Relativity replaced – Ether found around Earth.

(Corrected and Completed)

by

Antonis N. Agathangelidis

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Mail Address: Th. Chatzikou 16, Thessaloniki 561 22, Greece
e-mail: **anagath1943@gmail.com**
Tel. 030 (2310) 695 647 , Tel. Fax. + 030 (2310) 733 645

RELATIVITY REPLACED - ETHER FOUND AROUND EARTH.

I. NUMEROUS REASONS TO ABANDON EINSTEIN'S RELATIVITY THEORIES.

II. PRE - RELATIVISTIC PHYSICS OFFERS ENTIRE THE "RELATIVISTIC" EXPERIENCE.

III. VERIFICATION OF STOKES' (1845) 'TERRESTRIAL LUMINIFEROUS ETHER' FROM EXPERIMENTS. ASTRONOMICAL AND COSMIC CONSEQUENCES OF THE GRAVITATIONALLY - BOUND ETHER; NON - EXPANDING UNIVERSE.

I. NUMEROUS REASONS TO ABANDON EINSTEIN'S RELATIVITY THEORIES!

In the Part I are exposed numerous and serious reasons to abandon Einstein's Special and General Relativity Theories, as:1) Lack of causality in SRT and GRT, 2) Usage of invalid axioms and principles ("Invariance of the speed of light", "Equivalence Principle", "Mach's Principle"), 3) Confusing theoretical mixing of SRT and GRT regions, 4) Theoretical-experimental failures of SRT-GRT on the speed of propagation of light, 5) Theoretical - experimental failures of GRT in atomic frequencies; GRT have failed: (i) in the Hafele-Keating experiment and also in GPS, and (ii) in the gravitational red-shift (additionally these GRT-explanations conflict each other)], 6) The failure of GRT to detect the 'far-distant-matter'- influence i.e. Earth's velocity relative to the 'far-distant-matter-frame' by means of two GRT-effects: the 'time-dilation' and the 'speed-of-light-variation' (Sagnac and Michelson-Gale experiments).

II. PRE-RELATIVISTIC PHYSICS OFFERS ENTIRE THE "RELATIVISTIC" EXPERIENCE.

In the Part II is given a detailed reproduction of some forgotten but famous proofs which together with the here proposed new ones, -all based essentially in pre-relativistic physics-, enable us to obtain here an integrated, -ready-for-College-classroom-, reproduction of entire the "SRT / GRT"- physics-results without any reference to Relativity theory. In more details: Pre-relativistic physics had contained in it Maxwell's E/M equations working into a space occupied by the unified (luminiferous-E/M) ether. The 'Energy - Mass Equivalence' (EME) had its own origin from Maxwell's E/M theory; after that the early combination (Lewis -1908-) of the EME with the Newtonian equations of motion had offered the well-known "SRT" - dynamics and kinematics explaining even and the 'life-time dilation' (in ether), while the early application (Dirac-1924-) of the conservation principles of mechanics, on the emitting (or absorbing) atom and the photon, had proved the introduction of the frequency retardation factor: $\sqrt{1-\upsilon^2/c^2}$ in the (classical) atomic-Doppler expressions; this same frequency retardation factor causes and the appearance of the 'head-light effect' (in ether). Every of these chapters can be proved without application of Lorentz transformations or SRT! On the other hand the application of the EME to gravity, imply a new equation for the conservation of the energy -both for matter or light- inside the gravitational field and by the additional assumption that the presence of the gravitational field and of 'luminiferous ether' offers *a virtual index of refraction* $n(r)$ *for light*, -where the '*Least-Time Principle*' is applied-, then, entire the group of the experimental results and phenomena briefly called today "GRT"- physics, is reproduced. Conclusively this improved pre-relativistic physics offers entire the so-called today "relativistic" –SRT and GRT- experience with the use of ordinary Newtonian time into a Euclidean space.

III. VERIFICATION OF STOKES'(1845) 'TERRESTRIAL LUMINIFEROUS ETHER' FROM EXPERIMENTS. ASTRONOMICAL AND COSMIC CONSEQUENCES OF THE GRAVITATIONALLY - BOUND ETHER; NON - EXPANDING UNIVERSE.

In the Part III is proved theoretically and experimentally the existence of a 'terrestrial luminiferous ether' (Stokes 1845). The universal ether is gravitationally-bound in the inner regions of the terrestrial *Roche lobe* (Sun-Earth system); in this manner the 'terrestrial ether' is formed, being carried along –translationaly- by Earth, and nearly no-participating in Earth's rotation about its axis. All old-classical and modern experiments searching for the 'cosmic' ether-drift are immediately explained without any connection to "space-and-time transformation" constrains. Although the contemporary stream of the physicists doesn't suspect the existence of a terrestrial -Stokes- luminiferous ether, yet its drifts, have experimentally been detected: 1) by the classical explanation of Michelson-Gale (1925) experiment (big Sagnac), 2) by re-interpretations of Hafele-Keating atomic-clock(s) experiment and of the Global Positioning System (G.P.S.) as well, and finally 3) by re-interpretation of Brillet-Hall laser-beating experiment. The existence of the gravitationally-bound ether implies new models and expressions for the annual starlight aberration and the astronomical Doppler effects; it be permitted theoretically the relative velocities between the stars or galaxies to become greater than local 'c'. The photons, due to a friction of the vibrators of the universal ether, continuously can lose part of their energy ('*tired*' *light*); the "cosmic red-shift" may, very well, takes place into a non-expanding Universe filed with ether. The bulk of energy coming to ether from the "tired photons" can be converted (from time to time and under suitable conditions) into "elementary" particles.

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I. NUMEROUS REASONS TO ABANDON EINSTEIN'S RELATIVITY THEORIES

A. LACK OF CAUSALITY IN SRT AND GRT

1. SRT OFFERS AN OBSERVATIONAL - MENTAL AND MATHEMATICAL "CAUSALITY"

SRT is very symmetric and treats the behavior of clocks (and rods) of the physically equivalent systems of reference, S and S′, being in linear relative translatory motion to each other. Additionally Einstein in SRT had denied the existence of any *luminiferous ether* in space. By definition thus there are no criteria of motion in the empty vacuum space of SRT; by which manner or physical cause then, two relatively moving clocks could do "feel" or "perceive" their own "motion" through the presumably empty vacuum space of SRT, so to change their own rhythms as Lorentz transformations (LT) dictate? Einstein said absolutely no word at this point, but finally we read about, "*some habitants of A-clock-system seeing the B-clock-system moving* $(+\upsilon)$ *and similarly some habitants of B-clock-system seeing the clocks of A-system moving* $(-\upsilon)$*"*. In SRT only the 'habitants-observers', by their visual perception (i.e. by their own mental function), "decide" about the state of "motion" or "no-motion" of the systems and so these habitants-observers "decide and compute" the relation of the rhythms of the clocks of the said systems. SRT offers thus one observational – mental and purely mathematical "causality" for the behavior of clocks. In order to avoid such an observational – mental and purely mathematical "causality" in Physics, we have to search about the real physical causes which should create the changes in the *time-rates* of the atomic clocks; such real causes are: (i) the absolute motion through a gravitational field, or (ii) the absolute motion through a magnetic or electric field, or (iii) the absolute motion-acceleration through "Mach's – far-distant-matter frame" (FDMF), or (iv) the motion through Stokes'-1845- ether (ether gravitationally-bound by Earth), etc. {It will be proved in Part III the reality of the last case (iv)}.

2. LT DENY LOGIC AND CAUSALITY.

Lorentz transformations (LT) are solved symmetrically relative to the primed and unprimed systems; this mean that two observers-clocks A (placed at $x_A = 0$) and B (placed at $x'_B = 0$), being moving rectilinearly with constant speed υ the one relative to the other, can use (after their meeting), symmetrical but contradictory LT-calculations for their own time-rates:

$$\Delta t_A = \frac{\Delta t'_B}{\sqrt{1-\frac{\upsilon^2}{c^2}}}$$ A's - calculation for the time-rate of B-clock

$$\Delta t'_B = \frac{\Delta t_A}{\sqrt{1-\frac{\upsilon^2}{c^2}}}$$ B's - calculation for the time-rate of A-clock

The application of LT to this very basic and simple case leads to this theoretical contradiction. This theoretical contradiction, (and breaking of our common-sense logic and classical Causality), is well known to the professors of Relativity since it really is the very first consequence of the LT/SRT. Many of the relativists feel non-comfortably when asked about it. This explains why many of them hurry to guess a reason for a *causal breaking* of LT-symmetry between the A and B observers-clocks, {they guess for example: either (i) the presence of gravity, or (ii) the curved trajectory of the one of the two clocks -Einstein (1905) [1]-, or (iii) the presence of matter at an area C, creating different state-of-motion of the A (relative to C) than the motion of B (relative to C), or (iv) the different motion of A and B clocks relative to the far-distant-matter frame (FDMF) i.e. the frame relative to which the far distant matter has homogeneous velocity distribution, or the frame relative to which the cosmic microwave background radiation (CMBR) appears to be homogeneous i.e. without any Doppler-shift to any direction, etc.}, but then they have to use these same guesses to convince Lorentz and Einstein to avoid the application of the symmetric LT to our own Earth-frame for the explanation of Michelson-Morley (M-M) experimental null result i.e. this M-M experiment still remains for an explanation!

3. LT ARE UNEARTHLY.

It is heard in the courses on relativity that the unique, non-symmetric relation, between the time-rate of a clock moving along a closed circular path and the time-rate of a stationary clock, is object of GRT. GRT is thus applicable for any concrete value of the radius R of the circular path of the moving clock (not excluding the radius of the Earth trajectory around Sun or the radius of Sun around the center of our own galaxy) and only for the non-existent "absolute straight-line" ($R=\infty$) are applicable the SRT/LT; i.e. LT are unearthly. GRT teaches thus that symmetric LT are unearthly and this really means that the Michelson-Morley (M-M) experiment still remains quite unexplained according to GRT. How the mathematical-physicists could generalize to GRT - "metric" ds without LT?

4. SPACE AND TIME TRANSFORMATIONS: NON-CAUSAL SUPER-OPTIMISTIC THEORIES FOR EVERYTHING.

Independently of any kind of the invented non-Galilean transformations [see D. 2. **(**Part I**)**], the "physics by space and time transformations", manipulates 'time', not defining the kind of clock! Although 'time' is not a readily definable concept in physics yet we are able to construct 'clocks' to 'measure' it! We can measure 'time', in principle, by a lot of different classes and subclasses of clocks: Atomic: disintegrating radioactive elements, μ-muons, π-pions, atomic frequencies, etc. Newtonian: free rotors, gun-machines, engines of any fuel, hand clocks, quartzes, strings, cords, sound going forth-back in a tube, light going forth-back between two mirrors, Thomson's oscillating circuits, motion of the ink-front in a blotting paper, candles, wicks of some definite length, etc. Biological:heart-beating cells, etc. Collectively thus and by their own definition it is asked from all the kinds of "space – and-time transformations", [see D. 2. **(**Part I**)**], to behave as super-optimistic and miraculous "theories for everything", ruling the changes for every macroscopic or microscopic kind of clocks (and material rods as well)!

Question one: Did really have been detected, in 1905, the "law" (-LT-), which rules the changes of the 'time-rates' of "every kind of clocks", due to their relative motion? But the relativists also support that: "in SRT we have to do with no-real, but with *kinematical* or apparent changes of time (and rods), to the relatively moving observer or frame of reference". Even accepting this answer, the relativists cannot avoid the "miracles" and the "super-optimism", because the clocks of SRT are regarded (tacitly) and clocks inside the gravitational field of GRT; and of course GRT also manipulates 'time' not-defining the kind of the used clocks! Thus GRT predicts real and universally recognizable (i.e. non-symmetric relations) and identical gravitational influences on the above-mentioned variety of clocks! In other words the GRT-formulas like these:

$$d\tau(r) = f_1\left(u^2, \chi\right)dt(r) \quad (1.1) \qquad\qquad dt(\infty) = f_2\left(\chi\right)dt(r) \quad (1.2)$$

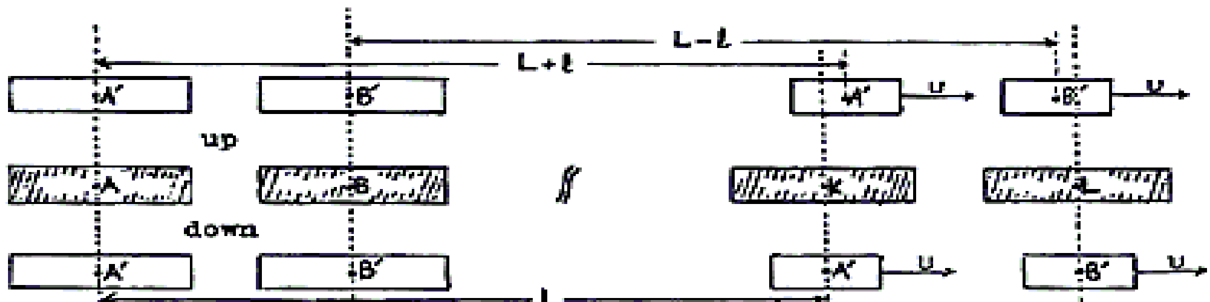
χ is the potential function and u is the velocity of a clock in the gravitational field, and $\tau(r)$ is the proper time and $t(r)$ the gravitational coordinate time -[see relation (1.24)]-, have, according to GRT, to be in rule for every kind of clocks! But in spite of our mathematical generalizations and the desire for unity of theories, the "ruling" of relations of the form (1.1) and (1.2) for "all the kinds of clocks", is very improbable to be true; gravity cannot affect or govern "all the kinds of clocks by exactly the same manner or law" (an atom differs than a quartz, or a mechanical clock, or a candle, etc)! The classical physicists should try to explain orthologically each one phenomenon by its own cause; never a classical physicist should think to write dawn a formula (i.e. a "time-transformation") and then to ask from it to govern collectively the changes of the time-rates of "all the kinds of clocks –based in a variety of phenomena-". From the physical point of view it is very improbable the mathematical "space-time theories" (SRT-GRT) to be theories of everything kind of clock. Of course the relativists test, 'SRT or GRT', showing confidence in the use of the accurate atomic-clocks only; but then they have not to speak generally about "time", -referred to all kinds of clocks- in their theory, but simply to confine their own theory and attention only at the physical behavior of the emitting-absorbing atoms under the conditions, of course, of high velocities and under the presence or not of gravity. {These cases will be studied in next Part II without any Relativity Theory}.

5. LT ON A FLAT ROTATING DISK.

Ehrenfest, Einstein's friend, had once asked him: "How it could be conceived the application of LT on a rotating flat disk"? How an outer and stationary observer could conceive the instantaneous "contraction" of the circumference of the rotating flat disk while its radius should remain unchanged? Although Einstein had caught this problem as a "proof" or "basis" for the introduction of non-Euclidean geometry in his own future theories, yet we can extract some conclusions from it. Let us suppose that in the circumference of the disk there are contained N atoms of some dimension D and let us suppose, that due to some cause, as the disk rotates the atoms may freely reduce their own dimensions to D/γ; but their number remains constant (N) and this of course means that the distances between the centers of the said atoms, remain unchanged and the circumference keeps its length unchanged too. The atomic nature of matter, (even if the atoms could really be "contracted"), protects us from any introduction of non-Euclidean geometry in the case of rotating flat disk. This theoretical consideration helps us to understand that the 'relativistic' or the 'non-relativistic' (FitzGerald-Lorentz) "contraction" of moving material rods is one entirely out-of-rule hypothesis.

6. EITHER NON-GALILEAN TRANSFORMATIONS ARE OUT-OF- RULE OR THEY VIOLATE CAUSALITY!

Let's suppose that a serie of equal and equidistant rods A,B,C,..,K,L are stationary in the absolutely resting system (= ether). Let's now accelerate two adjacent rods A' and B', to the right-side of the page (Fig 1–down and up-), starting simultaneously from the rest (and under identical conditions), until these two rods acquire the same velocity υ, then we should have: either (1) an apparent or real contraction of both (about their center for example) with no changing of the distance of their centers (Fig. 1 –down-) i.e. any non-Galilean transformation is out of rule, because there exists a moving "length" (= the distance of the middles of the two rods) that remains unchanged; or (2) Let that together with above contractions we should have and a (suitable) contraction of their centers (Fig.1–up-); then we should have a clear breaking of the Causality Principle for the macroscopic phenomena because equal forces acting under identical conditions and for equal time intervals, would produce unequal effects (transpositions)! Above syllogism consists a dynamical disproof for non-Galilean transformations (=non-GT) **In Fig. 1 it is proved that it have to be** $(\partial x/\partial x')=1$; **Figure 1: *"Contraction of rods" is an out-of-rule hypothesis***



From Figure 2 below we conclude also that: $(\partial y/\partial y')=1$ (otherwise the acceptation of a coefficient in the transformations so that $(\partial y/\partial y')\neq 1$ should lead to a violation of Newton's third Law of motion, (breaking of Causality Principle).

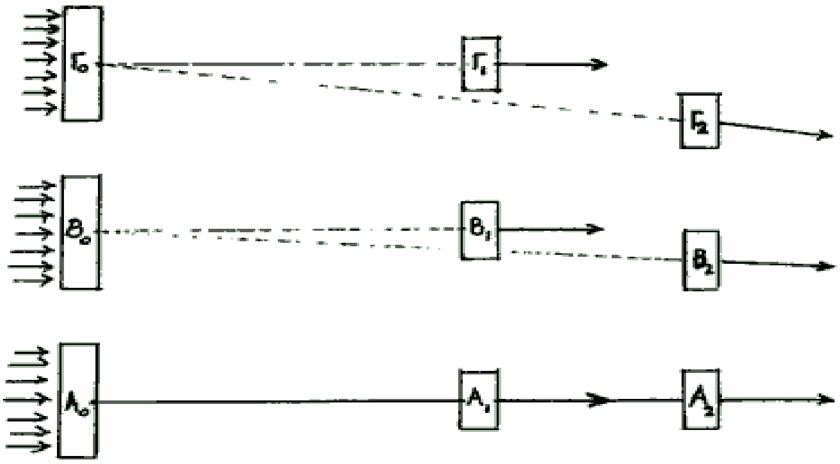


Figure 2

7. GRT DESTROYS CAUSALITY AND E=mC^2

By zeroing Swartzschild's metric (1.4), outside of the attracting mass M, we easily obtain values for the speed of light ranging between two extremes; the minimum for the "radial propagation" $(d\vartheta = d\varphi = 0)$:

$$C^2(r)_{Rad.\mathrm{Pr}op.} = C_\infty^2\left[1-\frac{2GM}{rC_\infty^2}\right]^2$$

and the maximum for the "normal" - to radial propagation- $(dr=0)$:

$$C^2(r)_{normal..toRad.\mathrm{Pr}op.} = C_\infty^2\left[1-\frac{2GM}{rC_\infty^2}\right]$$

i.e. we find that $C^2(r)$ have to satisfy the inequality:

$$C_\infty^2\left[1-\frac{2GM}{rC_\infty^2}\right] \geq C^2(r) \geq C_\infty^2\left[1-\frac{2GM}{rC_\infty^2}\right]^2$$

Which value among the infinite values of $C^2(r)$ between the said extremes, of above inequality, is inserted in the Law: $E = m\cdot C^2(r)$ and also into the various known formulas of SRT like:

$$m = \frac{m_o}{\sqrt{1-\dfrac{\upsilon^2}{C^2(r)}}}, \quad \tau = \frac{\tau_o}{\sqrt{1-\dfrac{\upsilon^2}{C^2(r)}}}, \text{ etc ?}$$

All these consist a serious breaking of the Causality Principle at the position $r=r$ in the gravitational field! (If any could argue instead that $C^2(\infty)$ is the asked value of

C^2 then it could mean that either: (i) above expressions are only valid at infinite distance from attracting mass i.e. no-where into long ranged gravity, or (ii) the gravity is floating over a sub-stratum of constant speed of light $C^2(r)=C^2(\infty)$! .

B. USAGE OF INVALID AXIOMS AND PRINCIPLES IN SRT AND GRT

1. THE "INDEPENDENCE OF THE SPEED OF LIGHT FROM THE VELOCITY OF THE MOVING SOURCE" IS BASIC PROPERTY OF LUMINIFEROUS ETHER, BUT ARBITRARY AXIOM OF SRT!

It is very important for the new generations of the physicists to know the older -but basic- concepts of physics. Huygens and later Fresnel had proposed the concept of the oscillating luminiferous ether in space in order to explain the wave-behavior and propagation of light. The existence of the luminiferous ether was straightened greatly and by Maxwell's unification of his own 'E/M-ether' to the 'luminiferous' one. The existence of the real light-waves and of the real E/M-waves means certainly and the existence of their common vibrating medium i.e. the ether. Additional evidences for the existence of the luminiferous ether emerge when we try to consider and test experimentally the properties of the speed of propagation of light through the ether-medium. The classical-ether-wave-theory-of-light (CEWTL) teaches that**:** at any point, in free space (filled by ether), the speed of light have to be: (i) independent of the direction of propagation (= differential homogeneity of ether), (ii) independent of the traveled distance or any "prehistory" of light ray, and (iii) independent of the velocity of the emitting source [2]**.** Above (i) to (iii) CEWTL-propositions are completed with one more one: (iv) the validity of Huygens Principle.

