the sake of simplicity, I assume that the increase in the illumination is linear. Thus I assume that the illumination over the photodiode generated by the real spot is the same as if generated by a light spot with an intensity equal to the mid-beam intensity. The electric current, I, produced by the photodiode is proportional to the light flux which falls on it. Thus, under the simplified assumption about the illumination, one can assume that the current is proportional to the length, x, of the light spot: $I \sim x$. This is so if the holes, as well as the light beam produced by the laser, are rectangular; taking into account that they are circular, for the "length" x one will obtain a certain "effective" length. Since the length of the light spot cannot be measured accurately, I shall not enter deeper into the problem about the "geometrical" estimation of the "effective" length.

When the rotational rate of the axle changes with ΔN, a Δx part of the light spot will not pass through the far holes and the illumination over the photodiode will diminish with ΔI which is proportional to Δx: $\Delta I \sim \Delta x$.

Thus one can write: $\Delta x/\Delta I = x/I$.

Since $\Delta x = (d/c)2\pi\Delta NR$, then for the *one-way velocity of light* one obtains:

$$c = \frac{2\pi\Delta NRd}{x} \; \frac{I}{\Delta I} \tag{1}$$

I measured: $I = 12.1$ mA, and $\Delta I = 1.08\ \mu A$ for $\Delta N = 100$ rev/sec. The measurement of ΔI can be made by compensating the voltage produced by the photodiode with a fixed voltage and measuring the generated current when increasing the rate of rotation. I used the differential method described in the section headed "The Differential 'Coupled-Shutters' Experiment". The length of the light spot was established to be $x = 3.2 \pm 0.3$ mm (when the axle is rotating). Thus according to equation (1), $c = (3.0 \pm 0.1).10^8$ m/sec. Let me emphasise that even if the light spot were rectangular and the intensity homogeneous, the measurement of the length will always include an error of about 10%. Since the errors in the measurements of ΔN, R, d, I, ΔI are less than 10%, *the error in x is the decisive one.* Thus, with this method, the *absolute* measurement of the one-way light velocity will always include an error of not less than 10%. The best measurements of the two-way light velocity (National Bureau of Standards, Colorado) have given an accuracy of 10^{-8}%, i.e. an accuracy *one milliard times higher* than that of my experiment. However, I believe that this is the first time that the *one-way* light velocity has been measured. Let me add that one measures the *two-way* light velocity tens of thousands of times every day (all radars on boats, planes, police cars represent measurements of the two-way light velocity). A simple indication that this experiment is different from all others is that: In this experiment there is *no* mirror, whereas in all other experiments there is a mirror.

It is amazing that the theoretical considerations of the possibilities for the one-way measurements with a rotating axle are scarce(10-12). The two-way measurement with a rotating toothed wheel was performed by Fizeau in 1849, and this was the first laboratory measurement of light velocity. Fizeau's basis was 8 km. Thus the two-way basis of 16 km was with four orders longer than the basis in my experiment, and Fizeau achieved a displacement with one hole during the trip of the light pulse there and back.

Finally, this represents a most inexpensive and realizable means for measuring the velocity of light and can be used for demonstration in colleges.

If the accuracy of this experiment is high enough (i.e. higher than 0.1%), it should establish that the one-way velocity of light is direction dependent (according to my theories) and one can give indication of absolute velocity of the laboratory. I doubt that the absolute velocity of the laboratory can be registered with the absolute method but only with the differential method (see below).

THE DIFFERENTIAL "COUPLED-SHUTTERS" EXPERIMENT

The differential "coupled-shutters" experiment is shown in Fig. 2. Instead of one laser and one photodiode, two pairs are used. According to equation (1), the velocity of light in the "direct" direction (i.e. along the component v of the laboratory's absolute velocity on the axis of the apparatus) and in the "opposite" direction (i.e. against v) will be:

$$c - v = \frac{2\pi\Delta NRd}{x}\frac{I}{\Delta I + \delta I}, \qquad c + v = \frac{2\pi\Delta NRd}{x}\frac{I}{\Delta I - \delta I}, \tag{2}$$

where $\Delta I + \delta I$ and $\Delta I - \delta I$ are the changes in the currents generated by the corresponding photodiodes when the rate of rotation is changed by ΔN. Dividing the second of these equations by the first, one obtains:

$$v = c\frac{\delta I}{\Delta I} \tag{3}$$

Thus the measuring method consists of the following:

One changes the rotational rate by ΔN and one measures the change in the current of any one of the photodiodes which is $\Delta I \cong \Delta I \pm \delta I$; then one measures the difference of both these changes which is $2\delta I$.

Both these measurements can be made by a differential method with the same ammeter, applying it to the *difference* in the outputs of both photodiodes. To measure $2\Delta I$ one makes one light spot "escape" from the far holes and the other to "enter". To measure $2\delta I$ one makes both light spots to "escape" (or "enter") from the far holes. In my experiment the fluctuations of the ammeter were about 1% of ΔI, and I could not register the Earth's absolute velocity (which is 0.1% of c). Thus I can only affirm that the results obtained

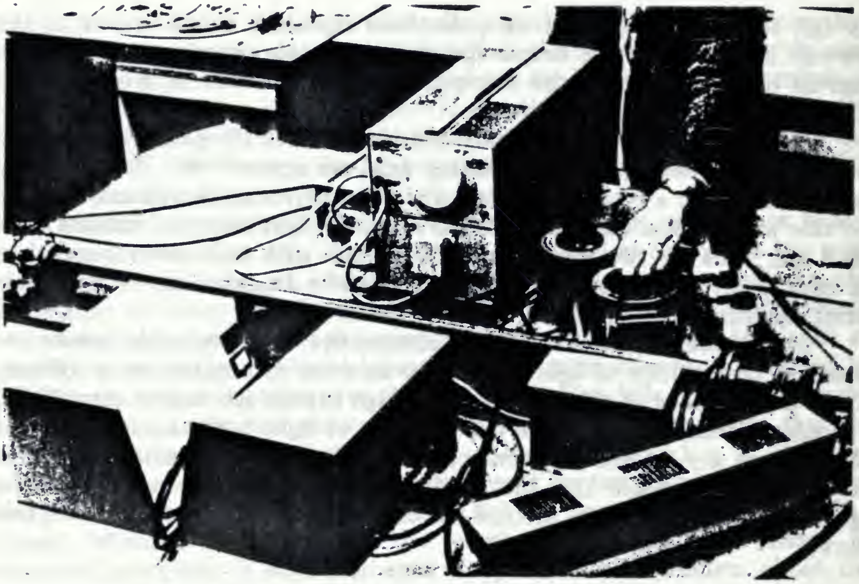

Figure 1. The oscilloscopic "coupled-shutters" experiment.

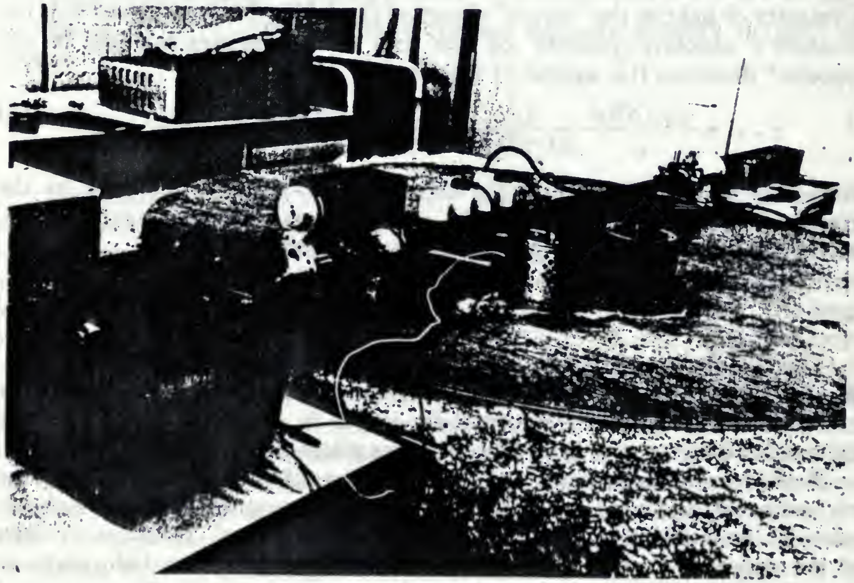

Figure 2. The differential "coupled-shutters" experiment.

showed that the component of the Earth's absolute velocity along the axis of the apparatus during the different hours of the day was not bigger than 3000 km/sec.

When the axle rotates with a constant speed the fluctuations of the current are with about an order lower . Thus, if I could rotate the whole platform, I could register the Earth's absolute motion. In such a case one has to rotate the platform through 360° when the axle rotates with a certain rate N and register $2\delta I$; to register $2\Delta I$ one changes the rate of rotation of the axle from zero to N proceeding as described above. However the platform was designed for the oscilloscopic "coupled-shutters" experiment (Fig. 1) and a rotation of the axle together with the lasers and the photodiodes was not possible. To obtain more accurate results one has to increase R, d and N, and diminish to the lower possible level the fluctuations of the current. An increase in the intensity of light (sending light, say, through *all* holes) will also enhance the accuracy. According to my estimation, with this method the Earth's absolute velocity could be measured with an accuracy as high as 1 km/sec.

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Measurement of the Laboratory's Absolute Velocity

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Abstract

The report is given on a local measurement of the absolute velocity of a laboratory. This is the resultant velocity due to all types of motion in which the laboratory takes part (about the Earth's axis, about the Sun, about the galactic center, about the center of the cluster of galaxies).

Harress (1912) and Sagnac (1913) established that the velocity of light is direction dependent with respect to a rotating disk. Michelson, Gale, and Pearson (1925) showed that such direction dependence exists also for the spinning earth.

Until now the "Sagnac effect" has been measured only for closed paths of the light beams where the effect is proportional to the *angular* rotational velocity. We measured the "Sagnac effect" for light beams proceeding along a straight line where the effect is proportional to the *linear* rotational velocity. Michelson, Gale, and Pearson measured only the diurnal angular rotational velocity, since the yearly and galactic angular rotational velocities are too small to be detected. We registered the galactic and supergalactic linear rotational velocities and small changes in their sum due to the yearly rotation, when performing the measurement during the different days of the year; the diurnal changes, being very small, could not be registered.

To measure the Sagnac effect along a straight line, one has to realize a Newtonian time synchronization [1] between spatially separated points. We succeeded in making such a synchronization with the help of a rotating axle.

The scheme of our interferometric "coupled-mirrors" experiment, with

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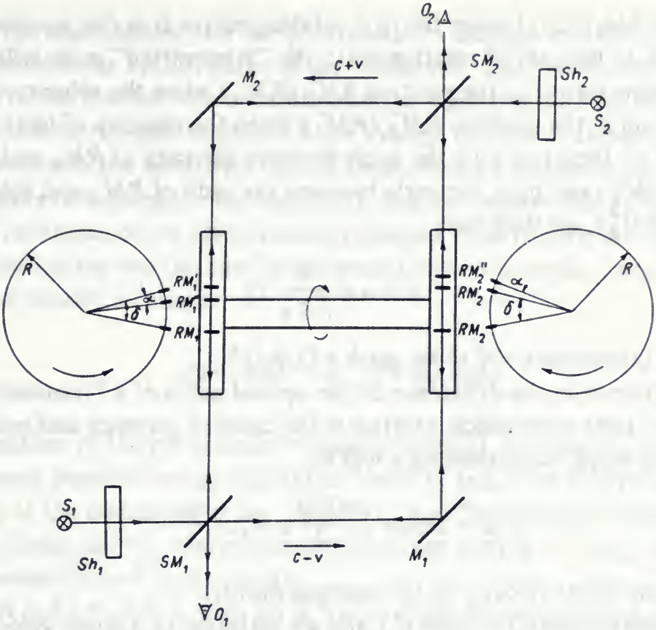

Fig. 1. The interferometric "coupled-mirrors" experiment.

whose help we measured the laboratory's absolute velocity, is the following (Figure 1).

Let us have a shaft with length d on whose ends there are two disks with radius R. On the rims of the disks, two mirrors RM_1 and RM_2 are fixed which we call the rotating mirrors. Monochromatic parallel light emitted by the source S_1 (or S_2) is partially reflected and partially refracted by the semitransparent mirror SM_1 (SM_2). The "transmitted" beam is then reflected successively by the mirror M_1 (M_2), by the rotating mirror RM_2 (RM_1), again by M_1, SM_1 (M_2, SM_2), and the observer O_1 (O_2) registers the interference which the "transmitted" beam makes with the "reflected" beam, the last one being reflected by the rotating mirror RM_1 (RM_2) and transmitted by SM_1 (SM_2). We call the direction from RM_1 to RM_2 "direct" and from RM_2 to RM_1 "opposite."

Let us now set the shaft in rotation with angular velocity Ω and let us put in action the shutters Sh_1 and Sh_2 which should allow light to pass through them only when the rotating mirrors RM_1 and RM_2 are perpendicular to the incident beams. This synchronization was performed by making the opening of the shutters ($\cong 10^{-6}$ sec) be governed by the rotating shaft itself. Later we realized that the shutters are not necessary and we used simple slits placed along the light paths to the rotating mirrors.

If, at rest, the "transmitted" light pulse reaches the second rotating mirror in the position $RM_2 (RM_1)$ when the first rotating mirror is in the position RM_1 (RM_2), then, in the case of rotating shaft, the "transmitted" pulse will reach the second rotating mirror in the position RM'_2 (RM'_1) when the velocity of light is equal to c, and in the position RM''_2 (RM''_1) when the velocity of light is equal to $c - v(c + v)$. Denoting by δ the angle between the radii of RM_2 and RM'_2 $(RM_1$ and $RM'_1)$ and by α the angle between the radii of RM'_2 and RM''_2 $(RM'_1$ and $RM''_1)$, we shall have

$$\delta \pm \alpha = \frac{d}{c \mp v} \Omega \tag{1}$$

from where (assuming $v << c$) we get $\alpha = \Omega\, dv/c^2$.

The difference in the difference of the optical paths of a "transmitted" and a "reflected" light pulse which interfere in the cases of presence and nonpresence of an "aether wind" with velocity v will be

$$\Delta = 2\alpha R = 2 \frac{dR\Omega}{c^2} v = 2d \frac{v_r v}{c^2} \tag{2}$$

where v_r is the linear velocity of the rotating mirrors.

If the wavelength of the light is λ and we maintain an angular velocity $\Omega = 2\pi N$ (N is the number of revolutions per second), then, during a rotation of the apparatus over 360° about an axis perpendicular to the absolute velocity v, the observers O_1 and O_2 should register changes in their interference pictures within

$$z = \frac{\Delta}{\lambda} = 4\pi \frac{dRN}{\lambda c^2} v \tag{3}$$

wavelengths.

In our actual setup, the "direct" beams are tangent to the *upper* parts of the rotating disks, while the "opposite" light beams are tangent to their *lower* parts. Thus the reflection of the "direct" and "opposite" beams proceeds on the same planes of the mirrors. The "observers" in our actual setup represent two photoresistors which are put in the "arms" of a Wheatstone bridge. The changes in both interference pictures are *exactly opposite.* Thus in our apparatus the mirrors RM_1 and RM_2 are exactly parallel and the photoresistors are illuminated *not* by a pattern of interference fringes but *uniformly.*

A very important difference between the deviative "coupled-mirrors" experiment [2] and the present one, which we call interferometric, is that the effect registered in the latter is independent of small variations in the rotational velocity. In the interferometric variant one *need not* keep the illumination over one of the photoresistors constant by changing the velocity of rotation when rotating the axis of the apparatus, but need merely register the *difference* in the illuminations over the photoresistors during the rotation. This (together with the high resolution of the interferometric method) is the most important advantage of the interferometric "coupled-mirrors" experiment.

Since the illumination over the photoresistors changes with the change in the difference in the optical paths of the "reflected" and "transmitted" beams according to the sine law, the apparatus has the highest sensitivity when the illumination over the photoresistors is the average one (for maximum and minimum illumination the sensitivity falls to zero). Hence a change in the velocity of rotation leads to a change in the sensitivity. Let us consider this problem.

If the resistance of the photoresistors changes *linearly* with the change in the illumination (as was the case in our setup), then to a small change dI in the energy flux density a change

$$dW = kdI = -k \frac{I_{\max}}{2} \sin \varphi \, d\varphi \tag{4}$$

in the resistance of the photoresistors will correspond, k being a constant, $I_{\max}$ the maximum possible energy (light) flux density, and φ the difference between the phases of the intensities in the "reflected" and "transmitted" beams.

For a change $\Delta\varphi = \pi$ the resistance will change with $W = -kI_{\max}$, as follows after the integration of equation (4).

Since it is $\Delta\varphi = 2\pi\Delta/\lambda$, then for $\varphi = \pi/2$, where the sensitivity is the highest, we shall have $\Delta W/W = \pi\Delta/\lambda$. Substituting this into equation (3), we obtain

$$v = \frac{\lambda c^2}{4\pi^2 dRN} \cdot \frac{\Delta W}{W} \tag{5}$$

The measuring method is: We set such a rotational rate N_1 that the illumination over the photoresistors will be minimum. Let us denote the resistance of the photoresistors under such a condition by W_1 and W_2 (it must be $W_1 = W_2$). We put the same constant resistances in the other two arms of the bridge, so that the same current J_0 (called the initial current) will flow through the arms of the photoresistors, as well as through the arms of the constant resistors, and no current will flow through the galvanometer in the bridge's diagonal. Then we set such a rotational rate N_2 that the illumination over the photoresistors is maximum and we connect in series with them two variable resistors, W, so that again the initial current J_0 has to flow through all arms of the bridge. After that we make the illumination average, setting a rotational rate $N = (N_1 + N_2)/2$ and we diminish correspondingly the variable resistors, so that again the initial current has to flow through all arms of the bridge and no current in the diagonal galvanometer. Now if we rotate the axis of the apparatus from a position perpendicular to its absolute velocity to a position parallel to its absolute velocity and we transfer resistance ΔW from the arm where the illumination over the photoresistor has decreased to the arm where it has increased, again the same initial current will flow through all arms and no current through the diagonal galvanometer. The absolute velocity is then to be calculated from equation (5).

When the illuminations over the photoresistors were averaged a change $\delta W =$

8×10^{-4} W in any of the arms of the photoresistors (positive in the one and negative in the other) could be discerned from the fluctuations of the bridge's galvanometer, and thus the resolution was

$$\delta v = \frac{\lambda c^2}{4\pi^2 dRN} \cdot \frac{\delta W}{W} = 17 \text{ km/sec} \tag{6}$$

The errors that can be introduced from the imprecise values of $d = 140$ cm, $R = 40.0$ cm, $N = 120$ rev/sec, and $\lambda = 633$ nm (a He-Ne laser) are substantially smaller than the resolution and can be ignored. To guarantee sufficient certainty, we take $\delta v = 20$ km/sec.

The experiment was not performed in vacuum.

The room was not temperature controlled, but it is easy to calculate that reasonable thermal and density disturbances of the air along the different paths of the interfering light beams cannot introduce errors larger than the accepted one.

The whole apparatus is mounted on a platform which can rotate in the horizontal plane and the measurement can be performed in a couple of seconds.

The magnitude and the apex of the Earth's (laboratory's) absolute velocity have been established as follows:

During a whole day we search for the moment when the Wheatstone bridge is in equilibrium if the axis of the apparatus points east-west. At this moment the Earth's absolute velocity lies in the plane of the laboratory's meridian. Thus, turning the axis of the apparatus north-south, we can measure v in the horizontal plane of the laboratory. The same measurement is to be made after 12 hr. As can be seen from Figure 2, the components of the Earth's absolute velocity in the horizontal plane of the laboratory for these two moments are

$$v_a = v \sin(\delta - \varphi), \qquad v_b = v \sin(\delta + \varphi) \tag{7}$$

where φ is the latitude of the laboratory and δ is the declination of the apex. From these we obtain

$$\begin{aligned} v &= \frac{[v_a^2 + v_b^2 - 2v_a v_b (\cos^2 \varphi - \sin^2 \varphi)]^{1/2}}{2 \sin \varphi \cos \varphi} \\ \tan \delta &= \frac{v_b + v_a}{v_b - v_a} \tan \varphi \end{aligned} \tag{8}$$

We take v_a and v_b as positive when they point to the north and as negative when they point to the south. Obviously, the apex of the absolute velocity points to the meridian of this component whose *algebraic* value is smaller. Thus we shall always assume $v_a < v_b$ and then the right ascension α of the apex will be equal to the local sideral time of registration of v_a. We could establish this moment within a precision of ±15 min. Thus we can calculate (with an accuracy not larger

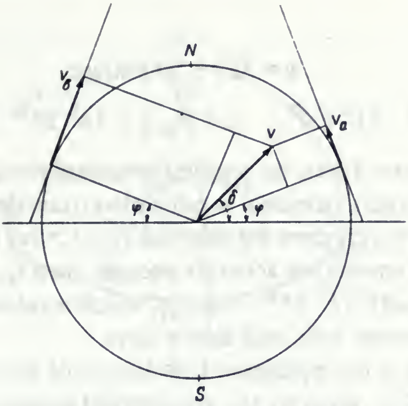

Fig. 2. The components of the laboratory's absolute velocity in the plane of the meridian.

than ±5 min) the sideral time t_{si} for the meridian where the local time is the same as the standard time t_{st} of registration, taking into account that sideral time at a middle midnight is as follows:

22 September:	0^h	23 March:	12^h
22 October:	2^h	23 April:	14^h
22 November:	4^h	23 May:	16^h
22 December:	6^h	22 June:	18^h
21 January:	8^h	23 July:	20^h
21 February:	10^h	22 August:	22^h

Our first measurement of the Earth's absolute velocity with the help of the interferometric "coupled-mirrors" experiment was performed on 12 July 1975 in Sofia ($\varphi = 42°41'$, $\lambda = 23°21'$). We registered

$$\begin{aligned} v_a &= -260 \pm 20 \text{ km/sec}, \qquad (t_{\mathrm{st}})_a = 18^h\ 37^m \pm 15^m \\ v_b &= +80 \pm 20 \text{ km/sec}, \qquad (t_{\mathrm{st}})_b = 6^h\ 31^m \pm 15^m \end{aligned} \tag{9}$$

Thus

$$\begin{aligned} &v = 279 \pm 20 \text{ km/sec} \\ &\delta = -26° \pm 4°, \qquad \alpha = (t_{\mathrm{si}})_a = 14^h\ 23^m \pm 20^m \end{aligned} \tag{10}$$

We repeated the measurement exactly six months later on 11 January 1976 when the Earth's rotational velocity about the Sun is oppositely directed. We registered

$$\begin{aligned} v_a &= -293 \pm 20 \text{ km/sec}, \qquad (t_{\mathrm{st}})_a = 6^h\ 24^m \pm 15^m \\ v_b &= +121 \pm 20 \text{ km/sec}, \qquad (t_{\mathrm{st}})_b = 18^h\ 23^m \pm 15^m \end{aligned} \tag{11}$$

Thus

$$v = 327 \pm 20 \text{ km/sec}$$
$$\delta = -21^\circ \pm 4^\circ, \quad \alpha = (t_{si})_a = 14^h\ 11^m \pm 20^m \tag{12}$$

For v and δ we have taken the root-mean-square error, supposing for simplicity $\varphi \cong 45^\circ$. The right ascension is calculated from the moment when v_a is registered, i.e., from $(t_{st})_a$, since for this case ($|v_a| > |v_b|$) the sensitivity is better. If our measurements are accurate enough, then t_{st}, which is taken as the second, must differ with $11^h\ 58^m$ from t_{st}, which is taken as the first, because of the difference between solar and sideral days.

The magnitude and the equatorial coordinates of the apex of the Sun's absolute velocity will be given by the arithmetical means of the figures obtained for the Earth's absolute velocity in July and January:

$$v = 303 \pm 20 \text{ km/sec}$$
$$\delta = -23^\circ \pm 4^\circ, \quad \alpha = 14^h\ 17^m \pm 20^m \tag{13}$$

Wilkinson and Corey [3], analyzing the slight anisotropy in the cosmic background radiation, obtained the following figures for the Earth's absolute velocity (the epoch is not given):

$$v = 320 \pm 80 \text{ km/sec}$$
$$\delta = -21^\circ \pm 21^\circ, \quad \alpha = 12^h \pm 1^h \tag{14}$$

It is beyond doubt that the absolute velocity of the laboratory measured by our method locally and when observing the slight anisotropy of the cosmic background radiation is the same physical quantity.

In Figure 3 we show the different rotational velocities in which our Earth takes part: v_E is the Earth's velocity about the Sun, which changes its direction with a period of one year; v_S is the Sun's velocity about the galactic center, which changes its direction with a period of 200 millions years; v is the geometrical sum of these two and of the velocity of our Galaxy about the center of the galactic cluster, which we measure with our apparatus. If we subtract geometrically v_S ($v_S = 250$ km/sec, $\delta = 27^\circ\ 51'$, $\alpha = 19^h\ 28^m$) from v [see the figures in equation (13)], we shall obtain the rotational velocity of our galaxy.

Let us now compare the figures in equation (10) with these obtained in 1973 with the help of the deviative "coupled-mirrors" experiment [2]. In 1973 the axis of the apparatus was fixed in the horizontal plane with an azimuth $A' = 84^\circ$. For the sake of simplicity (see Figure 3), we shall assume $A = 90^\circ$. In a day the axis of the deviative "coupled-mirrors" implement rotated in a plane parallel to the equatorial and thus the velocity $v'_{eq} = 130 \pm 100$ km/sec, which we measured, was the projection of the absolute velocity v in the equatorial plane. Proceeding from Figure 3, we obtain $v_{eq} = 251$ km/sec, if we use the

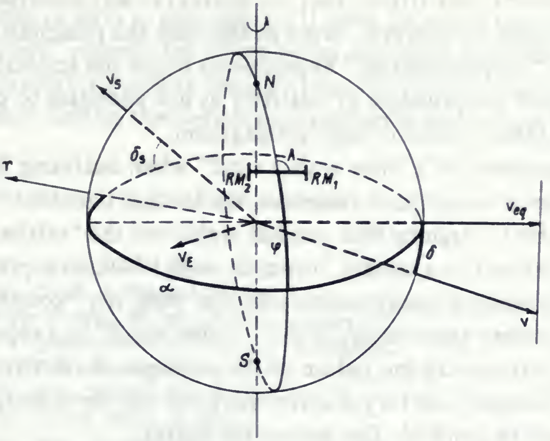

Fig. 3. The Earth in summer viewed from the Sun at about noon for Sofia. The "direct" direction of the implement points from the east to the west.

figures in (10). On 12 July the maximum effect in the deviative variant must be registered 6 hr before the registration of v_a and v_b, i.e., it must be $t_{\text{dir}} = 0^{\text{h}}\ 31^{\text{m}}$, $t_{\text{opp}} = 12^{\text{h}}\ 37^{\text{m}}$. We established $t_{\text{dir}} = 3^{\text{h}} \pm 2^{\text{h}}$, $t'_{\text{opp}} = 15^{\text{h}} \pm 2^{\text{h}}$ in the period between 25 July and 23 August. Thus the reduction of t_{dir}, t_{opp} to the first days of August (the average of our 1973 measurements) should increase the differences between t_{dir}, t_{opp} and t'_{dir}, t'_{opp}. The reduction of $A = 90^\circ$ to $A' = 84^\circ$ will, however, diminish these differences and the difference between v_{eq} and v'_{eq}. Nevertheless, despite the perceptible differences between the figures obtained in 1973 and 1975, we are even surprised that our very imperfect deviative "coupled-mirrors" experiment led to such relatively good results.

Note Added in Proof

During the lectures which I gave in the last two years in several European and American universities and on scientific congresses, inevitably one and the same question has been posed: Is the effect registered in my "coupled-mirrors" experiments due to a certain rotational velocity of the laboratory, thus representing a *non-inertial* effect known to physics for 70 years, or this is an *inertial* effect due to the uniform velocity of the laboratory with respect to the world aether, thus disproving categorically the principle of relativity. To all persons who posed this question I remembered Archimedus' theorem about the inexistance of a most big number ("To any number big enough always can be found another one which will be bigger"). I formulated a similar theorem: To any enough uniform velocity always can be found a point in the world, so that the motion with this "inertial" velocity can be considered as a rotation about this center. This theorem thus affirms that the motion of *any* material object in our world is non-inertial. Is, however, saved in this way the principle of relativity? No, it isn't. My "coupled-mirrors" experiments impel the scientific community to definitely reject the principle of relativity as not adequate to physical reality and restore the aether model of light propagation.

After the discovery of a "*new* aether wind" when analysing the slight anisotropy in the cosmic background radiation, the leading scientists tried to save the principle of relativity, arguing that one has registered the "relative" velocity of the Earth with respect to a certain "material object" which is presented by the isotropically propagating background radiation. Well, my "coupled-mirrors" experiments represent registration of this "aether wind" in a closed laboratory! It is clear that to recognize the failure of the principle of relativity in the third fourth of the Twentieth century is a very hard nut for the scientific community. But this nut must be cracked. The sooner the better.

I must note that many scientists are doubtful whether I, indeed, have registered the effects reported in this paper and of the different high-velocity light experiments reported in the monograph [4]. So, for example, Prof. P. Bergmann wrote me a year ago: "I affirm that your "coupled-mirrors" experiment must give a null result, and the effects registered by you are due to side causes." In my answer I wrote: "If you shall publish this opinion in the press, I shall immediately send you $500." I heard no more from Bergmann.

I should like to mention that my friend Prof. Prokhovnik, a member of the organizing committee of the International Conference on Space-Time Absoluteness which had to meet in May, 1977 in Bulgaria but was prohibited by the Bulgarian government, dedicated an *excellent* critical paper to the "coupled-mirrors" experiment [5]. Prof. Prokhovnik, as Lorentz, Builder, Ives, and Janossy, defends the conception of the world aether; however, according to him, a certain "twist" will appear in the rotating axle which will annihilate the positive "aether wind" effect. I called this the "Lorentz twist" [6]. My experiments undoubtedly show that such a *hypothetical* "Lorentz twist" does not exist. According to my absolute space-time theory [1], the "Lorentz contraction" does not represent a physical effect. The null result in the Michelson-Morley experiment and the specific (*not entirely Newtonian*) character of the Lienard-Wiechert potentials [1] impel us to introduce certain changes in the traditional *aether-Newtonian* character of light propagation. I called this slightly revised model (only within effects of second order in v/c) the *aether-Marinov* model of light propagation [7].

Finally, I wish to inform the reader that in 1979, I carried out the differential "coupled-shutters" experiment in the Free University of Brussels, with whose help for the first time in history the unidirectional light velocity has been measured in a laboratory [8]. It is highly astonishing that the differential "coupled-shutters" experiment represents, maybe, *the most simple and easily realisable* experiment for a laboratory measurement of the light velocity, and can be set up in a couple of days in any college. It must be noted that the differential "coupled-shutters" experiment offers better technical possibilities for registration of the laboratory's absolute velocity than the interferometric "coupled-mirrors" experiment, and its theoretical explanation is much more simple.

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Decisive experiments for the proof of the light velocity's direction dependence

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[**Abstract** : Analysing the "coherent lasers" experiment (Carnahan[2]) and pointing out its ingenious connection with the recently performed disrupted "rotating disk" experiment (Marinov[16]), we show that the velocity of light is direction dependent with respect to any observer moving in absolute space. This allows us to set firm logical grounds for our "coupled-mirrors" experiment (Marinov[18,17]) with the help of which for the first time in history we have measured the Earth's absolute velocity in a laboratory.]

1. *Introduction*

Carnahan[2], aiming to refute the principle of relativity, had proposed a very interesting first-order in v/c experiment whose theoretical analysis was criticized by Shamir and Fox[19]. In a reply, Carnahan[3] recognized that his prediction was wrong. Further neither has his experiment been discussed (except to be referred to or shortly described in review articles) nor has someone tried to realize it.