During the 20th and the beginning of 21st Centuries, *there absolutely were not any experiment or observation*, which could disprove the property (iii) of CEWTL [3, 4, 5, 6]; this of course means that luminiferous ether exists! Even SRT had recognized that above (iii) property is in rule! Einstein had assumed axiomatically the invariance of the speed of light and for the moving (-in-ether) frame "vanishing"-in words- the meaning of the ether! Tolman [7] notes about the property (iii): "*At the time of Einstein's development of the SRT, no experimental evidence had been assembled to show that the velocity of light is independent of the velocity of its source, and the adoption of the principle was due to its familiarity in the wave theory of light*".

Thus every time the physicists conclude the constancy of light, as it emerges from fast emitting sources [3,4,5,6], have not to hurry to see this as a proof of SRT only, but instead we have to remember first that it consists the basic and logical property of the wave theory of light (through an existing ether – medium)!

Of course the classical physicists had expected to find a Galilean variation of the speed of light as it could be measured on a whatsoever moving open-in-ether frame;

this was obtained really as early as in (1913) by Sagnac [8] experiment and twelve years later (1925) by Michelson-Gale [9] experiment! [see and below E.1. (Part III)].

2. "EQUIVALENCE PRINCIPLE" IS OUT-OF-RULE

(a) First reason**.** Exactly like gravitation acting on the attracted masses, 'inertial forces' (IF) are proportional to the mass of the body they 'act'; but except of this formal analogy, and unlike gravitation, the inertial forces (IF) are independent from the presence of matter at various distances from the body they 'act'.

(b) Second reason**.** Einstein had similiarized the 'inertial effects' into a rectilinearly moving, but accelerating or decelerating, cabin and the appearance of the 'centrifugal force' into it, when this cabin moves on a curved path, to the action of gravitational forces acting on the bodies of the cabin; but the existence of the linear-velocity-depended Coriolis force, should mean then, and the corresponding existence of a...*linearly* (*1st –power*) *velocity-depended gravitation*; but we have not-found yet, in Nature, any such '1st –power-velocity-depended gravitational force'!

3. '**MACH'S PRINCIPLE**' IS DOUBTFUL AND INCONSISTENT TO **SRT** AND **GRT**.

(a). When a mass circulates around a center in a frame, this mass (even variable) appears also accelerating and in every translationally moving reference frame; this means that physics needs some kind of '*absolute frame*' to describe the acceleration and the related to acceleration quantity –*mass*-. In GRT, instead of the '*absolute frame*' or '*absolute space*', the '*action-from-the-far-distant-matter*' (AFFDM) i.e. '*Mach's Principle*' has been invented. In an accelerating frame, like gravitation, a stamp and an elephant do feel the same 'inertial' acceleration, this mean that the inertial masses of the bodies are proportional to the inertial forces (IF) which would 'act' on them; but the IFs are independent of the presence of matter at various distances from the bodies. Why then the mass of the body should have to be determined by the presence of the 'far-distant matter'?

(b). It is well known that SRT dictates the changes of the *time-rates* -and the changes of the masses as well- of two clocks which are moving rectilinearly with constant velocity to each other; but into the region of SRT the proper frames of the said clocks are physically equivalent and due of the assumed lack of any 'ether-medium' we cannot explain physically the appearance of the 'time-dilation'; it gives an explanation why Einstein had left SRT ("*in hands of small angels*") and run to GRT. In GRT there are taking place absolute –but effective- motions into the relatively long ranged (1/*r*) gravitational potentials, the additivity of which, explains why Einstein had accepted the long-ranged '*action-from-the-far-distant-matter*'. This is in reality the introduction of the '*absolute space*' from the back door. It was easy now for Einstein –like Newton- to understand the appearance of the 'mass' during the acceleration of a body. Additionally the moving atomic-clocks were ready to *change really* their own *time-rates* as they had acquired an absolute –always accelerated-motions through the '*far-distant-matter frame*' (FDMF). FDMF is the frame relative to which the far distant matter has homogeneous-velocity-distribution, or otherwise the frame relative to which the cosmic microwave background radiation (CMBR) appears to be homogeneous i.e. without any Doppler-shift.

Einstein had made once [10] the proposition: *A rotating disc which translates in its plane, and three clocks –one placed in the center and the other two at the rim diametrically on the said disc- can indicate, by the momentary variation of their own time-rates, the direction and the velocity of the said disc without any other external information* (= Einstein's-rotating-atomic-clock-method E-RACM).

The AFFDM comes in flat contradiction first to SRT -since at least the E-RACM should show $V = 0$ into the FDMF only, while it should give $V \neq 0$ for any other frame-. On the other hand the AFFDM should force the macroscopically resting bulk of matter in our Lab to behave with new absolutely changed laws of physics not compatible with the "Relativity Principle" of SRT; this can be proved by following simple reasoning: Let our Lab is moving relative to the FDMF with a velocity vector V; due of the thermal motion of the atoms, a bulk of resting matter in our Lab appears momentary to have the half number of its atoms to move parallel to vector V and half of its atoms to move anti-parallel (with a mean thermal velocity $\bar{u}$). The bulk thus of the stationary matter in our Lab should have to appear necessarily a 'velocity coupling' ranging between the extreme values: ($V+\bar{u}$) and ($V-\bar{u}$) relative to FDMF; this exactly makes the half bulk of matter to show: 1) absolutely increased (and decreased) the masses of the atoms and of other particles, 2) absolutely decreased (and increased) the atomic and other frequencies, and 3) absolutely increased (and decreased) the life-times of the unstable particles, etc. All these mean that the properties of the resting bulk matter should change *absolutely* (depended from velocity V); this mean that and the rest laws of Physics also can be affected absolutely implying the breaking of the *equivalence* of the Galilean frames moving relative the FDMF. This breaking of the *equivalence* of the Galilean frames implies also the breaking of the 'Relativity Principle' used in SRT. With the SRT being so destroyed how could one generalize to GRT?

C. CONFUSING THEORETICAL MIXING OF SRT AND GRT EXPERIMENTAL REGIONS.

A comparative inspection of the (TABLE **I**), containing the classical optical experiments and other assumed "relativistic" phenomena, reveals that sometimes *circular* motion is overlooked in order to verify SRT as in Michelson-Morley (M-M), in annual aberration, synchrotron radiation -'head-light'- effect, mass-increase and even the *muon life-time dilation* in MSR at CERN [11]; While sometimes *circular* motion is suitable to verify only GRT as in Sagnac [8], Michelson-Gale (M-G) [9], or Hafele-Keating (H-K) [12,13] around-the-globe-atomic-clock-experiment! SRT and GRT are seen here to be mixed; the foundations of both theories are thus brought into question. It is very important to see the similarity of the conditions of the three optical experiments: M-M, Sagnac and M-G; their optical arrangements absolutely were rotating around their corresponding axes of rotation, yet their explanations are so different! WHY?

TABLE I. CONFUSING THEORETICAL MIXING OF SRT AND GRT REGIONS

EXPERIMENTS-PHENOMENA	**MOVING FRAME** (circulating around)	**OFFICIAL THEORY**
Michelson-Morley and M-M / type experiments	Earth's frame (circulating Sun)	**SRT**
Annual starlight aberration	Earth's frame (circulating Sun)	**SRT**
Synchrotron radiation (head-light effect)	frame of the electron (circl. in magn. field)	**SRT**
Sagnac-effect [8]	Rotating optical arr/nt (about its axis)	**NO SRT (!) GRT**
Michelson-Gale (M-G) [9]	Rotating optical arr/nt (around Earth's axis)	**NO SRT(!) GRT**
Mass increase	frame of the particle (circ. in accelerators)	**SRT**
Life-time dilation (unstable particles)	frame of the μ-muon (circ.in Muon SR [11])	**SRT (& GRT)**
Hafele-Keating (H-K) [12,13]	frame of Cs-atom. clock (around Earth's axis)	**GRT (supposedly)**
Hafele-Keating (H-K)	frame of Cs-atom. clock (around Sun or galaxy)	**NO SRT (!) NO GRT(!)**

D. THEORETICAL-EXPERIMENTAL FAILURES OF SRT - GRT ON THE SPEED OF PROPAGATION OF LIGHT

1. SAGNAC AND MICHELSON-GALE RESULTS HAVE REVEALED ETHER DISPROVING THE AXIOM OF THE "INVARIANCE" OF THE SPEED OF LIGHT

It is classically known that the Sagnac [8] and Michelson-Gale (M-G) [9] experimental effects are of first order (in υ / c), performed at the ultra low velocities (υ), of their light-circuit elements. Both of these experiments have easily been explained classically by the application of the Galilean velocity composition: *between the linear velocities* υ *of the momentary translating* (*in rotation*) *optical-path elements with the velocity* c *of the propagating light wave in ether* i.e. we see that the speed of light is not invariant relative to the momentary translations of the (slow rotating) observer in the ether [see E.1. (Part III)].

These two experiments lead to a direct experimental disproof of Einstein's axiom about the "invariance" of the velocity of light (SRT)! That is why, in relativistic bibliography, we often read the note [14]: *"the positive Sagnac and M-G effects are the optical analogs of the Foucault's positive mechanical experiment; these two effects are explained by the use of GRT"*.

We have two ready direct objections at this point: 1) It is not so right, in order to explain such a simple positive rotational interference experiment, to use such a heavy theory (GRT); we have only to think that the planning of these rotational-interference experiments was not accidental, instead, these two experiments were planned and performed because of the self-evidence of their own positive results and the self-evidence of the Galilean composition between the involved velocities. 2) The phrase "*optical analogs of the Foucault's positive mechanical experiment*" seems to be out of target; because in Foucault's experiment it is present the 'Coriolis force', which depends from the velocity-vector of a moving body -through a rotating frame-; but 'Coriolis force' and 'Equivalence Principle' of GRT are mutually excluding each other [see B.2.(b) (Part I)]!

2. WHY LT HAVE FAILED IN THE FIRST-ORDER (υ / c) EXPERIMENTS?

We have seen that SRT is in flat contradiction to Sagnac [8] and M-G [9] experiments although these are first order effects in (υ / c); and in similarity with M-M experiment all these three optical arrangements absolutely were rotating around the corresponding axes (in Sagnac the axis passes through the center of the arrangement, in M-G the axis is Earth's one, and in M-M the arrangement is rotated around Sun), yet their explanations are so different! Why? [see C**.** (Part I)].

In trying to establish LT, Robertson [15], had used four conditions: (i) the condition of the "*invariance*" of the speed of light relative to the stationary and moving frame {hidden into the very known Poincare's-Einstein's relation,

$t_B = (t_A^I + t_A^{II}):2$ for the synchronization of the distant clocks, -presumably being in rule relative to the *ether-frame*- , but Einstein [1] had accepted and used it axiomatically and for the moving frame}, (ii) the condition the Michelson-Morley experiment to give zero result, (iii) the condition the Kennedy-Thorndike [2] experiment to give zero result, and (iv) the condition the Ives-Stilwell [16] second order (υ^2/c^2) Doppler effect to be explained.

Later (1961-6), in order to avoid the lack of causality imposed by the symmetric LT, Tagherlini [17], Palacios [18], and present author [19, 20], (independently from each other and Robertson) had tried to establish other 'non-symmetric space and time transformations'.

Tagherlini and author had used the conditions (ii, iii, iv) and the basic assumption-knowledge: (v) that the speed of light in ether is always constant and independent of the velocity of the emitting source. They obtained:

$$x = x'\sqrt{1-\beta^2} + \frac{\upsilon t'}{\sqrt{1-\beta^2}}, \qquad y = y', \qquad z = z', \qquad t = \frac{t'}{\sqrt{1-\beta^2}}$$

(Tagherlini - Agathangelidis transformations) (TAT)

Palacios had used the conditions (ii, iii, and v) and his transformations were the following:

$$x = x'\left(1-\beta^2\right) + \upsilon t', \qquad y = y'\sqrt{1-\beta^2}, \qquad z = z'\sqrt{1-\beta^2}, \qquad t = t'$$

(Palacios transformations) (PT),

it was above $\beta = \upsilon / c$

Author doesn't believe yet in any kind of valid "*space and time transformations*" (STT) simply because he doesn't believe in mathematically - generalized theories for every kind of clock [see A.4. (Part I)].

An elementary and trivial condition in STT states that for $\upsilon \to 0$ every STT tends to become a Galilean one i.e.:

$$\text{if} \qquad \upsilon \to 0 \qquad \Rightarrow \qquad (\text{STT}) \to (\text{GT}) \qquad (1.3)$$

Mathematically the condition (1.3) is very easy to be written on the paper and really is verified by the experiment for all the kinds of STT except the LT! By applying thus STT to calculate the first order physical effects (at ultra low velocities) as the starlight aberration, the Sagnac and M-G effects, the modest transformations [GT, TAT, PT] can explain the starlight aberration, even the Sagnac and M-G experiments; but the famous LT fail to explain the first order -low velocity- Sagnac [8] and M-G [9] experiments!

This failure of LT is a first experimental disproof of Einstein's idea to accept the constancy of the speed of light, not only in ether, but also relative to the moving-in-ether S'-system. But these experiments had considered to be of lower importance, perhaps: (1) because of their low speeds, (2) because their total effect is simply analogous to the product: ($A\omega$) (i.e. the product of the area A of the closed interferometer with its angular speed ω) protecting SRT from the danger of a "written" Galilean addition of "linear velocities", and (3) because these experiments had came "too late" (Sagnac in 1913 and M-G in 1925) when meanwhile Einstein managed to jump from SRT to GRT. If Sagnac and M-G experiments had been performed before the M-M one, it should be very doubtful, if SRT (and GRT) could be appeared at all.

3. THE GRT- EXPLANATION OF SAGNAC AND M-G EXPERIMENTS HAD USED A GALILEAN COMPOSITION OF VELOCITIES FOR LIGHT!

For the GRT-explanation of the Sagnac and M-G experiments, Alley [21] starts with Schwarzschild's *metric* expression for the outer region of a spherical mass M and for non-rotating coordinates:

$$ds^2 = \left(1 + \frac{2\chi}{c^2}\right)c^2 dt^2 - \left[\frac{dr^2}{1 + \left(\frac{2\chi}{c^2}\right)} + r^2\left(d\vartheta^2 + \sin^2\vartheta d\varphi^2\right)\right] \qquad (1.4)$$

$\chi = -\frac{GM}{r}$, c is the speed of light at infinite distance ($r = \infty$) from mass M, and dt is the fixed coordinate time-interval.

He considers a motion on the equator so that

[$dr = 0$ and $\vartheta = 90^o, \sin\vartheta = 1, d\vartheta = 0$]

(angle ϑ is measured from pole), thus equation (1.4) becomes:

$$ds^2 = \left(c^2 + 2\chi\right)dt^2 - r^2 d\varphi^2 \qquad (1.5)$$

By omitting the term 2χ, of gravitational influence, the relation (1.5) is confined into:

$$ds^2 = c^2 dt^2 - r^2 d\varphi^2 \qquad (1.6)$$

We have now to go on the rotating frame (its angular speed ω, around an axis perpendicular to the said equator and passing through the said pole); following Alley, we do the transformations:

$$\varphi - \omega t = \varphi_{Ro} \quad (1.7) \ , \qquad r = r_{Ro} \quad (1.8) \ , \qquad t \approx t_{Ro} \quad \text{or} \quad dt \approx dt_{Ro} \quad (1.9)$$

(by omitting the second order kinematical changes of the time-rates)

The relation (1.6) is expressed now for the rotating (Ro) frame as**:**

$$ds_{Ro}^2 = (c^2 - r_{Ro}^2\omega^2)dt_{Ro}^2 - 2r_{Ro}^2\omega d\varphi_{Ro}dt_{Ro} - r_{Ro}^2 d\varphi_{Ro}^2 \qquad (1.10)$$

Since for the light we have

$$ds = ds_{Ro} = 0 \qquad (1.11)$$

and putting $\left(\frac{r_{Ro}d\varphi_{Ro}}{dt_{Ro}}\right) \equiv v$; the (1.10) turns to the relation

$$v^2 + 2r_{Ro}\omega v - (c^2 - r_{Ro}^2\omega^2) = 0 \qquad (1.12)$$

The solutions of the above equation are the following two:

$$v = -r_{Ro}\omega \pm c \qquad (1.13)$$

These are the two GRT-solutions giving the speed of light for the rotating frame; these two apparent velocities were well known from the classical explanation of Sagnac [8] and M-G [9] [see and E.1. (Part III)].

The GRT-explanation of Sagnac is highly theoretical and perhaps absurd. Even if this GRT-explanation is correct, yet it comes after the first classical-self-evident explanation of the Sagnac and M-G effects. On the other hand, this success of GRT to explain Sagnac and M-G essentially with the classical manner i.e. the Galilean composition of velocities for light (GCVL), generates big questions: Why we had to invent such perplexed theories, first the SRT and later the GRT, so that to deduce finally the 'Galilean composition of the velocities for light' (GCVL)?

Additionally in this GRT-explanation of Sagnac and M-G, we have made and our hidden application of the 'Galilean composition of the velocities for light' (hidden GCVL):

The relation of the angles is essentially relation between their own arcs under some radius R; the relations (1.7)-(1.9) are hiding a relation of the form:

$$\varphi R = \varphi_{Ro}R + (\omega t_{Ro})R \qquad (1.14)$$

from which by time-differentiation (1.9) we reveal one more hidden GCVL.

$$\frac{(d\varphi)R}{dt} \approx \frac{(d\varphi_{Ro})R}{dt_{Ro}} + (\omega R) + \text{(second order terms)} \qquad (1.15)$$

Question: Let's consider our LAB being close at the rim of an enormous rotating (non-heavy) disk; and let this disk has the dimensions of Earth's orbit around

Sun and its angular speed is $\omega = 2\pi$ (rad /year). Let's also assume that a pencil of light circulates the disk (with the help of suitable mirrors -polygonal version of Sagnac-). Then according to classical explanation, as well as the GRT-one of Sagnac, we should have to observe on Earth apparent speeds of propagation of light equal to:

$$C'_{+} \approx C - \omega r_{Sun-Earth} \approx C - 30 \,(\text{km/sec}) \qquad (1.16),$$

$$C'_{-} \approx C + \omega r_{Sun-Earth} \approx C + 30 \,(\text{km/sec}) \qquad (1.17)$$

(+ corresponds to the direction of motion of Earth around Sun and – to the opposite direction). Why then in the M-M experiment we have found the invariance of the velocity of light? Which is the meaning of LT after the GRT-explanation of Sagnac [8] and M-G [9] experiments?

1st answer: For the GRT-believers the system LT/SRT is very troubling and has not any application in their science!

2nd answer**:** For the classical physicist the logical answer, is that the M-M null result imposes the existence of the Terrestrial - Stokes (1845) ether, which is gravitationally-bound to Earth and carried totally by it, in its translation in space, but not-participating in the rotation about Earth's axis [for details see PART III]**.**

E. THEORETICAL - EXPERIMENTAL FAILURES OF GRT IN ATOMIC FREQUENCIES (ATOMIC-CLOCKS).

1. FAILURES OF GRT IN HAFELE-KEATING EXPERIMENT AND IN G.P.S.

(a). ***GRT-first-failure in Hafele-Keating experiment*** (*Hafele had "explained" Hafele-Keating experiment with a mistake*). Since 1972 H-K experiment (and result) is regarded by GRT-believers as a very important and "official" test of GRT. But in reality it is fatal for GRT! In order to prove this we are forced here to repeat Hafele's [12] or GRT-methodology:

Hafele [12] starts with Swartzschild's *metric* expression (1.4), referred for a non-rotating coordinate frame, outside of a spherical source -mass M - of gravitational potential χ. After a simple algebra, and for a weak gravitational field i.e. for $|\chi| << c^2$ and for slow velocities i.e. for $u^2 << c^2$, equation (1.4) turns into the relation:

$$ds \cong \left(1 + \frac{\chi}{c^2} - \frac{u^2}{2c^2}\right) cdt \qquad (1.18)$$

Relation (1.18) is valid for the stationary-non-rotating frame in the gravitational field of mass M, $\chi = -\frac{GM}{r}$ is the gravitational potential of the attracting mass M at the distance r, and dt is the fixed coordinate time interval.

After that Hafele *tacitly* assumes a similar expression valid for the moving frame:

$$ds' \cong \left(1 + \frac{\chi'}{c^2} - \frac{u'^2}{2c^2}\right) c\,dt' \qquad (1.19)$$

Hafele's clocks are regarded to be fixed ($u' = 0$) inside their own frames (i.e. in the ground-based frame and in the frame of the flying airplane), and for this reason all Hafele's clocks (in flying airplanes and the ground-based) have to show their own '*proper times*':

$$dt' \equiv (d\tau) = d\tau_\alpha \text{ or } d\tau_{gr} \qquad (1.20)$$

Additionally Hafele had made tacitly his own *erroneous* assumption:

$$\chi' = 0\,(!) \qquad (1.21)$$

for all his clocks; as if his own clocks had been**:** (i) fixed at infinite distance from Earth or, (ii) placed inside satellites orbiting around Earth. In cases (i, ii) the clocks are regarded to be into "gravity-free" reference frames where ($\chi' = 0$), and also he tacitly assumes the relativistic equation of "*space-time-interval invariance*":

$$ds = ds' \qquad (1.22)$$

Hafele thus had transformed (tacitly and erroneously), the GRT-"law" (1.19), into the SRT- expression:

$$ds = c\,d\tau \qquad (1.23)$$

Hafele then [12] combines relation (1.18) with the relation (1.23) to produce his own basic but unsuitable relation, connecting the *fixed coordinate time-interval* dt and the *proper time-interval* $d\tau$:

$$d\tau \cong \left(1 + \frac{\chi}{c^2} - \frac{u^2}{2c^2}\right) dt \qquad (1.24)$$

Relation (1.24) is Hafele's basic-unsuitable relation, theoretically true for orbiting clocks (like in G.P.S.), and not true for the Hafele's Earth-based and flying clocks! This is the first theoretical failure of GRT in H-K experiment.

(b). ***GRT-second-failure in Hafele-Keating experiment and also failure in G.P.S.*.** Hafele [12] had managed finally to calculate the H-K [13] experiment by making use of the '*Earth-centered*' *and non-rotating* frame, (the velocities of all flying Cs-clocks and the velocity of the fixed-on-the-ground-clock had all been calculated relative to this frame), of course, and with the use of the unsuitable formula (1.24); the last relation (1.24) should really be transformed into a more suitable one if the H-K experiment should carried out by satellites orbiting around Earth (as in GPS)!

Hafele secondly had avoided to complete his own theoretical calculations and for the Helio-centric non-rotating frame. Such a complete calculation leads to the second-GRT-failure for the H-K experiment. As now Earth is in orbit around Sun, Hafele's unsuitable formula (1.24) should be transformed into a "more correct" one. Following the *"space-time metric"* methodology, we are forced to use Hafele's relation (1.24) and to use now the '*Sun-centered*' and non-rotating frame (simultaneously with the '*Earth-centered*' one). We expect thus to get a more complete and more correct calculation for H-K result and of GPS as well.

In order to obtain this more complete and correct calculation we have agreed here to start with relation (1.24), but with two necessary changes: (i) In place of the potential χ we will put the sum of the two separate potentials due to the masses (M_S, M_E) of Sun and of Earth (additive property of the potentials) and (ii) In place of the velocity vector u we will put the vector sum of the velocity of the clock around Earth's axis plus the orbital velocity V of the Earth around Sun (Fig.3).

Let's note by χ_{gr} and χ_α the potentials of the atomic clocks respectively fixed on the ground and aboard on the airplane (at height h), we have:

$$\chi_{gr}=\chi_{E,gr}+\chi_{S,gr}=-\frac{GM_E}{R}-\frac{GM_S}{r\cdot\left(1-\frac{R\sin\Theta_{gr}}{r}\right)}\approx-\frac{GM_E}{R}-\frac{GM_S}{r}-\frac{GM_S}{r^2}R\sin\Theta_{gr} \tag{1.25}$$

and

$$\chi_\alpha=\chi_{E,\alpha}+\chi_{S,\alpha}=-\frac{GM_E}{R\cdot\left(1+\frac{h}{R}\right)}-\frac{GM_S}{r\cdot\left[1-\frac{(R+h)}{r}\sin\Theta_\alpha\right]}\approx-\frac{GM_E}{R}+\frac{GM_E}{R^2}h-\frac{GM_S}{r}-\frac{GM_S}{r^2}R\sin\Theta_\alpha \tag{1.26}$$

In these calculations we have took: h (the height of flight) $<<R$ (Earth's equatorial radius) $<<r$ (Earth-Sun distance).

$\frac{GM_E}{R^2}\equiv g$ (the strength of gravity on Earth's surface). Let's note by u_{gr} and u_α the velocities of the clocks, respectively fixed-on-the-ground and of the flying one, relative to the Sun-centered and non-rotating frame. From Fig. 3 we have for the velocity vector of the fixed-on-ground clock: $\vec{u}_{gr}=(\vec{\Omega}\times\vec{R})+\vec{V}$, and for the velocity of the flying clock, at height h: $\vec{u}_\alpha=\left[\vec{\Omega}\times(R+\vec{h})+\vec{\upsilon}_\alpha\right]+\vec{V}\approx\left[(\vec{\Omega}\times\vec{R})+\vec{\upsilon}_\alpha\right]+\vec{V}$ Ω is Earth's angular speed about its axis, υ_α is the velocity of the flying airplane relative to the ground (equatorial flight) , υ_α also is the velocity of an orbiting atomic clock, and V is the orbital velocity of the Earth around Sun or around the center of our galaxy.

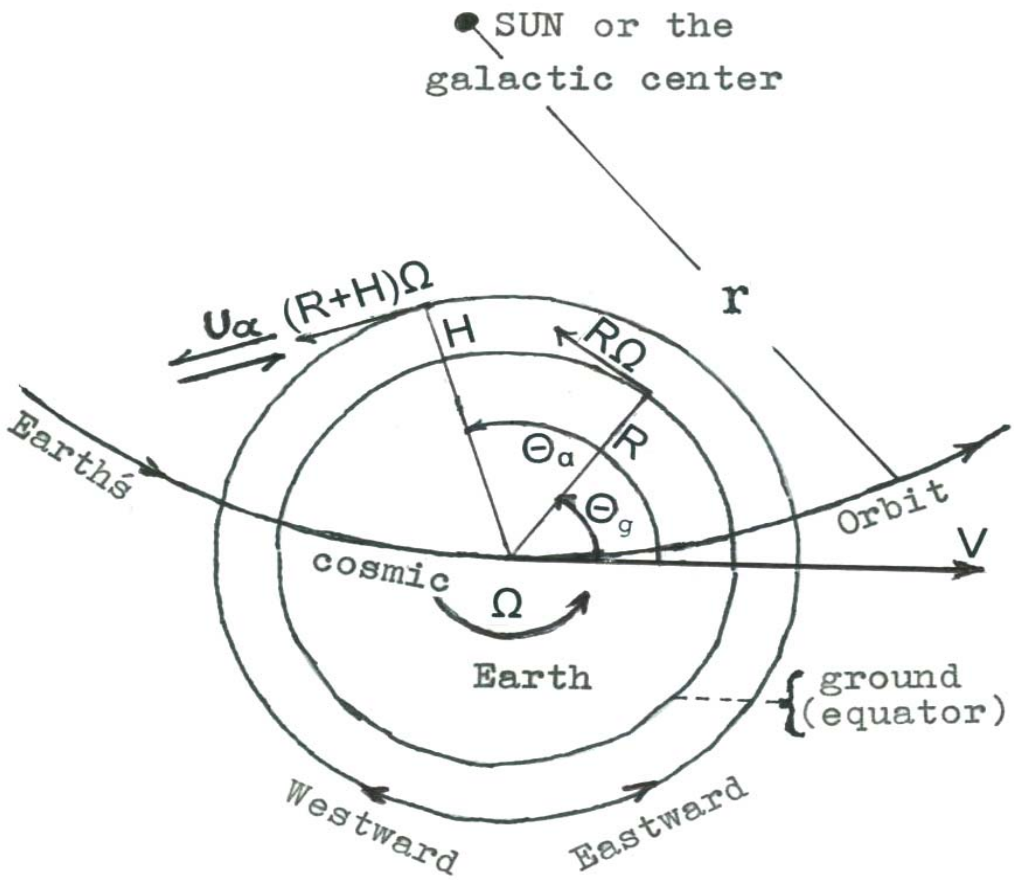


Fig. 3 GRT is failed in Hafele-Keating experiment and GPS

In this Figure, Θ_{gr} and Θ_α , are the angles of the atomic clocks on ground and aboard the airplane or satellite respectively, both being measured from Earth's velocity vector V . Ω is Earth's angular speed about its axis. $\pm\upsilon_\alpha$ is the velocity of the air-plane relative to the ground (the sign + is used in the Eastward and the – in the Westward flying of atomic clocks), $\pm\upsilon_\alpha$ is also the orbital velocity of satellite in GPS. The time-differences between the flying –around-the-world-circumnavigated atomic-clocks-' and the ground-based ones are really depended from their linear velocities relative to Earth's non-rotating frame. But if one would apply correct and complete GRT-calculation he have to take description relative to Sun non-rotating frame, (or relative to galaxy non-rotating one), then he should expect the coupling of the known linear velocities of the clocks around Earth's axis with Earth's cosmic velocity V ; but unfortunately, for GRT, such an effect has not been found experimentally, as if Earth was not moving –accelerated- at least around Sun (or around the center of galaxy) and "GRT – time- rates were not-velocity-depended!

Now we get for the squares of the above velocities:

$$u_{gr}^2 = \Omega^2 R^2 + V^2 - 2(\Omega R)V \sin\Theta_{gr} \qquad (1.27)$$

and

$$u_\alpha^2 \approx \Omega^2 R^2 + \upsilon_\alpha^2 + 2(\Omega R)\upsilon_\alpha + V^2 - 2(\Omega R)V \sin\Theta_\alpha - 2\upsilon_\alpha V \sin\Theta_\alpha \qquad (1.28)$$

Θ_{gr} and Θ_α -Fig. 3- are the angles respectively of the fixed-on-ground clock and of the flying one (both measured from Earth's orbital velocity vector V).

Applying now twice Hafele's [12] relation (1.24), first for the fixed-on-ground clock and second for the flying one, we get:

$$\frac{\Delta\tau_{gr}}{\Delta t_{gr}} \cong \left(1 + \frac{\chi_{gr}}{c^2} - \frac{u_{gr}^2}{2c^2}\right) \qquad (1.29)$$

relation (1.29) is Hafele's equation for the fixed-on-the-ground clock, integrated over entire time of H-K experiment i.e. 'from the initial departure of flying clock until its final arrival to the base airport' and

$$\frac{\Delta\tau_\alpha}{\Delta t_\alpha} \cong \left(1 + \frac{\chi_\alpha}{c^2} - \frac{u_\alpha^2}{2c^2}\right) \qquad (1.30)$$

relation (1.30) is Hafele's equation for flying clock integrated over the entire time of H-K experiment i.e. from 'the initial departure of flying clock until its final arrival to the base airport'.

For a full circumnavigation around the globe the equality of the coordinate-time intervals becomes evident [12].

$$\Delta t_\alpha = \Delta t_{gr} \qquad (1.31)$$

Thus by dividing in members (1.30) by (1.29) we get the ratio of the *proper times* of the clocks of the H-K experiment:

$$\frac{\Delta\tau_\alpha}{\Delta\tau_{gr}} \approx 1 + \frac{\chi_\alpha - \chi_{gr}}{c^2} - \frac{u_\alpha^2 - u_{gr}^2}{2c^2} \qquad (1.32)$$

Substituting now into (1.32) the suitable expressions from (1.25), (1.26), (1.27), and (1.28) we get the more complete calculation of H-K experiment:

$$\frac{\Delta\tau_\alpha}{\Delta\tau_{gr}} \approx 1 + \frac{gh}{c^2} - \frac{\upsilon_\alpha^2}{2c^2} - \frac{\Omega R\upsilon_\alpha}{c^2} - \frac{GM_S}{r^2c^2}R(\sin\Theta_\alpha - \sin\Theta_{gr}) + \frac{\Omega RV}{c^2}(\sin\Theta_\alpha - \sin\Theta_{gr}) + \frac{V\upsilon_\alpha}{c^2}\sin\Theta_\alpha \qquad (1.33)$$

We see that the complete theoretical calculation of H-K experiment contains in it, except the known Hafele's 'geocentric' terms –the unit and the first three terms in (1.33)-, and the rest 'Heliocentric' ones.

The magnitude of the first 'Heliocentric' term is of the order of Hafele's ones. After their separate averaging the two sinusoids, add nothing to the Hafele's result {since it is $\Theta_\alpha = \Theta_{gr}$ at the beginning of the experiment and $\Theta_\alpha = \Theta_{gr} \pm 2\pi$ at the end of the circumnavigation around the globe [(+) for the Eastward-flight-experiment and (-) for the Westward-flight one]}.

But the existence of the 'Heliocentric' (read and 'galaxy-centric') terms, containing V, inserts enormous changes in Hafele's 'geocentric' calculation; their magnitudes are correspondingly 10^2 (and 10^3) times than the Hafele's terms; and they by no means can be averaged to zero during the real journey of the traveled clock **(**really these terms could be averaged to zero only under very symmetric flight-conditions **–** symmetric relatively to the direction of Earth's orbital velocity-). The 'Heliocentric' or ('galaxy-centric') terms are very dominant yet they don't appear in H-K [13] results!

Conclusion the complete and more correct relativistic calculation for the H-K experiment is in flat contradiction to the experimental results! This is the GRT-second-failure in H-K experiment!

By applying now (1.33) for an atomic clock on a satellite (of GPS) we have to put in (1.33) ($\Omega R = 0$) and (1.33) becomes:

$$\frac{\Delta\tau_\alpha}{\Delta\tau_{gr}} \approx 1 + \frac{gh}{c^2} - \frac{\upsilon_\alpha^2}{2c^2} - \frac{GM_S}{r^2c^2} R(\sin\Theta_\alpha - \sin\Theta_{gr}) + \frac{V\upsilon_\alpha}{c^2}\sin\Theta_\alpha \qquad (1.34)$$

But the "time keeping" in GPS works very well with the above first two or three terms only; and it is inert relative to the last term $\frac{V\upsilon_\alpha}{c^2}\sin\Theta_\alpha$ containing the "coupling of υ_α - i.e. the orbital velocity of the satellite- with the cosmic velocities V of the Earth". Really, if GRT was true, due of the big values of V the term $\frac{V\upsilon_\alpha}{c^2}\sin\Theta_\alpha$ should be superimposed, in some of the atomic clocks of GPS –where vector V is coplanar with the orbit of the satellite- , creating big alternate time-gains and time-losses, (each one during the half period of revolution around Earth). But such an effect has not been observed yet in any one of the various satellites of GPS (otherwise the cosmic velocity V of the Earth should be determined)!

Conclusion the complete and more correct relativistic calculation for the "time keeping" in GPS is in flat contradiction to observation!

2. GRT DOUBLY FAILS IN THE GRAVITATIONAL RED-SHIFT.

(a). ***Eddington's first arbitrariness leads GRT to a gravitational blue-shift.*** Eddington [22], in his effort to prove a gravitational red-shift by means of Schwarzschild's '*metric*', had applied twice the equation (1.4). He considered a stationary gas (being in hydrostatic equilibrium state around the central mass M – creating the field-). He had put, in equation (1.4), the values $dr = d\vartheta = d\varphi = 0$ at the distances $r = r$ and $r = \infty$ respectively (from the central mass M).

Thus Eddington [22] had got the two separate equations:

$$ds^2_{r=r} = \left[1 - \frac{2GM}{rc^2}\right] c^2 dt^2_{r=r} \qquad (1.35)$$

and

$$ds^2_{r=\infty} = c^2 dt^2_{r=\infty} \qquad (1.36)$$

After that, Eddington quite arbitrarily had assumed the additional equality between the '(space-time) – *intervals*':

$$ds^2_{r=r} = ds^2_{r=\infty} \quad \text{(Eddington's first arbitrary assumption)} \quad (1.37)$$

In his own words explaining the relation (1.37): "*The test of similarity of the atoms* (placed at the positions $r = r$ and $r = \infty$) *is that corresponding* (space-time) – *intervals should be equal, and accordingly the* (space-time) *interval of vibration of all the atoms will be the same* "

But half a page below, Eddington overturns the above assumption by saying that: "*Strictly speaking, an atom at Sun and another on Earth cannot be exactly similar because these are in different kinds of space-time*".

Additionally to this situation there are also possibly different "energetic charges" of the atoms at these physically different (corresponding) positions, so that it is not at all evident, why we have to admit the equation (1.37)!

In GRT, we have been familiarized, with the so called '*space-time-interval*' *invariance* of the form

$$ds' = ds$$

which is referred ONLY to those ds' or ds , which have their own ordinary-space components in common and their own ordinary-time ones in common too; this mean that (in GRT) these ds' or ds are related to each other by means of a local (generalized) transformation**.** The assumed auxiliary relation (1.37), is quite arbitrary and out of the accepted methodology of GRT because it does not belong to any kind of local transformation.

Following thus Eddington, we can substitute (1.35) and (1.36) in (1.37), getting the relation:

$$dt_{r=\infty} \approx \left[1 - \frac{GM}{rc^2}\right] dt_{r=r} \qquad (1.38)$$

By making a quick first inspection of (1.38), we are surprised, because we see in it the self-evident interpretation**:** $dt_\infty < dt_r$ i.e. "The *time- flowing*, close to the central mass, is faster relative to the slower *time –flowing* at the infinite distance (from the central mass M)". And since it is common belief and knowledge that the *time-flowing* -of any clock- is proportional to its frequency, we have arrived, at the conclusion for the GRT-gravitational shift:

$$\frac{\nu_r}{\nu_\infty} = \frac{dt_r}{dt_\infty} \approx 1 + \frac{GM}{rc^2} \quad \text{(gravitational blue-shift)} \qquad (1.39)$$

This is the GRT- first-failure on gravitational red-shift; (here we have used Eddington's [22] assumption *that light travels in the gravitational field without any chance in its frequency*).

(b). ***Eddington's second arbitrariness leads to a gravitational red-shift and GRT to inconsistency.*** Eddington [22], in order to transform the above (1.39) blue-shift relation into a red-shift one, inserted another very invisible arbitrariness**:** by baptizing the dt_r and dt_∞, as *times of vibration of clocks-atoms* (i.e. 'periods of the clocks' –atoms-), and by taking in mind of course that the emitted frequencies from the atoms are the inverses of their own *times of vibration*, Eddington obtained his own "red-shift":

$$\frac{\nu_r}{\nu_\infty} = \frac{dt_\infty}{dt_r} \approx 1 - \frac{GM}{rc^2} \quad \text{(gravitational red-shift)} \qquad (1.40)$$

Eddington thus had regarded the time intervals dt_r and dt_∞, in the relation (1.39), not as time-flowing but … as the periods of the clocks (-emitting atoms-). This is a serious inconsistency in the GRT-methodology: because in the entire the body of GRT we manipulate 'clocks' and 'time-flowing' but not periods of clocks.

3. THE GRT-GRAVITATIONAL RED-SHIFT EXPLANATION CONFLICTS THE HAFELE-KEATING GRT-FORMULA!

In the Hafele-Keating equation (1.24), dt is the *time flow* or *time interval* for the local stationary clock in the gravitational field, and $d\tau$ is the '*proper time interval*' of a clock in orbit around the mass M . But if one should use the above time-symbols as meaning "periods" of the involved clocks, -as it was happened with (1.40) relation-, then the meaning of the Hafele-Keating equation (1.24) should entirely be inversed (faster *time-flowing* in the lower altitudes) and the H-K theoretical calculations should flatly be disproved by the experiment! That is why Eddington's explanation for the

GRT-gravitational red-shift is quite erroneous leading straightway to the exclusion of Hafele-Keating result from GRT. This is a death-end for the GRT [23].

F. THE FAILURE OF GRT TO DETECT THE 'FAR-DISTANT-MATTER-INFLUENCE' I.E. EARTH'S VELOCITY RELATIVE TO THE 'FAR-DISTANT-MATTER-FRAME' BY MEANS OF TWO GRT-EFFECTS: THE 'TIME-DILATION' AND THE 'SPEED-OF-LIGHT-VARIATION'(SAGNAC).

The above mentioned E-RACM method, [see B.3.(b), (Part I)], emerges from SRT and after our analysis of Hafele-Keating experiment, [see E.1.(b), (Part I)]-, it emerges and from GRT by using the Schwarzschild's '*metric*'. The E-RACM method tacitly, but unsuccessfully, has been applied in H-K experiment as well as in GPS: *any atomic clock (fixed on the rotating equator or flying suitably or orbiting around the globe) should also indicate the translational motion of the Earth in space*.

But unfortunately for GRT, it was proved in [E.1.(b), (Part I)] that H-K [13] result does not reveal any *coupling* between the *velocity* $\vec{\upsilon}_\alpha$ of the airplane (or of the velocity of the ground $\vec{\Omega}\times\vec{R}$) with the *orbital velocity* $\vec{V}$ of the Earth around Sun (or around the galactic center). The Hafele-Keating experiment does really and accurately expresses the (integrated) time-dilation effects for the clocks *around* Earth's axis, but (in spite of our relativistic calculations)- there is not any physical 'coupling' between the velocities $\vec{\upsilon}_\alpha$ of the involved-flying clocks with Earth's any 'cosmic velocity' $\vec{V}$ (ranging between the values 30-400 km/sec); otherwise the H-K [13] result should have to be greatly (10^2 or 10^3 times) blurred because of the large magnitude of V and the asymmetry of the commercial flights around the globe.

Similarly the famous Global Positioning System GPS, consists another very good **E**-RACM (which has tacitly been failed to work and measure the cosmic velocities of the Earth in space); this happens because the orbiting atomic clocks "go" as the active first three terms of (1.34) relation, while these clocks don't obey the "inactive" relativistic *velocity-coupling* term $\frac{V\upsilon_\alpha}{c^2}\sin\Theta_\alpha$.

The lack of big sinusoidal fluctuations in the "time rates" i.e. the lack of a big "time-gain" and a big "time-loss" during the period of the orbit, (in some of GPS-atomic clocks), contains in it and the failure of SRT and GRT.

Turner and Hill [24] have also tried unsuccessfully to apply Einstein's **E**-RACM but unfortunately for them their experiment was quite unsuitable to detect the 'far-distant-matter' (FDM) - influence [see E.3.(e), (Part III)].