After a critical analysis of Carnahan's experimental arrangement, we came to the conclusion that the marvelous theoretical grounds which it offers for a reliable logical proof of the light velocity's direction dependence were not revealed during the mentioned discussion, in which the essence of the analysed experiment remained obscure.

In Section 2 of the present paper we give a theoretically sound mathematical description of this "coherent lasers" experiment, as we call it, working with the apparatus of our absolute space-time theory (Marinov[14]). However, since this experiment is of first order in v/c, it can be treated (excluding the problem about the change in the initial phases of the lasers when rotating them in a horizontal plane) by the most simple traditional Newtonian apparatus, and the results obtained with an accuracy of first order in v/c will be the same as ours. To save time, we shall not give our criticism of Carnahan's and Shamir and Fox's theoretical considerations; comparing our exposition with theirs the reader can find the differences.

In Section 3 we point out the connection between the "coherent lasers" experiment and the disrupted "rotating disk" experiment performed recently by us (Marinov[16]). This parallel will favour the breaking of the *psychological* anti-absolutist barrier which has, for so many years, hampered the sound evolution of high-velocity physics.

Then, in Section 4, we analyse the possibilities which today's experimental techniques offer for a practical performance of the "coherent lasers" experiment. Since only a change in the velocity of the implement but not its absolute velocity can be registered with the help of this experiment, only a reader who has overcome the psychological anti-absolutist barrier (we call it the *horror spatii absoluti*) can see in the "coherent lasers" experiment a confirmation of the light velocity's direction dependence.

Let us introduce some basic notions of our absolute space-time theory. We assume that light propagates with a constant velocity along all directions only in absolute space. In any frame moving with respect to absolute space light velocity is direction dependent. The relevant formulas are given in (Marinov[14,16]). According to our theory, any clock (imagine for simplicity a light clock) which moves with a velocity v in absolute space (called a *proper clock*) goes at a lower rate than a similar clock which rests in absolute space (called an *absolute clock*) and the relation between their readings is

$$t_o = t(1-v^2/c^2)^{\frac{1}{2}} \qquad \cdots \qquad (1)$$

We call this effect the *absolute time dilation*; t is called *absolute time* and t_o is called *proper time*.

Suppose that a light source which is at rest in absolute space emits light with frequency ν, measured in absolute time by an observer also at rest, and wavelength λ, called, respectively, *emitted frequency* and *wavelength*. An observer who moves in absolute space will register a different frequency, called *observed frequency*; however the wavelength (which for the sake of uniformity we call observed too) will remain the same, since the velocity of light with respect to the observer will change. If the observer remains at rest in absolute space and the source moves, again the observed frequency will be different from the emitted one; this time, however, the wavelength will be different also, since the velocity of light with respect to the observer remains the same. If source and observer move with the same velocity v which makes an angle θ with the source-observer line, then the observed frequency (measured in proper time) and wavelength will be (Marinov[18]).

$$\nu_0 = \nu, \qquad \lambda_0 = \frac{\lambda}{1+(v/c)\cos\theta} \qquad \cdots \qquad (2)$$

More details about the absolute treatment of the light Doppler effect can be found in Marinov[18]. Let us emphasize that, according to the theory of special relativity, the velocity of light is equal to c with respect to any inertially moving observer and thus for any observer the product of frequency and wavelength is equal to c. For special relativity the cases "source at rest, observer moving" and "observer at rest, source moving", as well as "source and observer at rest" and "source and observer moving with the same velocity" are *physically identical*.

2. *Theoretical analysis of the "coherent lasers" experiment*

As is well known (see, for example, Harvey[9]), the coherence of light emitted by lasers is much higher than the coherence of light emitted by other sources. The coherent length of a laser beam can be hundreds of kilometers, while that of other light sources is only centimeters. For this reason, light beams emitted by two different lasers can interfere in the same manner as light emitted by a single source and split into two beams can interfere if the two beams meet again, after having covered slightly different light paths. Before the invention of lasers, a single light source was always used in all optical experiments with the help of which the presence of an "aether wind" was sought for. The inevitable result was that in all "inertial" experiments (*i. e.*, those performed with inertially moving implements) the light beams had to cover the light paths "there-and-back" and the first-order in v/c effects always vanished in the final result, while second-order in v/c effects were not registered (as we show in Marinov[14], no second-order effects can appear at all). The *unique* experiment where first-order in v/c effects have been observed was the historical Harress-Sagnac experiment on the rotating disk (repeated by Michelson, Gale and Pearson on the rotating Earth) where the implement is not moving inertially and the light beams cover closed paths, propagating only "there".

However, if we have at our disposal two different light sources which produce coherent light, then first-order in v/c experiments can be set up also on inertially moving implements. This was the intention of Carnahan.

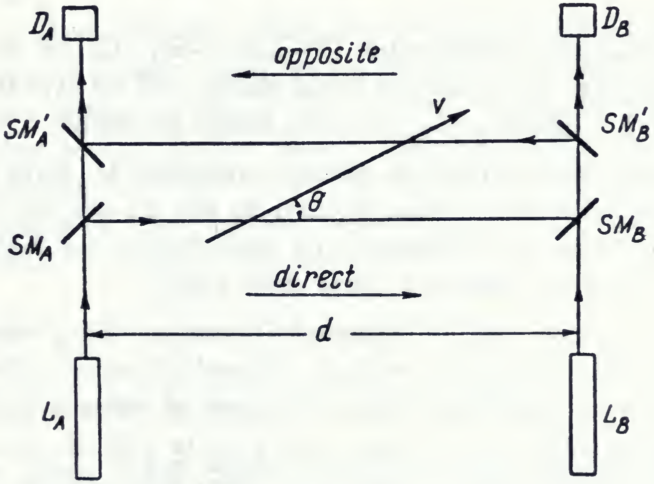

Fig. 1
The "coherent lasers" experiment.

The scheme of the 'coherent lasers" experiment is as follows (Fig. 1). Light emitted from the laser L_A (or L_B) is partly reflected and partly refracted by the semi-transparent mirror SM_A (SM'_B). The refracted beam proceeding from L_A (L_B) interferes with the transmitted beam proceeding from L_B (L_A), after the latter has covered a distance d in the "opposite" ("direct") direction and after being reflected by the semi-transparent mirror SM'_A (SM_B). The photodetector D_A (D_B) indicates the result of the interference.

For the sake of simplicity, we shall assume that the semi-transparent mirrors SM_A and SM'_A (SM_B and SM'_B) lie at the same point (see Fig. 2) which we shall call point A (point B).

Let us suppose first that the implement is at rest in absolute space. Let the instantaneous electric intensities of the light beams produced by L_A at point A and by L_B at point B be, respectively,

$$E_A = E_{max} \sin(\omega_A t + \alpha_A), \quad E_B = E_{max} \sin(\omega_B t + \alpha_B) \qquad (3)$$

where

$$\omega_A = \omega + \triangle\omega/2 = \frac{2\pi c}{\lambda_A} = \frac{2\pi c}{\lambda - \triangle\lambda/2}, \quad \omega_B = \omega - \triangle\omega/2 = \frac{2\pi c}{\lambda_B} = \frac{2\pi c}{\lambda + \triangle\lambda/2} \quad \dots \qquad (4)$$

are the angular frequencies ($0 < \triangle\omega << \omega$), λ_A, λ_B are the wavelengths, α_A, α_B are the initial phases, and we have assumed that the amplitudes E_{max} in both beams are equal.

If we wish to find the electric intensitias at point A (or point B) after the mixing, we have to add E_A and E_B, taking for the latter an additional phase shift $2\pi d/\lambda_B$ (or taking for the former an additional phase shift $2\pi d/\lambda_A$).

Let us now set the implement in motion with a velocity v which makes an angle θ with the "direct" direction of the axis. If we wish to find the electric intensity at point A (point B) after the mixing in this case, we have to add E_A and E_B, taking for the latter an additional phase shift $2\pi d/\lambda_{Bo}$ (taking for the former an additional phase shift $2\pi d/\lambda_{Ao}$), where λ_{Bo} (λ_{Ao}) is the observed wavelength of the "opposite" ("direct") beam. Thus, denoting by t the proper time of a clock attached to the implement (for brevity we omit the subscript "o"), we shall obtain for the electric intensities at points A and B, respectively, (see (2))

$$(E_A+E_B)_A=E_{max}\sin(\omega_A t+\alpha_A)+E_{max}\sin(\omega_B t+\alpha_B+2\pi d/\lambda_{Bo})$$

$$=2E_{max}\sin\left\{\frac{1}{2}\left[2\omega t+\alpha_A+\alpha_B+\frac{d}{c}\left(\omega-\frac{\Delta\omega}{2}\right)\left(1-\frac{v}{c}\cos\theta\right)\right]\right\}$$

$$\cdot\cos\left\{\frac{1}{2}\left[\Delta\omega t+\alpha_A-\alpha_B-\frac{d}{c}\left(\omega-\frac{\Delta\omega}{2}\right)\left(1-\frac{v}{c}\cos\theta\right)\right]\right\}$$

$$=2E_{max}\cos\left(\frac{1}{2}\psi_A\right)\sin(\omega t+\beta_A) \qquad \cdots \qquad (5)$$

and

$$(E_A+E_B)_B=E_{max}\sin(\omega_A t+\alpha_A+2\pi d/\lambda_{Ao})+E_{max}\sin(\omega_B t+\alpha_B)$$

$$=2E_{max}\sin\left\{\frac{1}{2}\left[2\omega t+\alpha_A+\alpha_B+\frac{d}{c}\left(\omega+\frac{\Delta\omega}{2}\right)\left(1+\frac{v}{c}\cos\theta\right)\right]\right\}$$

$$\cdot\cos\left\{\frac{1}{2}\left[\Delta\omega t+\alpha_A-\alpha_B+\frac{d}{c}\left(\omega+\frac{\Delta\omega}{2}\right)\left(1+\frac{v}{c}\cos\theta\right)\right\}\right]$$

$$=2E_{max}\cos\left(\frac{1}{2}\psi_B\right)\sin(\omega t+\beta_B) \qquad \cdots \qquad (6)$$

Let the photodetectors transform the incident light intensity into electric tension which we should lead to the mid-point of the line joining points A and B (let us call this point C). Designate by U_A, U_B the electric tensions on the outputs of the detectors D_A, D_B. Since U_A, U_B will be proportional to the squares of the variable amplitudes of $(E_A+E_B)_A$ and $(E_A+E_B)_B$, respectively, we can write

$$\left.\begin{aligned} U_A&=U_{max}\cos^2\left(\frac{1}{2}\psi_A\right)=\frac{1}{2}U_{max}(1+\cos\psi_A),\\ U_B&=U_{max}\cos^2\left(\frac{1}{2}\psi_B\right)=\frac{1}{2}U_{max}(1+\cos\psi_B),\end{aligned}\right\} \qquad \cdots \qquad (7)$$

where U_{max} is the amplitude of the electric tension whose angular frequency is $\Delta\omega$.

Leading the electric tensions U_A, U_B to the mid-point C and taking into account the additional phase shifts for U_A and U_B because of the different velocities of propagation of the electromagnetic energy in the "direct" and "opposite" directions we obtain for their sum

$$\begin{aligned}(U_A+U_B)_C&=\frac{1}{2}\,U_{max}\left\{1+\cos\left[\psi_A+\frac{d}{2c}\,\Delta\omega\left(1+\frac{v}{c}\cos\theta\right)\right]\right\}\\&\quad+\frac{1}{2}\,U_{max}\left\{1+\cos\left[\psi_B+\frac{d}{2c}\,\Delta\omega\left(1-\frac{v}{c}\cos\theta\right)\right]\right\}\\&=U_{max}\left\{1+\cos\left[\Delta\omega t+\alpha_A-\alpha_B+\frac{d}{c}\Delta\omega+\frac{d}{c^2}\,\omega v\cos\theta\right]\cos\left(\frac{d}{c}\,\omega\right)\right\}\end{aligned}\qquad\cdots\qquad(8)$$

Let us analyse this result. Obviously

$$\cos(2\pi d/\lambda)=\begin{cases}+1 & \text{for}\quad d=n\lambda,\\-1 & \text{for}\quad d=(n\pm 1/2)\,\lambda,\\\ \ 0 & \text{for}\quad d=(n\pm 1/4)\,\lambda,\end{cases}\qquad\cdots\qquad(9)$$

n being an integer. Thus the "percentage modulation" of the resultant electric tension depends on the number of the middle wavelengths λ placed along the distance d. Hence to be able to measure a change $v\cos\theta$ in the component of the velocity of the implement along its axis the following two conditions must be available

$$\Delta\omega=0,\qquad d\neq(n\pm 1/4)\,\lambda\qquad\cdots\qquad(10)$$

In such a case, if during a definite time the component of the absolute velocity of the implement along its axis changes from 0 to $v\cos\theta$, this will lead to a phase shift in the argument of the resultant electric tension equal to $(d/c^2)\omega\, v\cos\theta$ radians, assuming that during this time the initial phases α_A, α_B remain constant.

Now we shall show that when rotating the implement with respect to its absolute velocity, *i. e.*, when "switching on an aether wind by rotation", the initial phases do *not* remain constant.

Let us suppose that the axis of the implement is first perpendicular to its absolute velocity (*i. e.*, $\theta=\pi/2$) and then let us rotate the implement (with an angular velocity Ω) in its plane, say, about the mid-point of the line connecting the lasers L_A and L_B, until its axis makes an arbitrary angle θ with the direction cf the absolute velocity v. Let the readings of two clocks attached to L_A, L_B be t'_A, t'_B before the rotation and t''_A, t''_B after the rotation (for brevity we omit the subscripts "o"). Let the proper times $\Delta t'_A = t''_A - t'_A$, $\Delta t_B = t''_B - t'_B$ correspond to the absolute time interval Δt. Because of the absolute time dilation we shall have

$$\Delta t_A = \int_0^{\Delta t} (1 - v_A^2/c^2)^{1/2}\, dt, \quad \Delta t_B = \int_0^{\Delta t} (1 - v_B^2/c^2)\, dt \qquad (11)$$

where

$$\left.\begin{aligned} v_A^2 &= v^2 + \left(\frac{d}{2}\,\Omega\right)^2 - vd\Omega \cos(\Omega t), \\ v_B^2 &= v^2 + \left(\frac{d}{2}\,\Omega\right)^2 + vd\Omega \cos(\Omega t) \end{aligned}\right\} \quad \cdots \qquad (12)$$

are the velocities of the lasers L_A, L_B during the rotation of the implement.

If we work with an accuracy of second order in v/c, we obtain after performing the integration, putting $\Omega \Delta t = \pi/2 - \theta$, and subtracting the second formula (11) from the first one

$$\Delta t_A - \Delta t_B = \frac{vd \cos\theta}{c^2} \quad \cdots \qquad (13)$$

Thus as a result of an increase in the rhythm of oscillation of the laser L_A and a decrease in the rhythm of the laser L_B (due to the absolute time dilation) the following additional phases should appear

$$\left.\begin{aligned} \alpha'_A &= \omega\,\frac{\Delta t_A - \Delta t_B}{2} = + \frac{d}{2c^2}\,\omega v \cos\theta, \\ \alpha'_B &= \omega\,\frac{\Delta t_B - \Delta t_A}{2} = - \frac{2}{2c^2}\,\omega v \cos\theta, \end{aligned}\right\} \quad \cdots \qquad (14)$$

which are *exactly* equal to these additional phase shifts which had to appear because of the different velocities of propagation of light along the "direct" and "opposite" directions, as can be seen comparing (14) with (8). Thus, when rotating the implement, the resultant tension $(U_A + U_B)_C$ will remain constant and the absolute velocity v cannot be measured.

Let us note that in our "coupled-mirrors" experiment (Marinov[13,16,17]) we measured the absolute velocity of the implement when "switching on an aether wind by rotation" because a rotating rigid shaft with two mirrors (or cog-wheels) on its ends represents *a unique* "clock" (with an enormous spatial extension, however !), while the lasers represent *two different* "clocks". If additional phases of the form (14) should appear in the "coupled-mirrors" experiment, then the shaft must get *twisted*. Certain scientists, endeavouring to save the principle of relativity, insist that such a twist inevitably has to appear ; let us call it (by analagy with the "Lorentz contraction") a "Lorentz twist". We can tell to these scientists only the following: Repeat our "coupled-mirrors" experiment and you will see with your own eyes that such a "Lorentz-twist" which you introduce *ad hoc*, trampling upon the energy conservation law and the whole body of dynamics, does not appear.

Thus any experiment by the help of which one aims to detect an "aether wind" when rotating two *independent* "light choppers" (the coherent light sources can be considered as extremely fast-operating "light choppers") must lead to a failure. Only when the spatially separated "light choppers" are driven by a rotating rigid shaft, *i. e.*, when a *unique* spatially extended "clock" drives the "light choppers" (*i. e.*, when a Newtonian time synchronization is realized (Marinov[15])), can the phase difference between them be preserved constant during the rotation and only then can the absolute velocity of the implement be measured.

Thus with the "coherent lasers" experiment we can measure only a *real* change in the velocity of the implement. The experiment is to be performed as follows : Assuming that the conditions (10) are fulfilled, let us measure some phase α of the electric tension $(U_A + U_B)_C$. If we know α_A and α_B, we could calculate $v \cos \theta$. However, the initial phases of the lasers are unknown. Let us then set the implement in motion with a certain velocity v along the "direct" direction (this velocity v is with respect to the Earth's surface). If the new phase which we shall measure is α', we shall have for the phase shift

$$\alpha' - \alpha = \frac{d}{c^2}\,\omega v \qquad \cdots \qquad (15)$$

The change in the sum of the phase shifts of the electric tensions U_A and U_B will be

$$(\psi'_A - \psi_A) + (\psi'_B - \psi_B) = \frac{2d}{c^2}\,\omega v \qquad \cdots \qquad (16)$$

Taking $\omega/2\pi = 5 \cdot 10^{14}$ Hz, $d = 1m$, $v = 45m/\text{sec} = 162$ km/h, we obtain a phase shift in the argument of the resultant electric tension $\alpha' - \alpha = \pi/2$.

3. *The "coherent lasers on a rotating disk" experiment*

To show more clearly why the inertial "coherent lasers" experiment is to be explained in the manner presented in the previous section, we shall consider the "coherent lasers on a rotating disk" experiment whose essence is as follows (Fig. 2):

Let us mount the implement from Fig. 1 on a rotating disk and measure the electric tensions U_A, U_B on the output of the detectors D_A, D_B. Let the first condition (10) be fulfilled. If the disk is first at rest and then set in rotation in a clockwise direction with a linear rotational velocity of its rim v, then the arguments of U_A and U_B will obtain additional phase shifts (see formulas (5), (6), (7) whose sum is given by formula (16). This "coherent lasers on a rotating disk" experiment is analogical to the historical "rotating disk" experiment of Harress-Sagnac, as can be seen immediately from Fig. 2 if both lasers are replaced by a unique light sources S and the mirrors M_A, M_B.

The substantial difference between the "coherent lasers on a rotating disk" experiment and the "rotating disk" experiment of Harress-Sagnac lies in the fact that there are *two* sources emitting coherent light in the former, while there is a *unique* light source in the latter. Thus if we should make angle θ in Fig. 2 almost equal to 2π and the source S is very near to the rim of the disk, then the "rotating disk" experiment will give a null result because the time lags which should appear along the path d will be compensated by the opposite time lags which will appear along the paths from S to M_A and M_B. However, the "coherent lasers on a rotating disk" experiment will always (at any angle θ in Fig. 2) give the result (16) because both coherent light sources are *spatially separated* here and, when "switching on the aether wind", *i. e.*, when

Fig. 2
The "coherent lasers on a rotating disk" experiment.

setting the disk in rotation, the difference in the initial phases of both lasers *cannot* change, as both lasers move all the time with the *same* absolute velocity (we suppose the disk to be at rest as a whole).

The "rotating disk" experiment will give the result (16) at any angle θ in Fig. 2 if the source S and the mirrors M_A, M_B

are placed very near to the center of the disk. The practical arrangement of this disrupted "rotating disk" experiment, as we call it, is shown in Fig. 3. Let us mention here that an interesting variant of the disrupted "rotating disk" experiment which can be carried out on the spinning Earth, where the angular velocity cannot be changed at pleasure, is considered in Marinov[15].

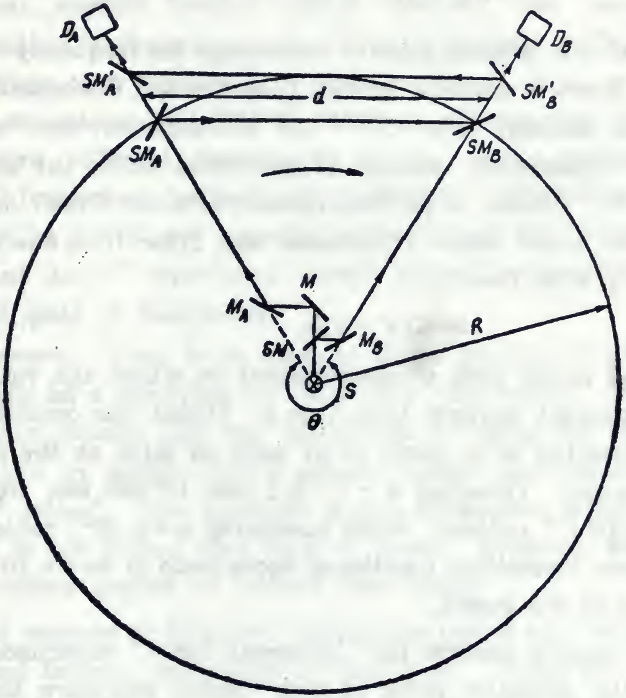

Fig. 3
The disrupted "rotating disk" experiment.

In Fig. 3 S is a light source, SM a semi-transparent mirror, and M, M_A, M_B are mirrors; the other elements are as in Fig. 1. This experiment was recently carried out by us in a slightly different arrangement (Marinov[16]) and its effect was *exactly the same one* as predicted by our theory. This gives us enough evidence to consider the theory of the "coherent lasers" experiment exposed in this paper as adequate to physical reality.

There is a rumour that Pythagoras liked to repeat the following words to his disciples: "When something in geometry is unclear, look at the circle".

Today we can say: "When something in space-time is unclear, one has to look at the rotating disk".

4. *The connection between the "coherent lasers" and light Doppler-effect experiments*

As at the present state of technology the frequency stability of the lasers is not high enough (Letohov and Chebotaev[10] have achieved stability $\delta\omega/\omega = 10^{-14}$ for 100 seconds), the "coherent lasers" experiment cannot be performed under the condition $\Delta\omega \cong 0$. Indeed, to perform it under this condition, one must have two lasers whose frequencies can differ from one another and vary with (see (15))

$$\delta\omega < (\alpha' - \alpha)/t, \qquad \cdots \qquad (17)$$

where t is the time of measurement in which the velocity of the implement changes from 0 to v. Under the condition (17) the measuring error could be at most as large as the effect to be measured. Choosing $\alpha' - \alpha = \pi/2$ rad, $t = 100$ sec, we obtain $\delta\omega < (\pi/2)10^{-2}$ rad/sec, while (assuming $\omega = \pi\ 10^{15}$ rad/sec) the frequency instablility mentioned above leads to $\delta\omega = \pi\ 10$ rad/sec for any of the lasers.

Let us now analyse the "coherent lasers" experiment from a slightly different point of view which will show that it is not necessary to spend time and efforts in its perfomance because, as we shall now show, it has already been carried out by Bömmel[1] in a very similar arrangement and has given the result predicted by us.

If we move the implement with a constant acceleration u, the velocity after any time interval t will be $v = ut$. Substituting this into (8) and assuming

$$\theta = 0, \quad d = n\lambda, \quad \alpha_A - \alpha_B + \frac{d}{c}\,\Delta\omega = 2\pi n, \qquad \cdots \qquad (18)$$

we obtain

$$(U_A+U_B)_C=2U_{max}\cos^2\left[\frac{1}{2}(\Delta\omega+\Omega)\,t\right] \quad \cdots \quad (19)$$

where

$$\Omega=\frac{d}{c^2}\,\omega u \quad \cdots \quad (20)$$

represents some additional frequency increase.

Thus, when accelerating the implement, the frequency of the resultant electric tension should increase (we repeat, the acceleration is along the axis of the implement). Taking the data given after formula (16) and $t=100$ sec, *i. e.*, $u=45$ cm/sec^2, we obtain $\Omega=(\pi/2)10^{-2}$ rad/sec. Hence now the lasers can have different frequencies ω_A, ω_B, and a change in the "beat" frequency $\Delta\omega$ is to be registered. Nevertheless, since it must be $\delta\omega<\Omega$, we have to conclude that this "accelerated coherent lasers" experiment cannot be performed either at the present state of technology.

However, there is no need at all to perform it because it will only be a repetition of Bömmel's experiment[1] where the frequency change (20) was established by using the Mössbauer effect and by accelerating a gamma emitter and absorber with $u=10^6$ m/sec^2. The accuracy of the Mössbauer effect ($\delta\omega/\omega=10^{-12}$) is not higher than that of lasers; however, such large accelerations cannot be realized with lasers.

The essence of Bömmel's experiment and of the "accelerated coherent lasers" experiment is the same. Since the emitter (say, mirror SM'_B in Fig. 1) and the receiver (mirror SM'_A) move with acceleration, then, as a result of the Doppler effect, the frequency received will differ from the emitted one. Indeed, as there is a certain time during which light has to cover distance d, the velocity of the receiver at the reception moment will be different (higher for u pointing along the emitter-receiver line) from the velocity of the emitter at the emission moment. This simple and clear physical phenomenon was pointed out by Einstein[7] and after half a century it was rediscovered by Lustig[11].

The analysis of the "coherent lasers" experiment given in the present paper allows one to understand that when the emitter and receiver move with acceleration, then the shift in the received frequency leads to an additional phase shift $\alpha'-\alpha$ which is equal to the product of the frequency shift Ω and the time t of accelerated motion. Thus the number of light waves (wavelengths) placed along the distance between emitter and receiver changes (the number increases for $\mathbf{c}\uparrow\uparrow\mathbf{u}$ and decreases for $\mathbf{c}\uparrow\downarrow\mathbf{u}$). Hence, as the velocity of light is the product of frequency and wavelength, it will be different for different velocities of the implement (with respect to the implement) because the frequency received remains unchanged. This conclusion can be made immediately from formulas (2).

Let us now consider the case of rotation of the "coherent lasers" implement with respect to its absolute velocity. As we showed in Section 2, according to our absolute space-time theory, no effect can now be registered. However, if one does not recognize the absolute time dilation, then one should expect an effect which can be registered by today's experimental techniques. Indeed, assuming $v=300$ km/sec and making a rotation from $\theta=90°$ to $\theta=0°$ in 10 seconds, we should realize an effective acceleration $u_{eff}=30$ km/sec. Thus, according to formula (20), one should obtain (for $d=1$ m) $\Omega/\omega \cong 3{\cdot}3\times10^{-13}$. Any traditional absolutist has to expect this result. Hence an eventual negative result of this experiment will constitute a very strong support for our absolute time dilation conception. It is interesting to note that this experiment has been performed using the Mössbauer effect and has given the negative (null) result predicted here. Indeed, Champeney and Moon[5] have rotated a disk on the opposite ends of whose diameter a gamma emitter and absorber have been placed. Champeney and Moon have registered no shift in the characteristic frequency of the absorber.

Let us calculate the result which a traditional absolutist has to expect in the Champeney and Moon experiment (see also

Champeney *et al.*[6], Turner and Hill[20]). Assuming that v is the component of the Earth's absolute velocity in the plane of the "rotor" and θ is the angle between it and the emitter-absorber-detector line, we shall have for the magnitude of the effective acceleration

$$u_{eff} = \frac{v \cos(\theta - \Delta\theta) - v \cos\theta}{\Delta t} = vf \sin\theta \quad \cdots \quad (21)$$

where $f = \Delta\theta / \Delta t$ is the angular velocity of the "rotor". Thus, according to (20),

$$\frac{\Omega}{\omega} = \frac{fd}{c^2} v \sin\theta \quad \cdot\cdot \quad (22)$$

Champeney and Moon have worked with $f/2\pi = 600$ rev/sec, $d = 8$ cm. Thus $\Omega/\omega = 3{\cdot}35 \times 10^{-12}\, v \sin\theta$, where v must be taken in km/sec. However, as Champeney and Moon have reported, no effect larger than $\Omega_r/\omega = 4{\cdot}25 \times 10^{-14}$ was registered. Thus one obtains $v \sin\theta < 1{\cdot}3 \times 10^{-2}$ km/sec, while we have established (Marinov[17]) that the Earth's absolute velocity is about 300 km/sec.

5. *Conclusion*

The "coherent lasers" experiment gives not a possibility for the measurement of the Earth's absolute velocity ; however, we hope that the analysis of this experiment performed in the present paper and its connection with the disrupred "rotating disk" experiment which we have pointed out will impel the scientific community to recognize the fact that we have measured the Earth's absolute velocity with the help of our "coupled-mirrors" experiment. If this should not succeed, one has to conclude that in the twentieth century it is as difficult for a human spirit to liquidate the chaos in the Universe, as in the sixteenth century it was difficult to liquidate the chaos in the solar system. The truth, the simplest, the most plain truth always must be crucified before being recognized.

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The Quasi-Doppler Experiment According to Absolute Space-Time Theory

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We find the relation between the frequencies received by two observers placed at a given parallel with 180° difference in longitude when they observe a distant light (radio) source. This relation depends on the absolute velocity of the Earth; however, because of the occurrence of aberration, the effect cannot be registered in practice.

Poincaré(5) pointed out that the historic Bradley experiment, with whose help the aberration of light was discovered, can be used for the establishment of the Earth's absolute velocity, if the aether model of light propagation is the true one. We call such a modification of the Bradley experiment the quasi-Bradley experiment, and we show(4) that, according to our absolute space-time theory, the quasi-Bradley experiment must give a positive result.

The Bradley experiment consists of a change of the direction under which a distant light source (a star) is seen when the observer changes his velocity. However, when the observer changes his velocity the received frequency also changes. This represents the well-known Doppler effect. In the present paper we consider the problem of whether the observation of the Doppler shifts in the frequencies of distant stars during the diurnal rotation of the Earth can give information about the Earth's absolute velocity.

We call the *aberration in frequency* (in contrast to the *aberration in direction* discovered by Bradley) the change in the frequency of light coming from a distant light source when the observer changes his velocity. If we call

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the *Doppler experiment*[2] the determination of light velocity when observing the aberration in frequency, then the Doppler experiment performed with the aim of measuring the Earth's absolute velocity will be called the *quasi-Doppler experiment*.

The treatment of the quasi-Doppler experiment in the framework of our absolute space–time theory is very simple. Let us have (Fig. 1) a distant light source (a star) S and two observers O_1, O_2 who rotate with relative velocities $\mathbf{v}_{r1}$, $\mathbf{v}_{r2}$ ($v_{r1} = v_{r2} = v_r$) about some center C which moves with an absolute velocity $\mathbf{v}$. The absolute velocities of O_1 and O_2, which lie on the same line with the center of rotation, are

$$\begin{aligned} v_1^2 &= v^2 + v_r^2 + 2vv_r \cos \varphi, \\ v_2^2 &= v^2 + v_r^2 - 2vv_r \cos \varphi \end{aligned} \qquad (1)$$

where φ is the angle between the velocity $\mathbf{v}$ and the velocity of the first observer $\mathbf{v}_{r1}$. Denote by δ the angle between the source–observer line and the velocity $\mathbf{v}$ at the moment of reception. Obviously δ is a constant angle, while φ changes by 2π during the period of rotation of O_1 and O_2. All angles are taken positive clockwise and negative counterclockwise.

According to our absolute space-time theory$^{(3)}$ if light with frequency ν is emitted by a source moving at velocity v, the frequency received by an observer moving at velocity v_0 will be

$$\nu_0 = \nu \frac{1 - (v_0/c) \cos \theta_0}{1 + (v/c) \cos \theta'} \left(\frac{1 - v^2/c^2}{1 - v_0^2/c^2} \right)^{1/2} \qquad (2)$$

where θ_0 is the angle between the line connecting the emission position of the source with the reception position of the observer and the velocity of the observer at the reception moment, while θ' is the angle between the line connecting the reception position of the observer with the emission position of the source and the velocity of the source at the emission moment.

Writing in formula (2) first $\nu_0 = \nu_1$, $v_0 = v_1$, $\theta_0 = \theta_1$, and then

[2] The Doppler experiment was been performed seven years ago by Hoff.$^{(1)}$ Let us note that if Bradley had had a prism with resolution better than $\Delta\nu/\nu = 10^{-4}$, he could have discovered the *yearly aberration in frequency*, which is $\Delta\nu/\nu = 2v/c = 2 \times 10^{-4}$, where $v = 30$ km/sec is the velocity of the Earth around the Sun. The Doppler experiment is much easier than the Bradley experiment because only two photographs of the spectrum of light coming from a certain star are to be taken with a time difference of six months. Of course, Bradley did not have a camera, and even if a suitable prism had been at his disposal, he would have been unable to measure the shift in the frequencies.

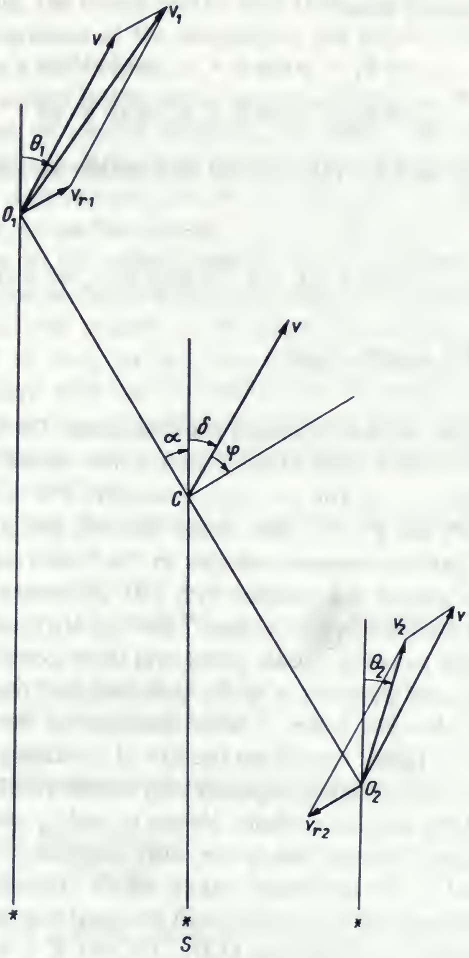

Fig. 1. The quasi-Doppler experiment.

$\nu_0 = \nu_2$, $v_0 = v_2$, $\theta_0 = \theta_2$ (see Fig. 1), and dividing the formulas obtained, we get

$$\frac{\nu_1}{\nu_2} = \frac{1 - (v_1/c)\cos\theta_1}{1 - (v_2/c)\cos\theta_2}\left(\frac{1 - v_2^2/c^2}{1 - v_1^2/c^2}\right)^{1/2} \tag{3}$$

Thus the relation between the frequency ν_1 received by the first observer and the frequency ν_2 received by the second observer does not depend on the velocity of the source.

From the figure we have

$$v_1 \cos \theta_1 = v \cos \delta + v_r \cos(\delta + \varphi)$$
$$v_2 \cos \theta_2 = v \cos \delta - v_r \cos(\delta + \varphi) \qquad (4)$$

Substituting (1) and (4) into (3), we find within an accuracy of second order in $1/c$

$$\frac{\nu_1}{\nu_2} = 1 - 2\frac{v_r}{c}\cos(\delta + \varphi) + 2\frac{vv_r}{c^2}[\cos\varphi - \cos\delta\cos(\delta + \varphi)]$$
$$+ 2\frac{v_r^2}{c^2}\cos^2(\delta + \varphi) \qquad (5)$$

This final expression is convenient for discussion. Let us measure ν_1 and ν_2 received from a given light (radio) source for which $\delta + \varphi = \pi/2$. If $\delta = 0$, we will have $\nu_1 = \nu_2$ for $\varphi = \pi/2$; however, if $\delta = \pi/2$, we will have $\nu_1 = \nu_2(1 + 2vv_r/c^2)$ for $\varphi = 0$. This result leads to the conclusion that we can measure the Earth's absolute velocity in the following manner: Let us have two receivers placed at a parallel with 180° difference in longitude. Let us observe a radio source when it "crosses" the line O_1O_2 and let the frequencies received be sent to some middle point and there compared. Imagine for simplicity that this middle point is at the pole and that the Earth represents a flat disk. As we showed in Ref. 3 when considering the so-called "rotor–rotor" experiment, if light is sent from the rim of a rotating disk to its center, then the change in the frequency depends only on the rotational velocity, not on the velocity of the disk as a whole. Hence ν_1 and ν_2 when received at the pole will suffer equal changes, due to the daily rotation of the Earth. If now we compare ν_1 and ν_2 for any radio source which "crosses" the line O_1O_2, then for $\delta = 0$ the frequencies ν_1 and ν_2 will be equal precisely at the moment when the radio source is on the line O_1O_2, i.e., for $\delta + \varphi = \pi/2$; however, for $\delta = \pi/2$ the frequencies ν_1 and ν_2 will be equal when [see (5) and take into account that for the case considered $\cos(\delta + \varphi) \approx 0$]

$$\cos(\delta + \varphi) = v/c \qquad (6)$$

Taking $v = 300$ km/sec,⁽²⁾ we obtain

$$\cos(\delta + \varphi) = \sin\alpha \approx \alpha = 10^{-3} = 3', 4 \qquad (7)$$

where α is the angle between the line O_2O_1 and the source–observer line. Such an angle is large enough to be reliably registered. However, the angle α is *exactly* equal to the aberration angle due to the motion of the Earth with velocity v. This signifies that when the line O_2O_1 makes an angle α with the source–observer line, the source *will be seen* along the direction O_1O_2. Thus, because of the occurrence of the aberration, the quasi-Doppler experiment leads in practice to a null result.

The problem solved in this paper was considered by Robertson,(6) who used the apparatus of special relativity, or rather, the technique of the Lorentz transformations. Robertson came to the conclusion that the relation between ν_1 and ν_2 depends only on the velocity of O_2 in the inertial frame where O_1 is at rest, or on the velocity of O_1 in the inertial frame where O_2 is at rest, i.e., only on the *relative* velocity of both observers: however (we should like to emphasize this), relative with respect to absolute space but not to the Earth, since with respect to the latter the relative velocity of both observers is equal to zero. In the case considered this relative velocity is equal to $2v_r$. We show with our formula (5) that the conclusion of Robertson is *not* true. The relation ν_1/ν_2 depends also on the absolute velocity v; however, the occurrence of the aberration in direction does not permit this dependence to be *experimentally* revealed.

Now we shall show that, for $v = 0$, our formula (5) [see also (3)] which reduces to

$$\frac{\nu_1}{\nu_2} = 1 - 2\frac{v_r}{c}\cos(\delta + \varphi) + 2\frac{v_r^2}{c^2}\cos^2(\delta + \varphi)$$
$$= \frac{1 - (v_r/c)\cos(\delta + \varphi)}{1 + (v_r/c)\cos(\delta + \varphi)} \tag{8}$$

is identical with both formulas obtained by Robertson,(6)

$$\nu_1{}' = \nu_2{}' \frac{1 - (V/c)\cos\varphi_2{}'}{(1 - V^2/c^2)^{1/2}}, \qquad \nu_2{}' = \nu_1{}' \frac{1 - (V/c)\cos\varphi_1{}'}{(1 - V^2/c^2)^{1/2}} \tag{9}$$

where $V = 2v_r$ is the relative velocity of O_1 with respect to O_2 (and vice versa), $\varphi_1{}'$ is the angle between the velocity of O_1 and the direction in which the source is seen if measured in a frame in which O_2 is at rest, and $\varphi_2{}'$ is the angle between the velocity of O_2 and the direction in which the source is seen if measured in a frame in which O_1 is at rest. Our angle $\delta + \varphi$ is between the source–observer line and the velocity $\mathbf{v}_{r1}$. Thus this is the angle between the velocity of O_1 and the *opposite* direction in which the source is seen if measured in a frame in which the Earth were at rest, i.e., in absolute space.

It is obvious that, because of the aberration in direction due to the motion of O_1 and O_2, we have

$$\varphi_1{}' = \pi - [\delta + \varphi + (v_r/c)\sin(\delta + \varphi)],$$
$$\varphi_2{}' = \delta + \varphi - (v_r/c)\sin(\delta + \varphi) \tag{10}$$

Putting (10) into (9) and taking into account that the aberration angle $(v_r/c)\sin(\delta + \varphi)$ is a small quantity, we obtain (8).

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NEWTONIAN TIME SYNCHRONIZATION WITH THE HELP OF LIGHT SIGNALS

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As light clocks with equal "arms" moving with the same velocity have the same rate, then, with the help of two such clocks put at the opposite ends of their mutual "arm", one can measure the laboratory's absolute velocity by rotating the apparatus over 360°.

In the numerous publications reviewed in ref. [1], show that the existence of absolute space can be esablished by measuring the *one-way light velocity*, i.e., y measuring effects of first order in v/c, where v is he absolute velocity of the laboratory and c the two-ay light velocity. According to my absolute space–ime theory which proceeds from the aether-Marinov nodel of light propagation and the Marinov transfornation [2], the effects of second order in v/c are null nd the search for such effects is a waste of time, efort, and money.

To be able to measure the one-way light velocity, ne must realize a *newtonian time synchronization* 3]. By the exchange of massless particles (photons) ne realizes an *einsteinian time synchronization* [3]. s I show [4], the exchange of massive particles neutrons) also leads to an einsteinian time synchroniation, as any particle is related to absolute space hrough its proper mass (the proper values of the hysical quantities must be measured *not* with respect o the inertial frame of reference used, as any relativt does, but *with respect to absolute space*). I formery supposed that the exchange of sound signals would ead to a newtonian time synchronization and proosed an experiment of this kind [5]. However, in he light of the recent *discovery* [4] that the motion f any particle is related to absolute space, I must rexamine the problem about the propagation of sound which is very complicated and needs a more profound theoretical and experimental investigation. Thus, at the present time, the unique way for the realization of a newtonian time synchronization remains the rotating axle. With the help of a rotating axle, in 1973, for the first time, I succeeded in registering the Earth's absolute motion in a laboratory [6] and in 1975/76, with the interferometric "coupled-mirrors" experiment, I established that the Sun's absolute velocity is 303 ± 20 km/s with equatorial coordinates of its apex $\delta = -23° \pm 4°$, $\alpha = 14$ h 17 min ± 20 min [1,7,8].

In the present note I shall show that there is a possibility for the realization of a newtonian time synchronization with the help of light signals. In the world literature a proposal of this kind *does not exist*. Let us have two *light clocks* (see, for example, ref. [2]) in which the points where one counts the periods of *any* of the clocks serves as a point of reflection for the light pulse of the other clock. Thus the "arms" of the light clocks are equal and consequently their periods must be equal too. If we rotate these two light clocks about an axis, perpendicular to their mutual "arm" and passing through its middle point, or passing through a point in a plane in which the clocks lie, *their periods will remain equal*. Thus sending light signals from the first to the second clock, and *vice versa*, and rotating the apparatus over 360°, we shall be able to measure the absolute velocity of the laboratory.

Let me note that if the "arms" of the light clocks were much shorter than the distance between them,

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then by rotating the clocks they would display a *different* time dilation, since in such a case the absolute velocities of the clocks during the rotation would be different. As I showed [9], according to the absolute time dilation conceptions [2,3], their periods will change in such a way that the absolute effect which *would be* registered in the case of synchronously going clocks will be *annihilated*. However, when their "arms" are equal, i.e., when their *space extension* is the same, their velocities remain equal for *any* motion of the clocks. If the clocks rotate about a point in the middle the absolute velocity of the clocks does *not* change during the rotation. If the clocks rotate about another point, their velocities are equal to the velocity of the middle point and the changes in their rates due to the absolute time dilation will be equal. Thus the "phase difference" between the readings of both clocks will not change and the clocks will remain *synchronous.* With the help of such synchronous clocks the one-way light velocity can be measured.

The performance of such a *"synchronous light clocks" experiment* is as follows (fig. 1): At the opposite ends, A and B, of an "arm" of length d there are two high-frequency shutters (Kerr cells). We shall consider the situation at point A. The situation at point B will be exactly the same. By applying a "starting" electric pulse of duration $T_0 < d/c$, one opens shutter Sh$_A$ and a light pulse, emitted by a laser L$_A$, goes to the opposite end B behind which is a semi-transparent mirror SM$_B$ and a photo-receiver (a rapid photo-diode) P$_{B1}$. The *reflected* light pulse returns back to point A where it illuminates another photo-receiver P$_{A2}$; the produced electric pulse of the same duration T_0 is applied to an oscilloscope Osc$_A$ and to the shutter which emits a new light pulse that performs exactly the same trip and action. The *transmitted* light pulse illuminates the photo-receiver P$_{B1}$ behind the semi-transparent mirror at B; the produced electric pulse is applied to an oscilloscope Osc$_B$ at point B. As the situation at point B is exactly the same as at point A, on the screen of the oscilloscope at A (as well as on that at B) one will see two pulses: one produced by the "to-and-fro" going light pulse, originating from the A-lase and one produced by the "to" going light pulse originating from the B-laser. By shifting the semi-transparent mirror one changes the *period* $T = 2d/c$ of the light clocks. By changing for a while the path of the electric pulse from the photo-receiver to the shutter one changes the time t_ψ between the openings of the shutters which we shall call "phase difference". Let u suppose that the periods of the light clocks are exactl equal and that $t_\psi = T/2$. If the axis of the apparatus i perpendicular to its absolute velocity, the two pulses on the screens of both oscilloscopes will coincide. Wh the axis AB becomes parallel to the absolute velocity v, the "to" pulse on the A-oscilloscope will become shifted by a "distance" $\Delta t = dv/c^2$ *in advance* with respect to the "to-and-fro" pulse, while the "to" puls on the B-oscilloscope will become shifted by the same "distance" *in retard* with respect to the "to-and-fro" pulse. These shifts appear because of the *Marinov effect* [1,9]. When the axis AB becomes anti-parallel to v everything will be *vice versa.*

Let us compare the "synchronous light clocks" experiment with our "rotating axle" experiments [1].

Advantages. (1) There is no mechanical part. (2) The axis of the apparatus can be made long enough; so, at $d = 3$ km, one has $T = 2 \times 10^{-5}$ s and for $v = 30$ km/s the Marinov effect is $\Delta t = 10$ ns. Such a shift ca reliably be registered on an oscilloscope [10].

Disadvantages. Since both light clocks are *independent*, it is a difficult problem to make their periods equal and maintain them equal during a whole day in which the measurement is to be made. Let us note tha a difference Δd in the "arm" of the light clock causes a change in its period $\Delta T = 2\Delta d/c$ and a "phase shift" *in a second* of $\Delta t_\psi = \Delta T/T = \Delta d/d$ s. Thus to have $\Delta t_\psi \leqslant \Delta t$ *in a second*, the "arms" of the light clocks must be equal to within $\Delta d = vd^2/c^2$ (=3 × 10^{-3} cm, for $v = 300$ km/s). To have $\Delta t_\psi \leqslant \Delta t$ *in a day*, Δd must be 5 orders lower. It is clear that the maintenanc of equal or nearly equal periods is a very difficult prob lem from a technical point of view. This is the *most important disadvantage* of the "synchronous light clocks" experiment. If one should reduce the "arm"

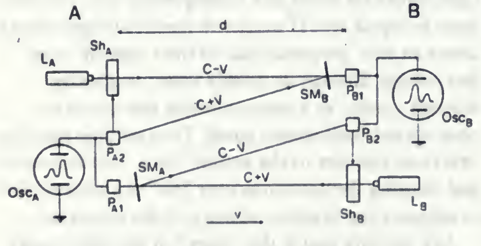

Fig. 1. Set-up of a "synchronous light clocks" experiment.

of the light clocks to a couple of meters (in which case the apparatus may be put on a rotating platform and the measurement of v performed in a couple of seconds), one *loses* the advantage of the long basis d, while the disadvantage of the unequal periods *remains*.

The editor of this journal suggested that I clearly state which is the prediction of the Einstein theory for the outcome of the "synchronous light clocks" experiment. My answer is the following: The relativity theory rejects the notion "newtonian time synchronization" as being deprived of sense. This theory also rejects the notions "absolute velocity" and "light velocity's direction dependence in an inertial frame" as physically senseless. Thus the relativity theory must predict a *null* result in this experiment, as well as in all experiments performed and proposed by me, *with a positive outcome.*

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Moving platform experiments

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Abstract : Proceeding from our absolute space-time theory, we calculate the effects of the *drag-of-light* experiments in which medium and interferometer move inertially with respect to each other or with respect to absolute space (called by us the *moving platform* experiments). We give an account on the performance of all four possible variants, three of which are carried out for the first time. The results obtained confirm our predictions and, considered together with the results of the *rotating disk* experiments, reveal the failure of the principle of relativity. We consider theoretically the phenomenon of drag of light aberration and propose an experiment for its observation.

1. Introduction

In the summer of 1973, using the deviative *coupled-mirrors* experiment, we measured for the first time in history the Earth's absolute velocity (Marinov 1974). Since only the fluctuation error of our implement was as large as the measured effect, the scientific community remained sceptical whether any positive effect had indeed been registered (Horedt 1975). For this reason two years later, with the help of the interferometric *coupled-mirrors* experiment, we measured for the second time this velocity with enough reliability (Marinov 1977), to establish that in July its magnitude is about 279 km/sec and its apex has right ascension about 14^h23^m and declination $-26°$. Thus we have definitely disproved the principle of relativity and restored the XIXth century aether conception of the propagation of light.

Because of the inertia of scientific thinking, the repetition of our *coupled-mirrors* experiment and the treatment of its positive effect in the frame of the Newtonian absolute space-time conceptions had to wait many years. Aiming to precipitate this process, the International Conference on Space-Time Absoluteness

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(ICSTA) was organized (Marinov 1976, 1977). However it was cancelled for political reasons and the postponed conference will now meet in an English-speaking country during 1981. In the present paper, we report the results of the *moving platform* experiments performed recently by us in order to give another *logically patent* disproof of the principle of relativity. We hope that the results of these experiments and their mathematical analysis will speed up the restoration of the aether model of light propagation.

2. The rotating disk (Harress) experiment

The *moving platform* experiment is tightly connected with the *rotating disk* experiment. For this reason we shall first give brief attention to the latter.

The theoretical analysis of the *rotating disk* experiment within an accuracy of first order in v/c has been given (Marinov 1978) and within an accuracy of second order in v/c (Marinov 1976). In the present paper we shall write all formulas within an accuracy of *first order* in v/c.

The *rotating disk* experiment can be performed in four different variants which we have called as follows :

1. The Harress-Marinov experiment, in which the medium is at rest and the mirrors rotate.

2. The Harress-Fizeau experiment, in which the mirrors are at rest and the medium rotates.

3. The Harress-Pogany experiment, in which the mirrors and medium rotate together.

4. The Harress-Sagnac experiment, in which the mirrors rotate and as medium vacuum (air) is taken.

The Harress-Sagnac experiment was performed first by Sagnac (1913) and repeated on the spinning Earth by Michelson and Gale (1912) ; the latter represents one of the greatest experimental achievements in human history. The Harress-Pogany experiment was performed first by Harress (1912) and repeated very carefully by Pogany (1928). We have recently performed the Harress-Marinov and Harress-Fizeau experiments ; the latter, in a substantially different arrangement called the *water tube* experiment, was performed first by Fizeau (1859). The Harress-Marinov experiment was performed first (in a slightly different arrangement than ours) by Dufour and Prunier (1942). Since the Zeeman-Marinov variant of the *moving platform* experiment (where the medium is at rest and the mirrors move) was performed first by us, we shall call, *exclusively for the sake of uniformity*, the common type of the *rotating disk* experiment where the medium is at rest and the mirrors rotate the Harress-Marinov experiment (1978).

3. The moving platform Zeeman experiment

The *moving platform* experiment is an analogue of the *rotating disk* experiment, where the motion of the medium or/and the mirrors (the interferometer) is not rotational but inertial. Now, again, four variants can be realized which we call :

1. The Zeeman-Fizeau experiment, in which the mirrors are at rest and the medium moves. This experiment was performed first by Fizeau (1859) with water and by Michelson and Morley (1886) with a solid medium. It was very carefully repeated by Zeeman with liquid and solid media.

2. The Zeeman-Marinov experiment, in which the medium is at rest and the mirrors move. This experiment was performed recently by us.

3. The Zeeman-Pogany experiment, in which mirrors and medium move together. This experiment was performed recently by us and, as a matter of fact, it can be carried out by anyone who would take the care to observe whether the interference picture in a Zeeman-type implement, in which *mirrors and medium are at rest*, should change during a day when the absolute velocity of the implement (or its component along the axis of the apparatus) changes, as a result of the Earth's rotation.

4. The Zeeman-Sagnac experiment, in which the mirrors move and as a medium vacuum (air) is taken. This experiment was performed recently by us and, as a matter of fact, it can be carried out by anyone who...(see the previous point).

Following Zernike (1947), we can reduce the *moving platform* experiment, stripped of all fundamentally irrelevant details, to the following ideal arrangement (Figure 1) : The box S contains a monochromatic source together with a device producing two parallel coherent light beams : B_v which propagates in vacuum and B_m which propagates in a medium with refractive index n. After travelling a distance L, they enter a second box O in which they are united and their interference observed. Both boxes are halfway immersed in the medium. First the boxes

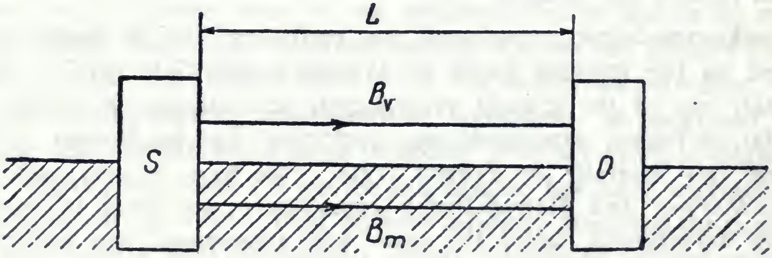

Figure 1. Principal scheme of the "moving platform" experiment (the inertial "moving platform" experiment).

(also called mirrors) and the medium are at rest and a specific interference picture is observed. Then one realizes the four different combinations mentioned above, and from the difference in the observed interference pictures conclusions can be drawn about the character of light propagation.

We suppose that the motion of the medium, or of the boxes, or both, proceeds from left to right.

4. The Zeeman-Fizeau experiment

We obtained (Marinov 1974, 1977) the following formula for the velocity of light in a medium moving at velocity v, if measured by an observer at rest,

$$c_m = \frac{c}{n} + v\left(1 - \frac{\nu}{n^2}\frac{dn}{d\nu} - \frac{1}{n^2}\right)\cos\theta, \tag{1}$$

where ν is the frequency of the light used, and θ is the angle between v and the direction of light propagation.

When mirrors and medium in figure 1 are at rest, a photon proceeding along the path B_m (a B_m-photon) will arrive at box O with the following time delay after a photon proceeding along the path B_v (a B_v-photon)

$$t = \frac{L}{c/n} - \frac{L}{c} = \frac{L}{c}(n-1). \tag{2}$$

When the medium is set in motion the time delay will become (for figure 1 we assume $\theta = 0$)

$$t_{Z-F} = \frac{L}{c_m} - \frac{L}{c} = \frac{L}{c}\left[n - 1 - \frac{v}{c}\left(n^2 + \nu\frac{dn}{d\nu} - 1\right)\cos\theta\right]\cdot \tag{3}$$

Hence, for the Zeeman-Fizeau experiment, the effect to be observed in the interference picture will correspond to a time difference

$$\Delta t_{Z-F} = t - t_{Z-F} = \frac{Lv}{c^2}\left(n^2 + \nu\frac{dn}{d\nu} - 1\right)\cos\theta. \tag{4}$$

Conventional physics (references are given in Marinov 1977) comes to formula (4) for a solid medium ; however, for a liquid medium which *washes* the boxes S, O as a river washes the columns of a bridge, it comes to the following formula

$$t'_{Z-F} = \frac{Lv}{c^2}\left(n^2 + n\nu\frac{dn}{d\nu} - 1\right)\cos\theta. \tag{5}$$

As we have shown (Marinov 1977), repeating very carefully the *water tube* experiment, formula (4) and *not* formula (5) holds good for a liquid medium.

Let us mention that for a liquid medium which *washes* the boxes Zernike comes to formula (5) and for a solid medium to the following *very bad* formula

$$t''_{Z-F} = \frac{Lv}{c^2}\left(n+\nu\frac{dn}{d\nu}-1\right). \tag{6}$$

It must be especially emphasized that if the liquid medium is closed in a box (whose length is L) and we shall move it between the boxes S, O which are to be placed far enough from each other, then conventional physics describes the effect also by the help of formula (4).

5. The Zeeman-Marinov experiment

We obtained (Marinov 1976) the following formula for the velocity of light in a medium at rest, if measured by an observer moving at velocity v,

$$c'_m = \frac{c}{n} - v\cos\theta. \tag{7}$$

where θ is the angle between v and the direction of light propagation.

An observer registers frequency ν of the photons when being at rest with respect to the source. When he moves with velocity v, the frequency received will be

$$\nu_0 = \nu\left(1+\frac{v}{c}\cos\theta\right), \tag{8}$$

where θ is the angle between v and the direction of light propagation.

Since n is the refractive index for the frequency ν, the refractive index for the frequency ν_0 will be

$$n(\nu_0) = n(\nu) + \frac{dn}{d\nu}\,d\nu = n + \frac{v}{c}\,\nu\frac{dn}{d\nu}\cos\theta. \tag{9}$$

Substituting this into (7), we obtain

$$c'_m = \frac{c}{n} - v\left(\frac{\nu}{n^2}\frac{dn}{d\nu}+1\right)\cos\theta. \tag{10}$$

For $n=1$, *i.e.*, for vacuum, we obtain

$$c' = c - v\cos\theta. \tag{11}$$

When the mirrors are set in motion, the time delay with which a B_m-photon arrives at box O after a B_v-photon becomes (for figure 1 we assume $\theta=0$)

$$t_{Z-M} = \frac{L}{c'_m} - \frac{L}{c'} = \frac{L}{c}\left[n-1+\frac{v}{c}\left(n^2+\nu\frac{dn}{d\nu}-1\right)\cos\theta\right]. \tag{12}$$

Hence, for the Zeeman-Marinov experiment, the effect to be observed in the interference picture will correspond to a time difference

$$\Delta t_{Z-M} = t - t_{Z-M} = -\frac{Lv}{c^2}\left(n^2+\nu\frac{dn}{d\nu}-1\right)\cos\theta. \tag{13}$$

Conventional physics also comes to the conclusion that the effect in the Zeeman-Marinov experiment is to be described by formula (13), because, according to the principle of relativity, there is *no physical difference* between this and the Zeeman-Fizeau experiment. Let us cite on this topic Post (1967) :

> The rotational Fresnel-Fizeau experiment (medium rotating, mirrors stationary) and Dufour-Prunier (1942) experiment (medium stationary, mirrors rotating) are physically equivalent.
>
> For the theory of uniformly translating systems it is immaterial whether one considers the medium to be moving with respect to the frame of reference of the observer or whether one considers the frame of reference to be moving with respect to the medium, because translatory motion does not generate any intrinsic physical changes in the body as long as the translation is uniform.
>
> For non-uniformly moving systems it is mandatory to distinguish between the motion of the object (medium) and the motion of the observer (frame of reference). The principle of relativity breaks down for non-uniform motion.

Thus, according to Post, the principle of relativity can break down only for non-inertial motion but it must hold good for uniform motion, and the Zeeman-Marinov experiment must have *exactly the same physical character* as the Zeeman-Fizeau experiment. For this reason the former has been considered only as a trivial tautology of the latter. Let us cite on this topic Zernike (1947) :

> One might further think of testing the principle (the principle of relativity—S. M.) by performing *both* experiments, medium moving and source *etc.* moving. This could not well be done with the flowing water, but it would be perfectly possible with the glass in Zeeman's arrangement... I communicated this suggestion to Zeeman in 1919 together with the above derivation of the formulas, but the experiment was never performed.

Our absolute space-time theory predicts for the Zeeman-Marinov experiment the same effect as for the Zeeman-Fizeau experiment ; however *these two experiments are physically not equivalent,* and the formulas with the help of which we obtain identical results are *different.* This difference in the formulas is very important and it shows that the principle of relativity breaks down also for inertial motion but the possibilities which Nature offers for the practical observation of its failure for inertial motion are very scarce (the first and still *unique* definitive *experimental disproof* of the principle of relativity is given by our *coupled-mirrors* experiment (Marinov 1974, 1977).

However, analysing the specific performance of the *moving platform* experiments in Sect. 8, one has to agree that even if the effects measured are the same as these predicted by the theory of relativity, nevertheless, the principle of relativity breaks down *conceptually* at this very moment when one tries to calculate (to explain) these effects. This is due to the fact that we have succeeded to model a translational motion by the help of rotational motion, preserving as far as needed the inertial character of the phenomenon, and we already know well that *on a rotating disk the velocity of light is direction dependent and the principle of relativity breaks down.* Let ue here emphasize that the direction dependence of light velocity on a rotating disk was publicly recognized by a relativity disciple (Grφn 1976) ; see also the very interesting paper of Browne (1977) who, according to our nomenclature (Marinov 1976, 1977), is a relative absolutist.

6. The Zeeman-Pogany experiment

We obtained (Marinov 1976) the following formula for the velocity of light in a medium moving with velocity v, and measured by an observer attached to the medium

$$c'_m = \frac{c}{n} - \frac{v}{n^2}\cos\theta, \tag{14}$$

where θ is the angle between v and the direction of light propagation.

When the mirrors are set in motion together with the medium, the time with which a B_m-photon arrives at box O after a B_v-photon will be (for figure 1 we assume $\theta = 0$)

$$t_{Z-P} = \frac{L}{c'_m} - \frac{L}{c'} = \frac{L}{c}(n-1) \tag{15}$$

Hence, for the Zeeman-Pogany experiment, the effect to be observed in the interference picture will correspond to a time difference

$$\Delta t_{Z-P} = t - t_{Z-P} = 0, \tag{16}$$

and thus no change will be registered.

The same result is predicted also by the principle of relativity.

7. The Zeeman-Sagnac experiment

The effect for the Zeeman-Sagnac experiment can be obtained immediately from formula (13), putting $n=1$, or from formula (16), i.e.,

$$\Delta t_{Z-S} = 0. \tag{17}$$

8. Practical realization of the moving platform experiment

The practical scheme of our set-up for the performance of the Zeeman experiment is shown in figure 2. We call this variant of the Zeeman experiment the *non-inertial moving platform* experiment, while the variant shown in figure 1 will be called the *inertial moving platform* experiment.