Of course some of the relativists could argue: "*we are unable to determine our velocity in space in accordance with SRT*"; But since SRT, is in rule only in "absolute rectilinear" relative motions of constant velocity, and since, our clocks move now in well established curved paths and into the long-ranged gravitational fields, this exactly means that our suitable better theory -the GRT-, have to be in rule! But alas the GRT is unable to determine the speed of the Earth through the 'far-distant-matter-frame' (FDMF), or at least around the center of the galaxy!

Similarly Brillet and Hall [25] had tried to determine, by their result, the lowest "directional anisotropy" of space. In spite of their more or less SRT-like explanation of this experiment, the failure of the GRT becomes self-evident; because we have the Earth absolutely moving on curved paths through the long-ranged gravitational potential of our galaxy (with SRT/LT being clearly out of rule). The GRT-theoretical calculation of Sagnac effect [D.3.(Part I)], applied now, for the rotating frame of entire the galaxy –with Sun moving around the galactic center at a velocity close to 300 km/sec- gives an expected Galilean variation of velocity of light:

$$C'_{SUN(+)} = c - 300\text{km/sec}, \qquad C'_{SUN(-)} = c + 300\text{km/sec}.$$

Why Brillet-Hall [25] had failed to verify the above values for the speed of light calculated by GRT? It is not right to use the very restricted SRT/philosophy, -revenge of SRT against GRT(!)-, in order to cover the failure of the more "suitable" and "general" GRT!

Conclusively: We have arrived again in a similar situation, as we were in 1900-epoch; GRT is now unable to determine, by means of GRT-calculations and methods, the velocity of the Earth into the galaxy or relative the FDMF. What explanation is given for that after the non-validity of LT/SRT on the whatsoever accelerating Earth? What cause then could cover and inactivate the great cosmic and absolute motion of the Earth around the galactic center so that this velocity cannot be detected by such a variety of relativistic methods and predictions? The explanation for this failure of GRT is the existence of 'terrestrial luminiferous ether'; a theory proposed by Stokes in 1845 in order to explain the appearance of the annual starlight aberration (Part III).

II. PRE-RELATIVISTIC PHYSICS OFFERS ENTIRE THE "RELATIVISTIC" EXPERIENCE

A. INTRODUCTION

1. MAXWELL'S E/M-THEORY IMPLIES THE 'ENERGY-MASS EQUIVALENCE'

The term 'pre-relativistic' physics includes: 1) the Newtonian mechanics, 2) the Newtonian gravity, 3) the Maxwellian physics with the E/M-wave and light-wave being propagated in ether, and 4) the 'energy-mass equivalence' (EME). It have to be noted that in spite of the continuous popular (and scientific) advertisement of SRT to acquire the exclusive "patent" of the EME, yet the EME needs-not the LT in order to be proved; instead, it was essential conclusion of the pre-relativistic Maxwellian E/M-theory. Regarding the EME, LT/SRT appear to be compatible with Maxwellian E/M theory [26]. The pre-relativistic-physics production of the EME is noted (although not literally) and by French [27]; he starts with the *mass of light* and by generalizing it for *other kinds of energies and material masses* he obtains in the introduction of his book the "relativistic" kinematics without any connection to LT. A very similar proving path is followed in present paper: as early as in 1908, Lewis [28] had embodied the EME into Newtonian mechanics producing the '*increase-of-mass law*'.

Although such a Newtonian mechanics is called today "relativistic"; yet the EME, can be characterized clearly as 'pre-relativistic' because of the ability of Maxwell's theory to prove the EME for light, and then to extent it for other kinds of energies and masses. Entire the so called "special-relativistic" dynamics and kinematics can very well be proved exclusively from the pre-relativistic physics i.e. without any connection to LT and SRT (see next B.C.D.E).

2. THE LIGHT–WAVES AND THE E/M–WAVES IMPOSE THE EXISTENCE OF 'LUMINIFEROUS ETHER'

The wave-behavior of light had imposed originally the existence of a vibrating carrier i.e. the *luminiferous ether* (Huygens, Fresnel). Later Maxwell had formulated his own E/M-theory assuming the free space to be completed by his '*E/M-ether-medium*' (endowed with ε = *electric permittivity*, and μ = *magnetic permeability*). Finally Maxwell managed to calculate the speed of propagation of E/M-wave equal to

$$\upsilon_{(E/M-wave)} = \frac{1}{\sqrt{\varepsilon\mu}}$$

Only when Maxwell had learned about the accurate magnitude of the speed of light c in vacuum (of his epoch) he was able to write down the equality:

$$\upsilon_{(E/M-wave)} = \frac{1}{\sqrt{\varepsilon\mu}} = c \qquad (2.1)$$

In that moment he realized the unity the two "ethers"; i.e. his own *E/M-ether-medium* was merged with the *lumniferous ether.* The detection of the E/M-waves had given an additional independent proof for the existence of the 'ether carrier' of the vibrations of light. Real waves are propagated into a real ether-medium! The invention of photon does not make it independent from the ether because photon is closely related to the wave-nature of light (i.e. frequency or wave-length).

3. MOMENTUM AND MASS OF LIGHT.

It is classically known from Maxwell's E/M-theory of light [29], that a light-wave of energy E does possess a linear momentum p (in the direction of propagation):

$$p = \frac{E}{c} \qquad (2.2)$$

The definition: '*Momentum = Mass* x *Velocity*' leads us to divide, above relation, in members by c to get the '*mass of light*'

$$\text{'}\textit{Mass of light}\text{'} \equiv \frac{p}{c} = \frac{E}{c^2} \qquad (2.3)$$

We also apply these two formulas and to the photon: $E = hv$

4. ENERGY-MASS EQUIVALENCE

Since the light energy is absorbed by matter and is transformed into kinetic energy of the electrons or of the atoms; we may admit, that according to the *Energy Conservation Principle,* not only the energy of light but every kind of energy, of amount E, do posses (or corresponds) to a mass m; and inversely we can suppose that every mass m contains an energy amount E connected by the relation:

$$E = m \cdot c^2 \qquad (2.4)$$

B. DYNAMICS AND KINEMATICS OF A SMALL MASS MOVING IN ETHER

1. MOMENTUM AND KINETIC ENERGY OF SMALL MASS, GENERALIZATION FOR A GRAVITATIONAL FIELD

(a) *The speed of light.* The gravitation changes the properties of the ether as a carrier of the vibrations of light. Oppositely to the motion of the material bodies, the speed of light in ether does not shows ballistic properties. Thus the speed of light: (1) remains independent of the velocity of the emitting atom; additionally we can assume that at each one point in the field the speed of light: (2) remains constant and independent of the direction of propagation and (3) independent of the traveled distance. In other words into a spherical gravitational field, we essentially assume the speed of propagation of light, to be a function $C(r)$ of the distance r from the center of attraction only.

(b) *Energy-mass equivalence.* We also assume that the rest-mass of a small-mass body is a function of r only and write $m_o(r)$ or $m_{o,r}$, similarly a moving-mass of velocity υ, but at the same distance r, is noted as $m_{\upsilon,r}$. Applying now the 'energy-mass equivalence' (EME) for the case of a body of small mass in the gravitational field, we write:

'*Energy at rest*': $$E_{o,r} = m_{o,r} C^2(r) \qquad (2.5)$$

'*Energy of moving mass*': $$E_{\upsilon,r} = m_{\upsilon,r} C^2(r) \qquad (2.6)$$

Taking the differences of the above expressions we write:

'*Kinetic Energy of body*': $$T_{\upsilon,r} \equiv \left[E_{\upsilon,r} - E_{o,r}\right] = \left[m_{\upsilon,r} - m_{o,r}\right] C^2(r) \qquad (2.7)$$

and for the (linear) momentum (omitting the subscription indices) we rewrite:

$$\vec{P} = m\vec{\upsilon} = m\frac{d\vec{r}}{dt}$$

the mass is assumed to be variable.

(c) *The increase of moving mass.* Let us consider now a body which moves under the action of a central gravitational field and acquires a velocity $\vec{\upsilon}$ at a given point $A(r,\varphi)$ of the field (Fig 4). The moving body is momentarily in a space where the speed of light is $C(r)$ and thus it has energy content $\left[m_{\upsilon,r} C^2(r)\right]$, while its energy content at rest, at the same point A is $\left[m_{o,r} C^2(r)\right]$. In trying to relate these two (local) quantities we must imagine that the body is accelerated from rest up to the velocity υ by the action of an imaginary mechanical force f_i such as the pressure on one side of the body or the pushing by a spring; this mechanical force has no influence on the speed of light $C(r)$ in the space in which it acts; the mechanical force f_i is imagined to act along a segment of a straight line of length $\Delta\ell$, whose starting point is A'; this point A' is at the intersection of the straight line, drawn from point $A(r,\varphi)$ in a direction opposite to that of the velocity vector $\bar{\upsilon}$, with the circle of radius $\Delta\ell$ whose center is the point $A(r,\varphi)$ (Fig 4). The body at A' is regarded to be at rest and the work of the mechanical force f_i gives to the body the velocity $\bar{\upsilon}$ at A. We can take the radius $\Delta\ell$ as small as we please, so that, instead of the rest-mass $m_o(A')$ at the point A', we may use the rest-mass $m_o(A)$ or $m_{o,r}$ at the point A; the speed of light is also assumed to have the value $C(r)$ everywhere in the elementary circle (of radius $\Delta\ell$).

Keeping all these in mind, we will follow Lewis' [28] line of thought; we will apply Newton's law of motion along the line $\Delta\ell$, for the imaginary linear acceleration of the body in a space where the speed of light is the constant $C(r)$ and the rest-mass of the body is $m_{o,r}$, we have:

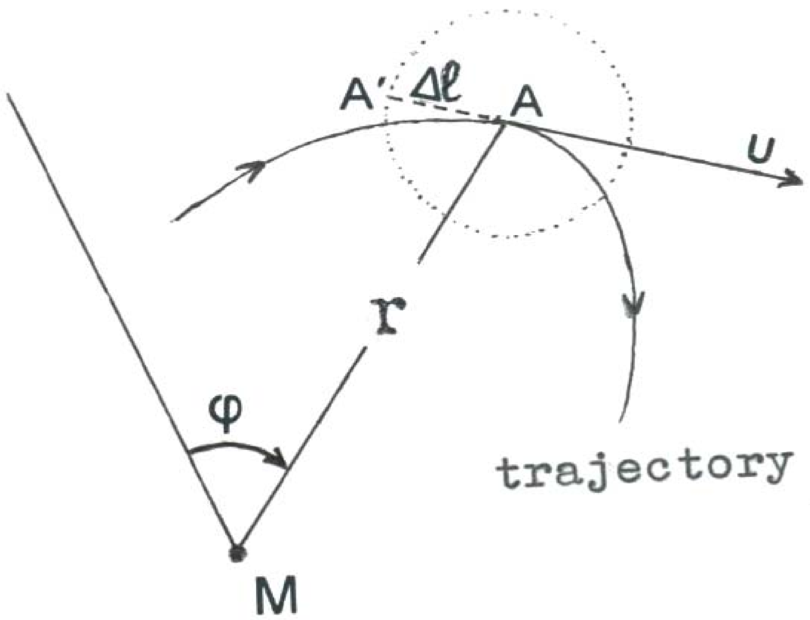


FIG. 4. A small moving mass in Newtonian field

FIG. 4 Applying Newton's law of motion for the imaginary linear acceleration of the body along the straight line element $\Delta\ell$, in a space (circle) where the speed of light is regarded constant $C(r)$ (the said circle is regarded arbitrarily small so that to satisfy the, 'local constancy of the speed of light', into it). Into the said circle Maxwell's energy-mass-equivalence (EME) law also is in rule. After Lewis (1908) –[28]-, the combination of the above two famous laws, leads us to the well known 'law-of-variation of the moving mass' without any connection to Lorentz transformations.

$$f_i = \frac{d(mu)}{dt} = \frac{d(mu)}{dx}\frac{dx}{dt} = \frac{d(mu)}{dx}u \qquad (2.8)$$

and

$$f_i dx = dm \cdot u^2 + \frac{m}{2} d(u^2) \qquad (2.9)$$

The (2.9) express the imaginary work dW of the force f_i; that work increases the total energy of the body:

$$f_i dx \equiv dW = dmC^2(r) \qquad (2.10)$$

We thus obtain from the last two relations:

$$\frac{dm}{m}\left(1 - \frac{u^2}{C^2(r)}\right) = \frac{d(u^2)}{2C^2(r)} \qquad (2.11)$$

Integrating from $u = 0$ to $u = \upsilon$ and from $m = m_{o,r}$ to $m = m_{\upsilon,r}$, we get

$$m_{\upsilon,r} = \frac{m_{o,r}}{\sqrt{1 - \dfrac{\upsilon^2}{C^2(r)}}} \qquad (2.12)$$

The quantity $m_{o,r}$ is the rest mass of the small body being at the distance r inside the gravitational field of a central mass; and it is a characteristic magnitude for each one kind of the ‘elementary’ particles at that distance. Oppositely to SRT the magnitude $m_{o,r}$ have lost the property of the “invariance”, relative to any Galilean reference frame. Multiplying in members (2.12) with $C^2(r)$ we obtain:

$$m_{\upsilon,r}C^2(r) = \frac{m_{o,r}C^2(r)}{\sqrt{1 - \dfrac{\upsilon^2}{C^2(r)}}} \quad \text{or} \quad E_{\upsilon,r} = \frac{E_{o,r}}{\sqrt{1 - \dfrac{\upsilon^2}{C^2(r)}}} \qquad (2.13)$$

From the above (2.13) we also obtain:

$$\{m_{\upsilon,r}C^2(r)\}^2 = p_r^2C^2(r) + \{m_{o,r}C^2(r)\}^2 \qquad (2.14)$$

or

$$E_{\upsilon,r}^2 - p_r^2C^2(r) = E_{o,r}^2 \qquad (2.15)$$

$p_r = m_{\upsilon,r}\upsilon$ is the momentum of the moving body

All above formulas will be used in the next three chapters (C, D, E) without the r subscript

C. 'LIFE-TIME' DILATION OF FAST UNSTABLE ATOMIC PARTICLES

(a) *Mechanism*: Although we don't clearly know the concrete mechanisms, which make the various unstable particles to disintegrate, yet we can simplify the problem, by similiarizing the 'unstable particles' with the 'unstable-(radioactive)-nuclei'.

If such is the case, excluding the details, we have some "entities" established temporarily inside 'potential-wells'; potential wells mean binding energies.

The definition of the binding energy (BE) of an 'unstable nucleus' (UN) which is at rest in ether is given by

$$(BE)_o \equiv \left[\sum_i m_{(i),o} N_{(i)} - M_{(UN),o}\right] \qquad (2.16)$$

$m_{o(i)}$ and $N_{(i)}$ are respectively the rest-masses and the number of the (similar) «constituents» and $M_{(UN),o}$ is the (total) rest-mass of the 'unstable nucleus'.

Assuming now the 'unstable nucleus' (UN) as moving rapidly through the ether, an increase of its binding energy has to take place:

$$(BE)_\upsilon \equiv \left[\sum_i m_{(i),\upsilon} N_{(i)} - M_{(UN),\upsilon}\right] = \left[\sum_i \frac{m_{(i),o}}{\sqrt{1-\frac{\upsilon^2}{c^2}}} N_{(i)} - \frac{M_{(UN),o}}{\sqrt{1-\frac{\upsilon^2}{c^2}}}\right] = \frac{(BE)_o}{\sqrt{1-\frac{\upsilon^2}{c^2}}} \qquad (2.17)$$

As now the moving 'UN' has a greater total binding energy, a longer life-time is expected for it. Unlike SRT the life-time dilation is a real phenomenon due to the real motion of UN through the ether.

(b) *Mechanism*: By assuming that the unstable particle disintegration can more or less be similiarized to the phenomenon of α-radioactivity (α-disintegration) and by assuming that the (inner) temperature of the 'unstable nucleus' is constant, the increase of the masses of its constituents would mean: 1) the reduction of the (inner) velocities of the particles and reduction of the frequency f with which the constituents hit the walls of the 'potential well', 2) from the QM point of view the increased-mass constituents have smaller probability T to escape from the 'potential barrier' and the 'unstable nucleus' lives for greater time τ $(\tau_\upsilon > \tau_o)$:

$$\tau_o = \frac{1}{\lambda_o} = \frac{1}{f_o \cdot T_o} \qquad (2.18)$$

and

$$\tau_\upsilon = \frac{1}{\lambda_\upsilon} = \frac{1}{f_\upsilon \quad T_\upsilon} \qquad (2.19)$$

The formulas are known from Nuclear Physics; $\lambda_o, \lambda_\upsilon$ are respectively the disintegration constants of the 'UN' for zero and υ velocity in ether and T is the 'transparence' or 'transmission coefficient' of the 'potential barrier', and since $f_\upsilon < f_o$ and $T_\upsilon < T_o$ we deduce the long living or life-time dilation of fast moving unstable particles.

D. EMISSION - ABSORPTION OF PHOTONS AND ATOMIC DOPPLER EFFECTS* (* Reproduction from [27])

1. EMISSION OF PHOTON

(a). ***Emission of photon from an atom initially being at rest in ether***. Consider an atom initially at rest in ether ($\upsilon = 0$). The rest mass of the atom is M_o. The next moment the atom emits a photon of energy $Q_{(\upsilon=0)} = h\nu_0$. The photon has a momentum $Q_{(\upsilon=0)}/c$ and thus the momentum of the recoiling atom is $-Q_{(\upsilon=0)}/c$. Let the moving mass of the atom, (after the emission), be M' and its rest mass (after the emission) M'_o, we then have:

$$M_o c^2 = M' c^2 + Q_{(\upsilon=0)} \qquad (2.20)$$

$$\frac{Q_{(\upsilon=0)}}{c} + M' u = 0 \qquad (2.21)$$

u is the velocity of the recoiling atom in ether.

Applying the relation (2.14) for the recoiling atom we get:

$$(M'_o c^2)^2 = (M' c^2)^2 - (M' u c)^2 \qquad (2.22)$$

we put

$$M'_o c^2 \equiv M_o c^2 - Q_o \qquad (2.23)$$

The relation (2.22) becomes after the (2.20), (2,21) and (2.23)

$$(M_o c^2 - Q_o)^2 = M_o c^2 [M_o c^2 - 2Q_{(\upsilon=0)}]$$

and solving for $Q_{(\upsilon=0)}$, we get

$$Q_{(\upsilon=0)} = Q_o\left(1 - \frac{Q_o}{2M_oc^2}\right) \qquad (2.24)$$

After Planck's theory we put: $Q_{(\upsilon=0)} = h\nu_{\upsilon=0}$ and $Q_o = h\nu_o$ and relation (2.24) becomes:

$$\nu_{\upsilon=0} = \nu_o\left(1 - \frac{h\nu_o}{2M_oc^2}\right) \qquad (2.25)$$

The quantities Q_o and ν_o, which have been introduced by the equation (2.23), correspond to the energy and the frequency of an *imaginary photon* emitted from the atom in such an imaginary process so that the emitting atom to be stationary before and after the emission of that photon.

(b). *Emission of photon from an atom moving in ether.* Consider an excited moving atom, of velocity $\vec{\upsilon}$ in ether, and of mass M (of rest-mass M_o); in next moments it emits a photon of energy $Q_\upsilon = h\nu_\upsilon$ to a direction forming an angle θ with the initial velocity of the atom. M' is the mass of the recoiling atom and M'_o is its rest mass.

The laws of conservation of energy and of momentum give us:

$$M'c^2 = Mc^2 - Q_\upsilon \qquad (2.26)$$

$$p'^2 = \left(\frac{Q_\upsilon}{c}\right)^2 + (p)^2 - 2\left(\frac{Q_\upsilon}{c}\right)p\cos\theta \qquad (2.27)$$

Applying relation (2.14) to the atom before and after the emission of the photon, we get respectively

$$(M_oc^2)^2 = (Mc^2)^2 - (pc)^2 \qquad (2.28)$$

$$(M'_oc^2)^2 = (M'c^2)^2 - (p'c)^2 \qquad (2.29)$$

Subtracting in members we get:

$$(M_oc^2 - M'_oc^2)(M_oc^2 + M'_oc^2) = (Mc^2)^2 - (M'c^2)^2 - (pc)^2 + (p'c)^2 \qquad (2.30)$$

we note:

$$M_oc^2 - M'_oc^2 \equiv Q_o \qquad (2.31)$$

After the (2.31) the first member of (2.30) becomes

$$(M_oc^2 - M'_oc^2)(M_oc^2 + M'_oc^2) = Q_o(2M_oc^2 - Q_o)$$

While the relations (2.26), (2.27) become:

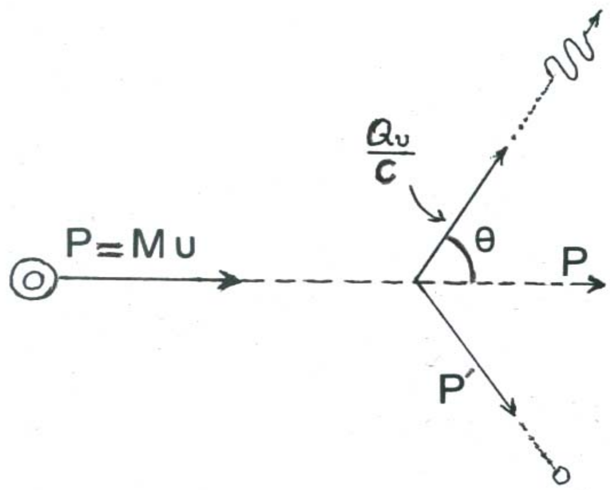


FIG. 5. Emission of photon from a moving atom

The emission of photon was regarded as a kind of particle-disintegration where the laws of conservation of energy and of momentum were applied. The recoiling, of the emitting atom in ether, creates essentially a longer-wavelength-emission (than the emission from a non-recoiling atom); that is why the calculations show the introduction of the (so-called "relativistic") frequency reduction factor $\sqrt{1-(\upsilon/c)^2}$, in the atomic-emission Doppler effect, without any use of Lorentz transformations!

$$(M'c^2)^2 = (Mc^2)^2 - 2Mc^2Q_\upsilon + Q_\upsilon^2$$
$$(p'c)^2 - (pc)^2 = Q_\upsilon^2 - 2Q_\upsilon(cp)\cos\theta$$

Substituting now these three last relations in (2.30) we get:

$$Q_o(2M_oc^2 - Q_o) = 2Mc^2Q_\upsilon - 2Q_\upsilon(cp)\cos\theta \tag{2.32}$$

but $p = M\upsilon$ and $M = \dfrac{M_o}{\sqrt{1-\dfrac{\upsilon^2}{c^2}}}$ and the (2.32) gives for Q_υ:

$$Q_\upsilon = Q_o\left(1-\frac{Q_o}{2M_oc^2}\right)\frac{\sqrt{1-\dfrac{\upsilon^2}{c^2}}}{1-\dfrac{\upsilon}{c}\cos\theta} = Q_{(\upsilon=0)}\frac{\sqrt{1-\dfrac{\upsilon^2}{c^2}}}{1-\dfrac{\upsilon}{c}\cos\theta} \tag{2.33}$$

The third member of (2.33) relation is understandable after the (2.24) relation. Since of Planck's theory $Q_\upsilon = h\nu_\upsilon$ and $Q_{(\upsilon=0)} = h\nu_{(\upsilon=0)}$, the last relation (2.33) becomes

$$\nu_{\upsilon} = \nu_{(\upsilon=0)} \frac{\sqrt{1-\frac{\upsilon^2}{c^2}}}{1-\frac{\upsilon}{c}\cos\theta} \qquad (2.34)$$

Relation (2.34) gives the frequency of a photon emitted by an atom moving with velocity υ in ether. This explains why the frequency emitted from an atom, moving with velocity υ in ether, is reduced by the factor $\sqrt{1-\upsilon^2/c^2}$ relative to the frequency expected from the classical Doppler effect. This explains and the Ives-Stilwell [16] experiment without any introduction of LT.

2. ABSORPTION OF PHOTON

(a). ***Absorption of photon by an atom resting in ether.*** A photon of energy $Q_{(\upsilon=0)}$ meets an atom initially at rest ($\upsilon = 0$) in ether. Let the rest-mass of the atom before the absorption be M_o, its rest-mass after the absorption be M'_o, and M' is the moving mass of the atom, as it moves -with velocity u - after the absorption.

The following relations are valid:

$$M_o c^2 + Q_{(\upsilon=0)} = M'c^2 \qquad (2.35)$$

$$\frac{Q_{(\upsilon=0)}}{c} = M'u \qquad (2.36)$$

The difference

$$M'_o c^2 - M_o c^2 \equiv Q_o \qquad (2.37)$$

is characteristic of the absorbing atom. Applying relation (2.14) to the absorbing atom we get:

$$(M'c^2)^2 = (M'uc)^2 + (M'_o c^2)^2 \qquad (2.38)$$

Relation (2.38) becomes after (2.35), (2.36) and (2.37)

$$(M_o c^2 + Q_{(\upsilon=0)})^2 = Q_{(\upsilon=0)}{}^2 + (M_o c^2 + Q_o)^2 \qquad (2.39)$$

and solving for $Q_{(\upsilon=0)}$, we get

$$Q_{(\upsilon=0)} = Q_o\left(1+\frac{Q_o}{2M_o c^2}\right) \qquad (2.40)$$

and finally

$$\nu_{(\upsilon=0)} = \nu_o \left(1 + \frac{h\nu_o}{2M_o c^2}\right) \qquad (2.41)$$

We have to note here that the quantities Q_o and ν_o which have been introduced by the equation (2.37), correspond to the energy and the frequency of an imaginary absorbed photon in an imaginary absorbing process where the atom could remain at rest before and after the absorption of that photon.

(b). ***Absorption of photon by an atom moving in ether.*** A photon of energy Q_υ hits an atom, moving with velocity υ in ether, under an angle θ, as noted in (Fig.6) Let the moving and the rest-mass of the atom before the absorption be M and M_o respectively, and let the moving and the rest-mass of the atom after the absorption be M' and M'_o respectively. We have respectively for energy and momentum conservation:

$$M'c^2 = Mc^2 + Q_\upsilon \qquad (2.42)$$

$$p'^2 = \left(\frac{Q_\upsilon}{c}\right)^2 + (M\upsilon)^2 + 2\left(\frac{Q_\upsilon}{c}\right)(M\upsilon)\cos\theta \qquad (2.43)$$

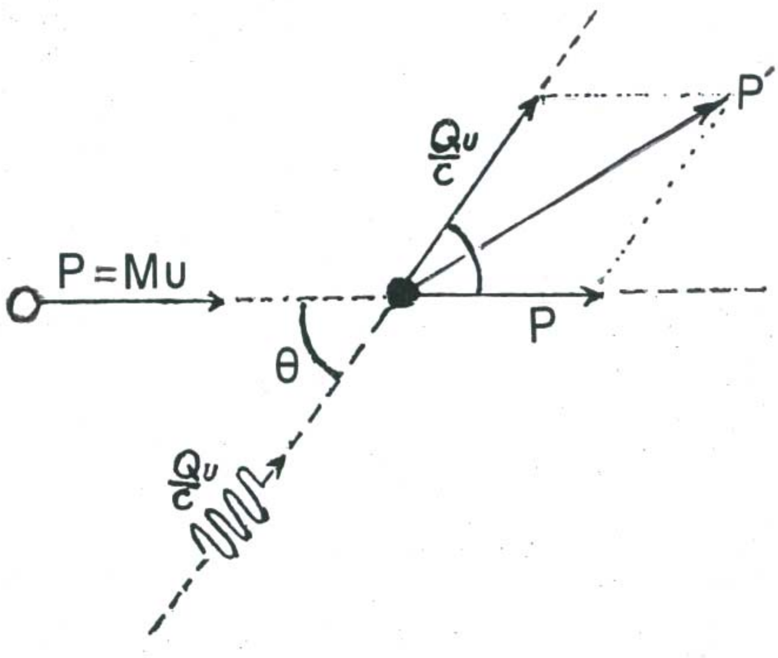


FIG. 6. Absorption of photon by a moving atom

The absorption of photon was regarded as a kind of particle-collision where the laws of conservation of energy and of momentum were applied. These laws of Mechanics imply the introduction of the (so-called "relativistic") frequency reduction factor $\sqrt{1-(\upsilon/c)^2}$ in the atomic-absorption Doppler effect without the use of any Lorentz transformations!

Applying (2.14) to the atom before and after the absorption, we have:

$$(Mc^2)^2 = (M\upsilon c)^2 + (M_o c^2)^2 \qquad (2.44)$$

and

$$(M'c^2)^2 = (p'c)^2 + (M'_o c^2)^2 \qquad (2.45)$$

We put $M'_o c^2 - M_o c^2 \equiv Q_o$ (2.46)

Subtracting in members the (2.44) from (2.45) and with the help of (2.42), (2.43) and (2.46) and using $M = \dfrac{M_o}{\sqrt{1-\dfrac{\upsilon^2}{c^2}}}$, we get

$$Q_\upsilon = Q_o\left(1+\frac{Q_o}{2M_o c^2}\right)\frac{\sqrt{1-\dfrac{\upsilon^2}{c^2}}}{1-\dfrac{\upsilon}{c}\cos\theta} = Q_{(\upsilon=0)}\frac{\sqrt{1-\dfrac{\upsilon^2}{c^2}}}{1-\dfrac{\upsilon}{c}\cos\theta}$$

The third member of the last relation becomes evident after the relation (2.40); and finally we have:

$$\nu_\upsilon = \nu_{(\upsilon=0)}\frac{\sqrt{1-\dfrac{\upsilon^2}{c^2}}}{1-\dfrac{\upsilon}{c}\cos\theta} \qquad (2.47)$$

Where $\nu_{(\upsilon=0)}$ and ν_υ are the absorbed frequencies, by the atom, respectively when it initially is at rest and when it initially moves with a velocity υ through the ether. The last relation (2.47) will applied below to the function of Cs-atomic-clocks (for the calculation of "kinematical effects") in the re-interpreted Hafele-Keating (H-K)ri experiment The same formula (2.47) is equally well applied for the "kinematical effects" of the orbiting atomic clocks of GPS [E.4.(Part III)].

E. SYNCHROTRON RADIATION 'HEAD-LIGHT' EFFECT

Charged particles accelerated in high-energy accelerators move in curved paths being centripetally accelerated in this deflection; they thereby emit E/M-radiation. This radiation is predominantly in the forward direction of the motion, as seen in the laboratory. This bunching of the radiant energy in the forward direction is the known 'head-light' effect or synchrotron radiation.

The 'head-light' effect may very well be understood as a result of the simultaneous validity of the following three, physical conditions or causes, which are true relative to the system of reference fixed with ether:

1). According to classical electrodynamics, based on Maxwell's equations, energy is radiated whenever a charge is accelerated. The energy radiated per unit time (dE/dt) depends only from the magnitude of the acceleration -a- but is independent from its sign and also is independent of the velocity -υ- of the accelerated particle, we have then:

$$\left(\frac{dE}{dt}\right)_{a,\upsilon\approx 0} = \left(\frac{dE}{dt}\right)_{a,\upsilon\neq 0} \qquad (2.48)$$

2). Because of the quantum nature of the radiation and of the free recoiling of the radiating particles, we may assume the application of the Conservation Principles of energy and momentum on the radiating particle. This means that we may assume the emission formula (2.34) to be also true for the radiating charges

$$\nu_{\upsilon} = \nu_{(\upsilon=0)} \frac{\sqrt{1-\beta^2}}{1-\beta\cos\theta} \qquad (2.49)$$

here $\beta = \upsilon/c$, $\nu_{(\upsilon=0)}$ is the frequency, emitted when the charged particle radiates at very small velocities ($\upsilon \approx 0$), and ν_{υ} is the frequency of quantum emitted from the charged particle, when it has a velocity υ (relative to ether). The angle θ is measured from the forward direction of motion of the radiating particle.

3). The efficiency of the accelerated charged particle to generate photons must not change when the acceleration of the particle takes place in the moment for which it rests in ether ($\upsilon \approx 0$) or when, the <u>same</u> acceleration, takes place while it has a velocity υ in ether. In other words it is assumed that the number of the generated separate photons per unit time, under constant acceleration, is the same no matter whether the acceleration be applied at small velocities ($\upsilon \approx 0$) or at high ones (υ):

$$N_{\ddot{r},(\upsilon\approx 0)} = N_{\ddot{r},(\upsilon)} = N \qquad (2.50)$$

Although the radiated electromagnetic field around the accelerated charged particle has not spherical symmetry, yet, for simplicity of our calculations, it will be assumed that, for very small velocities ($\upsilon \approx 0$) the charged particle radiates uniformly in space; the directions of propagation of the photons ($h\nu_{(\upsilon=0)}$) are uniformly distributed on a sphere, which rests in ether, of radius 1 and with its center,

of course, on the "stationary" but accelerated charged particle.

Thus the surface density of the 'traces' of photons on the unit sphere is $S_{(\upsilon\approx 0)} = N/4\pi$.

And the total radiated energy (per unit time) is:

$$\left(\frac{dE}{dt}\right)_{a,(\upsilon\approx 0)} \equiv h\nu_{(\upsilon=0)}N \qquad (2.51)$$

In search of a function giving a non-uniform density for the radiated photons around the charged particle of velocity υ, we may select the ellipse of parameter $\eta(\beta)$ and of eccentricity $\varepsilon(\beta)$, to give the number of the radiated photons (per unit of time, per sterad), flying between the angles θ and $\theta + d\theta$ (Fig. 7). The angle θ is measured from the forward direction of motion; for $\theta = 0$ we get the maximun and for $\theta = \pi$ the minimun density of the radiated photons. The «ellipse» is rotated around its major axis, which lies on the direction of vector $\vec{\upsilon}$; the produced ellipsoid is assumed (or asked) to give the surface density $S(\beta,\theta)$ of the radiated photons on the stationary –in ether- sphere of radius 1.

$$S(\beta,\theta) = \frac{N}{4\pi}\frac{\eta(\beta)}{[1-\varepsilon(\beta)\cos\theta]} \qquad (2.52)$$

The number of photons, that are radiated between the angles: θ and $\theta + d\theta$, is

$$dn(\beta,\theta) = (2\pi\sin\theta)S(\beta,\theta)d\theta = \frac{N}{2}\frac{\eta(\beta)}{[1-\varepsilon(\beta)\cos\theta]}\sin\theta d\theta \qquad (2.53)$$

Integrating the first member from 0 to N -(condition 3)- and the third member from 0 to π, we get

$$N = \frac{N}{2}\eta(\beta)\cdot\int_0^\pi \frac{\sin\theta d\theta}{1-\varepsilon(\beta)\cos\theta} = \frac{N}{2}\frac{\eta(\beta)}{\varepsilon(\beta)}\ln\left[\frac{1+\varepsilon(\beta)}{1-\varepsilon(\beta)}\right] \qquad (2.54)$$

From this relation we can solve for $\eta(\beta)$:

$$\eta(\beta) = \frac{2\varepsilon(\beta)}{\ln\left[\frac{1+\varepsilon(\beta)}{1-\varepsilon(\beta)}\right]} \qquad (2.55)$$

The total radiated energy (per unit time) is the integral:

$$\left(\frac{dE}{dt}\right)_{a,(\upsilon)} = \int_0^\pi (h\nu)(2\pi\sin\theta)S(\beta,\theta)d\theta \qquad (2.56)$$

Substituting the values of ν and S from (2.49) and (2.52), respectively the integral (2.56) is written:

$$\left(\frac{dE}{dt}\right)_{a,(\upsilon)} = \frac{N}{2}\int_0^\pi \frac{h\nu_{(\upsilon=0)}\eta(\beta)\sqrt{1-\beta^2}\,\sin\theta d\theta}{[1-\beta\cos\theta][1-\varepsilon(\beta)\cos\theta]} =$$

$$= \frac{N}{2} h\nu_{(\upsilon=0)} \eta(\beta)\sqrt{1-\beta^2}\, \frac{1}{\beta-\varepsilon(\beta)}\left[\ln\frac{1+\beta}{1-\beta} - \ln\frac{1+\varepsilon(\beta)}{1-\varepsilon(\beta)}\right] = Nh\nu_{(\upsilon=0)} \qquad (2.57)$$

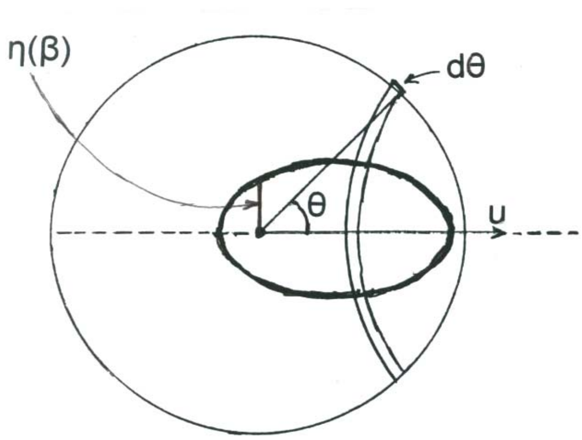


FIG. 7. The "Head-light" effect

The existence of the frequency reduction factor $\sqrt{1-\beta^2}$ (where $\beta = \upsilon / c$) in the atomic-emission formula (2-49), combined with the laws of conservation of radiated energy, forces the emitted photons to be concentrated mostly to the direction of motion creating the "head-light" effect. The parameter $\eta(\beta)$ and the eccentricity $\varepsilon(\beta)$ of the ellipse (which is sketched with the one of its focus on the moving-radiating particle) are to denote the variation of the density $S(\beta,\theta)$ of the emitted photons (with the variation of the velocity of the source).

the last member of the continuous relation is a consequence of the relations (2.48) and (2.51). From the last relation (2.57) we get:

$$\sqrt{1-\beta^2}\,\frac{\eta(\beta)}{2}\,\frac{1}{\beta-\varepsilon(\beta)}\left[\ln\frac{1+\beta}{1-\beta} - \ln\frac{1+\varepsilon(\beta)}{1-\varepsilon(\beta)}\right] = 1$$

The last relation becomes after the (2.55) relation:

$$\sqrt{1-\beta^2}\,\frac{\varepsilon(\beta)}{\beta-\varepsilon(\beta)}\left[\ln\frac{1+\beta}{1-\beta} - \ln\frac{1+\varepsilon(\beta)}{1-\varepsilon(\beta)}\right] = \ln\frac{1+\varepsilon(\beta)}{1-\varepsilon(\beta)} \qquad (2.58)$$

with the help of a computer we may find the arithmetical solution of (2.58) i.e. we may calculate the values of $\varepsilon(\beta)$ for some values of β; then from (2.55) we may calculate the corresponding values of $\eta(\beta)$.

TABLE II. Synchrotron radiation –'head-light' effect

$\beta = \frac{\upsilon}{c}$	$\varepsilon(\beta)$	$\eta(\beta)$
0.001	0.0004980587	0.9999999173
0.01	0.005	0.9999916666
0.1	0.0501256286	0.9991619119
0.2	0.1010205144	0.9965889781
0.3	0.1535359952	0.9920922177
0.5	0.2679491924	0.9755914628
0.7	0.4083673673	0.9416974954
0.8	0.5	0.9102392266
0.9	0.6267890062	0.8514885324
0.99	0.8676087275	0.6556272546
0.999	0.9562460683	0.5032607622
0.9995	0.9688656093	0.467272254

Inspecting the Table II we find a clear 'head-light' effect since as β increases, $\varepsilon(\beta)$ also be increased; while the $\eta(\beta)$, the parameter of the ellipse -determining the density at the angle $\theta = \pi/2$ -, be decreased. Thus when $\beta \to 0$, then $\varepsilon(\beta) \to 0$, and $\eta(\beta) \to 1$ and $S(0,\theta) = \frac{N}{4\pi}$; and when $\beta \to 1$, then $\varepsilon(\beta) \to 1$, and $\eta(\beta) \to 0$.

F. IMPROVED NEWTONIAN GRAVITATION

1. EQUATIONS OF MOTION AND ENERGY-CONSERVATION OF A SMALL MATERIAL MASS IN A SPHERICAL GRAVITATIONAL FIELD.

Our starting point is the well-known Newtonian law of motion:

$$\vec{F} = \frac{d\vec{P}}{dt} = \frac{d(m\dot{\vec{r}})}{dt} \qquad (2.59)$$

The Newtonian attraction, between central mass M and the small mass m, is also assumed:

$$\vec{F} = -\frac{G \cdot Mm}{r^2} \cdot \hat{r} \qquad (2.60)$$

It was assumed, [see B.1(a). (Part II)], that the speed of light in a spherical gravitational field -produced by the central mass M - is a function $C(r)$, of the distance from the center of the field, only. In [B.1(b), (Part II)] it was assumed that when a small mass m is in a space where the speed of light is $C(r)$, its energy content is $\left[mC^2(r)\right]$.

We assume the validity of the following 'improved' equation expressing the conservation of the energy inside the Newtonian field $(M >> m)$:

$$\vec{F} \circ d\vec{s} + d\left[mC^2(r)\right] + dW = 0 \qquad (2.61)$$

The term $\vec{F} \circ d\vec{s}$ is the produced elementary work by the attracting force on the attracted small mass *m*. The term $d\left[mC^2(r)\right]$ is the elementary increase of the energy content of the mass *m* inside the gravitational field of the mass *M*. While *dW* is not necessarily any "radiated gravitational energy" (if this phenomenon be really in rule) it instead can be due to the kinetic energy imparted to masses of the ether around.

We can omit from (2.61) the radiation term as significantly small; we can thus write the relation (2.61) for the case of solar attraction (*M*>>*m*):

$$\vec{F} \circ d\vec{s} + d\left[mC^2(r)\right] = 0 \qquad (2.62)$$

This relation also determines the changes of the attracted mass at different positions inside the spherical gravitational field of the mass M and it must not be confused at all with the relation (2.10). {Relation (2.10) was used in order to study the changes of mass m with velocity but <u>at the same point</u> of the gravitational field and which changes of mass are produced by offering the work of another external, foreign, imaginary force not affecting the local value $C(r)$ of the speed of light (for example: a charged particle initially passes from the point A, inside the gravitational field of

Earth, with a very small velocity and then it leaded to an accelerator from which it comes back at A with a very high velocity)}.