S is a light source (He-Ne laser), Sh a shutter which is governed by the rotating turn about and lets light pulses (of a duration $\cong 10^{-8}$ sec) pass only when the mirrors M_1, M_2, M_3 are parallel to the diametrically opposite small sides of the medium. As a transparent medium we have taken distilled water

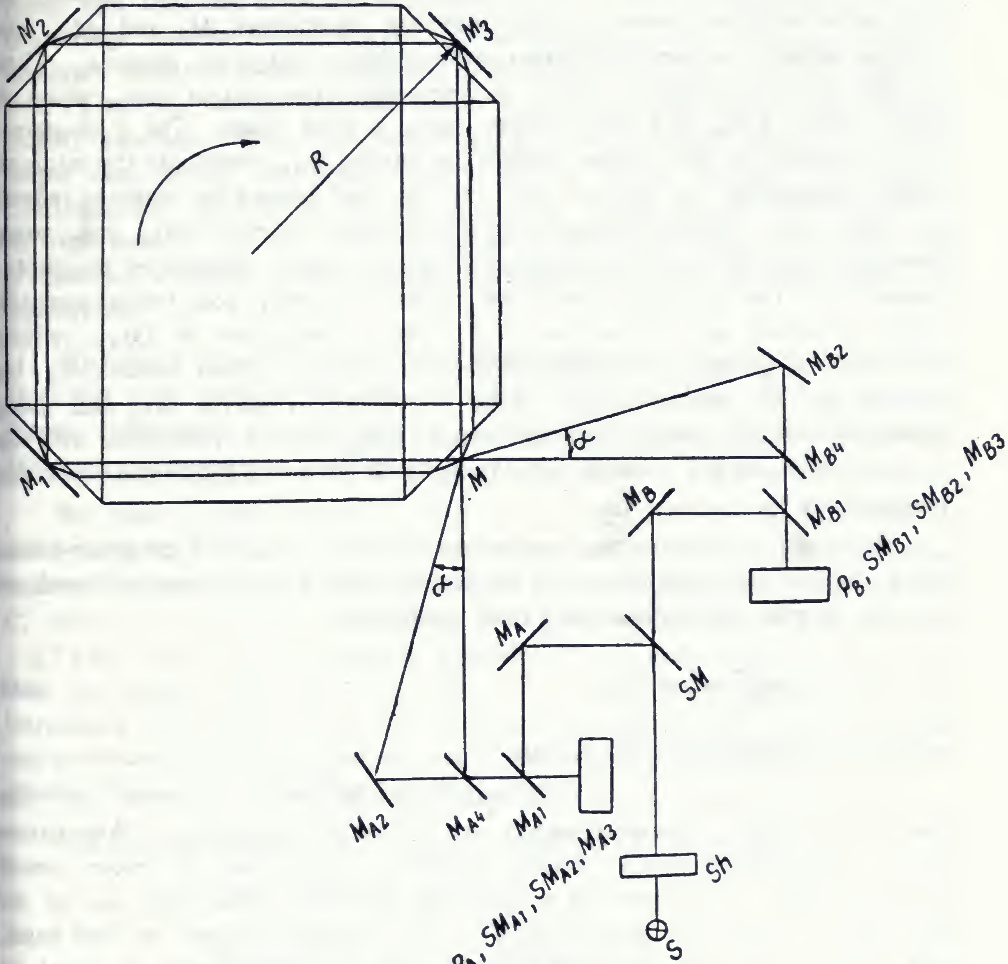

Figure 2. Actual scheme of the "moving platform" experiment (the non-inertial "moving platform" experiment).

put in a metallic vessel of the form shown in figure 2. Glass windows are placed also in the metallic interfaces which divide the ring into compartments. Taking into account the thickness of the glass plates and their refractive index, we have placed the mirrors M_1, M_2, M_3 in such positions that the real light path (distance multiplied by refractive index) along the contour $M-M_1-M_2-M_3-M$ should be exactly equal to the light path which is to be covered if mirrors M_1, M_2, M_3 were *immersed* in water. The distance between the mirrors M_1 and M_3, and also between mirror M_2 and point M, is $2R$.

The light beam emitted by S splits at semi-transparent mirror SM into A-beam and B-beam which follow identical paths and for this reason we shall follow only the A-beam. After reflection on mirrors M_A and M_{A1}, the A-beam reflects on semi-transparent mirror SM_{A1} and goes *upwards*. Then it splits into two daughter beams at semi-transparent mirror SM_{A2} which is placed above SM_{A1} and their planes make a right angle. The A'-daughter-beam reflected on SM_{A2} then reflects on mirror M_{A2}, enters into the medium, reflects successively on mirrors M_3, M_2, M_1, and, leaving the medium, reflects on mirror M_{B2}. Then it reflects on semi-transparent mirror SM_{B2} and, going *downwards* through the semi-transparent mirror SM_{B1}, illuminates the photoresistor P_B. The A-daughter-beam transmitted by SM_{A2} goes further *upwards*, reflects on mirror M_{A3} whose plane is parallel to the plane of SM_{A2}, reflects on mirror M_{A4}, and, proceeding *above* the medium, reflects successively on mirrors M_3, M_2, M_1 and M_{B4}. Then it reflects on mirror M_{B3} and, going *downwards* through semi-transparent mirror SM_{B2} (where it interferes with the A'-daughter-beam) and through semi-transparent mirror SM_{B1}, illuminates the photoresistor P_B.

The angle α between the projections of the A'- and A''-daughter-beams in the plane of the figure, before the entrance of the A'-beam into the medium and after its exit, can be determined from Snell's law

$$\sin\left(\frac{\pi}{4}+\alpha\right) = \frac{\sqrt{2}}{2}n, \qquad (18)$$

where n is the refractive index of water.

The photoresistors P_A and P_B which are illuminated *uniformly* by the interfering B- and A-daughter-beams are put in the arms of a Wheatstone bridge. Our interferometric bridge method is described in more detail (Marinov 1977). The bridge has a maximum sensitivity when the *sum of the differences* in the light paths of the A'- and A''-daughter-beams, on one hand, and of the B'- and B''-daughter-beams, on the other hand, is equal to $(2n+1)\lambda/2$ (n is an integer and λ the light wavelength). When this sum is equal to $n\lambda$ the sensitivity falls to zero. As we already explained (Marinov 1977), a maximum sensitivity is to be adjusted by the help of a tuner which can be put, say, between mirror M_{A2} and point M. However, this can be done if the temperature of the water (which is crossed *only* by the A'- and B'-daughter-beams) is maintained constant with a very high precision, since, as a matter of fact, the water represents another tuner which leads to very considerable fluctuations in the A'- and B'-light-paths corresponding to the fluctuations of the water temperature. We worked without maintaining a maximum sensitivity which is, as reported by Marinov (1974), about $\delta\Delta = \pm 2.5 \times 10^{-4}\lambda$. We have chosen, with enough surety, an average sensitivity $\delta\Delta = \pm 10^{-2}\lambda$.

Let us emphasize that the thermal fluctuations change the water refractive index and thus lead to *exactly equal* changes in the A'- and B'-light-paths, so that the bridge remains in equilibrium (as mentioned above, only its sensitivity changes). However, when we begin to rotate medium or mirrors, the illuminations over P_A and P_B change *oppositely*, since now the A'- and B'-light-paths change *exactly oppositely*. Thus, with the increase of the rotational velocity, the bridge comes into greater and greater disequilibrium, passes through a maximum disequilibrium, and, when the *sum* Δ *of the changes* (at rest and rotation) *of the differences* in the A'- and A''-light-paths, on one hand, and B'- and B''-light-paths, on the other hand, becomes equal to λ, the bridge comes again into equilibrium.

We rotated the disk first counter-clockwise with angular velocity Ω_1 and then clockwise with angular velocity Ω_2, taking $\Omega = \frac{1}{2}(\Omega_1 + \Omega_2)$. For the Zeeman-Fizeau experiment we measured $N_{Z-F} = 50.80 \pm 0.04$ rev/sec and for the Zeeman-Marinov experiment $N_{Z-M} = 50.94 \pm 0.04$ rev/sec, having $N = \Omega/2\pi$.

We take (Landölt-Bornstein 1962) $n = 1.3317 \pm 0.0003$ for the light with $\lambda = 632.8$ nm of the He-Ne laser used. The error $\delta_n = \pm 0.0003$ corresponds to a change in the refractive index with the temperature which was maintained at $T = 20° \pm 3°$ C, since it is $dn/dT = 10^{-4}$ degree^{-1}. From the same source we read $dn/d\lambda = -2.7 \times 10^{-5}$ nm^{-1} and we assumed $\delta(dn/d\lambda) = 0$. We had $R = 30.6 \pm 0.2$ cm ; we took an enough large error δR which has to compensate also possible errors introduced at the measurement of the thickness of the glass plates and errors which can be introduced from the replacement of the real light-paths of the A'- and B'-daughter-beams by idealized paths only in water.

The working formula obtained from (4) and (13) is the following

$$\Delta = \lambda = 2c\Delta t_{Z-F} = -2c\Delta t_{Z-M}$$

$$= 2\frac{Lv}{c}\left(n^2 + v\frac{dn}{dv} - 1\right)\cos\theta = 8\,\frac{\Omega R^2}{c}\left(n^2 - \lambda\frac{dn}{d\lambda} - 1\right), \tag{19}$$

having taken into account that for our arrangement we have

$$L = 4\sqrt{2}\,R, \qquad v = \frac{\sqrt{2}}{2}\,\frac{\Omega R}{\cos\theta}. \tag{20}$$

Let us emphasize that the effects in the Harress-Fizeau and Zeeman-Fizeau experiments are *absolutely identical*, while the effects in the Harress-Marinov and Zeeman-Marinov experiments are *substantially different*.

Substituting all measured quantities into formula (19), we obtain the following figures for the velocity of light

$$c_{Z-F} = (3.01 \pm 0.07) 10^8 \text{ m/sec}, \qquad c_{Z-M} = (3.02 \pm 0.07) 10^8 \text{ m/sec} \tag{21}$$

where for δ_c we have taken the maximum absolute measuring error.

For the Zeeman-Pogany and Zeeman-Sagnac experiments we registered no perceptible disequilibrium of the bridge when rotating the disk.

9. The drag aberration

In the previous sections of this paper, as well as in all of our referred papers, we analyse only the effects caused by a moving medium on light velocity. However, when the velocity of the medium and the direction of light propagation are not parallel, also a change in the direction of light propagation does appear. This effect has some common features with the aberration of light discovered by Bradley and we call it the *drag aberration.*

Let us have (figure 3) a transparent medium with parallel surface planes on which a light beam is incident under an angle ϕ at a point P. If the angle of refraction is ψ, this beam will leave the medium at a point Q underman an angle ϕ equal to the angle of incidence.

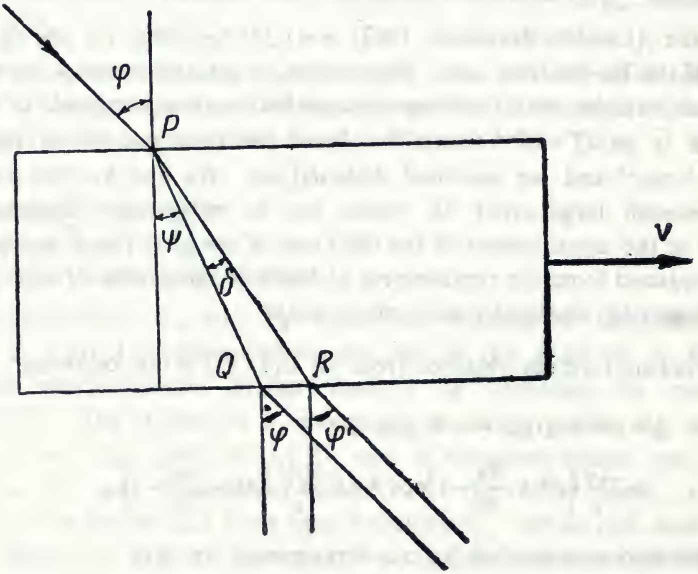

Figure 3. The drag aberration.

Let the medium now be set in motion with velocity v from left to right (imagine that the medium is represented by a horizontol disk which rotates about a vertical axis, and the light beam strikes it somewhere near the rim). Now the light beam will leave the medium at a particular point R. We call the angle $\delta = QPR$ the *drag angle* (or the *drag aberration*).

We shall find the drag angle, proceeding from our hitch-hiker model of light propagation (Marinov 1974*b*), and perform all calculations within an accuracy of first order in v/c.

Formula (1) written without the dispersive term shows that, within an accuracy of first order in v/c, the velocity of light in a medium represents a vector sum of the velocities c/n and $v(1-1/n^2)$, θ being the angle between these two velocities. Here n is the refractive index of the medium for the frequency ν of the used monochromatic light. Let us now take the dispersion into account. Since the molecules of the medium move with respect to the light source, a Doppler effect will occur and the effective refractive index will be given by formula (9). Thus the velocity of the photons in the moving medium will be a vector sum of the velocity

$$\frac{c}{n(\nu_0)} = \frac{c}{n}\left(1 - \frac{v\nu}{cn}\frac{dn}{d\nu}\cos\theta\right) \tag{22}$$

and the velocity $v(1-1/n^2)$, noting that the substitution of (9) into the last expression will lead to terms of second order in v/c. The magnitude of the sum of these two vectors gives the result (1).

Taking into account that the photons cross the medium for a time

$$t = \frac{PQ}{c/n(\nu_0)} = \frac{dn}{c\cos\psi}\left(1 + \frac{v\nu}{cn}\frac{dn}{d\nu}\cos\theta\right), \tag{23}$$

where d is the thickness of the medium, we obtain for the distance QR along which the photons will be "aberrated" (within an accuracy of first order in v/c)

$$QR = v\left(1 - \frac{1}{n^2}\right)t = \frac{dv}{c\cos\psi}\left(n - \frac{1}{n}\right), \tag{24}$$

Thus the drag angle will be

$$\delta = \frac{QR\cos\psi}{PQ} = \frac{v}{c}\left(n - \frac{1}{n}\right)\cos\psi. \tag{25}$$

This formula can be easily verified experimentally by silvering the parallel planes of the medium, making them light reflecting, so that the beam has to undergo a high number of reflections before leaving the medium. By the help of our cylindrical mirrors indicator (Marinov 1974 *a*), the appearing drag aberration can be reliably registered. Such an experiment was recently carried out by Jones (1975) under the condition $\psi = 0$, and it has verified formula (25).

Player (1975) and Rogers (1975), proceeding from the Lorentz transformation and *considering only the particular transverse case* $\psi=0$, have obtained the following formula for the drag of light

$$\delta=\frac{v}{c}\left(n_g-\frac{1}{n}\right), \tag{26}$$

where

$$n_g=n+\nu\,\frac{dn}{d\nu} \tag{27}$$

is the group refractive index and n is the phase refractive index.

In our hitch-hiker model of light propagation there is also a difference between group and phase velocities, since the *coherent* photons interfere and the energy in a light pulse will be transferred by the group and not by the phase velocity. Indeed, according to our model, all photons move with the same velocity in the gaps between the molecules, but the photons with a higher frequency move with a lower *average* velocity because they are hitched longer time on the molecules or because they are hitched on a larger number of molecules along a length unit. Thus a pulse of photons with different frequencies will have not the same form after having crossed a transparent medium as the photons with higher frequencies will lag behind the photons with the lower ones.

In our analysis of the drag aberration, we showed that in terms of first order in v/c dispersion does not appear.

However we have to point out that for the general case $\psi\neq0$ the use of the Lorentz transformation in obtaining the drag angle formula leads to a physically unsound result, and we are very surprised that Player and Rogers have overseen this failure of special relativity.

Let us attach a rest frame K to the laboratory and a moving frame K' to the medium, so that their x-axes are parallel to the velocity v of the medium and their y-axes point downwards (figure 3).

The components of the velocity of the photons which propagate in vacuum (*i.e.*, before their entrance into the medium) are :

(*a*) in frame K

$$c_x=c\sin\phi, \qquad c_y=c\cos\phi. \tag{28}$$

(*b*) in frame K' (see, for example, formulas (19) (Marinov 1974*b*)

$$c'_x=\frac{c\sin\phi-v}{1-v\sin\phi/c}, \qquad c'_y=\frac{c\cos\phi(1-v^2/c^2)^{\frac{1}{2}}}{1-v\sin\phi/c}. \tag{29}$$

Thus the angle of incidence of the photons in frame K' will be

$$\sin\phi' = \frac{c'_x}{c} = \frac{\sin\phi - v/c}{1 - v\sin\phi/c} \cong \sin\phi - \frac{v}{c}\cos^2\phi, \tag{30}$$

and the angle of refraction in frame K', according to Snell's law, will be (we assume $dn/d\nu = 0$)

$$\sin\psi' = \frac{\sin\phi'}{n} = \frac{1}{n}\left(\sin\phi - \frac{v}{c}\cos^2\phi\right) = \sin\psi + \frac{v}{c}\left(n\sin^2\psi - \frac{1}{n}\right).$$

The components of the velocity of the photons in the medium with respect to frame K' will be

$$c'_{mx} = \frac{c}{n}\sin\psi', \qquad c'_{my} = \frac{c}{n}\cos\psi', \tag{32}$$

and the components of the velocity with respect to frame K will be (see again formulas (19) (Marinov 1947*b*)

$$c_{mx} = \frac{c'_{mx} + v}{1 + c'_{mx}v/c^2}, \qquad c_{my} = \frac{c'_{my}(1 - v^2/c^2)^{\frac{1}{2}}}{1 + c'_{mx}v/c^2}. \tag{33}$$

Thus, when the medium is moving, the angle of refraction with respect to frame K will be $\psi + \delta$, so that we shall have

$$\sin(\psi + \delta) = \frac{c_{mx}}{c_m} = \sin\psi + \frac{v}{c}\left(n - \frac{1}{n}\right), \tag{34}$$

and for the drag aberration angle we obtain

$$\delta \cong \sin\delta = \frac{v}{c}\left(n - \frac{1}{n}\right)\frac{1}{\cos\psi}. \tag{35}$$

This result is unsound, because for $\psi \to \pi/2$ it gives $\delta \to \infty$, while, obviously, it must be $\delta \to 0$, as this is to be obtained from our formula (25).

It is clear that the automatic application of the Lorentz transformation to the drag aberration phenomenon leads to an unsound result, and this phenomenon cannot be explained without referring to its physical essence. Hence the Lorentz transformation is not a *deus ex machina* and is to be applied with attention, after a due *physical* analysis of the problem considered. Here we have once more to recognize that physics is not a mathematical apparatus to which a physical reality is attached, but a mathematical apparatus attached to physical reality.

We see further that the hitch-hiker model is mathematically extremely simple and physically very clear. In our opinion, any efforts are to be made to explain all light propagation phenomena in a medium by this model and to find *experimenta crucis* in its favour (Marinov 1977).

Let us mention that for the propagation of light in a gas only the hitchhiker model can be adequate to physical reality, since the gaps between the molecules are there too large and can be changed at pleasure. Thus it is highly artificial to accept that in these gaps light propagates with velocity c/n, lower than c. An experimentum crucis for gases is the following: In a transparent gas the average velocity will diminish (and thus the refractive index increase) when increasing the density of the gas, while the light intensity will remain the same (assuming hundred percentual transparence). On the other hand, in a non-transparent gas the light velocity will be always c (and the refractive index constant, equal to unity), while only the light intensity will diminish with the increase of the density.

10. Conclusions

The effects registered by us in the four different variants of the moving platform experiment are the same as those predicted by the relativity theory. Nevertheless, when one considers them together with the effects in the rotating disk experiments (for which the principle of relativity *experimentally* breaks down), the conclusion is to be drawn that the principle of relativity breaks down also for inertial motion, *at least conceptually*.

We have to emphasize once more that the motion of the medium or/and the mirrors in our realization of the moving platform experiment is not inertial. However, this non-inertial moving platform experiment has *actually* exactly the same character as the inertial moving platform experiment, of which until now only the Zeeman-Fizeau variant is carried out. The practical realization of the inertial Zeeman-Marinov, Zeeman-Pogany and Zeeman-Sagnac experiments is not problematic, and our first intention was to realize them. Later, however, we came to the conclusion that they will give *exactly the same results* as our non-inertial variants. On the other hand, only the comparison of the non-inertial Zeeman-Marinov experiment with the rotating disk experiment, leads to the *firm conclusion* that, since the velocity of light along the rim of a rotating disk is direction dependent, it will be direction dependent on any platform moving inertially with respect to absolute space and thus the calculation of the effect in the Zeeman-Marinov experiment is to be made with the help of formulas which are *different* from those used in the calculation of the effect in the Zeeman-Fizeau experiment. On the third place we must mention that the implement with which we have performed our rotating disk experiment (Marinov 1978) could easily be transformed for the realization of the non-inertial moving platform experiment.

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Are Phonons Particles?

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If phonons are particles, they must be attached to absolute space through their proper masses, which depend on the absolute velocities. In such a case one should be able to register with phonons the Sagnac and Marinov effects which have been observed with massless and massive particles (photons and neutrons). The experimental possibilities for such experiments are analyzed.

According to my absolute space–time theory,(1–3) the proper mass of a particle depends *not* on its velocity with respect to the inertial frame of reference used, but on its ***velocity with respect to absolute space.*** I call the first (*relative*) form of the proper mass *Einstein's* and the second (*absolute*) form *Marinov's*. As I showed recently,(3,4) if a particle with a mass m, moving at a velocity $v = c/n$ in the inertial frame of reference used (where c is the velocity of light and $n \geqslant 1$ is a number), strikes perfectly elastically another particle with mass M which is at rest in the frame, and $m \ll M$, then, proceeding from the absolute form of the laws of momentum and energy conservation, one obtains for the recoil velocity of the impringing light particle

$$v' = \frac{c}{n} + \frac{V}{n^2}(\cos\theta - \cos\theta') + \frac{V^2}{cn^3}(\cos\theta - \cos\theta')^2 \tag{1}$$

where $\mathbf{V}$ is the velocity of the inertial frame in absolute space, θ is the angle between $\mathbf{v}$ and $\mathbf{V}$, and θ' is the angle between $\mathbf{v}'$ and $\mathbf{V}$; the equation is written within an accuracy of second order in V/c. Thus, measuring the velocity of the light particle before and after the collision, one can calculate the absolute velocity of the frame. Such experiments with massless particles,

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$n = 1$ (photons), were performed by Harress[5] and Sagnac[6] on a rotating disk in a laboratory, by Michelson *et al.*[7] on the spinning Earth, and by me[8,9] in the inertially moving laboratory. The first authors measured the so-called *Sagnac effect*, which is proportional to the absolute *angular* velocity of the *area* covered by the photons in mutually opposite directions after their "collision" with a semitransparent mirror (the heavy mass M), while I measured the *Marinov effect*, which is proportional to the absolute *linear* rotational velocity of the *straight path* covered by the photons in mutually opposite directions. The verification of formula (1) for massive particles, $n > 1$ (neutrons), was performed recently by Werner *et al.*,[10] who measured a Sagnac effect. I proposed[2] an experiment for measurement of the Marinov effect with the help of neutrons.

According to my theory, the energy e and the mass m are two different names (with different dimensions!) of the same entity, which represents the third one axiomatically introduced in physics (after space and time). In my theory, the equation $e = c^2m$ says no more than the equation 1 m = 100 cm. If the propagation of sound represents the transfer of energy, then a mass is also transferred. The proper mass and proper energy of massive and massless particles are attached to absolute space. Is the sound energy also attached to absolute space, i.e., are phonons (until now considered as particles only for mathematical convenience) real particles or not? The most definite answer can be given by measuring the Sagnac and Marinov effects with phonons. If the effects exist, phonons are to be considered as real particles; if not, the essence of sound energy will pose *terrible difficulties* to theoretical physics. Indeed, if the propagation of sound is an isotropic phenomenon, i.e., if sound propagates with the same velocity along any direction in a homogeneous medium, independently of the absolute velocity of the medium, then one can realize (if not practically, at least theoretically) a transfer of energy *with respect to absolute space* by a velocity higher than that of light. So, for certain directions of propagation the proper energy of sound will become equal to infinity and for others it will become imaginary. Thus phonons will represent the mysterious tachyons to which so many scholastic papers have been dedicated in recent years. However, I cannot imagine a physicist with a sound mind who can imagine energy as an imaginary quantity, and the mess in theoretical physics will become complete. According to my current conceptions,[11] the Sagnac and Marinov effects for phonons must be present and phonons are to be considered as particles similar to neutrons and electrons.

At the present state of technique, a "rotating disk" experiment with sound cannot lead to a reliable result. Indeed, if at the rim of a rotating disk one separates a sound wave (or sound pulses), half of which proceeds along the direction of rotation and the other half oppositely, the "direct" wave, on the grounds of formula (1), will reach the separation point with the following time delay after the "opposite" wave:

$$\Delta t = \frac{d}{v'_{\mathrm{dir}}} - \frac{d}{v'_{\mathrm{opp}}} = \frac{2dV}{c^2} = \frac{4\Omega S}{c^2} \tag{2}$$

where d is the path covered, S is the area encircled by this path, and Ω is the angular velocity of the disk (any angular velocity is taken with respect to absolute space). The last transition in this formula can be obtained in an elementary way by supposing that the closed path represents a polygon circumscribed around a circle with a radius R and by making the substitutions $d = 2S/R$, $V = \Omega R$. If ν is the frequency of the phonons (the frequency of the sound pulses), the phase difference between the "direct" and "opposite" phonons will be

$$\Delta\psi = 2\pi\nu\,\Delta t = 4\pi\nu dV/c^2 = 8\pi\nu\Omega S/c^2 \tag{3}$$

Using ultrasonic waves with a frequency $\nu = 1$ MHz and supposing $\Omega = 900$ rad/sec, $S = 1$ m^2, one obtains $\Delta\psi = 8\pi \times 10^{-8}$ rad. Let me note that the "rotating disk" experiment with light leads to reliable results because the frequency of light is much higher.

Thus one must try to measure the Marinov effect with sound because (i) for the Marinov effect the velocity V is much higher, and (ii) the path d can be made much longer. So, taking in formula (3) the same frequency of ultrasonic signals as above, $V = 300$ km/sec,$^{(9)}$ and $d = 10$ km, one obtains a phase difference $\Delta\psi = 0.4\pi$ rad.

For the measurement of the Marinov effect, however, one must be able to realize a *Newtonian time synchronization*$^{(12)}$ between space-separated points. There are two methods for realization of a Newtonian time synchronization: (i) by the help of a rotating axle, a method already experimentally verified,$^{(8,9)}$ and (ii) by the help of two parallel light clocks, a method only recently proposed.$^{(13)}$ Obviously, since for the detection of a Marinov effect with phonons a very long basis is needed, one can use only the second method. The rotating axle can be used only if one succeeds in mastering a reliable detection of small phase shifts of sound pulses.

However, since the direction dependence of light velocity is already firmly established,$^{(9)}$ a type of Briscoe experiment$^{(11,14,15)}$ can decide whether the velocity of sound is also anisotropic. Namely, if a type of Briscoe experiment gives a null result, i.e., if with this experiment the Earth's absolute velocity cannot be measured, then the velocity of sound is *anisotropic* and both anisotropy effects—of sound and of light—annihilate each other. If, however, the result is positive, this will signify that the velocity of sound is isotropic in any medium moving in absolute space. In

Briscoe's proposal(14) one sends parallel light (electromagnetic) and sound waves and one measures the anisotropy in light velocity *assuming* that the velocity of sound is isotropic. Briscoe's proposal was published as a patent and remained unnoticed by the scientific community. After the revival of Briscoe's ideas in two of my publications,(1,11) only one article dedicated to this method has appeared.(15) The author, Dr. H. Yilmaz, who visited me in Cleveland in June 1978, has tried to realize his variation of Briscoe's experiment,(16) but no information has reached me about the results obtained and one is impelled to suppose that either Yilmaz' method has not given the necessary accuracy (Yilmaz expected(15) a fantastic accuracy of m/sec in the determination of V) or the results obtained are null. If Yilmaz' method has given a null result, this must be published, as, together with the positive result in my "coupled-mirrors" experiments,(8,9) one obtains an experimental confirmation of my hypothesis that phonons are particles and theoretical physics is saved once again from an unpleasant mess.

I should like to point out that if the ultrasonic "coupled-shutters" experiment proposed by me in Ref. 11 were to be carried out with the effective technique of the differential "coupled-shutters" experiment,(17) then the basis between the shutters can be reduced from kilometers to meters and the experiment can be performed in the laboratory. The method is essentially that previously discussed.(11) However, it is now proposed to replace the observers by transducers of light into electric current, photodiodes. The difference in the currents produced by the two photodiodes can be detected by a sensitive galvanometer (see Ref. 17). It is proposed to generate the two necessary light beams from a single laser source, so as to avoid inevitable differential intensity fluctuations. The material conducting the sound signals must be chosen to have good thermal stability. The "creep" of the small pulses over the oscilloscope screen (see the figure in Ref. 11) can be considerably reduced or totally excluded during the short time of measurement if a rotating platform is used (if necessary, one should make a thermal stabilization).

The "functioning" of the experiment can be well understood by consulting Table I. The table is set at the condition that the absolute velocity of the apparatus is perpendicular to its axis. The first line gives the number of light "waves" n along the distance d, i.e., the number of light pulses which can be counted between both shutters on a *momentary photograph*. The second line gives the number of sound "waves" n_s along distance d, i.e., the number of sound pulses which can be counted between both shutters at an *instant*. The third line gives the "phase difference" between both shutters in radians. So, if the phase difference is $\psi = 0$, both shutters are opened or closed together; if $\psi = \pi/2$ (or $3\pi/2$) one of the shutters is half opened and the other is half closed; if $\psi = \pi$, one of the shutters is opened when the other

Table I

$n = d/\lambda$	m				$m + \frac{1}{4}$				$m + \frac{1}{2}$				$m + \frac{3}{4}$			
$n_s = d/\lambda_s$	m_s	$m_s + \frac{1}{4}$	$m_s + \frac{1}{2}$	$m_s + \frac{3}{4}$	m_s	$m_s + \frac{1}{4}$	$m_s + \frac{1}{2}$	$m_s + \frac{3}{4}$	m_s	$m_s + \frac{1}{4}$	$m_s + \frac{1}{2}$	$m_s + \frac{3}{4}$	m_s	$m_s + \frac{1}{4}$	$m_s + \frac{1}{2}$	$m_s + \frac{1}{4}$
υ	0	$\pi/2$	π	$3\pi/2$	0	$\pi/2$	π	$3\pi/2$	0	$\pi/2$	π	$3\pi/2$	0	$\pi/2$	π	$3\pi/2$
O_L sees	max	av	min	av	av	min	av	max	min	av	max	av	av	max	av	min
O_R sees	max	av	min	av	av	max	av	min	min	av	max	av	av	min	av	max

is closed. It is important to note that if the phase shift of the detecting shutter near the first of the observers O_A is ψ with respect to its chopping shutter, then the phase shift of the detecting shutter near the second observer O_B is $-\psi$ with respect to its chopping shutter. The fourth line gives the light intensities registered by the observer O_A, and the fifth line gives those registered by O_B.

Let us suppose, for example, $n = m$, $n_s = m_s + 1/4$, where m and m_s are integers. Thus we shall have $\psi = \pi/2$ for one observer and $\psi = -\pi/2$ for the other one. In this case both observers see average light intensity. Let under these conditions an "aether wind" appear by rotating the axis of the apparatus over 90°. If the "aether wind" leads to a change $\Delta n = 1/4$ in the number of light waves, then, for the case shown in the figure of Ref. 11,

$$n_A = m + 1/4, \qquad n_B = m - 1/4 = (m - 1) + 3/4 \tag{4}$$

Thus, if the phase difference remains the same, $\psi = \pi/2$, both observers will register minimum light. This change in the illuminations can be achieved if, when there is no "aether wind," one changes the phase difference from $\psi = \pi/2$ to $\psi = \pi$, i.e., if one changes the number of sound waves along the tract d by $\Delta n_s = 1/4$. With the help of this table one can show that *always* an "aether wind" effect can be annulled by a corresponding change in the phase difference. Let me note that *this is the reason* that does *not* permit one to measure the absolute velocity of the laboratory by an "uncoupled shutters" experiment. Since in the "uncoupled shutters" experiment one cannot know which is the phase difference between the shutters, one is unable to distinguish the absolute effect due to an "aether wind" from the effect due to a change of the phase difference between the uncoupled shutters.