In the case of spherical gravitational field the attracting mass M (Sun) is assumed to be stationary at the origin of the coordinates and the attracted mass m (Planets) to move around the origin $(M >> m)$ (Fig, 8)

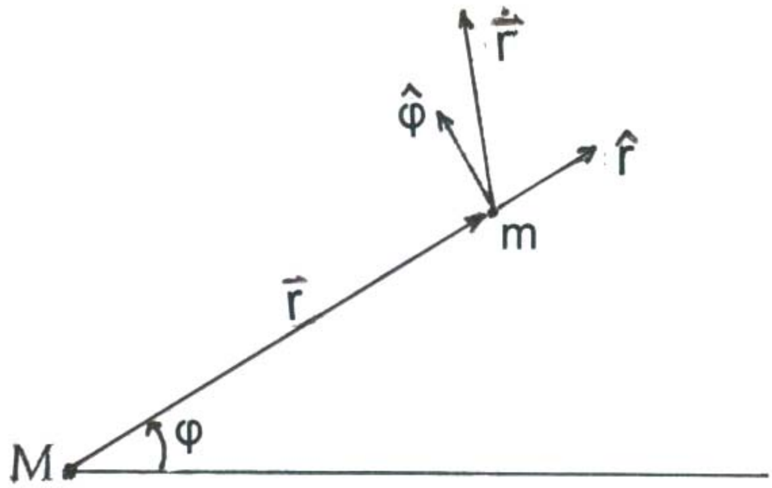


FIG. 8 Small material mass in a Newtonian field

Presumably the small material mass m is attracted by the Newtonian central force passing through the mass M. Newton's laws: of motion (2.59), of gravitational attraction (2-60), and the energy-conservation equation (2-62) are assumed to be in rule.

From (2.59) and (2.60) we have:

$$-\frac{G\cdot Mm}{r^2}\cdot\hat{r}=\frac{d(m\dot{\vec{r}})}{dt}=\frac{dm}{dt}\dot{\vec{r}}+m\frac{d\dot{\vec{r}}}{dt} \qquad (2.63)$$

It is $\vec{r}=r\cdot\hat{r}$. The unit vector $\hat{\varphi}$ (Fig. 8) is perpendicular to $\hat{r}$ one and thus we have:

$$\dot{\vec{r}}=\dot{r}\cdot\hat{r}+r\dot{\varphi}\cdot\hat{\varphi} \qquad \frac{d\dot{\vec{r}}}{dt}=(\ddot{r}-r\dot{\varphi}^2)\hat{r}+\frac{1}{r}\frac{d}{dt}\left(r^2\dot{\varphi}\right)\hat{\varphi}$$

Substituting, $\dot{\vec{r}}$ and $\dfrac{d\dot{\vec{r}}}{dt}$ into (2.63), we get:

$$-\frac{GMm}{r^2}\cdot\hat{r}=\frac{dm}{dr}\dot{r}^2\cdot\hat{r}+\frac{dm}{dr}\dot{r}r\dot{\varphi}\cdot\hat{\varphi}+m\left(\ddot{r}-r\dot{\varphi}^2\right)\cdot\hat{r}+\frac{m}{r}\frac{d}{dt}\left(r^2\dot{\varphi}\right)\cdot\hat{\varphi} \qquad (2.64)$$

Equating separately the coefficients of the unit vectors $\hat{r}$ and $\hat{\varphi}$ in the vector equation (2.64), we get:

$$-\frac{GM}{r^2}m = \frac{dm}{dr}\dot{r}^2 + m\left(\ddot{r} - r\dot{\varphi}^2\right) \qquad (2.65)$$

$$-\frac{dm}{dr}\dot{r}r\dot{\varphi} = \frac{m}{r}\frac{d}{dt}\left(r^2\dot{\varphi}\right) \qquad (2.66)$$

Equation (2.65) may be written slightly differently:

$$-\frac{GM}{r^2} = \frac{dm}{mdr}\dot{r}^2 + \left(\ddot{r} - r\dot{\varphi}^2\right) \qquad (2.67)$$

Relation (2.66) expresses the well known law of the constancy of the angular momentum $\Re$, i.e.

$$mr^2\dot{\varphi} = \Re \qquad (2.68)$$

We easily obtain from (2.68):

$$\dot{\varphi} = \frac{\Re}{mr^2}$$

$$\dot{r} = \frac{\Re}{r^2 m}\frac{dr}{d\varphi}$$

$$\ddot{r} = \frac{\Re^2}{m^2}\frac{1}{r^4}\frac{d^2r}{d\varphi^2} - \frac{\Re^2}{m^2}\frac{2}{r^5}\left(\frac{dr}{d\varphi}\right)^2 - \frac{\Re^2}{m^2}\frac{dm}{mdr}\frac{1}{r^4}\left(\frac{dr}{d\varphi}\right)^2$$ (m depends only from r).

Substituting now $\dot{\varphi}, \dot{r}, \ddot{r}$ into the relation (2.67), we get the equation of the planetary motion around the Sun:

$$-\frac{1}{r^2}\frac{d^2r}{d\varphi^2} + \frac{2}{r^3}\left(\frac{dr}{d\varphi}\right)^2 + \frac{1}{r} = GM\frac{m^2}{\Re^2} \qquad (2.69)$$

By replacing $\vec{F}$, from the equation (2.60) into the equation (2.62), and by omitting -for the simplicity of writing- the parenthesis (r), from the symbol $C(r)$ of the speed of light, we get:

$$\frac{dm}{mdr} = \frac{GM}{C^2r^2} - \frac{dC^2}{C^2dr} \qquad (2.70)$$

2. 'LEAST-TIME PRINCIPLE' AND ENERGY-CONSERVATION FOR LIGHT IN A SPHERICAL GRAVITATIONAL FIELD. ENERGETIC – NEWTONIAN INFLUENCE ON LIGHT; CHANGE OF PLANCK'S CONSTANT.

It has been stated that the speed of light inside a spherical gravitational field, created by the central mass M, is a function of the distance r only from M i.e. $C(r)$. This means that the presence of the gravitational field on the surrounding ether medium, - around M -, creates a virtual index of refraction $n(r)$:

$$n(r) \equiv \frac{C(\infty)}{C(r)}$$

This forces us to accept Heron's-Fermat's 'Least-Time Principle': The light is assumed to follow, inside the gravitational field, such a path so that the total time takes its minimum value**:**

$$\int \frac{ds}{C(r)} = \int \frac{\sqrt{r^2 + \left(\frac{dr}{d\varphi}\right)^2}}{C(r)} d\varphi = \text{Minimum} \qquad (2.71)$$

From Calculus of Variations we know that the condition:

$$\int I(\varphi, r, r_\varphi) d\varphi = \text{minimum}, \quad \text{where} \quad r_\varphi \equiv \frac{dr}{d\varphi},$$

is fulfilled when and only when:

$$\frac{\partial I}{\partial r} - \frac{d}{d\varphi}\left(\frac{\partial I}{\partial r_\varphi}\right) = 0 \qquad (2.72)$$

it is $I \equiv \dfrac{\sqrt{r^2 + \left(\frac{dr}{d\varphi}\right)^2}}{C(r)}$

The condition (2.72) becomes for our integral (2.71)

$$\frac{d^2 r}{d\varphi} - \frac{2}{r}\left(\frac{dr}{d\varphi}\right)^2 + \frac{d[C^2(r)]}{2C^2(r)dr}\left[r^2 + \left(\frac{dr}{d\varphi}\right)^2\right] - r = 0 \qquad (2.73)$$

The 'Least-Time Principle' is in rule and is expressed by the equation (2.73), which gives the path and the bending of the light ray inside the gravitational field.

The factor $\frac{d[C^2(r)]}{C^2(r)dr}$ is function of r and is independent of the angle φ, and thus it can be determined along a known path of photon: the radial propagation (φ=constant) on which the validity of the Least-Time Principle is true and also the Newtonian laws (2.59), (2.60) and the energy-conservation equation (2.62) are assumed to be in rule.

The energy of photon is $(h\nu)$, its mass $m_{ph} = (h\nu)/C^2$ and its momentum $P_{ph} = (h\nu)/C$, where $C \equiv C(r)$ is the local speed of light in the field.

For a radial propagation of light the Newtonian laws (2.59) and (2.60) give:

$$-\frac{GM}{r^2}\left(\frac{h\nu}{C^2}\right) = \frac{d}{dt}\left(\frac{h\nu}{C}\right) = \frac{d}{dr}\left(\frac{h\nu}{C}\right)C \qquad (2.74)$$

The energy law (2.62) is written, for the radially propagating photon:

$$d(h\nu) = \frac{GM}{r^2}\left(\frac{h\nu}{C^2}\right)dr \qquad (2.75)$$

From the (2.74) and (2.75) we get:

$$\frac{d[C^2]}{dr} = 4\frac{GM}{r^2} \qquad (2.76)$$

Integrating:

$$\int_{C(r)}^{C(\infty)} d[C^2] = \int_r^\infty 4\frac{GM}{r^2}dr$$

We get for the speed of light $C(r)$:

$$C^2 = C_\infty^2\left[1 - \frac{4\alpha}{r}\right] \qquad (2.77)$$

$\{\alpha \equiv \frac{GM}{C_\infty^2}$; in the case of Sun: α_{Sun}= 1.47 km$\}$ When the light propagates to escape from the field its speed $C(r)$ increases, up to the limit $C(\infty)$. From (2.76) and (2.77) we get:

$$\frac{d[C^2]}{C^2 dr} = \frac{4\alpha}{\left[1 - \frac{4\alpha}{r}\right]r^2} \qquad (2.78)$$

Substituting (2.78) into (2.73) we get the equation of the path of the light ray inside the gravitational field:

$$\frac{d^2r}{d\varphi^2}-\frac{2}{r}\left(\frac{dr}{d\varphi}\right)^2+\frac{2\alpha}{\left[1-\frac{4\alpha}{r}\right]r^2}\left[r^2+\left(\frac{dr}{d\varphi}\right)^2\right]-r=0 \qquad (2.79)$$

In order to solve this equation, for the case of Sun (where $\alpha << r$), we can make a simplifying substitution putting in the denominator the number 1 in place of the factor $[1-4\alpha/r]$.

$$\frac{d^2r}{d\varphi^2}-\frac{2}{r}\left(\frac{dr}{d\varphi}\right)^2+\frac{2\alpha}{r^2}\left[r^2+\left(\frac{dr}{d\varphi}\right)^2\right]-r=0 \qquad (2.80)$$

By doing the transformation $r=1/u$, equation (2.80) becomes:

$$\frac{d^2u}{d\varphi^2}+u=2\alpha\left[u^2+\left(\frac{du}{d\varphi}\right)^2\right] \qquad (2.81)$$

Equation (2.81) represents with a good approximation a hyperbolic path for light ray. The deflection D of light ray (i.e. the difference: π minus the angle of the two asymptotes of the hyperbola), has the value

$$D=|\pi-2\varphi_\infty|=\frac{4\alpha}{r_o}=\frac{4GM}{r_oC_\infty^2} \qquad (2.82)$$

(r_o is the closest distance of the path of light from the attracting central mass M).

In contrary to what happens with the material bodies, which at a definite distance r from the attracting mass *M* may acquire a variety of speeds, the light do possess a definite speed $C(r)$ only (!) obeying the laws (2.76) and (2.77).

For the light both the Least-Time Principle (2.73) and the Energy Conservation Principle (2.75) are in rule. Of course such an assumption leads to the consequence for the partial-restricted- validity of the Newtonian dynamics on photon; thus the gravitational centripetal component $\vec{F}\circ\widehat{N}$ (normal to the path of light ray) does not produces any effect; but the gravitational tangential component, acting along the real path of light, does really acts so that the relation (2.75) to be fulfilled. Thus the inner product $\vec{F}\circ\hat{\tau}$ is the tangential or "energetic" component of the Newtonian attraction which acts on the photon. We have (Fig. 9)

$$\vec{F}\circ\hat{\tau}=-\frac{GMm_{ph}}{r^2}\hat{r}\circ\hat{\tau}=-\frac{GM}{r^2}\left(\frac{h\nu}{C^2}\right)\cos\omega \qquad (2.83)$$

and

$$\frac{d\vec{P}_{ph}}{dt}\circ\hat{\tau}=\frac{d(P_{ph}\hat{\tau})}{dt}\circ\hat{\tau}=\frac{d}{dr}\left(\frac{h\nu}{C}\right)\frac{dr}{ds}\frac{ds}{dt}=\frac{d}{dr}\left(\frac{h\nu}{C}\right)C\cos\omega \qquad (2.84)$$

Equating the second members of the last two relations we get the relation (2.74).

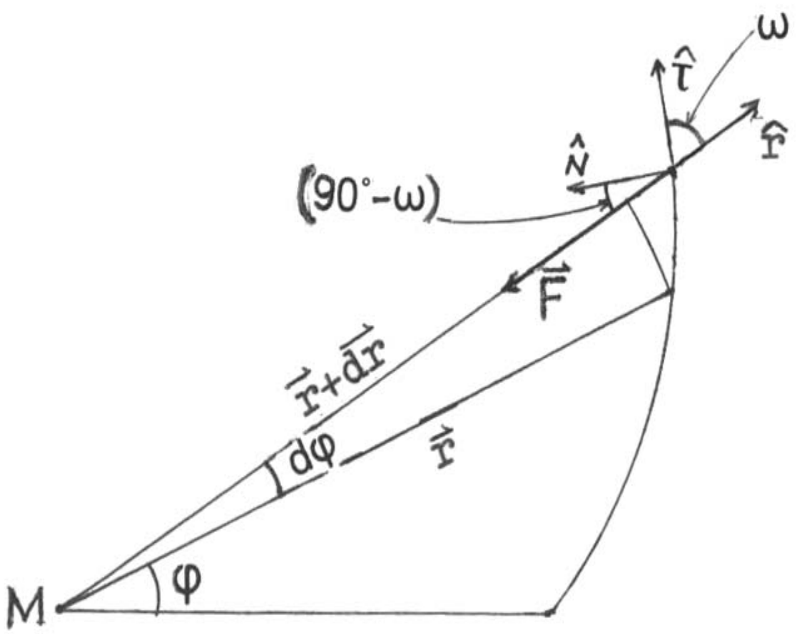


FIG. 9. Propagation of light in Newtonian field

After the constancy of the speed of propagation of light in ether [see B.1.(Part I) and B.2(a).(Part III)], it has been stated that the speed of light inside a spherical gravitational field, created by the central mass M, is a function of the distance r only i.e. $C=C(r)$. That is why the Heron's-Fermat's "*Least – Time Principle*" be applied for the calculation of the bending of light ray in the gravitational field; of course the energy-conservation equation (2.75) is also assumed to be in rule. In present theory, like GRT, Newton's transverse force component seems to be inactive in the case of light propagation, but Newton's tangential component works well to satisfy the energy-conservation equation (2.62).

The work of the gravitation on the photon is:

$$\vec{F}\circ d\vec{s}=(\vec{F}\circ\hat{\tau})ds=-\frac{GM}{r^2}\left(\frac{h\nu}{C^2}\right)\cos\omega ds=-\frac{GM}{r^2}\left(\frac{h\nu}{C^2}\right)dr \qquad (2.85)$$

$$\frac{d\vec{P}_{ph}}{dt}\circ d\vec{s}=\left(\frac{d\vec{P}_{ph}}{dt}\circ\hat{\tau}\right)ds=\frac{d}{dr}\left(\frac{h\nu}{C}\right)C\cos\omega ds=d\left(\frac{h\nu}{C}\right)C=d(h\nu)-(h\nu)\frac{dC}{C} \qquad (2.86)$$

From the relation (2.76) we get:

$$\frac{dC}{C}=\frac{2GM}{r^2C^2}dr$$

and the (2.86) becomes

$$\frac{d\vec{P}_{ph}}{dt}\circ d\vec{s}=d(h\nu)-\frac{2GM}{r^2}\left(\frac{h\nu}{C^2}\right)dr \qquad (2.87)$$

Equating the second members of the relations (2.87) and (2.85) we get the Energy Conservation equation for the photon (2.75).

Substituting now the function $C(r)$, from relation (2.77) into the relation of the energy (2.75) we get:

$$\frac{d(h\nu)}{(h\nu)}=\frac{\alpha dr}{r(r-4\alpha)} \qquad \text{(where } \alpha\equiv GM/C_\infty^2\text{)} \qquad (2.88)$$

We assume here the Eddington's [22] concept which states that the action of the gravitational field does not affect at all the frequency (ν) of the propagating wave-train of light: *"..the 'first' wave-crest of light needs a time interval δt to propagate from point A to B, the 'second' wave-crest needs the same time interval too to cover the same distance i.e. the wave-crests arrive at the same rate as they emitted".* {Of course this Eddington's concept also express the steady-state of the space where any kind of wave-trains are propagated; otherwise an 'evacuation' or an 'infinite condensation' of the space with the wave-crests should take place}

We accept thus $\nu=$ constant; the (2.88) and (2.75) give:

$$\frac{dh}{h}=\frac{\alpha dr}{r(r-4\alpha)}=\frac{GM}{r^2C^2}dr \qquad (2.89)$$

By integration we get the function $h(r)$ of Planck's constant:

$$h_r=h(r)=h_\infty\left[1-\frac{4\alpha}{r}\right]^{\frac{1}{4}} \qquad (2.90)$$

The local value $h(r)$ of Planck's constant increases [up to the limiting value $h(\infty)$] as r increases to infinite.

For weak field [$(\alpha/r)<<1$] the relation (2.90) changes into

$$h\approx h_\infty\left[1-\frac{\alpha}{r}\right] \qquad (2.91)$$

3. INTERPLANETARY RADAR-ECHOES TEST

The geometry of the test is well known (Fig. 10) [32, 33], the Sun is at the origin, the Earth has instantaneous rectangular coordinates $(-x_E, D)$ and the Planet has coordinates (x_P, D), D is the distance of the Sun from the straight line connecting Earth and Planet

In this experiment, the real time (t_{real}) for the journey of the radar waves from Earth to the inner planet P (Venus or Mercury) and back, is measured. The classical time (t_{CL}), for the same journey of light, at the well-known terrestrial speed C_T, is calculated. We then find the difference:

$$[\Delta t]_{\text{obs}} = t_{real} - t_{CL} \qquad (2.92).$$

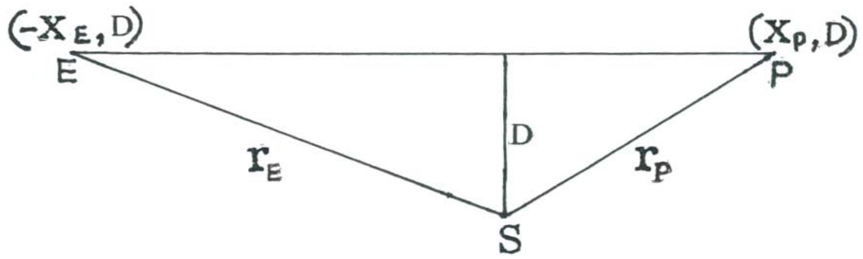


FIG. 10. Shapiro's radar-echoes test

The geometry of the light path to and from the planet is taken here to be a straight line y = D (because the real curving of the light path introduces only a second order effect for correction). Like in Shapiro's initial work, the planet and Earth are taken immovable; (the real motions of the planets and Earth had taken into consideration later).

We follow Shapiro [32, 33] in ignoring the motions of the Earth and the Planet during a single transit. These motions are by no means negligible, but they may be taken into account in a straightforward way when reducing the observational data. We also follow Shapiro [32, 33] in neglecting the departure of the radar path from the straight line y = D. Path curvature is easily seen to produce a contribution to the transit time that is of second order in $\left[\frac{GM_S}{DC^2}\right]^2$ which we neglect since we shall work with first order in $\left[\frac{GM_S}{DC^2}\right]$.

For the theoretical calculation of $[\Delta t]$ in the relation (2.92), we have to use formula (2.77) for the speed of light in a spherical ($M_S >> m$) gravitational field. The effect of gravity on the speed of light i.e. the term of (2.77) that contains r has dimensions of 'potential' and thus one expect some kind of additivity of the effects owed in the presence of two or more masses; but because of the smallness of the masses of the Earth and Planets relative to the mass M_S of Sun we have to calculate the time through the integral:

$$(t)_{th.} = \int_{-x_E}^{x_P} \frac{2dx}{C_\infty\left[1-\frac{4\alpha_S}{r}\right]^{\frac{1}{2}}} \approx \frac{2(x_P+x_E)}{C_\infty} + \frac{4\alpha_S}{C_\infty}\int_{-x_E}^{x_P}\frac{dx}{\sqrt{D^2+x^2}} \qquad (2.93)$$

For the calculation of the Terrestrial speed of light C_T we have to take in mind the potential of the Sun in the vicinity of the Earth and the potential of the Earth itself on its surface:

$$C_T \approx C_\infty\left[1-\frac{2\alpha_S}{r_E}-\frac{2\alpha_S}{332000R_E}\right] = C_\infty\left[1-2{,}1(10^{-8})\right] \qquad (2.94)$$

Where R_E = 6360 km is Earth's radius and $r_E \approx 1.5$ (10^8 km) the distance Earth-Sun, and $\alpha_S \equiv \frac{GM_S}{C_\infty^2} \approx 1.47$ km, The mass of Earth is the 1/332000 of the mass of Sun. Thus, in (2.94) we express the best known value of the speed of light (in vacuum), used on Earth, in terms of C_∞ and the vise versa. Thus the classical time t_{CL} is

$$(t_{CL}) = \frac{2(x_P+x_E)}{C_T} \approx \frac{2(x_P+x_E)}{C_\infty}\left[1+2{,}1(10^{-8})\right] \qquad (2.95)$$

Subtracting in members relation (2.95) from (2.93) we can give the theoretical calculation of the delay of the radar echo.

$$[\Delta t]_{th} = \frac{4\alpha_S}{C_\infty}\ln\left[\frac{x_P+\sqrt{D^2+x_P^2}}{-x_E+\sqrt{D^2+x_E^2}}\right] - 4{,}2(10^{-8})\frac{(x_P+x_E)}{C_\infty} \qquad (2.96)$$

Assuming circular and coplanar, with ecliptic, planetary orbits we can take for Earth: $r_E \equiv 1$AU = 150 (10^6 km), $r_V \approx 0.72$ AU = 108 (10^6 km) for Venus and $r_M \approx 0.37$ AU = 55 (10^6 km) for the Mercury; additionally by taking $D = R_{Sun} \approx$ 695700 km (= Sun's radius) and approximately $C_\infty = 3$ (10^5 km/s), we get from (2.96) the time differences:

$[\Delta t_V]_{Theor} =$ 195 μsec for Venus, and $[\Delta t_M]_{Theor} = 190$ μsec for Mercury.