The sound signals give one permission to "couple" the independent shutters. If the propagation of sound is isotropic, i.e., if there is no "aether wind" for sound, then after the rotation of the apparatus the phase difference will remain the same and the appearing change in the light intensities registered by O_A and O_B will be attributed to the "aether wind." However, if there is an "aether wind" also for sound, the phase difference will change *exactly* by the amount to annihilate the "aether wind" effect for light. Thus, if the ultrasonic "coupled-shutters" experiment gives a null result, then, since the anisotropy of light propagation is already firmly established, one has to conclude that phonons are particles and they are attached to absolute space in the same manner as photons and electrons.

If we assume that the propagation of sound is isotropic and the "creep" of the sound waves is negligible, the measuring procedure in the ultrasonic "coupled shutters" experiment is the following: One chooses the conditions $n = m + 1/4$ and $n_s = m_s$, i.e., $\psi = 0$. Rotating the platform with the apparatus in the laboratory, one eliminates the appearing difference current produced by the photodiodes by changing the paths of the "direct" and "opposite" light pulses (it is sufficient to change the path only of the "direct" or only of the "opposite" light pulses, but by double the amount). If the component of the absolute velocity of the laboratory along the axis of the apparatus changes from 0 to V, one has to change the paths of the "direct" and "opposite" light pulses by Δd, so that

$$v = (\Delta d/d)c \tag{5}$$

The sensitivity of the method can be established in practice extremely easily. If δd is the minimum shift which leads to an effect discernible from the fluctuations of the galvanometer, the accuracy with which the absolute velocity can be measured is

$$\delta v = (\delta d/d)c \tag{6}$$

In my differential "coupled-shutters" experiment$^{(17)}$ the rotating disks had 30 holes and when they rotated with a constant rate $N = 200$ rev/sec, i.e., when the chopping frequency was $f = 6$ kHz, the current fluctuation δI was about a 10^{-7} part of the current I produced by the photodiodes.

Take now formula (4) from Ref. 11 (see the same formula on p. 151 of Ref. 18), which says that if a δn part of the light pulses (in more in the "direct" pulses and in less in the "opposite" pulses) can be discerned from the fluctuation, then the absolute velocity can be measured with an accuracy

$$\delta v = c^2 \delta n/2fd \tag{7}$$

For the differential "coupled-shutters" experiment,$^{(17)}$ the inaccuracy calculated according to this formula, where one puts $\delta n = \delta I/I$, is $\delta v = 500$ km/sec.

For the ultrasonic "coupled-shutters" experiment, using the same formula and putting there $\delta n = 10^{-7}$, $f = 0.3$ MHz, one obtains, for the same basis $d = 150$ cm, $\delta v = 10$ km/sec.

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Contrary to Wilczyński, There is no Aberration for Comoving Source and Observer

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The aberrational method for measurement of the Earth's absolute velocity proposed by Wilczyński cannot give a positive result.

Wilczyński[(1)] supposes that if one observes a parallel beam of light produced by an earthbound source (say, a laser), then, at different positions of the source–observer line with respect to the absolute velocity of the Earth, one should be able to register an aberrational effect caused by the motion of the Earth with respect to absolute space. I appreciate very much the good intentions of Dr. Wilczyński to help the process of restoration of the absolute space–time conceptions. However, his proposed experiment cannot increase the number of experimenta crucis in favor of the absolute conceptions because, unfortunately, it will give a null result. This becomes clear immediately, upon glancing at Fig. 1.

Light produced by the laser L is observed by the observer O with the help of the optical tube T. The axes of L and T coincide and thus the laser beam strikes observer O. As L, T, and O move with a certain absolute velocity, I show in Fig. 1 the situation in absolute space, supposing that the absolute velocity v is pointing from left to right. The photons emitted by L at the moments t_1' and $t_2' = t_1' + l/c$ will enter tube T at the moments $t_1 = t_1' + d/c$ and $t_2 = t_2' + d/c = t_1 + l/c$, respectively, where d is the distance between the outlet of L and the inlet of T, l is the length of T, and the times are measured on a clock attached to the laboratory, i.e., on a proper clock,

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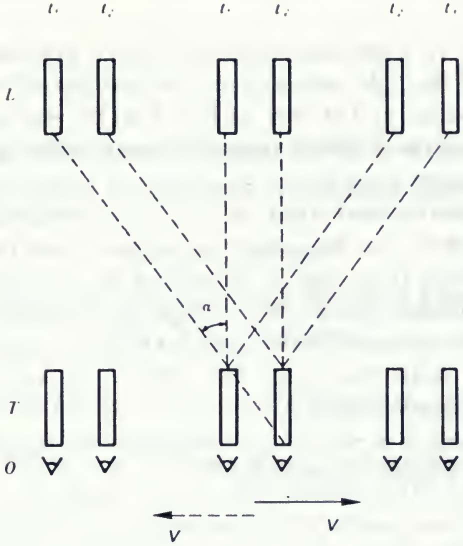

Fig. 1. Wilczyński's experiment analyzed in absolute space.

according to my terminology.[(2)] One can call the angle α between the line connecting the emission position of L with the reception position of T and the axis of the tubes an "aberration angle." However, this aberration angle cannot be measured if one turns the system through 180° with respect to the absolute velocity. This case is also shown in Fig. 1, where the absolute velocity presented by the dashed vector is pointing from right to left, i.e., in the figure the whole universe is rotated over 180°. Now the photons emitted by L at the moments t_1'' and $t_2'' = t_1'' + l/c$ will reach T at the moments $t_2 = t_1'' + d/c$ and $t_1 = t_2'' + d/c = t_2 + l/c$. In both cases the tubes remain aligned along their mutual axis and no effect can be registered. Let me especially emphasize that the angle between the *absolute* velocity of the photons *in* the laser and the axis of the laser is also equal to the aberration angle α.

If the effect predicted by Wilczyński existed, it would have been revealed long ago. Indeed, let us send a laser beam through an ordinary water pipe having length, say, $d = 100$ m. As the "aberration angle" for the Earth's absolute velocity of 300 km/sec[(3)] is $\alpha = 10^{-3}$ rad, supposing that at the daily rotation of the Earth our system turns through 180° with respect to its absolute velocity, the light spot will be "removed" from the outlet of the water pipe over a distance $x = 2\alpha d = 20$ cm. Thus, if the pipe has a diameter less than 20 cm, the laser light seen at the beginning from the outlet of the pipe would disappear after the rotation.

I should like to emphasize that the Earth's absolute velocity is one-thousandth part of the light velocity, and the absolute effects of first order in v/c are *huge*. However, as I showed in Ref. 4, in the *predominant part* of the experiments, the absolute effects *annihilate each other*, and the final effect which one can observe is *null*.

The unique aberrational effect which can give evidence for the absolute motion of the Earth can be observed in the quasi-Bradley experiment considered in Section 16 of Ref. 4. According to the analysis performed in the frame of the absolute space–time conceptions, the aberrational ellipses of stars lying near the anti-apex of the Earth's absolute velocity are 0."08 larger than those lying near the apex. This effect has been pointed out by Poincaré(5) and recently Chang.(6)

Let me note that it is exactly the aberration that annihilates the absolute effect in the quasi-Doppler experiment.(7)

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The quasi-Roemer and quasi-Bradley experiments according to absolute space-time theory

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[**Abstract** : We show that with the help of the quasi-Roemer experiment ; *i.e.*, observing the eclipses of a Jupiter's satellite over a 12-year period, it is theoretically impossible to register the Sun's absolute velocity, if measuring the time on a clock attached to the Earth ; while with the help of the quasi-Bradley experiment, *i.e.*, observing during the course of a year the aberration ellipses of distant stars, it is theoretically possible to establish the Sun's absolute velocity.]

1. *Introduction*

In 1973 we carried out the deviative "coupled-mirrors" experiment[1] and in 1975/76 the interferometric "coupled-mirrors" experiment[2,3] for measurement of the light velocity's anisotropy in a laboratory moving in absolute space. The last experiment helped to reliably register the Sun's absolute velocity ; its magnitude is $v = 303 \pm 20$ km. sec^{-1} and the equatorial co-ordinates of its apex are $\alpha = 14^h\ 17^m \pm 20^m$, $\delta = -23^\circ \pm 4^\circ$. This experiment represents an experimentum crucis in favour of our absolute space-time theory[4-6] whose formulas differ in terms of first order in v/c from those given by the Einstein theory of relativity and in terms of second order in v/c from those given by the Newtonian (aether) theory. Thus a reconsideration of all important high-velocity experiments is necessary, and their description within the framework of the absolute space-time

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theory, thus adequately to physical reality, must be given. This we do in a series of paper,[7-22] one of which is the present one.

2. *The quasi-Roemer experiment*

In 2 we consider the 300-year old experiment of Roemer who, for the first time, measured the velocity of light. As Maxwell[23] pointed out, the Roemer experiment could be used to establish the Sun's absolute velocity and, if carried out with this aim, we call it the quasi-Roemer experiment. The adherents of the relativity theory support the opinion that with the help of the quasi-Roemer experiment the Sun's absolute velocity cannot be registered (see, for example, ref. 24). One must come to this conclusion immediately considering only the principle of relativity. Indeed, since the Sun system is to be identified with a large laboratory, its absolute motion cannot be registered by performing measurements in this laboratory. Thus Bottlinger[25] pointed out that the quasi-Roemer experiment offers a feasible experimentum crucis for an eventual rejection of the principle of relativity. This problem was considered in detail by Janossy[26].

For his pert Courvoisier[27] tried even to calculate the Sun's absolute velocity, analysing the differences in the calculated and observed moments (the residuals) for the eclipse observations of Jupiter's satellites, given by Brower and de Sitter for the years 1908-1926. He obtained for the component of the Sun's absolute velocity in the plane of the ecliptic $v_S = 715 \pm 95$ km. sec^{-1}, directed to a point with right ascension $\alpha = 132^\circ \pm 6^\circ$. Ruderfer[28] made a preliminary analysis of the residuals given by Sampson[29] for the eclipse observations of Jupiter's satellites during the years 1878-1903 and found a periodic variation that can be explained by the influence of the absolute motion of the Sun system. However, Ruderfer points out that the quasi-Roemer experiment is not yet theoretically resolved by him and he supposes that not all "aether" effects are taken into account, when one claims the availability of a positive effect in this experiment.

The standpoint of our absolute space-time theory is the following :

1. After having made a critical analysis of the real situation with the quasi-Roemer experiment and of the observational data available, we remained highly dubious that some effect can be practically registered, if one assumes that the theory predicts it and that the Sun's absolute velocity in the plane of the ecliptic is about 300 km sec^{-1}.

2. Since in the quasi-Roemer experiment there is no practical possibility for a realization of a Newtonian time synchronization[4], then theoretically it cannot give a positive effect, if the moments of observation are registered on a precisely going earthbound clock.

Now we shall prove our second assertion, which will invalidate the treatment of the first assertion.

Let us assume certain conditions which will simplify our calculations, without discrediting the essence of the demonstration, and which moreover are adequate enough to the existing situation (see Fig. 1) :

(*a*) The orbits of the Earth and Jupiter (whose velocities with respect to the Sun are v_E, v_J) and of the Jupiter's satellite (whose velocity with respect to Jupiter is v_s) are coplanar, circular and all bodies revolve uniformly.

(*b*) The diameter of the Earth is too small with respect to its distance to Jupiter, so that we shall leave without attention the diurnal paralax, *i.e.*, we shall assume that the observations are made always from the center of the Earth.

(*c*) The effective diameter of Jupiter which is responsible for the eclipses, and the refraction in its atmosphere do not change during the whole time of observation.

(*d*) The period of revolution of the satellite is much shorter respectively to the year and even respectively to the day.

Suppose that at the initial year of observation, when the Earth and Jupiter are in opposition, the absolute velocity of the Sun system v_S makes an angle θ with the opposition line.

Let us observe the zeroth eclipse of the satellite at the moment t°, read on a terrestrial clock, when the Earth and Jupiter are at the positions E_0, J_0, *i.e.*, half a year before the moment when they will be in opposition.

The first eclipse will occur at the moment

$$t^1 = t^\circ + T - \frac{J_1E_1 - J_0E_0}{c_0'} \quad \dots \quad (1)$$

where T is the period of revolution of the satellite, E_1, J_1 are the positions of the Earth and Jupiter at the moment t^1, and c_0' is the proper relative velocity of the light[6] coming from Jupiter with respect to the Sun system. According to our absolute space-time theory[6] we have

$$c_{0,}' = \frac{c}{1+(v_S/c)\cos\theta'} = c\frac{1-(v_S/c)\cos\theta}{1-v_S{}^2/c^2} \quad \dots \quad (2)$$

where c is the absolute velocity of light, θ' is the angle between v_S and the line of light propagation registered with respect to the moving Sun's frame and θ is the same angle registered with respect to absolute space. Since Jupiter covers (1/12)th part of its orbit during a year, we shall assume the Jupiter's year much longer than the Earth's year and the positions J_0 and J_n very near to one another. Thus in Eq. (2) we can consider angle θ' ($=\theta$ within the necessary accuracy of first order in v_S/c) to be equal to the angle θ in Fig. 1, *i.e.*, to the angle between the opposition line and the Sun's absolute velocity.

Let the *n*th eclipse be observed at the moment t^n when the Earth and Jupiter are in opposition. We shall have

$$\Delta t_{0,}{}^n = t^n - t^0 = nT - \frac{J_nE_n - J_0E_0}{c_0'} = nT - \frac{2R}{c}\left(1+\frac{v_S}{c}\cos\theta\right), \quad (3)$$

where R is the radius of the Earth's orbit.

Finally, suppose that the $2n$th eclipse is observed at the moment t^{2n} after another half-year when the Earth and Jupiter are at the positions E_{2n}, J_{2n}. We have

$$\Delta t_0{}^{2n} = t^{2n} - t^0 = 2nT - \frac{J_{2n}E_{2n} - J_0E_0}{c_0'} = 2nT. \quad \dots \quad (4)$$

From here we can determine the period T of revolution of the satellite. Using (4) in Eq. (3), we find

$$\Delta t_0{}^n = \frac{\Delta t_0{}^{2n}}{2} - \frac{2R}{c} - \frac{2Rv_S}{c^2}\cos\theta = \overline{\Delta t_0{}^n} - \frac{2Rv_S}{c^2}\cos\theta, \qquad (5)$$

where $\overline{\Delta t_0{}^n}$ is this time interval which follows the initial moment, after whose elapsing one has to observe the nth eclipse if the absolute velocity of the Sun is equal to zero, or if the velocity of light is not direction dependent. When Roemer made his observations, he compared the calculated time interval $\Delta t_0{}^{2n}/2$ with the actually measured time interval $\Delta t_0{}^n$ and, knowing R, he established c.

Any traditional absolutist would conclude that making use of Eq. (5) one could establish the component v_S of the Sun's absolute velocity in the plane of the ecliptic when performing observations of the eclipses of a Jovian satellite during 12 years in which the angle θ between v_S and the opposition line takes different values in the range of 360°, so that the difference $\delta t = \Delta\overline{t_0{}^n} - \Delta t_0{}^n$ will vary in the range

$-(2Rv_S/c^2) < \delta t < (2Rv_S/c^2)$. Taking $R = 150\times 10^6$ km. $v_S = 300$ km sec^{-1}, we find -1 sec $< \delta t < +1$ sec.

However, taking into account the absolute kinematic time dilation[6], we shall come to the conclusion that, if one measures the time on a terrestrial clock, no positive effect can be registered. Indeed, let us assume that the Earth covers the path E_0E_n during the absolute time interval (read on clock which rests in absolute space) Δt^n. The time $\Delta t_0{}^n$ read on the proper terrestrial clock will be (see Eq. (6.4) in ref. 4)

$$\Delta t_0{}^n = \int_0^{\Delta t^n} [1-(v_E+v_S)^2/c^2]^{\frac{1}{2}} dt$$

$$= [1-(v^2{}_E+v^2{}_S)/2c^2]\Delta t^n - \int_0^{\Delta t^n} \frac{\Omega R v_S}{c^2}\cos\left(\frac{\pi}{2} - \theta + \Omega t\right) dt$$

$$= [1-(v^2{}_E+v^2{}_S)/2c^2]\Delta t^n + (2Rv_S/c^2)\cos\theta, \quad \ldots \qquad (6)$$

where Ω is the angular velocity of the Earth, so that $v_E = \Omega R$, and we have carried out the calculation with an accuracy of second order in "velocity/light velocity".

Comparing Eqs. (5) and (6), we conclude that no positive effect can be registered in the quasi-Roemer experiment, because the time interval between the zeroth and *n*th eclipses actually registered on a terrestrial clock will vary exactly in such a manner that the positive effect δt, which a traditional absolutist awaits to be registered, will be compensated for by a change in the rate of the terrestrial clock. For the case shown in Fig. 1, the time rate of the terrestrial clock is higher on a larger part along the path between the zeroth and *n*th eclipses and lower on a larger part along the path between the *n*th and (2*n*)th eclipses.

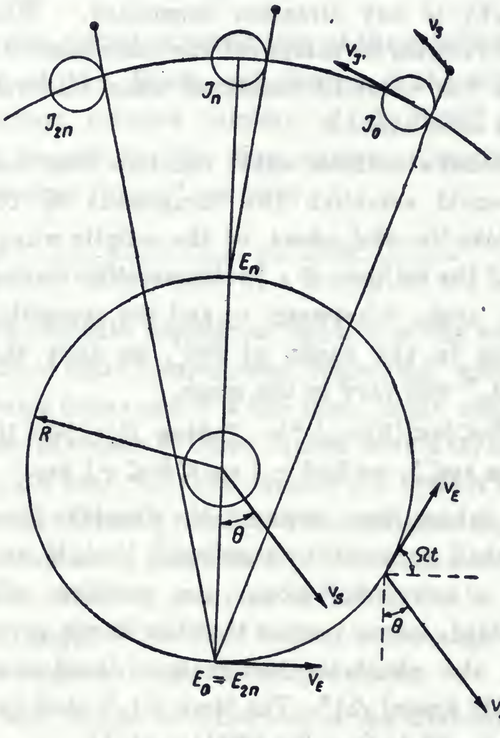

Fig. 1
The quasi-Roemer experiment.

If a Newtonian time synchronization would be realized (*i.e.*, if absolutely synchronized clocks are placed along the Earth's orbit, so that the time can be registered on these clocks), a positive effect will be registered from which the Sun's absolute velocity can be calculated. However we do not see any possibility for the realization of a Newtonian time synchronization in this experiment.

In conclusion, let us note another intersting result of the above analysis. Since we established[8] that the Sun moves towards a point with right ascension $\alpha \cong 14^h$ (let us take $\alpha \cong 12^h$) with a velocity whose component in the plane of the ecliptic is about 300 km sec^{-1}, we have to conclude that the spring and the summer are with 2 sec longer than the autumn and the winter, if measured on a terrestrial clock.

3. *The quasi-Bradley experiment*

In 3 we consider the second fateful experiment with the help of which in 1727 Bradley, for a second time, measured the light velocity. As Poincaré[8a] pointed out, the Bradley experiment could be used for the establishment of the Sun's absolute velocity and, if carried out with this aim, we call it the quasi-Bradley experiment. The adherents of the relativity theory defend the opinion that by the help of the quasi-Bradley experiment the Sun's absolute velocity cannot be measured (see, for example, ref. 31). This conclusion follows immediately from the principle of relativity.

Our standpoint is the following :

1. We predict theoretically the existence of a positive effect in the quasi-Bradley experiment.

2. At the present state of technique its practical realization seems to be problematic and is to be considered as a challenge to the astronomers.

Now we shall prove the first assertion (see Fig. 2). If we observe a star on the celestial sphere from a platform (the Earth) moving with an absolute velocity v, then the relation between the emission angle θ', which represents the angle between the velocity v and the source-observer line at the moment of emission of light, and the reception angle θ, which represents the same angle at the moment of reception, will be (see Eq. (2))

$$(1+\frac{v}{c}\cos\theta')(1-\frac{v}{c}\cos\theta)=1-v^2/c^2. \qquad \ldots \qquad (7)$$

Now suppose that our platform (the Earth) moves with a velocity v_E with respect to another platform (the Sun) which for its part moves with a velocity v_S respectively to absolute space,

$$v=v_E+v_S. \qquad \ldots \qquad (8)$$

Let us suppose that at the moment of emission an Earth's observer and an observer who rests with respect to the Sun

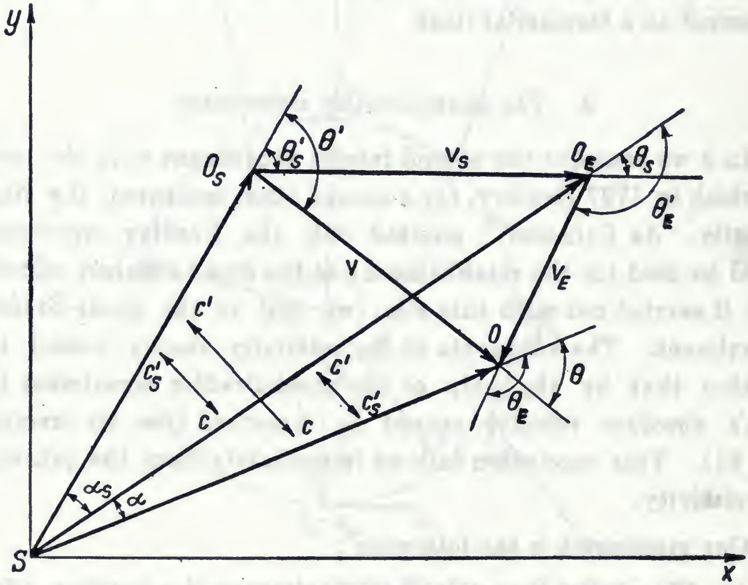

Fig. 2
The angles involved in the quasi-Bradley experiment.

(called the Sun's observer) are at the point O_S. The light emitted at this moment by a star which is at the point S will be received by the Sun's observer when he crosses point O_E and by the Earth's observer when the latter crosses point O. We have :

(*a*) Observation by the Sun's observer in absolute space. For this case θ'_S is the emission angle and θ_S the reception angle distance SO_E is proportional to the absolute velocity of light c and distance SO_S to the relative light velocity with respect to the Sun c'_S.

(*b*) Observation by the Earth's observer in absolute space. For this case θ' is the emission angle and θ the reception angle, distance SO is proportional to the absolute light velocity c and distance SO_S to the relative light velocity with respect to the Earth c'.

(*c*) Observation by the Earth's observer in a frame attached to the Sun. For this case θ'_E is the emission angle and θ_E the reception angle, distance SO is proportional to the relative light velocity with respect to the Sun c'_S (since this is the velocity of light which travels along a given direction with respect to a frame attached to the Sun) and distance SO_E to the relative light velocity with respect to the Earth c'.

Let us emphasize that we suppose all velocities (absolute and relative) to be measured in absolute time[6]. Consider now an imaginable emission which occurs at the moment when the Earth's observer is at the point O_E and a reception which occurs at the moment when this observer arrives at the point O, the velocity of light being equal to c_S'. By analogy with (7) we have

$$[1+(v_E/c_S') \cos \theta_E'] [1-(v_E/c_S) \cos \theta_E]=1-v_E^2/c_S'^2, \qquad (9)$$

where[16])

$$c_S'=c\left[\frac{1-(v_S/c) \cos \theta_{Sm}}{1+(v_S/c) \cos \theta_{Sm}} \right]^{\frac{1}{2}} \qquad \ldots \qquad (10)$$

is the relative light velocity in a frame attached to the Sun and θ_{Sm} is the middle angle between θ_S' and θ_S

$$\theta_{Sm}=(\theta'_S+\theta_S)/2, \qquad \ldots \qquad (11)$$

Putting (10) into Eq. (9) and working within an accuracy of third order in "velocity/light velocity" (*i.e.*, putting $\theta_E=\theta_E'=\theta_{Em}$ in the terms of second and third order), we obtain

$$\cos \theta_E=\cos_E\theta'+(v_E/c) \sin^2\theta_{Em}[1+(v_S/c) \cos \theta_{Sm}] \qquad (12)$$

Designating by $\alpha=\theta'_E-\theta_E$ the aberration angle, we find within the necessary accuracy

$$\alpha=(v_E/c) \sin \theta_{Em}+(v_E v_S/c^2) \sin \theta_{Em} \cos \theta_{Sm}=\alpha_E+\Delta\alpha \qquad (13)$$

where α_E is the aberration angle caused by the motion of the Earth if the Sun were at rest in absolute space and $\Delta\alpha$ is the variation caused by the absolute velocity of the Sun, in dependence on the angle θ_{Sm} made by the light beam coming from the star and the velocity of the Sun.

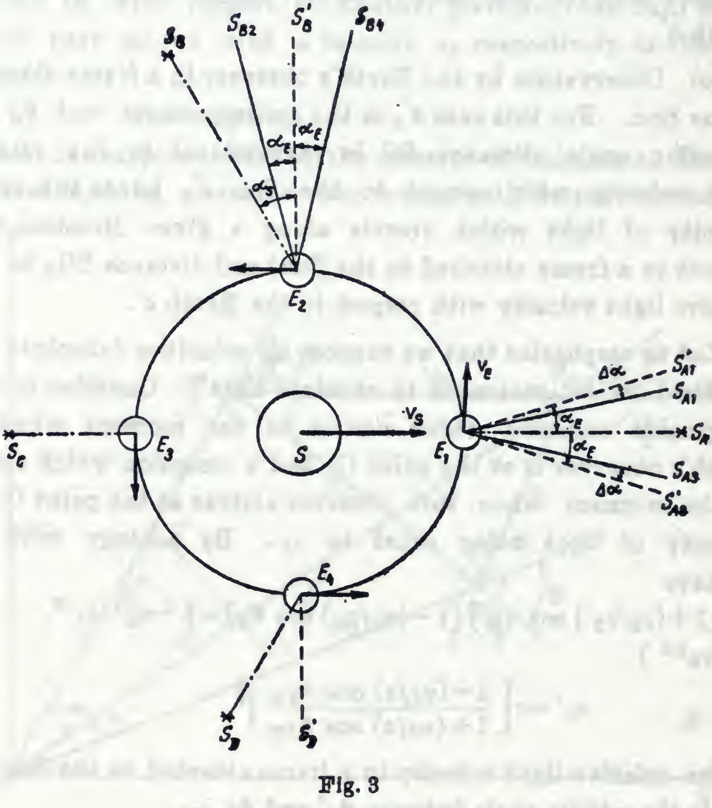

Fig. 3
The quasi-Bradley experiment.

In Fig. 3 we show four different positions of the Earth (E_1, E_2, E_3, E_4) on its orbit around the Sun (S) at four different moments with intervals of three months when four different stars (S_A, S_B, S_C, S_D) are in range with the Earth in the plane of the ecliptic, if being observed from the Sun. The real positions of the stars S_A and S_C and their positions observed from the Sun coincide, since the angle θ_{Sm} between the Sun's velocity v_S and the propagation direction of the light coming from these stars is equal to π or to 0. The positions of the stars S_B and S_D observed from the Sun are tilted to an angle $\alpha_S=v_S/c$ with respect to their positions, since for these two stars the angle θ_{Sm} is equal to $\pi/2$. *i.e.*, they will be seen along the directions to S_E' and S_D'.

The star S_A will be observed from the Earth's position E_1 tilted to an angle $\alpha_E=v_E/c$, *i.e.*, along the direction to S_{A1}', if the Sun is at rest in absolute space and the velocity of light coming from S_A is equal to c. However, when the Sun moves and the velocity of light coming from S_A is $c+v_S$, this star will be seen from E_1 tilted to an angle

$$\alpha_{ap}=\alpha_E-\Delta\alpha=v_E/(c+v_S)=\alpha_E-(v_Ev_S)/c^2. \quad \ldots \quad (14)$$

i.e., along the direction to S_{A1}. The same star when observed from the position E_3 after six months will be tilted oppositely to the same angle α_{ap}. *i.e.*, along the direction to S_{A3}. Thus in a year the stars which lie near the apex of the Sun will describe over the celestial sphere a small are equal to $2\alpha_{ap}=2\alpha_E-2V_EV_S/c^2$. Analogically we conclude that the stars which lie near the Sun's anti-apex will describe a small arc equal to $2\alpha_{anti-ap}=2\alpha_E+2V_Ev_S/c^2$. For the difference between these two arcs we obtain

$$\Delta=2\alpha_{anti-ap}-2\alpha_{ap}=4\Delta\alpha=4v_Ev_S/c^2. \quad \ldots \quad (15)$$

It can be seen immediately that the star S_B will be observed from the position E_2 tilted additionally to an angle $\alpha_E=v_E/c$, *i.e.*, along the direction to S_{B2} and the same star will be observed after six months from the position E_4 tilted oppositely to the same angle α_E, *i.e.*, along the direction to S_{B4}, both at rest and at motion of the Sun.

Taking $v_E=30$ km. sec^{-1}, $v_S=300$ km. sec^{-1}, we obtain $\Delta=4\times10^{-7}$ rad$=0.''08$. Since the accuracy with which today the positions of the stars on the celestial sphere can be established is of the same order, the quasi-Bradley experiment is to be considered as a challenge to the experimenters.

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LETTER TO THE EDITOR

Experimental refutation of the principle of equivalence

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It is shown that our "coupled-mirrors" experiment, with the help of which we measured the Earth's absolute velocity, gives also an experimental refutation of the principal of equivalence,

According to Einstein's principle of equivalence. an observer placed in a laboratory where all masses have the same acceleration can by no means establish whether this acceleration has a kinematic character (thus being due to an accelerated motion of the laboratory with respect to distant stars, for example, by a rocket thrust) or a dynamic (gravitational) character (thus being generated by a gravitational action of nearby masses, for example, by the Earth's attraction).

In the light of the positive results in our "coupled-mirrors" experiments, $^{1-4}$ the principle of equivalence in the above given formulation must be rejected. Indeed, as the "coupled-mirrors" apparatus represents an absolute speedometer, if we measure the absolute velocity of an accelerated laboratory at two different moments, this velocity will have two different values when the acceleration is kinematic and the same value when the acceleration is dynamic (gravitational). Such an experiment performed

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with the aim of refuting Einstein's principle of equivalence is called by us the accelerated "coupled-mirrors" experiment.

When performing our interferometric "coupled-mirrors" experiment[4] we established that during the different days of the year the absolute velocity of the laboratory was different. This was due to the fact that when revolving around the Sun the Earth moves with acceleration and this kinematic acceleration has led to changes in the absolute velocity of the laboratory. However, the dynamic gravitational acceleration due to the Earth's attraction has led to no changes. Thus the principle of equivalence which asserts that kinematic and dynamic accelerations cannot be experimentally discerned must be definitely abandoned as not adequate to physical reality.

When the laboratory is in a conservative external field and it is free (as is the case with our Earth in the gravitational field of the Sun or with an artificial satellite revolving about the Earth), the accelerometer shows null effect and the absolute speedometer shows changes in the laboratory's absolute velocity. Only when the kinematic acceleration is due to the action of internal forces (as is the case with a space ship accelereted under the action of its own thrust), both the accelerometer and the absolute speedometer show effects.

If in the future the accuracy of our "coupled-mirrors" apparatus will be enhanced enough, it can become an indispensable instrument in space navigation. At the present time the space ships have no speedometers. The absolute speedometer may become useful also in sea navigation where, by the help of an electronic calculator, the absolute speed will be transformed to the speed with respect to the Earth's surface. At the present time all logs give the velocity with respect to water but not to the shore which one needs to know.

We wish to emphasize that the refutation of the principle of equivalence in its Einstein's formulation does not influence the equivalence between "inertial" and "gravitating" masses. However, we show[3,5] that the notion "inertial mass" is a historical misunderstanding. The mass is only gravitational. as the "inertial" energy of a mass m moving with a velocity v in absolute space

$$e_0=mc^2(1-v^2/c^2)^{-\frac{1}{2}} \quad \dots \quad (1)$$

is nothing more than its gravitational energy with the mass of the whole world taken with a negative sign. As we showed,[3],[5] the gravitational potential of the world is equal to $-c^2$. On the other hand, according to our theory[3], the gravitational potential is velocity dependent. So the gravitational potential of mass m is

$$\phi=-\sigma m(1-v^2/c^2)^{-\frac{1}{2}}r^{-1} \quad \dots \quad (2)$$

where σ is the gravitational constant and r is the distance to the reference point. Considering the mass of the world, M, as a spherical shell distant r from m, we can write

$$M=c^2r\sigma^{-1} \quad \dots \quad (3)$$

and from (2) and (3) we obtain (1). This demonstration shows that. since the mass of the world as a whole is at rest in absolute space, v in (1) and (2) must be the absolute velocity of m.

We showed[6] to experimental verifications of the formula (2). If the gravitational potential has not the form (2), the photons cannot interact with matter as the mass of the photons is equal to zero. Meanwhile gravitational interaction of photons is experimentally observed (frequency shift. bending of light rays).

Of an extreme importance is the assertion of our absolute space-time theory that the velocity v in Eq. (1) must be the absolute velocity. Proceeding from this fundamental assertion. we explained[7] the Sagnac effect observed recently with neutrons[8] and we showed[7] that the velocity of light in a moving laboratory is direction dependent not because there is an "aether" in which light propagates like sound in the air, but because the proper mass of any photon is attached to absolute space through its absolute velocity. All these conclusions can be obtained in the most elementary way from the momentum and energy conservation laws for an elastic collision between two particles with great differences in their masses, taking e_0 in the form (1), where v is the absolute velocity of m.

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The interrupted ‘rotating disc’ experiment

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Abstract. Realising a modification of the historical Harress–Sagnac experiment, we establish that the velocity of light along the chord of a rotating disc is direction dependent.

According to our absolute space–time theory (Marinov 1977, 1981a), the velocity of light with respect to a frame moving at velocity v in absolute space, if measured with the help of a clock which rests in this frame, is called the proper relative light velocity and is

$$c'_0 = c/(1 + v \cos \theta'/c), \tag{1}$$

where θ' is the angle between the velocity v and the direction of light propagation measured with respect to the moving frame; c is the velocity of light with respect to absolute space measured on a clock which rests in absolute space, or the ‘to-and-fro’ velocity in any inertial frame measured on a clock attached to this frame.

In the historical Harress–Sagnac experiment (called also the ‘rotating disc’ experiment) two photons (two light pulses) which fly together are separated by a semi-transparent mirror. One of these photons (called ‘direct’) proceeds along the direction of rotation and the other (called ‘opposite’) in the opposite direction. Hence, according to our formula (1), the ‘direct’ photon will return to the point of separation (the semi-transparent mirror) after the ‘opposite’ one with the time delay

$$\Delta t_0 = \int_0^d \frac{\mathrm{d}r}{(c'_0)_{\mathrm{dir}}} - \int_0^d \frac{\mathrm{d}r}{(c'_0)_{\mathrm{opp}}} = \frac{2}{c^2}\int_0^d v \cos \theta' \,\mathrm{d}r = 4\frac{\Omega S}{c^2}, \tag{2}$$

where Ω is the angular velocity of rotation, d is the path covered ($\mathrm{d}r$ is its differential element) and S is the area encircled by both photons respective to the moving disc.

The same time delay, measured with the help of a clock which rests in absolute space, will be $\Delta t = \Delta t_0(1 - v^2/c^2)^{-1/2}$. This is the fundamental relation expressing the *absolute* time dilation which is firmly defended by our theory (Marinov 1975a). If $v \ll c$, we can assume $\Delta t = \Delta t_0$, and this assumption is always to be made when effects which are first-order in v/c are analysed, as is the case in the present paper. In (Marinov 1978a) we analyse the first-order effects in the different variations of the ‘rotating disc’ experiment which can be set up if a refractive medium is being used, and in (Marinov 1976) the second-order effects.

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Formula (2) can be written in the following form, where not the area encircled but the path covered by the photons should figure:

$$\Delta t = \frac{2}{c^2}\int_0^d v \cdot \mathrm{d}\boldsymbol{r} = \frac{2vd}{c^2}, \tag{3}$$

the result on the RHS being obtained by the assumption that the 'direct' and 'opposite' photons fly along the circumference of the rotating disc (this can be done with the help of a polyhedral mirror); then $d = 2\pi R$ is the circumference of the disc, where R is its radius.

In the Harress–Sagnac 'rotating disc' experiment the point of separation of the 'direct' and 'opposite' photons is the same as the point of their meeting, so that the light paths of the interfering photons are closed curves. If we interrupt these closed paths and make the points of separation and meeting different, the light paths of the 'direct' and 'opposite' photons which become different for rest and motion of the disc may be made straight lines. This is the interrupted 'rotating disc' experiment reported in the present paper. This experiment shows patently that the velocity of light is direction dependent along a straight line on a rotating disc. Its scheme was the following (see figure 1).

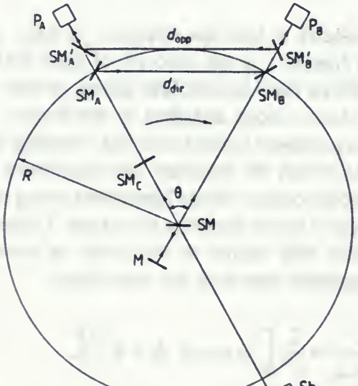

Figure 1. The interrupted 'rotating disc' experiment.

The light source S was a He–Ne laser. Sh was a shutter which was governed by the rotating disc and let light pass only at a strictly defined position of the disc when both photoresistors P_A, P_B were illuminated. Later we realised that since the areas of the photoresistors are small, the shutter is unnecessary. If S, P_A and P_B were also to be mounted on the rotating disc, the shutter Sh would be entirely unnecessary. SM was a semi-transparent mirror, M a mirror, and SM_C a corrective semi-transparent mirror which reduced the number of photons along the path to SM_A to the number of photons along the path to SM_B.

Let four photons be emitted by S at the same moment and suppose that they cover the following paths:

first photon: $S - SM - SM_C - SM_A - SM'_A - P_A$;
second photon: $S - SM - SM_C - SM_A - SM_B - SM'_B - P'_B$;
third photon: $S - SM - M - SM - SM_B - SM'_B - SM'_A - P_A$;
fourth photon: $S - SM - M - SM - SM_B - SM'_B - P_B$.

Using formula (2) and figure 1, we find that in the case of rotation (with respect to the case at rest) the time it takes for the third (fourth) photon to reach P_A (P_B) is shorter than the time it takes for the first (second) photon to reach P_A (P_B) by the amount

$$\Delta t_A = (2\Omega R^2/c^2) \tan \tfrac{1}{2}\theta \qquad (\Delta t_B = (\Omega R^2/c^2) \sin \theta). \tag{4}$$

The photoresistors P_A, P_B were put in the arms of a Wheatstone bridge. They were illuminated *uniformly* by interfered light. When the disc was at rest, the bridge was put into equilibrium, so that both photoresistors were illuminated by equal light intensities. This was achieved by adjusting micrometrically SM'_A and SM'_B and changing in such a way the path difference between the first and third photons until the bridge comes into equilibrium. Then we set the disc in rotation. With increasing rotational velocity, the bridge came into greater and greater disequilibrium, passing through a state of maximum disequilibrium. At a certain angular velocity Ω, when the sum of the differences in the optical paths $\Delta = (\Delta t_A + \Delta t_B)c$ became equal to the wavelength λ of the light used, the bridge was again in equilibrium. In this case

$$\lambda = \Delta = (\Omega R^2/c)(2 \tan \tfrac{1}{2}\theta + \sin \theta). \tag{5}$$

We experimentally checked this formula. The sensitivity of the method is considered in (Marinov 1977, 1978a). Our interferometric 'bridge' method leads to a precision $\delta\Delta/\lambda = \pm 2.5 \times 10^{-4}$ when we search for a maximum sensitivity, i.e. when the illumination over the photoresistors at equilibrium of the bridge should be the average. We have not searched for a maximum sensitivity, taking $\delta\Delta/\lambda = \pm 10^{-2}$.

We experimentally checked formula (5), putting $\lambda = 632.8$ nm, $\theta = 60.0° \pm 0.5°$, $R = 40.0 \pm 0.2$ cm. The number of revolutions per second $N = \Omega/2\pi$ was measured by a light stroboscopic cyclometer and maintained automatically with a precision $\delta N/N = \pm 2 \times 10^{-4}$. We registered $N = 92.90 \pm 0.02$ rev s^{-1}. Putting the figures into formula (5), we obtained, supposing the velocity of light is unknown, $c = (2.98 \pm 0.07) \times 10^8$ m s^{-1}, where $\delta c = \pm 7 \times 10^6$ m s^{-1} was the maximum error.

Apart from the experiment reported in this paper, on the same disc we carried out two other groups of very important experiments: two variations of the Harress–Sagnac 'rotating disc' experiment and the original non-inertial 'moving platform' experiment (Marinov 1978a, 1981b). The same method was always used, namely, we generated *two pairs* of interfering light beams which illuminated two photoresistors put in the arms of a Wheatstone bridge. Always, when changing the velocity of rotation, the illumination over one of the photoresistors increased and over the other decreased, thus bringing the bridge into disequilibrium. In all these experiments the light source and the photoreceivers are solid with respect to the laboratory and only at a certain position of the rotating disc (over a small angle of rotation) did the photoreceivers become illuminated. We succeeded in having stable interference pictures which were not disturbed by the rotation of the disc and the trembling of the different mirrors. We consider our method as original and very sensitive and we suppose it can be applied in other domains of measuring technique when one can make the effect to be measured influence in the 'opposite' sense the interference pictures in two pairs of light beams and become competitive to the well known 'lever of Jones'.

One of the referees suggested I must clearly state whether the result of the reported experiment is in contradiction to the predictions of special relativity. I discussed this topic in numerous publications (let me cite Marinov 1975b, 1978b). According to me, special relativity cannot explain even the result of the historical Harress–Sagnac experiment, as for its explanation one must assume that in a moving frame the velocity of light is direction dependent. The relativists have overcome this difficulty by stating that a Sagnac effect appears only on a closed path and is a result of a non-inertial motion (the disc is rotating!). Thus, according to special relativity, on a straight path on a rotating disc a 'Sagnac effect' does not exist, as a straight path may be chosen short enough and considered as inertially moving. I called (Marinov 1982) the effect (2) (area multiplied by angular velocity) the *Sagnac effect*, and the effect (3) (distance multiplied by linear velocity) the *Marinov effect*, as I was the first to observe it (Marinov 1974, 1980). Thus, according to relativity, a Sagnac effect does exist but a Marinov effect does not exist. Indeed, if a Marinov effect exists along a chord on a disc rotating in a laboratory, it must exist along a chord on a rotating disc representing our spinning Earth, and along a chord on a rotating disc representing our Earth revolving around the Sun, or around the centre of the Galaxy. Thus if the effect I have measured in the experiment reported in this paper is accepted, one must by the law of formal logic accept my measurements of the Earth's absolute velocity.

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Problems of Synchronization in Special Relativity: A Reply to G. Cavalleri and G. Spinelli

Stefan Marinov[1]

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I defend the opinion that Cavalleri and Spinelli, who in the last years abandoned many of the relativity dogmas and embraced many of the absolute conceptions, are still very far from an adequte understanding and interpretation of physical reality.

I was one of the referees of Cavalleri and Spinelli's paper(1) in the present issue of this journal, and my lengthy and detailed criticism is published in Ref. 2, p. 228. Of my 17 critical remarks, Cavalleri and Spinelli (C-S) have taken into account only two, *viz.* Nos. XIII and XVI, and introduced relevant corrections in their paper. The authors have not taken into account the remaining 15 remarks, which remain valid for the revised version of their paper. Here I should like to give only certain general statements:

1. THE MARINOV TRANSFORMATION

At the present time there are three competitive space-time transformations: those of Galilei, Lorentz, and Marinov. Which is the right one? But, first, concerning the names of the transformations: Was the transformation $x' = x - Vt$, $t' = t$, invented by Galilei? Certainly not. Greeks, Egyptians, and Chinese worked with this transformation, and when a Redskin in a reservation sees his boat at a distance x upwards in a river, he

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knows very well that after a time t the distance will be $x - Vt$, if V is the velocity of water. The Lorentz transformation was proposed first by Voigt. The Marinov transformation was proposed first not by Tangherlini, as C-S assert, but by Ives. I am sure, however, that the Ives transformation will remain in physics under my name for the following reasons (see Refs. 3–5).

1. I gave first the transformation formulas for the velocities, including those for light.

2. I gave first the connection between the Lorentz velocity transformation and the Marinov velocity transformation.

3. I showed first that the absolute velocity v and the relative velocity v' are physically adequate quantities, while the Lorentz relative velocity v'_L (a term introduced by me for the relative velocity in the Lorentz transformation) is not an actual velocity, but a mathematical result following from the artificially introduced relative time in the Lorentz transformation.

4. I showed first that the Marinov transformations form a group.

5. I showed first that any particle is attached to absolute space through its proper mass and thus that the link of the Marinov transformation to absolute space is not only kinematical, but also dynamical.

6. I made first a strong difference between the notions "Lorentz invariance" (available to an observer at rest in absolute space who describes the motion of a particle moving first with velocity v with respect to absolute space and then with another velocity v') and "Marinov invariance" (available when there is a particle moving with a certain velocity v in absolute space and an observer who first is at rest with respect to absolute space and then moves with a velocity V). For C-S, as for any contemporary physicist, if the velocity between a particle and an observer changes, it is of no importance whether the particle or the observer changes its velocity. Meanwhile these two cases are not identical, because, in the first case, the particle changes its velocity with respect to distant matter and thus its time energy changes too, while in the second case the time energy of the particle remains unchanged. It is important to note that the Lorentz invariance concerns 4-scalars, while the Marinov invariance concerns 3-scalars.

7. I showed that "length contraction" (or "dilation") in the Lorentz and Marinov transformations is not a physical effect but a result of the peculiar character of light velocity. [N.B.: The reasonings of C-S on "noninstantaneous Lorentz contraction," on "acceleration of the atoms," etc. are comical: To produce acceleration of atoms and deformation of crystals one must invest *energy*. Where does this energy come from? For Einstein the contractions are seeming, but for an absolutist (such as C-S) they must be real, physical.]

'8. I showed that the peculiar character of light velocity consists in the following. According to the Newton (Galilei, Redskin) conceptions, the velocity of light in a moving frame must be $c' = (c^2 - V^2 \sin^2 \theta)^{1/2} - V \cos \theta$, where c is the velocity of light in absolute space, V is the velocity of the moving frame, and θ is the angle between $\mathbf{c}'$ and $\mathbf{V}$. Meanwhile, the physically adequate formula for the velocity of light in a moving frame is $c' = c^2/(c + V \cos \theta)$, and with this formula one can explain all experiments available. Until now I could not find an explanation for this strange fact; and, as I always note, the deduction which I give of the Marinov transformation does *not* satisfy me.

Now let us return to the question, "Which of the three transformations is the right one?" The Galilei transformation is not true, as it is a "relativistic" transformation; it is not attached to absolute space and of importance is only the relative velocity between both frames. Then it fails to give right answers for high velocities. I showed that the Lorentz and Marinov transformations can be mathematically reconciled, since in the Lorentz transformation time is relative and the velocity of light absolute, while in the Marinov transformation time is absolute and velocity of light relative. I showed that if one calculates correctly (i.e., if one divides the space differentials by the differentials of absolute time, and not, as Einstein did, by the differential of relative time), then the space-time Lorentz transformation leads to the correct velocity transformation. I have experimentally shown that relative light velocity and absolute time are physically adequate quantities. Thus I have demonstrated that the Marinov transformation is the physically adequate one.

2. SLOW TRANSPORT OF CLOCKS

Many (naive!) absolutists think that by a slow transport of clocks one can realize a Newtonian (absolute) time synchronization between spatially remote clocks in a frame moving in absolute space with velocity V. Such was also the viewpoint of Torr and Kolen(6) who even carried out an experiment, hoping to be able to measure the Earth's absolute velocity by sending one-way electromagnetic signals between absolutely synchronized clocks and registering the first-order (in V/c) effects. In his talk at the International Conference on Space-Time Absoluteness (Genoa, July 1982) Professor Torr said he had arrived at the conclusion that during the transport the clock suffers a time dilation such that the expected first-order effect in the anisotropic light velocity will be compensated. However, Torr was of the opinion that a third-order effect may be observed. As his experiment had given a daily sinusoidal effect (over a distance of 500 m) correlated to *sideral* time, he accepted it as a third-order effect and calculated an absolute Earth velocity of the order of tens of thousands of km/sec. I showed[7] that, when working with the Marinov transformation, the compensation continues to the third order in V/c.

C-S have also understood that there is a compensation of the first-order effect. But when they write, "These simple considerations seem not yet to have been understood by Marinov," I can only express my regret that they did not attend the ICSTA conference in Genoa and take part in the discussion of the engineering aspect of the problem and in the discussion no longer of the first-order effect (there almost all good space-time specialists arrived at the compensation conclusion), but of the third-order effect.

3. EXPERIMENTAL MEASUREMENT OF THE EARTH'S ABSOLUTE VELOCITY

C-S replaced the naive ether of the 19th century by a new ether which is not naive. Very good. However, in any ether (naive or non-naive) the velocity of light in a moving frame must be direction-dependent. Thus, with the help of a rotating shaft and two oppositely directed light beams, one is able to measure the Earth's absolute velocity. I measured this velocity twice[8,9] and constructed a third very simple apparatus for its measurement.[10] C-S assert that if my experiments gave positive results, I should abandon the "Marinov transformation" (which predicts those results). Strange logic! But C-S assert that my experiment seems not to be reliable, without stating what is the prediction of *their* theory. It is interesting, however, to note that when I invited Professor Cavalleri to see my experiment and to check its reliability, he declined (see Ref. 2, p. 236).

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CORRESPONDENCE

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Paris, November 27, 1990

Dear Dr. Marinov,

Just few words in haste (since I am overworked and been sick lately) to answer your letter dated Nov.20th 1990.

1°) I have, of course, transmitted your letter to the referee since it is my deliberate policy never to referee myself any subject on which I am personnally involved... to avoid possible biases or injustices.

2°) My own personal independent private reactions (they will thus not enter into the final referee's judgement of your letter) are as follows :

a) Your formula (1) is exactly the relativistic formula one can (and has) deduce d directly from relativity theory (see Møller's book "The Theory of Relativity" (Clarendon Press), Oxford, p. 161). It results from conventional relativistic electromagnetism so that I cannot understand why you reject the "idiotic" Einstein theory and"wrong concepts of the Maxwellians" in your letter : You should agree with them to be consistent.

b) Since Relativity Theory implies energy-momentum and angular moment conservation they can and have been also deduced from (1); so that you must accept Maxwell's displacement currents... and your Bul-Cub Machine proves nothing... except perhaps the existence of the said currents.

c) I am not "converted" to Ampère forces but just think there is now sufficient experimental evidence for them and that they correspond to the "effective" non relativistic limit ($V_e \ll c$) of the total sum of Grossmann-Lorentz forces in the particular case of non relativistic electron (ion) motions in current elements. Indeed the Lorentz force (1) has been directly verified for free charged particle motions in modern accelerators. Currents are complex many body problems which only yield average macroscopic integrated forces.

d) Your arguments of p.2 (last paragraph) and of p.5 are (in my opinion) incorrect. You do not really discuss Graneau's results.

Evidently Ampère knew nothing of electrons (or ions) or magnetic vector potentials... but his results represented a fantastic step forward which led to Maxwell's and Einstein's discoveries. Your utilization of uncontrolled language against them just antagonizes people and is detrimental to the ideas you are defending.

Yours sincerely, J.P. VIGIER

Vigier

Editorial note. With this letter Prof. Vigier answers Marinov's letter published in TWT-VIII, p. 316.

GALILEAN ELECTRODYNAMICS
Box 251
Boulder, CO 80306
tel. 303-444-0841

December 2, 1990

Dear Dr Marinov:

Thank you for your letter of 23 November and the enclosures. I am particularly grateful for the copy of the pages in *Vestnik AN SSSR* no. 7/1990, about which I had not known. Please continue to send such items if you can, as they are of great interest to me and I may use them for "Dissident News." The Jan/Feb 1991 issue which goes out this week has a translation of *Literaturnaya Gazeta*'s interview with Dr Denisov.

I wish I could continue in this happy vein, but you make it very difficult. Please read my last letter again. I cannot accept any of the papers you sent because they are not original publications.

As for the personal opinions I gave you, please do not twist my words. By "tasteless" I do not, of course, mean my or your personal taste. In formalities I ask no more than any other regular scientific journal. The gist of it is this: the Einsteinians regard us all as cranks, so why do you go out of your way to prove them right with your eccentricities?

Now about your paper. As I wrote to you, I was only told that you have not performed the experiments that you claim, but now I am beginning to get suspicious on my own account. On p. 30 you say "The measured ratios B_d/B_0 were pretty near to the calculated according formula (4)." But formula (4) is not only absurd -- the magnetic induction INCREASES with r -- but it is clearly the result of an elementary error: you assumed d << r, but then calculated the approximation for d >> r, as you will quickly see when you look up (4). What kind of experiment is it that gives results "pretty near" to those calculated by a formula that resulted from an error and is obviously absurd?

So that makes me suspicious of the other experiment, too. You have a photograph of somebody (presumably yourself) sitting at some kind of a pot with leads. Very nice for a family album, but worthless for a scientific journal. What is needed is a photograph showing the detailed construction of your apparatus with exchangeable rotors. (*Galilean Electrodynamics* prints photographs, see my paper on electron clusters.)

As one not totally ignorant of electromagnetics, I always thought that a displacement current has the same magnetic and ponderomotive effects as a conduction current, because the other current has no way of knowing whether the electrons in the first current moved as free electrons or as electrons displaced within their atoms. But I have an open mind and am willing to listen to somebody who says "Not so, because ...''

Send me a paper that makes the point convincingly, and I will send it to reviewers. As of now, you have one experiment that confirms an erroneous absurdity, another that is dubious, and two historic ones, one of them confirming your doubts, the other contradicting them and allegedly refuted by you in a reference to an obscure (not easily available) paper. Hardly convinving. You start out very well with (2) and (3) and the physical aspect, the Eichenwald experiment, the history, but then you go under. Can you really not do any better?

I will not only set the type for you, but also correct the English (there is high tension like Hochspannung or vysoké napětí, but otherwise Spannung is voltage), replace the Marinovs with "author," put the many "I did this" and "I did that" in the passive voice (as is customary), but I can't write the physics for you. Also please add the titles of the papers in the references to give the reader an idea what they are about.

Yours sincerely,

Petr Beckmann

Editorial note. Marinov's letter of the 23.XI.1990 is published in TWT-VIII, p.319.

STEFAN MARINOV
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Tel. 0316/377093

5 December 1990

Prof. J. Vigier
PHYSICS LETTERS
Institut H. Poincare
11, rue P. et M. Curie
F-75231 Paris Cedex 05

Dear Prof. Vigier,

Thank you very much for your letter of the 27 November 1990.

I am looking forward for the opinion of the referee on my paper V 1607 a, entitled "On the electric intensities induced in railguns", as well as for your decision.

Here are my comments to the items of your letter:

a), b) The formula (1) in my paper V 1607 a

$$E_{glob} = - \text{grad}\Phi - \partial\mathbf{A}/\partial t + \mathbf{v}\times\text{rot}\mathbf{A} \qquad (1)$$

is, of course, the formula used in the theory of relativity for describing the force acting on a unit positive electric charge moving with a velocity $\mathbf{v}$ from the part of an electromagnetic system generating the electric and magnetic potentials Φ, $\mathbf{A}$ at the reference point crossed by the particle at the reference moment. This formula is called the "Lorentz formula". As I note at the end of my paper, it was introduced by Maxwell who died in the year when Einstein was born. And Maxwell, as a supporter of the aether concepts was, of course, not a "relativist". Moreover formula (1) is a "far action" formula.

I reject the theory of relativity and some of Maxwell's concepts, not because they make use of formula (1) but because they have NOT UNDERSTOOD this formula and the experimental consequences to which this formula leads. The conclusions following from this formula are:

(i) Formula (1) is valid only in absolute space (the space in which light velocity is isotropic). If the unit positive charge moves with a velocity $\mathbf{v}$ in a laboratory where the electric and magnetic potentials are Φ, $\mathbf{A}$, but this laboratory moves with a velocity $\mathbf{V}$ in absolute space, the force acting on the unit charge will be

$$E_{glob} = - \text{grad}\Phi - \partial\mathbf{A}/\partial t + \mathbf{v}\times\text{rot}\mathbf{A} + \varepsilon_0\mu_0\mathbf{v}.\mathbf{V}\text{grad}\Phi + \mathbf{V}\times\text{rot}\mathbf{A} + (\mathbf{V}.\text{grad})\mathbf{A}. \qquad (2)$$

I show why formula (2) is the relevant one in my paper "Absolute and relative Newton-Lorentz equations" published in PHYSICS ESSAYS which is enclosed. This paper was rejected by you with a letter of the 1 June 1989, a copy of which is enclosed. Your referee who has suggested rejection of this paper HAS TO APPEAR now with a criticism in your journal. If he will do this, I shall send you 1000 $. The money can be sent to you immediately and then if in six months from the present day the paper will not appear, you have to send the money to me. If the paper will appear, you can share the money with the author.

(ii) Formula (1) violates Newton's third law. Indeed, every student can show that according to this formula the force with which a charge q_1 moving with a velocity $\mathbf{v}_1$ acts on a charge q_2 moving with a velocity $\mathbf{v}_2$ is not equal and oppositely directed, in general, to the force with which the charge q_2 acts on q_1. Also every student can show that if the electric charges move along closed current loops, then the forces with which the loops act one on another are equal and oppositely directed. However, every student can show that if the loops contain condensers between whose plates the currents are interrupted, then the forces with which two such current loops act one on another, in general, are not equal and oppositely directed. Thus making experiments with such UNCOMPLETE loops, one can demonstrate violations of Newton's third law. First this was done by Graham and Lahoz (NATURE, **285**, 154, 1980) who have not ubderstood the essence of their experiment and then by me with two machines: The Bul-Cub machine without stator and the Rotating Ampere bridge with displacement current. The report on the first machine entitled "Very easy demonstration of the violation of the angular momentum conservation law and of the failure of conventional electromagnetism" was rejected by the following journals: J. Fr. Inst., J. Phys. D, Nuovo Cimento, Can. J. Phys., Spec. Sc. Techn., Ann. der Phys., Galilean Electrodyn., Fizika. The report on the second machine entitled "Extremely easy experiment demonstrating violation of the angular momentum conservation law" was submitted to your journal (Nr. V 727 a) and rejected by your letter of the 1 Sept. 1989 (a copy of which is not enclosed).

These experiments violating Newton's third law demonstrate that Maxwell's displacement current is a fiction. That Maxwell's displacement current is a fiction was shown patently also by Whitehead (Physik. Zeitschr., **4**, 229, 1903) and by my childishly simple repetition of Whitehead's experiment. The report on my repetition entitled "Repetition of Whitehead's experiment for demonstrating that displacement current is a pure mathematical fiction" was submitted to your journal (Nr. V 1281 a) and rejected by your letter of the 2 May 1989 (the copy is not enclosed).

Further experiments carried out by me which contradict the principle of relativity are:

- My inertial Kennard experiment reported in the paper entitled "Action of constant electric current on electrons at rest due to the absolute velocity of the Earth". The report on this experiment was rejected by the following journals: Nature, J. Phys. A, Europh. Lett., Physics Essays, Czech. J. Phys., Ind. J. Theor. Phys., Acta Phys. Hung.

- My inverse rotational Rowland experiment reported in a paper entitled "Childishly simple experiment violating the principle of relativity" which was submitted to your journal (Nr. V 1465 a) and rejected by your letter of the 14 May 1990 (a copy is not enclosed).

- The numerous optical experiments carried out by me in the last 20 years which have shown that velocity of light in an INERTIALLY moving laboratory is direction dependent. The reports on my experiments have been published in Czech. J. Phys., **B24**, 965, 1974, Gen. Rel. Grav., **12**, 57, 1980, TWT-II, 1984, p. 68. That the velocity of light is direction dependent in a rotating laboratory was shown by your compatriot Sagnac in 1913.

Thus I call the theory of relativity "idiotic" not because it makes use of formula (1) but because it gives WRONG predictions to MANY experiments. I call certain of Maxwell concepts WRONG exactly on the same ground.

Not only the theory of relativity but WHOLE CONTEMPORARY PHYSICS implies energy, momentum and angular momentum conservation. But there are machines which show that these laws of conservation CAN BE VIOLATED. The Swiss machine TESTATIKA which I HAVE TESTED is a PERPETUUM MOBILE. My above mentioned machines violate the angular momentum conservation law. You write: "You must accept Maxwell's displacement current". NO, NO, NO! I do not accept Maxwell's displacement current because this is an IDIOTIC concept. There is NO displacement current. Then you write: "...your Bul-Cub Machine proves nothing... except perhaps (!!!!!!!) the existence of displacement currents". NO! This machine shows exactly the OPPOSITE, namely, that there is NO displacement current.

c) I do not know experiments which show the existence of repulsive forces acting between colinear currents. If you know such experiments, I shall be very thankful to you if you will MENTION them, giving EXACT references. ALL experiments which we know show that the magnetic forces are acting PERPENDICULARLY to the current elements, as it is shown by the Lorentz formula (1). Lorentz' formula has been verified in milliards of experiments.

d) I give an explanation why a wire along which current flows attracts negative electric charges (as Sansbury has demonstrated). You affirm that my explanation is not correct. If you will give me ANOTHER explanation which, ACCORDING TO YOU, is correct, I shall send you $ 100. --- I do not discuss Graneau's results as Graneau's experiments are not PURE, i.e., they are not "yes-no" experiments, as, for example, are my experiments, Sansbury's experiment, Franciso Müller's experiment, Kennard's experiment, etc.

Ampere was a genius. His formula for the interaction between current elements is a formula written by the hand of a genius, as it works ALMOST in any case. However this formula is WRONG. Maxwell also was a genius, although his "Treatise" is VERY BADLY written. Certain of Maxwell's concept as the concept of "displacement current", the concept that the POTENTIAL electric and magnetic fields "propagate" with the velocity of light, his "closed loops" and "flux" concepts are WRONG. Einstein was a clever man but ALL what he has done in SPACE-TIME PHYSICS is WRONG! I do not know a discovery done by Einstein in space-time physics. If you mean that he has discovered something, I shall be very curious to hear WHAT. (Sorry, he introduced first the gravitational time dilation.)

See enclosed your homework for the next week.

Sincerely yours,

Stefan Marinov

HOMEWORK FOR PROF. VIGIER

In the following homework the questions are to be answered only by "yes", "no", "I do not know".

1. Answer the questions concerning the effects observed in my repetition of Whitehead's experiment, posed at the beginning of my letter to Prof. Vigier of the 7 May 1990 which is enclosed. The drawing of the experiment is also enclosed.