These theoretical predictions are in best agreement to Shapiro's [33] measurements.

4. THE MEANING OF THE 'POTENTIAL ENERGY', REST-ENERGY OF A SMALL MASS IN A SPHERICAL GRAVITATIONAL FIELD.

The relation (2.62) expresses the conservation of the energy, for the material mass m inside the gravitational field; it reads:

$$\frac{GMm}{r^2}dr = d(mC^2) \qquad (2.97)$$

The first member of this relation gives the increase of the so called 'potential energy' of mass m inside the gravitational field and the relation (2.97) reveals that this increase of the mysterious 'potential energy' is wholly enclosed in the mass m increasing its energy content $[mC^2]$ by an amount equal to $d(mC^2)$

It has been proved in [B.1(c), (Part II)] that the moving mass $m_{\upsilon,r}$ and the mass at rest $m_{o,r}$, of a small body at distance r from the central attracting mass are related by the law (2.12):

$$m_{\upsilon,r} = \frac{m_{o,r}}{\sqrt{1-\frac{\upsilon^2}{C_r^2}}}$$

here $C_r = C(r)$ is the local speed of light. In this paragraph the subscriptions (υ, r) have been omitted for simplicity; thus by m we mean $m_{\upsilon,r}$, by m_o we mean $m_{o,r}$ and by C we mean the local speed $C(r)$ of light.

We can, thus, rewrite the relation (2.97):

$$\frac{GM}{r^2}\frac{m_o}{\sqrt{1-\frac{\upsilon^2}{C^2}}}dr = d\left(\frac{m_oC^2}{\sqrt{1-\frac{\upsilon^2}{C^2}}}\right) \qquad (2.98)$$

and after some algebra:

$$\frac{GM}{r^2C^2}dr = \frac{d(m_oC^2)}{m_oC^2} + \left[\frac{d(\upsilon^2)}{2C^2} - \frac{\upsilon^2}{C^2}\frac{d(C^2)}{2C^2}\right]\cdot\left[1-\frac{\upsilon^2}{C^2}\right]^{-1} \qquad (2.99)$$

The term $\dfrac{d(m_oC)}{(m_oC)}$ is independent of the velocity υ of the body and thus it can be determined from (2.99) by putting $\upsilon \to 0$, we then get:

$$\left[\frac{GM}{r^2C^2}dr = \frac{d(m_oC^2)}{(m_oC^2)} + \frac{d(\upsilon^2)}{2C^2}\right]_{\upsilon\to 0}$$

But for $\upsilon \to 0$ the Newtonian laws (2.59) and (2.60), give the well known expression:

$$\left[\frac{GM}{r^2}dr = -\frac{d(\upsilon^2)}{2}\right]_{\upsilon\to 0}$$

From the two last relations we get for the rest-energy:

$$\frac{d(m_oC^2)}{(m_oC^2)} = \frac{2GM}{r^2C^2}dr \qquad (2.100)$$

By following now the opposite procedure we can arrive at a known conclusion; thus by substitution of (2.100) into (2.99) we get:

$$-\left[1-\frac{\upsilon^2}{C^2}\right]\frac{GM}{r^2}dr = \frac{d(\upsilon^2)}{2} - \upsilon^2\frac{d[C^2]}{2C^2} \qquad (2.101)$$

From the conservation of the angular momentum we have: $\dot{\varphi} = \dfrac{\Re}{mr^2}$ and the velocity square becomes $\upsilon^2 = \left[\left(\dfrac{dr}{d\varphi}\right)^2 + r^2\right]\dot{\varphi}^2 = \left[\left(\dfrac{dr}{d\varphi}\right)^2 + r^2\right]\dfrac{\Re^2}{m^2r^4}$

and $$\frac{d(\upsilon^2)}{2dr} = \left[\frac{d^2r}{d\varphi^2} + r\right]\frac{\Re^2}{m^2r^4} - \frac{\Re^2}{m^2}\left[\left(\frac{dr}{d\varphi}\right)^2 + r^2\right]\cdot\left[\frac{dm}{mdr}\frac{1}{r^4} + \frac{2}{r^5}\right]$$

on the other hand the (2.76) gives

$$\frac{dC^2}{C^2dr} = \frac{4GM}{r^2C^2}$$

by which the (2.70) is changed into

$$\frac{dm}{mdr} = -\frac{3GM}{r^2C^2} \qquad (2.102)$$

Substituting the υ^2, $d(\upsilon^2)/2dr$, m/mdr and $d[C^2]/C^2dr$ in relation (2.101), we finally get the relation (2.69).

5. PLANETARY PERIHELIA ADVANCES

The equation (2.69) gives the planetary trajectories around Sun ($M >> m$).

The transformation $r = 1/u$, makes the equation (2.69) to be transformed into:

$$\frac{d^2u}{d\varphi^2} + u = \frac{GM}{\Re^2}m^2 \qquad (2.103)$$

$\Re$ is the angular momentum constant and m is the mass of the planet. The mass m changes, as planet moves in the field of Sun, according the relation (2.102) which by (2.77) becomes:

$$\frac{dm}{m} = -\frac{3GM}{r^2C^2}dr = -\frac{3\alpha}{r(r-4\alpha)}dr \tag{2.104}$$

Integrating (2.104) we get for the mass square (m^2):

$$m^2 = K^2\left(1-\frac{4\alpha}{r}\right)^{-\frac{3}{2}} \tag{2.105}$$

K is the integration constant. Developing in powers of (α/r) and omitting the powers higher than first, we have:

$$m^2 \approx K^2\left(1+\frac{6\alpha}{r}\right) = K^2(1+6\alpha u) \tag{2.106}$$

Let us try to relate the integration constant square (K^2) with the mean square of mass $\langle m^2 \rangle$ of the planet, calculated through the angle φ (from 0 to 2π rads) and for simplicity (and with insignificant error) along the classical Keplerian planetary ellipse:

$$\langle m^2 \rangle = \frac{1}{2\pi}\int_0^{2\pi} m^2 d\varphi \approx K^2\left(1+\frac{6\alpha}{2\pi}\int_0^{2\pi} u d\varphi\right) \tag{2.107}$$

but the classical Keplerian orbit has the equation:

$$u = \frac{1}{r} = \frac{1}{P}(1+\varepsilon\cos\varphi)$$

ε is the eccentricity of the Keplerian ellipse and P its parameter:

$$\frac{1}{\mathrm{P}} = \frac{GM}{\Re^2}\langle m^2 \rangle$$

Substituting u and ($1/P$) into the relation (2.107) we get:

$$\langle m^2 \rangle \approx K^2\left(1+6\alpha\frac{GM}{\Re^2}\langle m^2 \rangle\right) \tag{2.108}$$

Eliminating K^2 between relations (2.108) and (2.106) and omitting the powers of (au) and (a/P) higher than the first we have:

$$m^2 \approx \langle m^2 \rangle\left[1+6\alpha\left(u-\frac{GM}{\Re^2}\langle m^2 \rangle\right)\right] \tag{2.109}$$

Substituting m^2 from (2.109) into differential equation (2.103) it takes the following form (from which the powers of αu or α / P higher than first have been omitted)

$$\frac{d^2u}{d\varphi^2}+\left(u-\frac{GM}{\Re^2}\left\langle m^2\right\rangle\right)\left(1-6\alpha\frac{GM}{\Re^2}\left\langle m^2\right\rangle\right)=0 \qquad (2.110)$$

The equation (2.110) has the solution

$$u=\frac{GM}{\Re^2}\left\langle m^2\right\rangle+\Sigma\cdot\cos(\psi-\psi_o) \qquad (2.111)$$

Σ is the constant of integration and the angle ψ:

$$\psi\equiv\varphi\sqrt{1-6\alpha\frac{GM}{\Re^2}\left\langle m^2\right\rangle}=\varphi\sqrt{1-\frac{6\alpha}{P}} \qquad (2.112)$$

(ψ_o is the value of ψ at $t=0$). It is clear that between two consecutive arrivals of the planet at its closest position to the Sun, ψ must change by 2π, and in order for this to happen, the angle φ must changed by

$$\Delta\varphi=\frac{2\pi}{\sqrt{1-\frac{6\alpha}{P}}}\approx 2\pi\left(1+\frac{3\alpha}{P}\right)$$

i.e. the perihelion revolves in the sense of the revolution of the planet at a rate:

$$\Delta\varphi-2\pi\approx 6\pi\frac{\alpha}{\mathrm{P}} \quad \text{(rads per planetary period)} \qquad (2.113\text{-a})$$

The relation (2.113) is identical with the known from GRT.

It must be pointed here that above result (2.113) does not alter at all if the mean square of mass $\left\langle m^2\right\rangle$ be calculated through other quantities (such as the distance r, or the time t) along the classical Keplerian ellipse:

$$\left\langle m^2\right\rangle=\frac{1}{r_{\mathrm{A}}-r_P}\int_{r_P}^{r_{\mathrm{A}}}m^2dr \quad \text{or} \quad \left\langle m^2\right\rangle=\frac{1}{T}\int_o^T m^2dt$$

$r_A=P/(1-\varepsilon)=$ (the distance of the aphelion from Sun) and $r_P=P/(1+\varepsilon)=$ (the distance of perihelion from Sun) and T is the period of planetary rotation about Sun.

6. BINARY-STAR PERICENTER ADVANCES

Let two stars of masses m_1 and m_2, being at a distance r the one from the other, are revolving around their common center of mass at the corresponding distances r_1 and r_2, it is clear ($r_1 + r_2 = r$), we also have:

$$r_1 \cdot m_1 = r_2 \cdot m_2 \ , \qquad r_1 = r \cdot \frac{m_2}{(m_1 + m_2)}, \qquad r_2 = r \cdot \frac{m_1}{(m_1 + m_2)} \qquad (1)$$

and

$$r_1 \cdot m_1 = r_2 \cdot m_2 = \mu \cdot r \quad \text{where} \quad \mu = \frac{m_1 \cdot m_2}{(m_1 + m_2)} \ (\text{'}\textit{reduced mass}\text{'}) \quad (2)$$

We will describe the Newtonian motion of the body-1 (and also of body-2) around the common center of mass. Since the gravitational fields are conservative it means that the momentary masses m_1 and m_2 are depended from their distances from the center of mass only, we have for body-1:

$$-\frac{G \cdot m_2 \cdot m_1}{r^2} \cdot \hat{r} = \frac{d(m_1 \cdot \dot{\vec{r}}_1)}{dt} = \frac{dm_1}{dt} \cdot \dot{\vec{r}}_1 + m_1 \cdot \frac{d\dot{\vec{r}}_1}{dt} = \frac{dm_1}{dr_1} \dot{r}_1 \cdot \dot{\vec{r}}_1 + m_1 \cdot \frac{d\dot{\vec{r}}_1}{dt} \quad (3)$$

Now we have $\vec{r}_1 \equiv r_1 \cdot \hat{r}$ and since $\dot{\hat{r}} \equiv \dot{\varphi} \cdot \hat{\varphi}$, $\dot{\hat{\varphi}} \equiv -\dot{\varphi} \cdot \hat{r}$ ($\hat{r}, \hat{\varphi}$ are unit vectors –Fig. 8- of essay) the velocity vector of body-1 is written as:

$$\dot{\vec{r}}_1 = \dot{r}_1 \cdot \hat{r} + r_1 \cdot \dot{\varphi} \cdot \hat{\varphi} \qquad (4)$$

it gives by differentiation:

$$\frac{d(\dot{\vec{r}}_1)}{dt} = (\ddot{r}_1 - r_1 \cdot \dot{\varphi}^2) \cdot \hat{r} + (2 \cdot \dot{r}_1 \cdot \dot{\varphi} + r_1 \cdot \ddot{\varphi}) \cdot \hat{\varphi} \qquad (5)$$

Inserting (3),(4) into (5) we get the vector equation for body-1:

$$-\frac{G \cdot m_2 \cdot m_1}{r^2} \cdot \hat{r} = \left[\frac{dm_1}{dr_1} \cdot \dot{r}_1^{\,2} + m_1 \cdot (\ddot{r} - r_1 \cdot \dot{\varphi}^2) \right] \cdot \hat{r} + \left(\frac{dm_1}{dt} \cdot r_1 \cdot \dot{\varphi} + 2m_1 \cdot \dot{r}_1 \cdot \dot{\varphi} + m_1 r_1 \cdot \ddot{\varphi} \right) \cdot \hat{\varphi}$$

From above relation we get the well known relations:

$$-\frac{G \cdot m_2 \cdot m_1}{r^2} = \frac{dm_1}{dr_1} \cdot \dot{r}_1^{\,2} + m_1 \cdot (\ddot{r} - r_1 \cdot \dot{\varphi}^2) \qquad (6)$$

$$\frac{dm_1}{dt} \cdot r_1 \cdot \dot{\varphi} + 2m_1 \cdot \dot{r}_1 \cdot \dot{\varphi} + m_1 r_1 \cdot \ddot{\varphi} = \frac{1}{r_1} \cdot \frac{d}{dt}\left(m_1 \cdot r_1^{\,2} \cdot \dot{\varphi} \right) = 0 \qquad (7)$$

From (7) we conclude:

$$m_1 \cdot r_1^{\,2} \cdot \dot{\varphi} \equiv M_1 (body-1..angular..momentum - cons\tan t-) \qquad (8)$$

From (8) we get :

$$\dot{\varphi} = \frac{M_1}{m_1 \cdot r_1^{\,2}} \qquad (9)$$

$$\dot{r}_1 = \frac{dr_1}{d\varphi} \cdot \frac{M_1}{m_1 \cdot r_1^{\,2}} \qquad (10)$$

and

$$\ddot{r}_1 = \frac{d^2 r_1}{d\varphi^2} \cdot \frac{1}{r_1^{\,4}} \cdot \left(\frac{M_1}{m_1} \right)^2 - \left(\frac{dr_1}{dt} \right)^2 \cdot \frac{2}{r_1^{\,5}} \cdot \left(\frac{M_1}{m_1} \right)^2 - \frac{dm_1}{m_1 \cdot dr_1} \cdot \frac{1}{r_1^{\,4}} \cdot \left(\frac{dr}{d\varphi} \right)^2 \cdot \left(\frac{M_1}{m_1} \right)^2 \quad (11)$$

Substituting (9), (10), and (11) into (6) relation we get:

$$-\frac{G\cdot m_2}{r^2}=\frac{d^2 r_1}{d\varphi^2}\cdot\frac{1}{r_1^{\ 4}}\cdot\left(\frac{M_1}{m_1}\right)^2-\left(\frac{dr_1}{dt}\right)^2\cdot\frac{2}{r_1^{\ 5}}\cdot\left(\frac{M_1}{m_1}\right)^2-\frac{1}{r_1^{\ 3}}\cdot\left(\frac{M_1}{m_1}\right)^2 \qquad (12)$$

Now we can do the well known transformation:

$r_1=\dfrac{1}{u_1}$ then we have $\dfrac{dr_1}{d\varphi}=-\dfrac{1}{u_1^2}\cdot\dfrac{du_1}{d\varphi}$ and $\dfrac{d^2 r_1}{d\varphi^2}=-\dfrac{1}{u_1^2}\cdot\dfrac{d^2 u_1}{d\varphi^2}+\dfrac{2}{u_1^3}\cdot\left(\dfrac{du_1}{d\varphi}\right)^2$

The last transformation relations make (12) to receive the form:

$$\frac{G\cdot m_2}{r^2}=\frac{d^2 u_1}{d\varphi^2}\cdot u_1^2\cdot\left(\frac{M_1}{m_1}\right)^2+u_1^3\cdot\left(\frac{M_1}{m_1}\right)^2$$

Which can retransformed back into the

$$\frac{G\cdot m_2}{r^2}=\frac{d^2\left(\frac{1}{r_1}\right)}{d\varphi^2}\cdot\left(\frac{M_1}{m_1\cdot r_1}\right)^2+\left(\frac{1}{r_1}\right)\cdot\left(\frac{M_1}{m_1\cdot r_1}\right)^2$$

after the relations (2) the last relation becomes:

$$G\cdot m_2=\frac{d^2\left(\frac{1}{r_1}\right)}{d\varphi^2}\cdot\frac{M_1^2}{\mu^2}+\left(\frac{1}{r_1}\right)\cdot\frac{M_1^2}{\mu^2} \qquad (13)$$

Now the corresponding –to (13)- relation for the body-2 (orbiting around the common center of mass) takes the form

$$G\cdot m_1=\frac{d^2\left(\frac{1}{r_2}\right)}{d\varphi^2}\cdot\frac{M_2^2}{\mu^2}+\left(\frac{1}{r_2}\right)\cdot\frac{M_2^2}{\mu^2} \qquad (14)$$

Where

$$m_2\cdot r_2^{\ 2}\cdot\dot{\varphi}\equiv M_2(body-2..angular..momentum-cons\tan t-) \qquad (15)$$

By adding in members (13) and (14) we get

$$G\cdot(m_1+m_2)=\frac{d^2\left(\frac{1}{r_1}\right)}{d\varphi^2}\cdot\frac{M_1^{\ 2}}{\mu^2}+\frac{d^2\left(\frac{1}{r_2}\right)}{d\varphi^2}\cdot\frac{M_2^{\ 2}}{\mu^2}+\left(\frac{1}{r_1}\right)\cdot\frac{M_1^{\ 2}}{\mu^2}+\left(\frac{1}{r_2}\right)\cdot\frac{M_2^{\ 2}}{\mu^2} \qquad (16)$$

By taking in mind (1)-(2) relations and that total angular momentum M is the sum of the two partial angular moments $M=M_1+M_2$ we get:

$$M=M_1+M_2=(m_1\cdot r_1^2+m_2\cdot r_2^2)\cdot\dot{\varphi}=\left(\mu\cdot r\cdot(r_1+r_2)\right)\cdot\dot{\varphi}=\mu\cdot r^2\cdot\dot{\varphi}$$

Then equation (16) offers finally the relative orbit of the two masses m_1 and m_2, it takes finally the form:

$$\frac{d^2\left(\frac{1}{r}\right)}{d\varphi^2}+\left(\frac{1}{r}\right)=\frac{G}{M^2}\cdot\frac{(m_1\cdot m_2)^2}{(m_1+m_2)} \qquad (17)$$

Since below we will assume the masses as being slightly variables (depending from *r*), and since the relative orbit of the two masses is also ellipse for this reason, the above relative ellipse it has a parameter P:

$$\frac{1}{\mathrm{P}} \equiv \left(\frac{G}{M^2} \right) \cdot \frac{(<m_1> \cdot <m_2>)^2}{(<m_1> + <m_2>)} \qquad (18)$$

Where P the parameter of the relative elliptic orbit $P = a \cdot (1-\varepsilon^2)$, α *the maximum semi axis* of the relative orbit, ε the eccentricity and the <*m*> s are to denote the mean values of rotating *masses* along the relative orbit.

Now because of the nature of Newtonian gravity to depend from the (mutual product of the two masses m_1 and m_2) we have to write down the "complementary" equation of the "Conservation of the Energy" for the gravitational field of the two masses in two symmetric ways:

$$-\frac{G \cdot m_2(attracting.mass)}{r^2} \cdot m_1(attracted) \cdot dr + d(m_1 \cdot C_1^2) + \Delta W_1 = 0 \qquad (19)$$

$$. -\frac{G \cdot m_1(attracting.mass)}{r^2} \cdot m_2(attracted) \cdot dr + d(m_2 \cdot C_2^2) + \Delta W_2 = 0 \qquad (20)$$

The quantities ΔW_1 and ΔW_2 don't correspond necessarily to any "radiation of gravity" (we don't know if such a "radiation" is produced at all), but we are sure that ether can inserted in the rotating system, (along the axis passing through the center of mass, -from the "North" and "South" poles of the axis-, of the rotating system and be finally centrifuged). The incoming fluid ether initially must flows around the limits of rotating Roche lobes and then it must be mixed with the resting ether being in the further wide space. This centrifuging of the fluid ether can be the cause for a perennial loss of the kinetic energy of the rotating system (i.e. the slight increase of the period of rotation of the system)

In the equations (19) and (20) the quantity C_1 is the speed of light in the position of mass-1, due of the presence of mass-2 (at the distance r), and similarly the quantity C_2 is the speed of light in the position of mass-2, due of the presence of mass-1 (at the distance r).