2. Answer the questions concerning the effects observed in my inverse rotational Rowland experiment (as well as of the direct and inverse inertial Rowland experiment which at the time being is only a Gedankenexperiment) posed in my letter to Prof. Vigier (at the end of the letter) of the 7 May 1990.

3) Answer the questions posed in Dr. Maddox' paper (Nature, **346**, 103, 1990) and in my comments to this paper entitled "How Dr. Maddox blabbed out the secret about the goat's ears of King Albert" about the effects observed by Kennard in his rotational Kennard experiment and by me in the inertial Kennard experiment. Dr. Maddox' paper as well as my comments and the MUTILATED by Dr. Maddox variation which will be published (let us hope) in NATURE are enclosed. Enclosed is also my letter to Dr. Maddox of the 6 November 1990.

If Prof. Vigier can solve Dr. Maddox' "conundrum" SAVING THE PRINCIPLE OF RELATIVITY, and if he will publish this solution in NATURE no later than in 6 months from the present day, I shall pay to Prof. Vigier 5,000 $. The sum can be sent immediately. If such a solution will not appear in 6 months, the money is to be returned to me plus 500 $ for lost interests and transfer taxes.

4)Answer whether my Rotating Ampere bridge with conduction current will rotate when sending direct or alternating current. The scheme of the experiment is enclosed. If the answer is positive (affirmation that the bridge will rotate), indicate on the enclosed drawing in which direction will the bridge rotate and indicate by the action of WHICH current elements on WHICH current elements a rotating moment is produced.

5) If there is a permanent magnet generating the magnetic potential **A** at a point crossed by a charge q moving with a velocity **v**, then the force acting on this charge is

$$\mathbf{f} = q\mathbf{v}\times\mathrm{rot}\mathbf{A}. \tag{1}$$

If the charge is at rest but the magnet moves with the velocity **v** the acting force is

$$\mathbf{f} = q(\mathbf{v}.\mathrm{grad})\mathbf{A}. \tag{2}$$

The theory of relativity asserts that in the second case the acting force must be

$$\mathbf{f} = -\, q\mathbf{v}\times\mathrm{rot}\mathbf{A}. \tag{3}$$

Write, according to you which is the right formula: formula (2) or formula (3).*

If all above questions will be not answered by Prof. Vigier, I think there is no sense to lead further a scientific discussion with him.

---

* If you think that neither (2) nor (3) is the right formula, then write the right formula.

Editorial note. The above letter remained unanswered.

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SB/SJJ

12 December 1990

Dr S Marinov
Institute for Fundamental Physics
Morellenfeldgasse 16
A-8010 Graz
AUSTRIA

Dear Dr Marinov

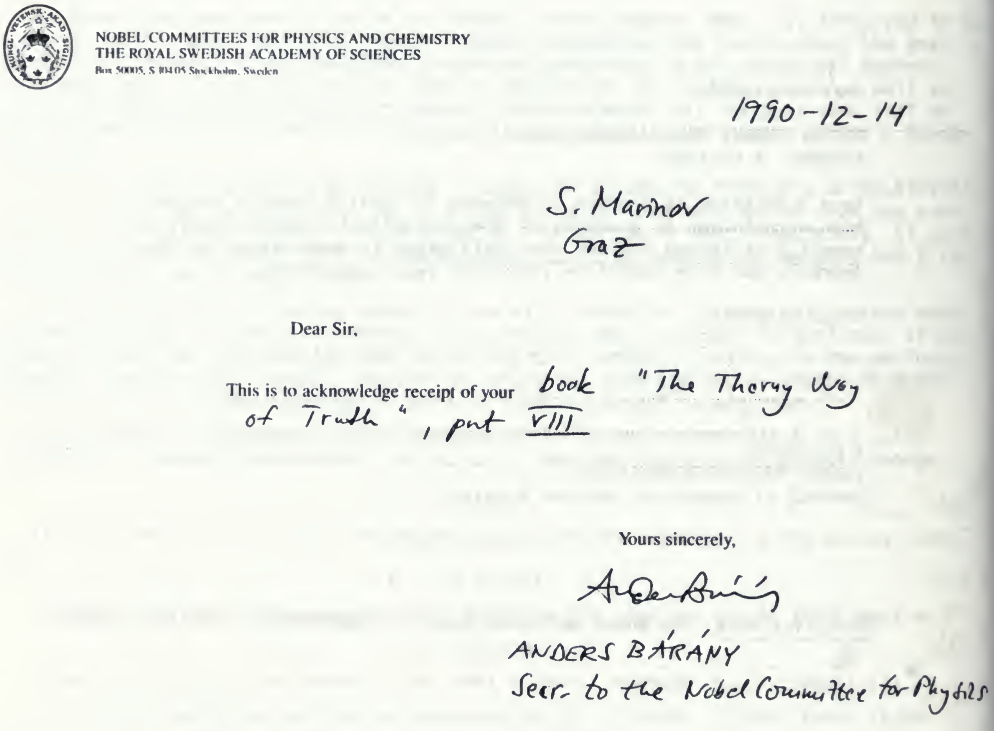
TITLE: Very easy demonstration ......
AUTHOR: S MARINOV

Your submission to Journal of Physics D: Applied Physics has now been scrutinised by a member of the journal's Editorial Board. I regret that it was decided that this paper is unsuitable for this journal, and I am therefore returning your typescripts.

Yours sinerely

S D Byford
Senior Editorial Assistant
Journal of Physics D: Applied Physics

Editorial note. The above mentioned paper is published in TWT-III, p. 48.



NOBEL COMMITTEES FOR PHYSICS AND CHEMISTRY
THE ROYAL SWEDISH ACADEMY OF SCIENCES
Box 50005, S 104 05 Stockholm, Sweden

1990-12-14

S. Marinov
Graz

Dear Sir,

This is to acknowledge receipt of your book "The Thorny Way of Truth", part VIII

Yours sincerely,

ANDERS BÁRÁNY
Secr. to the Nobel Committee for Physics

STEFAN MARINOV
Morellenfeldgasse 16
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Tel. 0316/377093

17 December 1990

Dr. Steven Rothman
JOURNAL OF APPLIED PHYSICS
Argonne Nat. Laboratory
P.O.Box 8296
Argonne
IL 60439-8296

Dear Dr. Rothman,

First I thank you for your letter of the 5 September 1990, although the rejection of my manuscript R-8095 was, of course, not pleasant for me (your letter was received in due time).

In the last years I have submitted several papers to your journal which have been rejected always by the motivation that my papers "deal with fundamental theory", meanwhile your journal is on applied physics. Your motivation is true. I submit my papers to all physical journals of the world dealing with fundamental physics but they are systematically rejected, as my paper "contradict firmly accepted theories". This is also true. The result of this politics of the physical journals is that extremely important physical discovery, having extremely big TECHNICAL applications, remains unknown to the scientific community.

The paper which I submit now to your journal was submitted to the following journals: PHYS. REV. LETT., Proc. IEEE, Int. J. Mod. Phys., Spec. Sc. Techn., Nuovo Cimento, Canadian J. Physics, Ann. der Phys., J. Franklin Inst., J. Phys. D. The referees' opinions of all these journals (I can submit them at interest) are, in principle, the following: Your Bul-Cub Machine will rotate, but there is nothing worth for communication, as the opposite angular momentum is "taken by the field", although NOBODY of the referees could show WHERE in the "electromagnetic field" is this opposite angular momentum stocked. I think that the readers of your journal who are familiar with the TECHNICAL APPLICATIONS of physics will understand that if I have succeeded to rotate a body of 2 kg suspended on two thin axles acting only with INTERNAL FORCES, this my discovery has TREMENDOUS PRACTICAL APPLICATION.

Hoping that you will grasp that my paper is a very important APPLIED physical paper, and (without bothering at the present time that it violates fundamental physical laws) you will submit it to a SERIOUS examination by your advisers, I decided to submit this paper to your journal.

I send you only one copy, as I am afraid that you will reject the paper AUTOMATICALLY. In the case that you will understand that the paper is IMPORTANT and must come to the attention of the scientific community, I shall submit other copies. The photographs will be submitted if the paper will be accepted for publication.

Thus the paper which I submit is entitled

VERY EASY DEMONSTRATION OF THE VIOLATION OF THE ANGULAR MOMENTUM
CONSERVATION LAW AND OF THE FAILURE OF CONVENTIONAL ELECTROMAGNETISM.

The PACS numbers of this paper are 03.50 and 41.10.

All eventual charges will be paid by myself.

Herewith I transfer the copyright for this paper to your journal.

Hoping to receive your acknowledgement for the reception of the paper and then in due time also your final decision,

Sincerely yours,

Stefan Marinov

PS. Enclosed is the paper which Dr. Maddox wrote recently
on some of the aspects treated in my paper.

Editorial note. Dr. Rothman answers the above letter with his own of the 4 January 1990.

STEFAN MARINOV
Morellenfeldgasse 16
A-8010 GRAZ — AUSTRIA

Tel. 0316/377093

19 December 1990

Dr. S. D. Byford
J. PHYS. D
Techno House
Bristol BS1 6NX

Dear Dr. Byford,

Thank you for your letter of the 12 December with which you rejected the publication of my paper

VERY EASY DEMONSTRATION OF THE VIOLATION OF THE ANGULAR MOMENTUM...

You have not enclosed the opinion of the member of the the Editorial Board and I do not understand the REASONS for the rejection of my paper. I beg you to tell me WHY the paper has been declined.

In my letter of submission of the 5 October 1990, a copy of which is ENCLOSED, I begge you in the case of rejection to answer three questions, so that I can see that my paper has been read and UNDERSTOOD.

I am sure that you (your referee) will give to my questions answers which are in CONFLICT with the experimental results. I consider such a situation as VERY BAD: a paper is rejected where effects are reported contradicting FUNDAMENTAL physical laws.

I know very well that you will suggest to me to send the paper to J. PHYS. A. Well. Go to Mrs. Linda Richardson and ask her to show you the correspondence between me and J. PHYS. A during the last 10 years. This journal neither rejects my papers nor examines them. I asked Mrs. Richardson at least 10 times on the phone to write me a letter that the J. PHYS. A does not wish to maintain scientific contacts with me or to EXAMINE the papers submitted by me and to take decision on acceptance/rejection. The same story is with almost ALL theoretical journals dedicated to fundamental physics.

But my machines are SIMPLE. They are practical machines. The engineers understand their effects, as engineers see EFFECTS and not FORMULAS and theoretical concepts.

Tell me: what are the purposes of your journal? Are you interested in spreading scientific information on IMPORTANT physical effects or not?

Please, be more specific and open. Answer WHY you have declined my paper and, please, be so kind to answer the three questions posed in my letter of the 5 October. I insist for these answers.

And please, be so kind to write me whether you wish to receive papers from me or not. Many journals (as PHYSICAL REVIEW, IL NUOVO CIMENTO, ANNALEN DER PHYSIK, etc.) have written to me such letters. I wish to have also from you such a letter to spare YOUR and my time. But if you wish to maintain scientific contacts and that I submit papers to your journal, please, OPEN YOUR MOUTH.

Hoping to receive your answer soon,

Sincerely yours,

J. Marinov

Stefan Marinov

PS. I enclose one copy of the rejected paper, so that you (your referee) can elaborate the answers to my three questions.

PPS. Enclosed is my address "MARINOV TO THE WORLD'S SCIENTIFIC CONSCIENCE" for whose publication I paid to NEW SCIENTIST 4,000 pounds. Read the last paragraph dedicated to my contacts with the J. PHYS. A.

Editorial note. The above letter remained unanswered.

STEFAN MARINOV
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Tel. 0316/377093

25 December 1990

Dr. Petr Beckmann
GALILEAN ELECTRODYNAMICS
Box 251
Boulder
CO 80306

Dear Dr. Beckmann,

Thank you very much for your letter of the 2 December which I answer after my return from a perpetual-motion-conference in Leningrad. I shall give you my news after having answered your letter.

I do not understand why you assert that my papers are not original publications. They are such.

I do not consider myself as an "eccentric". I do theory, I carry out experiments, I publish papers and books, I visit scientific conferences and organize my own. If my "literary style" does not enter in the frames of the Anglo-Saxon scientific style, this does not bother me at all. I am a fiction writer and poet, I know the "belle literature" of the biggest world nations well and I can permit me to have my own scientific style. However when an editor requires to introduce changes in my "style" in making it conform to the style of his journal, I always do this. Now I have rewritten my paper "Repetition of Whitenead's experiment...", submitted to your journal on the 23 November, so that it fulfills all your suggestions. I made of this paper <u>two</u> papers, as this presentation will be more didactic. If you would have some other suggestions, I shall gladly take them into account and rewrite again my papers. (Every rewriting of a paper increases its quality).

Your criticism concerning the ratio B_d/B_o is a result of a simple misunderstanding from your side and careless reading of my paper. $(B_r/B_o)_{d=Const}$ increases for $d \gg r$ with the increase of r and this is exactly the experimental result observed by Bartlett and Corle. If r is comparable with d, which is the case in MY experiment, one must work with the EXACT formula (4). If you will take the care to calculate the figures in the column "Author's theory" of Table 1 on p. 7 of the now submitted paper, you will see that the EXACT formula has been used.

Following your suggestion I put the photograph of me when carrying out the kinetic displacement current experiment in my family album (THE THORNY WAY OF TRUTH is also a kind of my "family album", see enclosed pp. 7-11 from TWT-VII).

I see that you, as well as all other physicists and electro-engineers, think that displacement current has the same magnetic and ponderomotive effects as conduction currents. If you will to have concepts adequate to physical reality, change your concepts as soon as possible.

Thus now I submit to your journal my two papers:

1. MAXWELL'S DISPLACEMENT CURRENT DOES NOT REACT WITH KINETIC FORCES TO THE ACTION...
2. MAXWELL'S DISPLACEMENT CURRENT DOES NOT ACT WITH POTENTIAL FORCES ON OTHER CURRENTS.

I suggest to you to publish them in the same issue. After their acceptance we shall speak about the other papers. I repeat I shall gladly take into account ANY your suggestion.

I, however, can not change "tension" to "voltage". I have MY terminology and MY symbolism. To make physics UNDERSTANDIBLE, the non-appropriate terms and symbols must be changed. Here I cannot make compromises. If you will call "tension" voltage (as the Saxons do), then the current is to be called "amperage" and the magnetic intensity "teslage". And note that I never use the term "electromotive FORCE".

I am looking forward for your decision about the acceptance/rejection of my two papers.

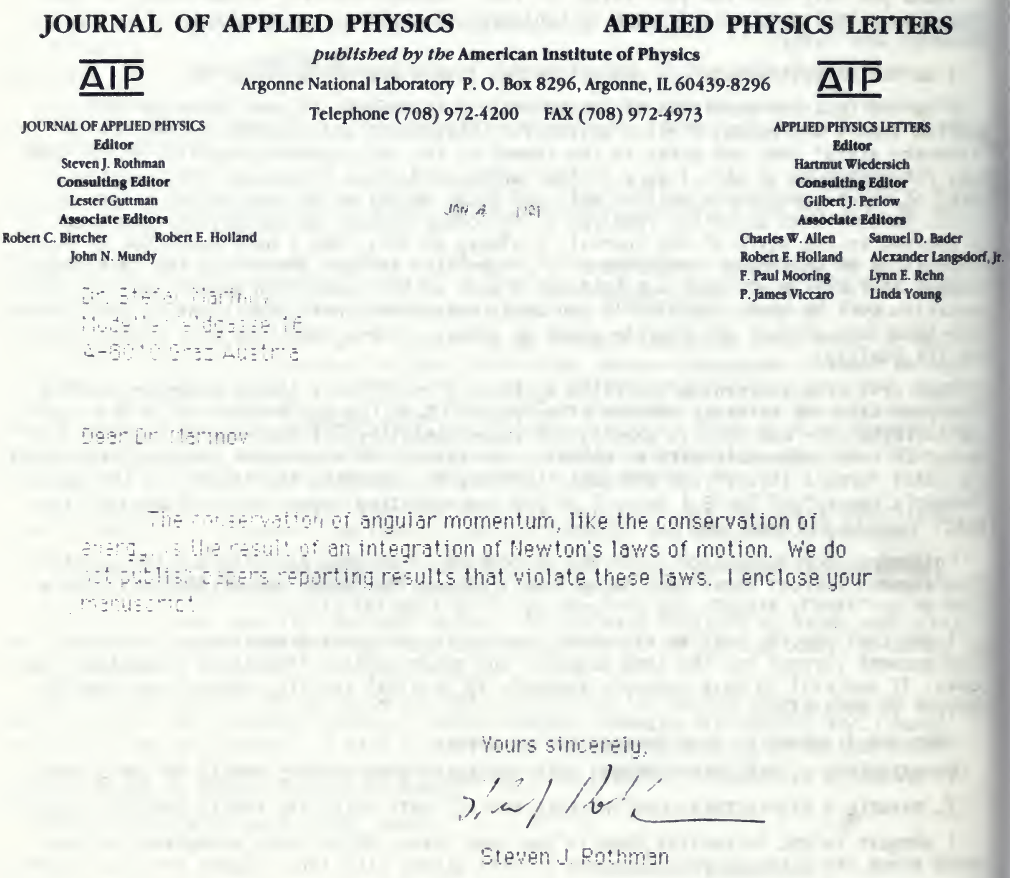
In Leningrad I met Svetlana, Parshin and Denissov*. You, surely, have received our letter when we were at Parshin's appartement. The situation is VERY INTERESTING there and, maybe, the first who will renounce the relativistic nonsense will be the Russian. There is NO political stability and consequently there is NO stability of the scientific establishment. This fact makes the Soviet "relativists" very nervous.

At the p.m.-conference Dr. Serogodsky reported on a p.m. of second kind constructed by him. After speaking with many other persons who have seen it, I concluded that the machine (of 18 kW) is working. I saw also the motors of Lihachov (at the Leningrad University) which also contradict to second thermodynamic law.

Yours:

*Peshchevitsky, Efimov, Smulsky, etc.

NOTE. A. D. Alexandrov is NOT the ex-president of the Academy!



JOURNAL OF APPLIED PHYSICS **APPLIED PHYSICS LETTERS**

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JAN 8 1991

Dr. Stefan Marinov
Morellenfeldgasse 16
A-8010 Graz Austria

Dear Dr. Marinov

The conservation of angular momentum, like the conservation of energy, is the result of an integration of Newton's laws of motion. We do not publish papers reporting results that violate these laws. I enclose your manuscript.

Yours sincerely,

Steven J. Rothman

Editorial note. With the above letter Dr. Rothman answers Marinov's letter of the 17 December 1990.

GALILEAN ELECTRODYNAMICS
Box 251
Boulder, CO 80306
tel. 303-444-0841

January 5, 1991

Dear Dr Marinov:

Thank you for your letter of 25 December, received today. Thank you for the news of your meetings in Leningrad and for your Christmas and New Year cards sent from there.

Believe me, I have no wish to quarrel with you, but I must now come to less pleasant matters raised in your letter.

In the preceding version of your paper (23 November 1990) your formula (4) is said to apply for $d << r$, but is clearly calculated for $d >> r$, and this is not simply a misprint, because it is repeated, besides which it is stated on p.29 that d varied from 0 to 6 cm, while r = 10 cm. On the same page you also clearly give yourself, and not Whitehead, as the author of the experiment described there.

As I said last time, the formula is the result of an error, and its dependence on r is absurd to boot; yet your experiment agrees with these erroneous and absurd values.

In response you claim that I read your letter carelessly, that this concerned Whitehead's, and not your experiment (in contradiction to your previous paper). I see that the new version no longer gives yourself as the author, and changes the condition of validity of (4) to the opposite, $d >> r$; yet the measurements of d and r remain what they were before in the later part of the new paper, where you again ascribe them to your own experiment. I am sorry, but far from allaying my previous suspicions, such manipulations only enhance them -- not to mention the persistence of the error (this time by quoting a wrong condition of validity) and the persistent agreement of the experiment with an erroneously calculated value.

My previous experience (such as the originality of the papers submitted in a still earlier letter) says that you are not an easy person to agree to such very obvious points, but fortunately you make it easy for me to reject the paper on other grounds. If you "cannot make compromises" on such matters as using your own terminology (however logical) for universally used and even officially standardized terms such as *voltage*, then there is no point in further discussing your papers. This journal adheres to the standardized and widely used terms, however inconsistent they may be, so if you know no compromise in this matter, that settles it, and we will put down the rejection of your paper to this point, even though in my opinion there are weightier reasons. But at least this way we can, I hope, lay the matter to rest on friendly terms.

I wish you and your family all the best for 1991.

Yours sincerely,

Petr Beckmann

Petr Beckmann
Editor

Editorial note. Marinov answers this letter with his own of the 16 January 1991.

STEFAN MARINOV
Morellenfeldgasse 16
A-8010 GRAZ — AUSTRIA
Tel. 0316/377093

14 January 1991

Patricia A. Morgan
Managing Editor
SCIENCE
1333 H Street, N.W.
Washington, D.C. 20005

Copies: 1. Prof. P. Beckmann
Prof. H. Hayden

Dear Dr. Morgan,

First I thank you for your prompt answer of the 17 August 1989 to my letter of the 5 August 1989, although the rejection of my paper "Violation of the laws of conservation of angular momentum and energy" was, of course, not pleasant for me.

Let me note that the mentioned paper was published in the proceedings of two international conferences: 1) the international conference on the fundamentals of physics and mathenatics, Perugia, Italy, September 1989, and 2) the international conference on free energy, Einsiedeln, Switzerland, October 1989. At interest I can send you reprints of the published paper, or of the Proceedings' volumes.

Now I have read in SCIENCE, **250**, 1208 (1990) the note of Robert Pool entitled "Tilting at Einstein" where it was announced that Prof. P. Beckmann and Prof. H. Hayden

> will pay $ 2000 to the first person who offers a valid optical experiment proving that the speed of light on Earth is the same east-to-west as west-to-east, within 50 meters per second. The winner does not even have to have done the experiment personally.

I have DONE such an experiment. Its sensitivity was estimated by me as 40 km/sec but one can always ACCEPT that,at relevant improvements and sophistications, the sensitivity can be increased to 50 m/sec required in the offer.

If this accuracy should be achieved, then if doing the experiment at the equator letting the axle of the apparatus pointing east-west, one will see that the compenent of the Earth's absolute velocity along the axis which one measures with this experiment will differ by ± 500m/sec for two measurements done with 12 hours of difference, due to the daily rotation of the Earth. This is the effect expected by Prof. Beckmann and Hayden when proceeding from the Michelson-Gale-Pearson (1925) experiment.

I hope that if SCIENCE will publish the report on my "coupled shutters" experiment, then I shall win the award.

I beg you to inform me as soon as POSSIBLE whether my paper will be accepted. In such a case I shall send you the photograph of the experiment and better reproductions of the drawings.

Sincerely yours,

S. Marinov

Stefan Marinov

PS. Enclosed are pages 12 - 16 from my book THE THORNY WAY OF TRUTH, Part VII, which throw additional light on my "coupled shutters" experiment and on the background of its execution.

<u>Editorial note</u>. SCIENCE answers the above letter with a letter of the 4 February 1991.

PHYSICS ESSAYS

AN INTERNATIONAL JOURNAL DEDICATED TO FUNDAMENTAL
QUESTIONS IN PHYSICS

Editor:
E. Panarella

15 January 1991
PE3384/kla

Dr. Stefan Marinov
Morellenfeldgasse 16
A-8010 GRAZ
AUSTRIA

Re: Manuscript: MAXWELL'S ILLUSION: THE DISPLACEMENT CURRENT, by Stefan Marinov, submitted for publication in Physics Essays (received 13 August 1990)

Dear Dr. Marinov:

Please find enclosed two reviews of your paper.

As you know, the Editorial Policy of "Physics Essays" prescribes that authors should take an objective and careful look at the reviewers' reports in order to see if there are elements of value that can be used to improve the quality of their papers, on both the aspects of correctness and of clarity of exposition, and this is what I am encouraging you to do now.

In particular, I believe you should address the very serious questions raised by the reviewers because they indicate that your paper has not succeded in making a strong case for what you propose. Moreover, it seems that this paper does not add anything new to the existing literature, because it is essentially an abstract from your book TWT.

Since I would like to keep a tight schedule on this process of revision, I would therefore like to have your revised manuscript, in triplicate, back to me by 8 May, 1991, at latest. Moreover, in retyping the manuscript, please follow the Instruction to Authors here enclosed.

I thank you for having submitted your paper to us.

Sincerely yours,

E. Panarella

Editorial note. Marinov answers the above letter with his own of the 11.II.1991.

EP/kla
Encl.

PHYSICS ESSAYS

First referee

REVIEWER'S REPORT ON THE PAPER: MAXWELL'S ILLUSION: THE DISPLACEMENT CURRENT, by Stefan Marinov.

The paper is actually an extract from TWT series, published by Stefan Marinov. The style of the paper is rather that of a student's educational book, long, repeating itself, repeating known scientific results and making no effective use of the limited available pages of a scientific journal. The author adopts for himself certain known results of the classical theory of Electrodynamics and certain others are characterized by the author's own wording: stupidities, nonsense, wrong, in error; without the author providing sufficient scientific evidence for it. Scientists following classical electrodynamics are called "stupid" and "more stupid ones" and the author as deserving the Prize of the Prussian Academy of Science.

However, the most important reason for declining at once this paper is the fact that the author claims to have performed a number of important experiments which show the most unexpected results by the classical. However, systematically, no one of these experiments has been witnessed by another person. It is generally known to the scientific community, involved to this aspects of electrodynamics, as well as similar aspects of space-time, that Stefan Marinov's experiments are a sort of thought experiments, never completed and most important never have shown the adverse results the author claims. Therefore, they can not be presented as real in this paper and most important they can not be used in a scientific journal as a proof of the author's claims.

It is my suggestion that the author should present his thought experiments or quasi-performed experiments as to what really they are. Alternatively, he could describe them to be performed by other people.

The paper by Stefan Marinov "Maxwell's Illusion:The Displacement Current", though it could be a good review and challenging paper, in its mispresentating facts form and attitude is one of the most inappropriate papers for publication in a scientific journal.

PHYSICS ESSAYS

Second referee

Reviewer's Report on:

MAXWELL'S ILLUSION: THE DISPLACEMENT CURRENT

by Stefan Marinov

I find myself in sympathy with many of the doubts expressed by the author with regard to Maxwell's displacement current and its ability to produce magnetic effects and respond magnetically to other currents. But then Marinov creates so much confusion that the reader is likely to prefer Maxwell's arguments.

For example, right at the beginning Marinov confused me with his distinction between 'potential' and 'radiation' fields. It is my understanding that Maxwell proposed only one kind of electromagnetic field. It consisted of a mechanical ether which transferred mechanical forces between electric charges and magnetic atoms. The same ether was also responsible for the propagation of light and other electromagnetic disturbances.

Later Einstein found it necessary to replace the mechanical ether with the medium of 'field energy'. Neither Maxwell nor Einstein referred to two different kinds of field.

Further along in his manuscript Marinov confuses the reader with 'potential action' and 'kinetic reaction'. What he probably means to imply is the magnetic interaction of currents.

The paper lacks clear-cut conclusions. Should the displacement current term be dropped from Maxwell's equations? Must we substitute something else for it? If not, will Maxwell's equations without the displacement current still agree with the radiation of electromagnetic energy from one antenna to another?

Whatever the faults of Maxwell's field theory, I do not think Marinov's paper is helpful in advancing the science of electromagnetism.

STEFAN MARINOV
Morellenfeld [illegible]
A-8010 GRAZ — AUSTRIA

Tel. 0316/377093

16 January 1991

Dr. Petr Beckmann
GALILEAN ELECTRODYNAMICS
Box 251
Boulder
CO 80306

Dear Dr. Beckmann,

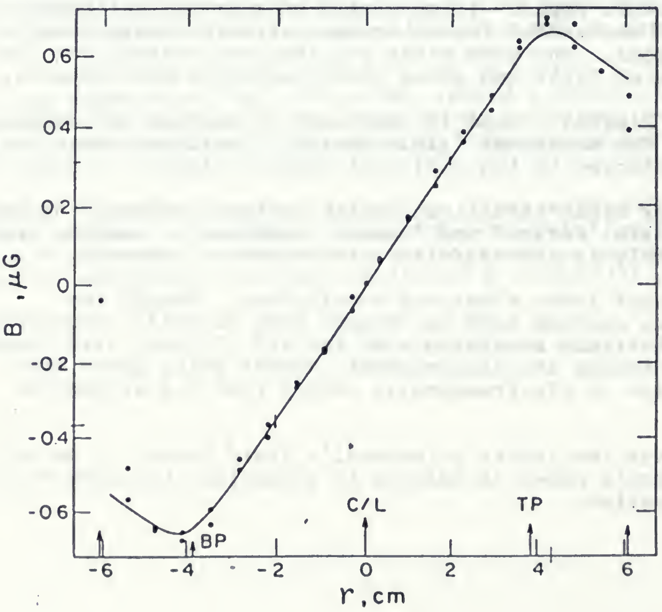
Thank you very much for your letter of the 5 January 1991.

Sorry! For our misunderstandings a misprint in my paper sent to you on the 23 Novembe 1990 is guilty. On line 11 from below on p. 29 one has to write $d \gg r$ instead of $d \ll r$. In your letter of the 2 December you wrote: "... but it is clearly the result of an elementary error: you assumed $d \ll r$, but then calculated the approximation for $d \gg r$, as you will quickly see when you look up (4)." Thus you noticed that there is a contradiction between the assumption in the text and the mathematical calculation. Without looking at the paper, I grasped to the first easy explanation: you have carelessly read the paper. Now I see that you read my paper with care and I must be more attentive when answering your criticism.

Although seeing that you read attentively my papers, nevertheless I again see that you read them not carefully enough. The situation is the following:

1.The magnetic intensity field between the plates of a condenser (with wires supplying the current coming from infinity and going to infinity) depends not only on d and r, i.e., on the distance between the plates and on the distance of the reference point from the middle point on the condenser's axis. It depends also on the radius R of the circular plates. I tried to find a formula, but this is a very difficult mathematical problem.

2. Experiments for $d \gg r$ have been NOT done by me. Such an experiment was done only by Bartlett and Corle. And Bartlett and Corley have indeed established that, for $d \gg r$ the intensity increases with the increase of r, reaches a maximum and then decreases. Here is the graph obtained by Bartlett and Corle:



3. My POTENTIAL displacement current experiment was done always for $r > d$.

4. My POTENTIAL displacement current experiment is NOT a repetition of Whitehead's experiment. This is an ORIGINAL experiment.

5. My POTENTIAL displacement current experiment is neither a repetition of Bartlett and Corle experiment, although they carried out also a POTENTIAL displacement current experiment, as in my experiment the space between the condenser plates was ALWAYS filled by a dielectric with very high permittivity.

6. Whitehead has done a KINETIC displacement current experiment.

7. My KINETIC displacement current experiment was a REPETITION of Whitehead's experiment, however a much more effective and didactic repetition, as a showed that if the space between the condenser plates will be filled not by a dielectric but by a conductor there IS rotation.

Thus I shall read in the future with more attention your comments, but, please, do not construct a pyramid on a simple and easily dicypherable misprint. And, please, read my papers with more attention.

I am not Saddam Hussein and I make compromises. If a condition for printing my papers is a change of "electrical tension" to "voltage", I shall accept this change, although, I must assure you that in all my publications I write and I shall continue to write the opposite (see, for example, my papers which are now published in PHYSICS ESSAYS).

Of course, if you will not accept my papers for publication, this will not influence at all my friendly relations to you. I admire you for yourfight for scientific truth and I am ready always to help your fight. You can always ask for my support. I wish also once more to thank you for your good will to send me your journal without charge. My financial situation is still very difficult, as I finance all my scientific activity from my own pocket. I should like very much to send you my books free of charge but I cannot, as the selling of my books is the most important source for my income and my experiments devour much, too much money.

On the 14 January 1991 I sent you the description of my "coupled shutters" experiment with which I wish to win the $ 2000 prise announced by you and by Dr. Hayden. I shall thank you very much if you will send the money to me AS SOON AS POSSIBLE. I construct now a variation of my machine MAMIN COLIU (a perpetuum mobile) which is much more effective than the six variations presented in THE THORNY WAY OF TRUTH, part III. I have only one problem to solve: the financial problem. All other problems are SOLVED. For this reason I beg you and Prof. Hayden to send me the award as soon as possible. Of course, if you will be the opinion that my experiment is not such a one which will be awarded by this prise, I beg you very much to present me the MOTIVATIONS.

Hoping to hear soon from you which decision will you take concerning my papers,

Sincerely yours,

S. Marinov

Stefan Marinov

Editorial note. Dr. Beckmann answers the above letter with his own of the 29 January 1991.

J. P. WESLEY, *Ph.D. Physicist*
Weiherdammstr. 24, *7712 Blumberg, West Germany*, Tel: 07702-658

22 January 1991

Dear Umberto,

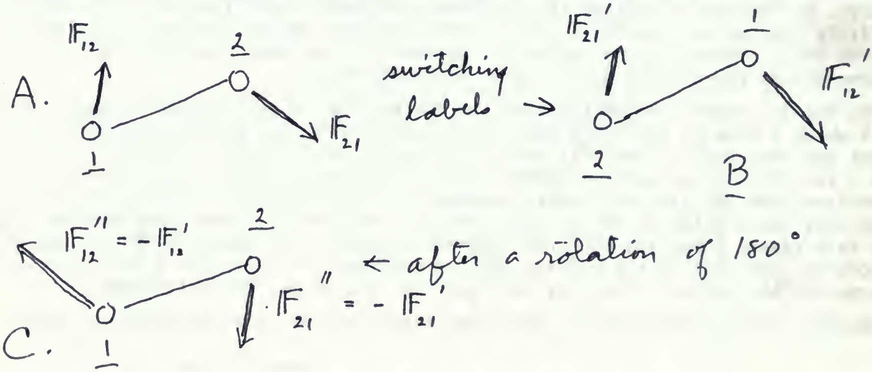
Thanks for your letter of 7 January 1991 and your previous letter.

I feel that your paper concerns electrodynamics and not simply mathematics. It should really contain the relevant references to give the reader a chance to examine the facts (Weber electrodynamics) rather than an empty theory (Maxwell electrodynamics which does not fit the facts). Francisco Müller's work has been published in the readily available book PROGRESS IN SPACE TIME PHYSICS 1987!!!!

Of course Ampere assumed Newton's third law to get his final force law. Newton's third law is a statement of mathematics! To deny Newton's third law is equivalent to denying that two plus two equals four. If one denies Newton's third law or denies that two plus two equals four, one cannot derive any sensible physics.

As you know, if one denies Newton's third law, one denies the conservation of energy, the conservation of linear momentum, the conservation of angular momentum, and one can lift oneself by ones own bootstraps. Etc. Etc. All sorts of well known absurdities result if one denies Newton's third law. What is, unfortunately, seldom realized is that it is simply a mathematical principle. Newton's third law says that labels should not be chosen such as to violate obvious symmetry.

To make this clear the fundamental situation involved is the following: Two identical bodies (charges, for example), body 1 and body 2, experience forces due to the other body, $\mathbb{F}_{12}$ and $\mathbb{F}_{21}$, as shown



Switching labels the original diagram A becomes diagram B with the forces $\mathbb{F}_{21}'$ and $\mathbb{F}_{12}'$. Nothing has changed physically! Next the figure is rotated through 180°. Again nothing has changed physically; the operation is a pure mathematical operation to get another point of view of the setup. Comparing diagram A with C it is clear that

$$-\mathbb{F}_{21}'' = \mathbb{F}_{12} \qquad \text{and} \qquad -\mathbb{F}_{12}'' = \mathbb{F}_{21} \,. \tag{1}$$

But since the two bodies are identical the physical situation has to be precisely the same for diagram A and C; so

$$\mathbf{F}_{12} = \mathbf{F}''_{12} \quad \text{and} \quad \mathbf{F}_{21} = \mathbf{F}''_{21} \; . \tag{2}$$

Combining Eqs.(1) and (2) it is seen that pure symmetry arguments yield Newton's third law:

$$\mathbf{F}_{12} = \mathbf{F}''_{12} = - \mathbf{F}_{21} \, , \quad \text{or} \quad \mathbf{F}_{21} = \mathbf{F}''_{21} = - \mathbf{F}_{12} \; . \tag{3}$$

For me Newton's third law is as obvious as two plus two equals four. I see no reason for discussing such a trivial symmetry condition!

I would like to attend your Ischia Conference if it materializes. I hope you get the requisite funds. And I hope I will have the requisite time to attend.

I keep hoping to get reports that your health is now perfect. Is it?

best regards

Paul

P.S. The congruency of the vectors $\mathbf{F}_{12}$ and $-\mathbf{F}_{21}$ is also clear from the above discussion; i.e., the line of action of $\mathbf{F}_{12}$ and $-\mathbf{F}_{21}$ must be the same.

copy to Marinov

Editorial note. The above letter was written by Prof. Wesley and addressed to Prof. Umberto Bartocci (Perugia). Marinov comments on this letter in his letter to Prof. Wesley of the 29 January 1991.

PHYSICAL SOCIETY OF JAPAN
Kikai-Shinko Building, 3-5-8 Shiba-Koen, Minato-ku
Tokyo 105, Japan

JAN. 2- 1991

Dr. Stefan Marinov
Institute for Fundamental Physics,
Morellenfeldgasse 16,
A-8010 Graz,
Austria

Dear Dr. Marinov:

This letter concerns with your article entitled "Childishly Simple Experiment Violating the Principle of Relativity" which you submitted for consideration to our journal. We sent the paper to our referee who is eminent in the fields of particle physics and relativity. According to his comments, your manuscript should not appear in our journal.

Considering the referee report, the editorial committee of our journal discussed your paper. Our conclusion is that your paper is not appropriate for publication in our journal. Consequently we regret that we cannot publish your article in the Journal of The Physical Society of Japan. We are returning herewith your manuscript to you.

Sincerely yours

Shobu Kaneko
Editor-in-Chief
Journal of The Physical
Society of Japan

SK/kk

Editorial note. The above mentioned paper is published in TWT-VII, p. 325.

"Childishly Simple Experiment Violating the Principle of Relativity"

Publication of this paper in our Journal is not recommended.

An experimental result which, the author asserted in this paper, shows the violation in the principle of relativity is unbelievable, because it contradicts many other experimental results which support the principle of relativity.
The author wrote quite little about his experiment, in spite of the importance of the result.
Sensitivity of the Hall detector, it's bias current, characteristics of the amplifier, smoothness and parallelism of the rotation of the detector, environmental conditions, and so on, should be calibrated, or evaluated, and described in the paper, if the author submit it again to the other journal.

STEFAN MARINOV
Morellenfeldgasse 16
A-8010 GRAZ — AUSTRIA

29 January 1991

Prof. J. P. Wesley
Weiherdammstr. 24
D-7712 Blumberg

Copy: Prof. U. Bartocci

Dear Paul,

Thank you very much for sending me the copy of your letter to Prof. Bartocci of the 22 January.

Your reasoning that the forces with which two particles, if we neglect their velocities, act one on another must be equal and oppositely directed is ABSOLUTELY RIGHT. Indeed, one can prove by a simple mathematics that, FOR THIS CASE, the third law of Newton MUST BE VALID, without going at all to physics.

But the magnetic forces between two particles are determined not only by their electric charges (which are scalar quantities) but also by their VELOCITIES (which are vectorial quantities). Here your mathematics cannot work and one must grasp to physics.

Let me cite on this topic Grassmann in his 1845 article (see TWT-VIII, p. 43):

> ... bei allen anderen Kräften sind es ursprünglich punktartige Elemente, d.h. Elemente ohne bestimmte Richtungen, welche auf einander wirken, und bei diesen läßt sich die Notwendigkeit der gegenseitigen Wirkung längs ihrer Verbindungslinie sogar *a priori* ableiten; was berechtigt uns aber, diese Ânalogie auf ein ganz fremdartiges Gebiet, auf welchem die Elemente mit bestimmten Richtungen begabt sind, zu übertragen?

Here is the dog burried.

I shall be very happy to receive your comments.

Yours: Stefan

GALILEAN ELECTRODYNAMICS
Box 251
Boulder, CO 80306
tel. 303-444-0841, FAX 303-444-0997

January 29, 1991

Dear Dr. Marinov:

I am overworked editing and printing *Galilean Electrodynamics* and other publications, and I really don't have time for bickering. I received your letter of 16 January, and you are only tying yourself up in further contradictions. You answer ALL of my objections attached to your original equation (4), including its originally claimed authorship, by blaming it all on a misprint. But not only is the "misprint" repeated several times, but if corrected, it now implies a situation where you did NOT measure. Really, all this is very embarrassing, and time-consuming, and let's just stop the bickering -- I dread your next explanation, please refrain from it. Frankly, I think that maybe you just wished so fervently to have measured the results that in the end you convinced yourself you measured them. It happens to lots of people.

Next, your mirror experiment. The conditions of the reward were not accurately given in the National Review article, but I will not hide behind technicalities. From the photograph, even though its exaggerated black-white contrast makes it difficult to see details, it appears that your telescope and beamsplitter are on the same table as the running motor. Really, Dr. Marinov, I have done interference experiments, and I would doubt that you can get any meaningful fringe shifts, or even fringes, with the vibrations of a motor on the table (take a look how Michelson did it!). I fear this experiment is more wishful thinking.

So let me turn to your statement "Of course if you will not accept my papers for publication, this will not influence my friendly relations with you." Let me take you up on that. I do not want bad relations with you. But no more experiments, please.

I read with great indignation about your forced stay in a psychiatric ward, and even more about what happened to you at the US embassy in Bulgaria. It sounds incredible, but after the incident with the Lithuanian sailor and the Medvid affair, it seems quite plausible.

I still think you are very talented, and hope you will submit a normal, theoretical paper that an independent reviewer without pro-Einsteinian prejudice will pass as dispassionate, of high quality, and therefore suitable for publication in *Galilean Electrodynamics*.

Yours sincerely,

Petr Beckmann
Editor

Editorial note. With this letter Dr. Beckmann answers Marinov's letter of the 16.I.1991. Marinov answers the above letter with his own of the 6 February 1991.

SCiENCE

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(202) 326-6500

CABLE ADDRESS: ADVANCESCI

4 February 1991

Dr. Stefan Marinov
Morellenfeldgasse 16
A-8010 Graz
AUSTRIA

Dear Dr. Marinov:

Thank you for submitting your manuscript to SCIENCE. We regret to say that on the scale relative to other manuscripts received at the same time, your paper was given a lower priority rating. We are therefore returning the manuscript copies without delay so that you can seek publication elsewhere.

The editorial on page 249 of our 18 January 1985 issue details some of the procedures we have established in an effort to evaluate manuscripts promptly and fairly. As you are aware, we receive many more papers than we can accept, and most of the work sent to us is publishable. We must make decisions based on, for example, area of discipline, novelty, and significance, over and above the usual criterion of research acceptable for more specialized journals. Our decision is not, therefore, a reflection of the quality of your research but rather of our stringent space limitations.

Sincerely,

Monica M. Bradford

Monica M. Bradford
Acting Managing Editor

MMB/mw
Enclosures

Editorial note. With this letter SCIENCE answers Marinov's letter of the 14 January 1991.

STEFAN MARINOV
Morellenfeldgasse 16
A-8010 GRAZ — AUSTRIA
Tel. 0316/377093

6 February 1991

Dr. Petr Beckmann
GALILEAN ELECTRODYNAMICS
Box 251
Boulder
CO 80306

Dear Dr. Beckmann,

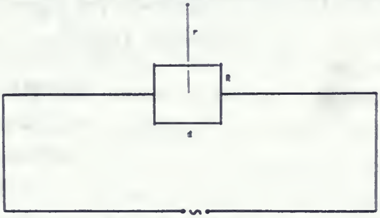
Thank you very much for your prompt answer of the 29 January to my letters of the 14 and 16 January.

I shall object your new comments on my potential displacement current measurements. I do not bicker with you and you can leave my objections without comments. But I have a rule which I have preserved during my WHOLE scientific life: I never leave criticism to my papers without comments: if the criticism is right, I accept it and I thank my referee (exremely rear occasions!); if the criticism is wrong, I present my objections and I again thank the referee for his attention to my work.

You assert that the misprint (I wonder why you put the word in quotation marks) on line 11 from below on p. 29, $d \ll r$, is repeated several times. I shall be very thankful to you if you will point to me the other places where you have found this misprint.

You write then: "...if (the misprint will be) corrected, it now implies a situation where you did NOT measure." I do not understand what you wish to say with this sentence and I am afraid that your English here is bad.

You write then: "Frankly, I think that maybe you just wished so fervently to have measured the results that in the end you convinced yourself you measured them." This experiment was one of the hundred experiments which I have carried out. I expected that if the distance d between the condenser's plates will increase but I maintain the same current in the circuit and the dielectric put between the plates has a very high permittivity (to evade any bickering let us accept $\varepsilon = \infty$), then the magnetic intensity measured at a point at a distance $r > R$, where R is the radius of the circular condenser's plates, will diminish. I beg you, dear Dr. Beckmann, tell me YOUR EXPECTATION! I am SURE, you will NOT give YOUR EXPECTATION! As far as the experiment is concerned, my measurements showed that the magnetic intensity decreases and gentlemen do not argue about facts.



Now to my "coupled shutters" experiment with which I wish to win your and Dr. Hayden's \$ 2000 prise (my "coupled mirrors" experiment reported in Gen. Rel. Grav., **12**, 57 (1980) is ANOTHER experiment!). You write: "... it appears that your telescope and beamsplitter are on the same table as the running motor. Really, Dr. Marinov, I have done interference experiments, and I would doubt that you can get any meaningful fringe shifts, or even fringes, with the vibrations of the motor on the table." These were your motivations for not giving me the award. My objections are the following: 1) What you call a "telescope" is a laser. 2) This experiment is NOT an interference experiment. Please, read the paper ATTENTIVELY. I further insist of giving me the award. If you have OTHER objections against the experiment, please, present them.

Now following your suggestion, I present a THEORETICAL paper for your journal entitled

EXACT CALCULATION OF THE PUSHING FORCE WHICH ACTS ON THE AMPERE BRIDGE.

The paper has also an experimental part consisting of the first 15 lines on p. 19. If you wish to have NO experimental results obtained by me published in your journal, you can cancel these fifteen lines and figures 3 and 4 (which I can also put then in my family album). I should, however, prefer to print the paper *in toto*.

Thank you for your compassion to my sufferings in totalitarian Bulgaria.

Sincerely yours, Stefan Marinov

STEFAN MARINOV
Morellenfeldgasse 16
A-8010 GRAZ — AUSTRIA
Tel. 0316/377093

11 February 1991

Dr. E. Panarella
PHYSICS ESSAYS
c/o Nat. Res. Council
Rm. 100, Bldg. M10
Ottawa
ONTARIO K1A 0R6

Dear Dr. Panarella,

Thank you very much for your letter of the 15 January 1991 and for the enclosed two referees' opinions on my paper MAXWELL'S ILLUSION: THE DISPLACEMENT CURRENT.

I send you my comments to the referees' criticism.

I prepared a new version of my paper written according to the Instructions of PHYSICS ESSAYS and I send it in three copies.

Your first referee writes:

> It is my suggestion that the author should present his thought experiments or quasi-performed experiments as to what really they are. Alternatevely, he could describe them to be performed by other people.

I shall suggest thus to you to publish my paper

EXTREMELY EASY EXPERIMENT DEMONSTRATING VIOLATION
OF THE ANGULAR MOMENTUM CONSERVATION LAW.

This paper was submitted to you with my letter of the 20 February 1989 (see your answer of the 26 June 1989). Suggest then to your referee to appear with a criticism on this paper in your journal. If my paper MAXWELL'S ILLUSION... will be printed, the readers of PHYSICS ESSAYS will read with big interest the paper EXTREMELY EASY...

Hoping to receive soon your decisions concerning these two papers,

Sincerely yours,
S. Marinov
Stefan Marinov

PS. The photograph to the secpnd paper will be sent if the paper will be accepted for publication.

[illegible] proble[illegible]
such a case meticulous definitions, extreme clarity and a [illegible] are indispensable.

In the new version such words as "stupidity" and "nonsense" have been canceled, but words as "wrong" and "in error" remained, when they deserve to be written.

I further am the opinion that the prize of the Prussian Academy of Sciences for the year 1882 must be awarded to Whitehead and to me, as we have presented "conclusive experimental verifications against the existence of electrodynamic actions caused by appearing or disappearing dielectric polarization of the strength which was predicted by Maxwell". The prize was awarded to Hertz for the discovery of the electromagnetic waves but it was not announced for this. Of course, one can present the objection that if "dielectric polarization" appears and disappears with high frequency (i.e., if the electric charges in the conducting currents have high accelerations), then electromagnetic waves are radiated and Hertz has experimentally detected exactly the "electrodynamic actions" of the radiated energy, thus that he has deserved the prize. However in the year 1879 when the prize was announced nobody presumed that electromagnetic energy can be radiated and the award was announced for establishing whether appearing and disappearing dielectric polarization acts with potential forces on other electromagnetic systems and reacts with kinetic forces to the action of the other electromagnetic systems. Whitehead and Marinov gave experimentally negative answers to these questions.

The referee notes that none of my experiments (which contradict well established concepts in conventional electromagnetism) has been witnessed by other person. My comments: Other persons can repeat my experiments and confirm or reject them, only if the reports on my experiments should be published, otherwise the scientific community remains unaware.

The referee asserts that "it is generally known to the scientific community... that Stefan Marinov's experiments are a sort of thought experiments, never completed and most important never have shown the adverse results the author claims." - Indeed, the relativists diffuse inofficially the rumours that my experiments which have demonstrated the invalidity of the principles of relativity and equivalence and of the laws of conservation have never been done and if they will be done, they will not show the results reported by me. The reason for this tactic is only one: to win some year more before recognizing officially the failure of relativity. One does not invalidate experiments by shouting: "The experiments were not done." One invalidates experiments by analyzing them critically in the press and by repeating them to show which are the true results.

Instead to do this, the referee prefers to sing the aria of Don Basilio.

AUTHOR'S COMMENTS TO THE REPORT OF THE *SECOND* REFEREE ON MARINOV'S PAPER "MAXWELL'S ILLUSION: THE DISPLACEMENT CURRENT"

I definitley sustain the opinion that there are *three* kinds of electromagnetic fields: 1) the *potential field*,which is inversely proportional to the square of the distance from the charge generating the field and proportional to the velocity of the latter, 2) the *radiation field*, which is inversely proportional to the distance from the charge radiating the field and proportional to the acceleration of the latter, and 3) the *radiation reaction field*, which is inversely proportional to the zeroth power of the distance form the charge radiating the field (i.e., this field acts on the radiating charge itself) and proportional to the super-acceleration of the latter.

The fact that Maxwell and Einstein have considered only one kind of electromagnetic fields is of no big importance. Here is to be added that at Maxwell's time the second and third electromagnetic fields were *unknown*.

Whether the referee considers certain "mechanical ether" as a physical reality is *his affair*. I have not heard about some experiment showing the existence of an "aether", so that, *at the present time*, this notion is absolutely *superfluous*.

In my writings I use only the notion "absolute space" which is the space of this reference frame in which velocity of light is isotropic.

According to my knowledge *nobody* has demonstrated experimentally the existence of potential "field energy". Thus, for me, this notion is superfluous. But radiated "field energy" *does exist* and Lebedev in 1905 has experimentally demonstrated its pressure.

Whether the referee is confused with the notions "potential action" and "kinetic reaction" is *his affair*. I should like only to note that according to my observations 90% of all physicists do not know that Newton's second law

$$mu = - \partial U/\partial r,$$

where m is the mass of a particle which acquires the acceleration $\mathbf{u}$ if its radius vector is $\mathbf{r}$ and U its potential energy with the surrounding system, gives the equality between two physically completely different quantities: the *kinetic* force which is on the left side of the above equation, and the *potential* force which is on the right side (perhaps the referee is in the 90%).

When two currents interact, always the one *acts* on the other with a potential force and the latter *reacts* with a kinetic force to the action of the first one. The fact that in no textbook on electromagnetism all over the world,where the potential action of the displacement current is considered,the question about the kinetic reaction of this current is even posed, is highly persuasive: all these textbooks writers are in the 90%.

The referee asks whether the displacement current term is to be dropped out from Maxwell's equation. The referee, obviously, has not read my paper with a due attention: the answer is given on pp. 7 and 8.

INTERNATIONALER FÖRDERKREIS
»MAINTOR ENERGIE-TECHNOLOGIE«
VORSITZENDER REINHOLD WILD

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Herrn
Stefan Marinow
Morellenfeldgasse 16

A 8010 Graz

12.3.91

Sehr geehrter Herr Marinow,

auf Ihre Anfrage über den gegenwärtigen Stand des MAINTOR-Energie-Technologie-Projektes möchte ich Ihnen mitteilen, daβ ich mich zuletzt erneut am Samstag, 23.Februar 1991, mit dem Erfinder getroffen habe.

Zu meiner Freude kann ich Ihnen berichten, daβ die doch wesentlich aufwendigeren Arbeiten als zunächst vorgesehen zur Fertigstellung des voll transparenten Acryl-Modells zur Betreibung einer Glühbirne zwar nur Schritt für Schritt, aber sehr konstant vorangehen und daβ ich aufgrund des am 23.Februar 1991 persönlich besichtigten Zwischenergebnisses weiterhin keine Zweifel an der überzeugenden Umsetzung der MAINTOR-Erfindung in praktische Modelle habe, die dann als Basis für konkrete Lizenz-Verhandlungen und die Vorbereitung der Massenfertigung dienen sollen.

Alle bisher gegen die Arbeitsweise der gezeigten Modelle aufgeworfenen Zweifel wurden bei dem am 23.2.1991 vorgeführten Modell berücksichtigt.

In Abstimmung mit dem Erfinder soll eine öffentliche Vorführung erst dann wieder erfolgen, wenn das derzeit in der Fertigstellung befindliche Modell komplett transportfähig und bis auf den rotierenden MAINTOR-Magneten und den Stabmagneten total in Acryl gehaltene Modell fertig ist und seine Transportfähigkeit und Funktionstüchtigkeit bewiesen hat.

Ich gehe davon aus, daβ ich nach Rückkehr von einer Reise Mitte März zu der nächsten Vorführung für Anfang April 1991 einladen kann.

Eine weitere Unterrichtung an Sie über diesen Termin ist durch mein Büro vorgemerkt.

Ich hoffe, daβ dieser Zwischenbericht Ihr Interesse gefunden hat und grüβe Sie

in freundlicher Verbundenheit
Ihr

Reinhold Wild

Marinov's note. I have the patent of the machine MAINTOR (MAgnetic INertial TOrque). This is a magneto-mechanical machine of the type of Schuhmacher's. ACCORDING TO ME, the MAINTOR machine WILL HAVE a perpetuum mobile effect!

Gruppo di Ricerca "Geometria e Fisica" dell'Università degli Studi di Perugia
Con gli auspici dell'Istituto Italiano per gli Studi Filosofici di Napoli

QUALE FISICA PER IL 2000 ?

PROSPETTIVE DI RINNOVAMENTO, PROBLEMI APERTI E VERITÀ "ERETICHE"

CONGRESSO INTERNAZIONALE
ISCHIA 29 MAGGIO/1 GIUGNO 1991
BIBLIOTECA ANTONIANA (ISCHIA PONTE)

(Dino Marsan, per gentile concessione della Società Ed. Andromeda)

Comitato Organizzatore: Umberto Bartocci, Dipartimento di Matematica, Università degli Studi, 06100 Perugia (075/5855008, 5002494; Fax 075/5852067) (Coordinatore del Congresso); Stefan Marinov, Morellenfeldgasse, 16, A 8010 Graz (Austria) (0043/316/377093); Roberto Monti, Istituto TE.S.R.E.-C.N.R., Via de' Castagnoli 1, 40126 Bologna (051/287040; Fax 051/229702).

Il Convegno si pone come obiettivo di compiere un'analisi storico-filosofica dei paradigmi della fisica del XX secolo assieme ad un esame di esperimenti e proposte teoriche alternative (teorie dell'etere, elettromagnetismo non-relativistico, nuovi modelli di atomo, fusione "fredda", etc.).
Sono previsti stands per editori di pubblicazioni scientifiche, e per progettisti o costruttori di macchine, ed una poster session. E' possibile partecipare anche soltanto con una relazione scritta.

Indirizzare ogni richiesta al coordinatore del Congresso.

WHAT PHYSICS FOR THE NEXT CENTURY?
PROSPECTS FOR RENEWAL, OPEN PROBLEMS, "HERETICAL TRUTHS"

INTERNATIONAL CONFERENCE - ISCHIA, ITALY, 29 MAY/1 JUNE 1991

Under the sponsorship of the "Istituto Italiano per gli Studi Filosofici" in Naples

ORGANIZING COMMITTEE

Umberto Bartocci, Department of Mathematics, University of Perugia, 06100 PERUGIA, ITALY (075/5855008, 5002494; Fax 075/5852067) (Coordinator of the Conference)

Stefan Marinov, Morellenfeldgasse, 16, A 8010 GRAZ (AUSTRIA) (0316/377093)

Roberto Monti, TE.S.R.E. - C.N.R., Via de' Castagnoli 1, 40126 BOLOGNA, ITALY (051/287040; Fax 051/229702)

GENERAL INFORMATION AND AIMS OF THE CONFERENCE

The Conference will take place in Ischia, a beautiful island near Naples, from 3 p.m. of Wednesday, 29th May, to 1 p.m. of Saturday, 1th June 1991.

Invited lectures will be given in the morning sessions, while the afternoons will be reserved to short communications (20 minutes). After each talk there will be 10 minutes for discussion.

The official languages are English and Italian.

There will be stands for editors of scientific publications, and for designers and constructors of machines, as well as a poster session.

The preliminary program of the meeting (and possible subsequent alterations) will be sent to all applicants.

More detailed information will be supplied on request by the coordinator of the Conference.

After the two Conferences "Galileo Back in Italy" (Bologna, 1988), and "Foundations of Mathematics and Physics in XXth Century: the Renouncement of Intuition" (Perugia, 1989), the aim of the present proposal is to offer a new opportunity for interchange of ideas and debate to scientists working in several areas with relevance to foundational problems in Physics, regardless of any academic divisions.

We believe we are living in the eve of revolutionary changes in the paradigms of Physics, and that it is then very important to encourage constructive criticism of the present received views. As a matter of fact, dissatisfaction with respect to the state of contemporary Physics has been expressed by many scientists through different channels. Both principles and experimental evidence of basic theories have been questioned, and alternative proposals have been put forward.

We hope that a most unprejudiced discussion may develop, and that a cooperative effort of the interested scholars, which is in many ways made difficult by the existing organization of research, may ultimately lead to significant progress in the desired direction.

An indispensable condition for a fruitful interaction to occur is absolute freedom of expression of one's own opinions. Thus there will be no form of preliminary "censorial" intervention by the Organizing Committee. Nevertheless, it would be useful for the organizers to have a short summary (or preferably a first draft) of a proposed communication, in order to arrange the program of the Conference in the most efficient way. Please send it to the coordinator of the Conference by 15.4.91.

It is also possible to participate by just submitting the text of a communication: if you happen not to be able to come personally, please send the manuscript to the coordinator by the aforesaid deadline in order to make it possible to have copies of it distributed during the meeting.

ACCOMMODATION AND OTHER SERVICES

All requests should be addressed to the coordinator of the Conference.

The participation charge (to cover handling costs, etc.) is 50 USA dollars (50.000 Italian Lire). If application arrive before April 15, 1991, the cost will be reduced to 30 USA dollars (30.000 Italian Lire). The money should be sent to the coordinator by international post order, or by bank order: credit the sum to the bank account N. 11515/11, Cassa di Risparmio di Perugia, Agenzia N. 6 , Via Fabretti N. 97, 06100 Perugia, Italy.

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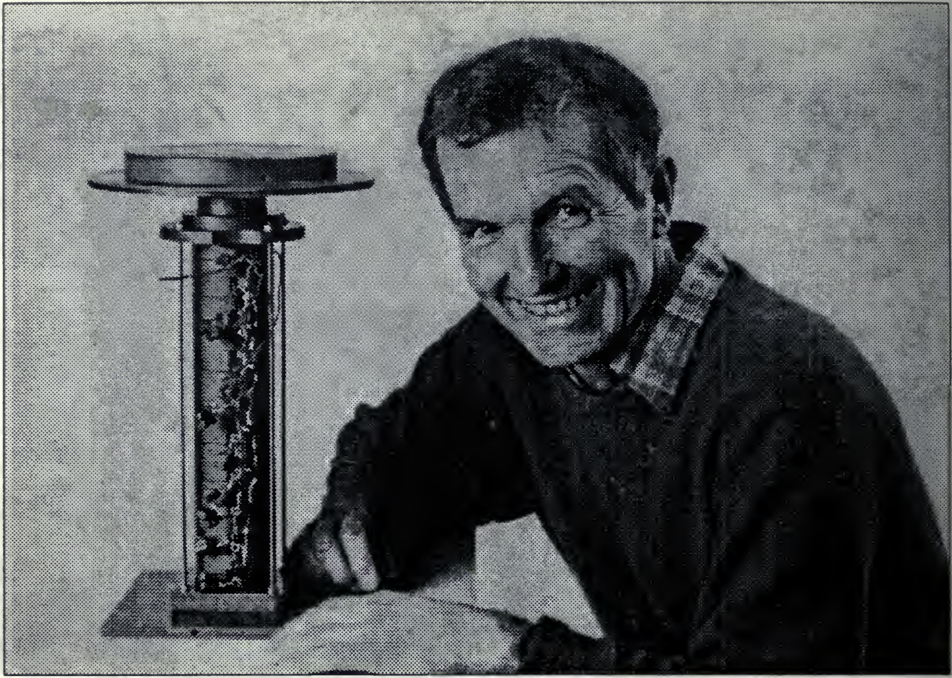

The ninth part of the collection of documents THE THORNY WAY OF TRUTH (TWT) ist dedicated to the perpetuum mobile IL NICOLINO DI VENETO (VENETIN COLIU) which was discovered and developed by the troika Cavalli, Vianello and Marinov. VENETIN COLIU has many common features with Marinov's MAMIN COLIU but there is the following substantial difference: MAMIN COLIU is a generator without electromagnetic braking (zero Lenz effect), while VENETIN COLIU is a generator with electromagnetic acceleration (anti-Lenz effect), i.e., when electric power is extracted from MAMIN COLIU the mechanical power needed for its rotation remains the same, while in VENETIN COLIU this mechanical power decreases. Meanwhile when extracting electric power from a conventional generator, the mechanical power needed for its rotation increases (normal Lenz effect). The appearance of the anti-Lenz effect in VENETIN COLIU can be explained by every child who has heard that the alternating current in a coil appears with a certain time retardation after the applied (in the case of a generator, induced) tension. Indeed, every logically thinking child comes to the conclusion that the magnetic field generated by this current will brake the rotation when the current has the same direction as the tension and will accelerate the rotation when its direction is opposite. Marinov is photographed above with one of the VENETIN COLIU machines constructed in January 1991. At the present time the accelerating power is still less than the friction braking power, but there is a hope that when this volume will be published the machine will be run as a perpetuum mobile. All Marinov's physics papers published in scientific journals which have not been reprinted in previous volumes of TWT are reprinted in this volume. Price: $ 25