Putting for moment $\Delta W_1 = 0$ and $\Delta W_2 = 0$ the (19) and (20) take the forms:

$$\frac{G \cdot m_2}{r^2} = \frac{dm_1}{m_1 \cdot dr} \cdot C_1^2 + \frac{dC_1^2}{dr} \quad \text{and} \quad \frac{G \cdot m_1}{r^2} = \frac{dm_2}{m_2 \cdot dr} \cdot C_2^2 + \frac{dC_2^2}{dr}$$

$$\text{where} \quad \frac{dC_1^2}{dr} = \frac{4G \cdot m_2}{r^2} \quad \text{and} \quad C_1^2 = C_\infty^2 \cdot \left[1 - \frac{4 \cdot G \cdot m_2}{r \cdot C_\infty^2} \right]$$

and

$$\text{where} \quad \frac{dC_2^2}{dr} = \frac{4G \cdot m_1}{r^2} \quad \text{and} \quad C_2^2 = C_\infty^2 \cdot \left[1 - \frac{4 \cdot G \cdot m_1}{r \cdot C_\infty^2} \right]$$

and

where C_∞^2 is the speed of light in ether in absence of gravity (being either at infinite distance from masses or at the limits of Roche lobes).

From the above relations we receive the relations:

$$\frac{dm_1}{m_1}=\frac{-3\cdot G\cdot m_2\cdot dr}{r\cdot C_\infty^2\cdot\left[r-\dfrac{4\cdot G\cdot m_2}{C_\infty^2}\right]}=\frac{-3\cdot\beta_2}{r\cdot[r-4\cdot\beta_2]}\cdot dr \quad \text{where} \quad \beta_2\equiv\frac{G\cdot m_2}{C_\infty^2}$$

and

$$\frac{dm_2}{m_2}=\frac{-3\cdot G\cdot m_1\cdot dr}{r\cdot C_\infty^2\cdot\left[r-\dfrac{4\cdot G\cdot m_1}{C_\infty^2}\right]}=\frac{-3\cdot\beta_1}{r\cdot[r-4\cdot\beta_1]}\cdot dr \quad \text{where} \quad \beta_1\equiv\frac{G\cdot m_1}{C_\infty^2}$$

From above we receive respectively by integration:

$$\frac{m_{1,\infty}}{m_1}=\left[\frac{1}{1-\dfrac{4\cdot\beta_2}{r}}\right]^{-\frac{3}{4}}\approx\frac{1}{1+\dfrac{3\cdot\beta_2}{r}} \quad \text{and} \quad \frac{m_{2,\infty}}{m_2}=\left[\frac{1}{1-\dfrac{4\cdot\beta_1}{r}}\right]^{-\frac{3}{4}}\approx\frac{1}{1+\dfrac{3\cdot\beta_1}{r}}$$

These equations give respectively

$$m_1\approx m_{1,\infty}\cdot\left(1+\frac{3\cdot\beta_2}{r}\right) \quad \text{and} \quad m_2\approx m_{2,\infty}\cdot\left(1+\frac{3\cdot\beta_1}{r}\right) \qquad (21)$$

Evidently, the mean values of the two masses m_1 and m_2 along the relative ellipse, are given respectively by:

$$<m_1>.\approx m_{1,\infty}\cdot\left(1+\frac{3\cdot\beta_2}{P}\right) \quad \text{and} \quad <m_2>.\approx m_{2,\infty}\cdot\left(1+\frac{3\cdot\beta_1}{P}\right) \qquad (22)$$

Now by eliminating the masses $m_{1,\infty}$ and $m_{2,\infty}$ between the corresponding pairs of equations (21) and (22) we do find finally:

$$m_1\approx.<m_1>\cdot\left[1+3\beta_2\left(\frac{1}{r}-\frac{1}{\mathrm{P}}\right)\right] \quad \text{and} \quad m_2\approx.<m_2>\cdot\left[1+3\beta_1\left(\frac{1}{r}-\frac{1}{\mathrm{P}}\right)\right] \qquad (23)$$

Replacing the masses m_1 and m_2 from (23) into the product $(m_1\cdot m_2)^2$ we get

$$(m_1\cdot m_2)^2\approx(<m_1><m_2>)^2+(<m_1><m_2>)^2\cdot\left[6\cdot(\beta_2+\beta_1)\cdot\left(\frac{1}{r}-\frac{1}{\mathrm{P}}\right)\right] \qquad (24)$$

while replacing the masses from (23) into the sum (m_1+m_2) we should get

$$m_1+m_2=(<m_1>+<m_2>)\left[1+\frac{<m_1>\cdot3\beta_2\cdot\left(\frac{1}{r}-\frac{1}{\mathrm{P}}\right)}{(<m_1>+<m_2>)}+\frac{<m_2>\cdot3\beta_1\cdot\left(\frac{1}{r}-\frac{1}{\mathrm{P}}\right)}{(<m_1>+<m_2>)}\right] \qquad (25)$$

Now by replacing (24) and (25) into the 2nd part of (17) and after (18) we get for the 2nd member of the relation (17):

$$\frac{G}{M^2}\frac{(m_1\cdot m_2)^2}{(m_1+m_2)}\approx\left[\frac{1}{\mathrm{P}}+\frac{6\cdot(\beta_2+\beta_1)\cdot\left(\frac{1}{r}-\frac{1}{\mathrm{P}}\right)}{\mathrm{P}}\right]\cdot\left[1-\frac{<m_1>\cdot3\beta_2\cdot\left(\frac{1}{r}-\frac{1}{\mathrm{P}}\right)}{(<m_1>+<m_2>)}-\frac{<m_2>\cdot3\beta_1\cdot\left(\frac{1}{r}-\frac{1}{\mathrm{P}}\right)}{(<m_1>+<m_2>)}\right]$$

A

fter the above we can write down the second member of the relation (17)

$$\frac{d^2\left(\frac{1}{r}\right)}{d\varphi^2}+\left[\left(\frac{1}{r}\right)-\frac{1}{\mathrm{P}}\right]\cdot\left[1-\frac{6G\cdot\left[(<m_2>+<m_1>)-<\mu>\right]}{\mathrm{P}\cdot C_\infty^2}\right]=0 \qquad (26)$$

The solution of the above differential equation is the following

$$\frac{1}{r}=\frac{1}{P}+\aleph\cdot\cos(\psi-\psi_0)$$

where $\aleph$ is the integration constant and the angle ψ:

$$\psi=\sqrt{1-\frac{6G\cdot\left[(<m_2>+<m_1>)-<\mu>\right]}{\mathrm{P}\cdot C_\infty^2}}\cdot\varphi$$

(ψ_0 is the value of ψ at the moment $t=0$)

It is clear that between two consecutive arrivals of the two masses m_1 and m_2 at their closest position ψ must change by 2π and in order for this to be happen the angle φ must changed by

$$\Delta\varphi=\frac{2\pi}{\sqrt{1-\frac{6G\left[(<m_2>+<m_1>)-<\mu>\right]}{\mathrm{P}\cdot C_\infty^2}}}\approx 2\pi\cdot\left(1+\frac{3G\left[(<m_2>+<m_1>)-<\mu>\right]}{\mathrm{P}\cdot C_\infty^2}\right)$$

i.e. the big axis of the relative ellipse revolves in the sense of revolution of the system at a rate:

$$\Delta\varphi-2\pi\approx 6\pi\frac{G\cdot\left[(<m_1>+<m_2>)-<\mu>\right]}{\mathrm{P}\cdot C_\infty^2}\ \text{(rads/period of revolution)} \qquad (2.113\text{-b})$$

This relation (2.113-b) can be applied succefully to Mercury's perihelion advance (of 43 degree seconds per century), as well as to the famous double pulsar PSR 1913+16 where $m_1=1.4$ and $m_2=1.42$ (solar masses), $\alpha=6.5$ light seconds, eccentricity $\varepsilon=0.617127$, and period of revolution of system $T=27907$ seconds. Then the relation (2.113-b) gives

$$\Delta\varphi-2\pi\approx 3.176^0 \text{ degrees per year}$$

Since the PSR 1913+16 system appears a "measured mean advance of 4.226^0 degrees per year" the difference of: 1.05^0 degrees per year have to be owed in the deviations from spherical symmetry of one or two of the masses due either of proximity of members or their fast rotations about their axes

NOTE. The measured reduction of the orbital period of the said double pulsar PSR 1913+16 does not necessarily means the emission of "gravitational waves" but instead it easily can be ascribed to the following phenomenon: "As the ether, -or a dark matter- is attracted by the gravity along the axis of that rapidly rotating binary system, it –the fluid ether-, can be set in motion undergoing *centrifugal motion outwards* while new ether –or dark matter- comes into this centrifuge along the *north* and *south poles* of the axis of rotation of the fast binary system".

G. GRAVITATIONAL RED-SHIFT.

For the emission (or absorption) frequency of an atom, being initially at rest in the ether of the gravitational field, we have to use the relation (2.25) [or (2.41)]; of course we have to attach to these relations the sub indices (r , in order to denote that these emission (or absorption) relations are valid into the gravitational field i.e. at a distance r from the center of attraction. Thus an atom at rest, in the ether of the gravitational field, emits a photon of frequency $[\nu_r]_{em}$:

$$[\nu_r]_{em} = [\nu_{o,r}]_{em}\left(1 - \frac{h_r[\nu_{o,r}]_{em}}{2\cdot[m_{o,r}]_{em}C_r^2}\right) \qquad (2.114)$$

the $[\nu_{o,r}]_{em}$ symbolizes the theoretical frequency which might be emitted from a stationary atom if no-motion of the atom were possible before and after the emission phenomenon, $[m_{o,r}]_{em}C_r^2$ is the rest-energy of the atom before the emission, h_r and C_r, are the local values of Planck's constant and the local speed of light respectively.

Similarly an atom being initially at rest, in the ether of the gravitational field, can absorb a photon of frequency $[\nu_r]_{ab}$:

$$[\nu_r]_{ab} = [\nu_{o,r}]_{ab}\left(1 + \frac{h_r[\nu_{o,r}]_{ab}}{2\cdot[m_{o,r}]_{ab}C_r^2}\right) \qquad (2.115)$$

the $[\nu_{o,r}]_{ab}$ symbolizes the theoretical frequency which might be absorbed if the absorbing atom remains at rest before and after the absorption phenomenon, $[m_{o,r}]_{ab}C_r^2$ is the rest-energy of the atom before the absorption, etc.
Now we can do one evident assumption about the emission frequencies: $[\nu_r]_{em}$, $[\nu_{o,r}]_{em}$ (as well as about the absorption ones: $[\nu_r]_{ab}$, $[\nu_{o,r}]_{ab}$):
Assumption: the gravitation acts in an identical manner or creates the same effect on each member of the above frequency-pairs:

$$[\nu_r]_{em} \leftrightarrow [\nu_{o,r}]_{em} \quad \text{and} \quad [\nu_r]_{ab} \leftrightarrow [\nu_{o,r}]_{ab} \qquad (2.116)$$

The above evident assumption is written mathematically:

$$\left[\frac{\nu_r - \nu_\infty}{\nu_\infty}\right]_{em} = \left[\frac{\nu_{o,r} - \nu_{o,\infty}}{\nu_{o,\infty}}\right]_{em} \qquad (2.117)$$

$$\left[\frac{\nu_r - \nu_\infty}{\nu_\infty}\right]_{ab} = \left[\frac{\nu_{o,r} - \nu_{o,\infty}}{\nu_{o,\infty}}\right]_{ab} \qquad (2.118)$$

From (2.117) and (2.114) we conclude:

$$\frac{d}{dr}\left[\frac{h\nu_o}{m_o C^2}\right]_{em} = 0 \qquad (2.119)$$

Similarly from (2.118) and (2.115), we conclude:

$$\frac{d}{dr}\left[\frac{h\nu_o}{m_o C^2}\right]_{ab} = 0 \qquad (2.120)$$

The relations (2.119) and (2.120) give respectively:

$$\frac{dh}{h} + \left[\frac{d\nu_o}{\nu_o}\right]_{em} = \left[\frac{d(m_o C^2)}{(m_o C^2)}\right]_{em} \qquad (2.121)$$

and

$$\frac{dh}{h} + \left[\frac{d\nu_o}{\nu_o}\right]_{ab} = \left[\frac{d(m_o C^2)}{(m_o C^2)}\right]_{ab} \qquad (2.122)$$

Substituting now the relations (2.89) and (2.100) into each one of the (2.121) and (2.122), we get:

$$\left[\frac{d\nu_o}{\nu_o}\right]_{em} = \left[\frac{d\nu_o}{\nu_o}\right]_{ab} = \frac{GM}{r^2 C^2}dr \qquad (2.123)$$

But from (2.117) and (2.118) we get respectively:

$$\left[\frac{d\nu}{\nu}\right]_{em} = \left[\frac{d\nu_o}{\nu_o}\right]_{em} \qquad \text{and} \qquad \left[\frac{d\nu}{\nu}\right]_{ab} = \left[\frac{d\nu_o}{\nu_o}\right]_{ab}$$

Substituting these last relations into (2.123) give the differential equation of the effect of gravitation on the emitted or absorbed frequencies:

$$\left[\frac{d\nu}{\nu}\right]_{em} = \left[\frac{d\nu}{\nu}\right]_{ab} = \frac{GM}{r^2 C^2}dr = \frac{\alpha}{r^2\left[1-\frac{4\alpha}{r}\right]}dr \qquad (2.124)$$

[The last relation is a consequence of the relation (2.77)]. The relation (2.124) describes the effect of the gravitational field on the spectral lines [and of course it does not be referred to any change in the traveling frequency of the propagated photon]. Integrating the relation (2.124) we have

$$\int_{\nu(r)}^{\nu(\infty)}\left[\frac{d\nu}{\nu}\right]_{em} = \int_{\nu(r)}^{\nu(\infty)}\left[\frac{d\nu}{\nu}\right]_{ab} = \int_{r}^{\infty}\frac{\alpha dr}{r^2\left[1-\frac{4\alpha}{r}\right]}$$

and finally:

$$\left[\frac{\nu(r)}{\nu(\infty)}\right]_{em}=\left[\frac{\nu(r)}{\nu(\infty)}\right]_{ab}=\left[1-\frac{4\alpha}{r}\right]^{\frac{1}{4}} \qquad (2.125)$$

and since ordinarily is $(a << r)$ the relation (2.125) becomes more simple (2.126):

$$\left[\frac{\nu(r)}{\nu(\infty)}\right]_{em}=\left[\frac{\nu(r)}{\nu(\infty)}\right]_{ab}\approx 1-\frac{a}{r} \qquad (2.126)$$

It has been proved that the frequency $\nu(r)$ of a spectral line emitted (or absorbed) by atoms at a distance r from the center of gravitation is smaller than the frequency $\nu(\infty)$ of the same spectral line emitted (or absorbed) at infinite distance; these frequencies are propagated unchanged through the gravitational field and thus the relative gravitational red-shifts (or the relative blue-shifts) are observed: (i) In the case of a radio-astronomical frequency measurement the arriving (at Earth) frequency is the $\nu(r)$ (if, of course, any Doppler and distance effect have taken into account) and be compared directly to our own terrestrial one, which is the $\nu(\infty)$ for the radiating object and (ii) In the case of a spectral analysis based in separation by wavelengths, (as it happens with the Grating-Interference- Spectroscopy), the arriving frequency $\nu(r)$ is measured through its observed wavelength (on Earth): $\lambda_{obs}(r)=\frac{C_{Earth}}{\nu(r)}$ and be compared with the corresponding spectral-line-wavelength produced on the Earth ie $\lambda_{Earth}\equiv\lambda(\infty)=\frac{C_{Earth}}{\nu_{Earth}}=\frac{C_{Earth}}{\nu(\infty)}$ and in this case we have again a gravitational red-shift; the gravitational z is defined by the relation:

$$z\equiv\frac{\lambda_{obs}}{\lambda_{Earth}}-1=\frac{\nu(\infty)}{\nu(r)}-1\approx\frac{\alpha}{r} \qquad (2.127)$$

In order to study the effects due to the gravitation of the Earth, we can apply twice the relation (2.126), first for the surface of the Earth ($r=R$= Earth's radius) and second for a height H above Earth's surface ie $r=R+\text{H},..(\text{H}<<R)$:

$$\frac{\nu_{(R+H)}}{\nu_{(R)}}\approx\frac{1-\frac{\alpha_{Earth}}{R+H}}{1-\frac{\alpha_{Earth}}{R}}\approx 1+\frac{gH}{C_{\infty}^{2}} \qquad (2.128)$$

$\alpha_{Earth}\equiv\frac{GM_{Earth}}{C_{\infty}^{2}}$ and $g=\frac{GM_{Earth}}{R^{2}}$ (the acceleration of gravity on Earth's surface). The time-rate of the atomic clocks (of Cs-beam) is proportional to the absorbed frequency –

of-the-electronically-generated-resonant oscillation-; the time indications of two identical atomic clocks being stationary at the heights $r = R$ and $r = R + H$, obey the relation:

$$\frac{t_{(R+H)} - t_{(R)}}{t_{(R)}} = \frac{\nu_{(R+H)} - \nu_{(R)}}{\nu_{(R)}} \approx \frac{gH}{C^2} \qquad (2.129)$$

III. VERIFICATION OF STOKES' (1845) 'TERRESTRIAL LUMINIFEROUS ETHER' FROM EXPERIMENTS. ASTRONOMICAL AND COSMIC CONSEQUENCES OF THE GRAVITATIONALLY - BOUND ETHER; NON-EXPANDING UNIVERSE.

A. THEORY DICTATES: NON-EMPTY 'VACUUM' SPACE

It is generally believed by past and present generations of physicists that physical free vacuum space is not simply an empty space; instead it is full of "something", since it has been endowed with some complex and very specific properties, such as: (i) to carry or propagate, the gravitational force (Newton), (ii) to create the appearance of the inertia (Newton's *absolute space*), (iii). to carry and propagate the light-wave (Huygens' - Fresnel's *luminiferous ether*), (iv) to carry and propagate the E/M-wave (Maxwell's *E/M-medium*), (v) to complete some of the 'missing', 'invisible-dark' mass of the galaxies (present-day Astronomy), (vi) to offer the base for various properties under the general label 'vacuum state', which Quantum Field Theories and the related Elementary Particle Physics, need, (vii) to obey a "fractal-like" model for the organization or appearance of the 'matter' etc.

B. GENERAL PROPERTIES OF THE LUMINIFEROUS ETHER

1. DEFINITION OF LUMINIFEROUS ETHER

The main aim of this Part –III- is to explore the properties of the non-empty 'vacuum' at the level of the propagation of light. The 'luminiferous ether' was defined initially by the previous A-(iii) property of the free space and later after Maxwell's E/M-theory it included in it the A-(iv) one; ie luminiferous ether, or simply ether, carries and propagates both: the light and the E/M-waves.

2. ADDITIONAL PROPERTIES OF LUMINIFEROUS ETHER

(a). *The independence of the speed of light in ether from the velocity of the moving source.* This is basic property of the ether, thus fast moving sources don't affect the speed of light. In next chapters it will be proved that the *terrestrial luminiferous ether* is carried translationally by Earth {-Stokes (1845)-}. The terrestrial fast moving sources: fast rotating mirrors [3, 34], or π-mesons emitting gammas [4, 5, 6] as well the extraterrestrial ones (double star-systems) [5], do not affect at all the speed of light in ether and of course relative to our own Earth-LABs.
(b). *The ether increases the moving atomic masses and changes the 'life-times'* *of moving unstable particles***.** These are absolute effects due to the motion in ether [see B. and C. (Part II)]**.**

(c). *Lorentz had proved the existence of the ether.* Lorentz in [35] had said: Fizeaus' results on the speed of the light, propagating through the flowing refracting medium (water), denote the existence of the ether-medium. Lorentz had reasoned as follows: If matter was the single-exclusive carrier of the vibrations of light, then the speed of light through a refractive material medium should be c/n and if this material medium be set into motion, (of velocity υ relative to our LAB), the total speed of light (relative to our LAB) should be $C_{Lab} = \pm\frac{c}{n} + \upsilon$

but the experiment shows systematically smaller velocities (relative to the Laboratory):

$$C_{(n,\upsilon)Lab} = \pm\left(\frac{c}{n}\right) + \upsilon\left(1 - \frac{1}{n^2}\right) \qquad (3.1)$$

Lorentz had seen the experimental result of relation (3.1) to mean: '*the light partially is propagating through matter and also is propagating in another stationary medium* (*ether*)'. Lorentz in [35] had very well explained the relation (3.1) theoretically by the combination of the following three basic assumptions: (1) the validity of Maxwell's E/M-equations, (2) with the light-wave propagating through the *resting luminiferous ether*, into which, (3) the atoms and their electrons of the refracting medium are moving through.

(d). *Moving bodies of small mass do not drag at all the ether.* This is a generally valid property; it is result of the hyperfine structure of the ether. This property is in rule into any model of ether and is used exactly to detect the said ether (*ether-drift*).

(e). *Moving refracting media into LAB do not drag at all the ether.* Except of the reason (d), this was proved by Lorentz [35], and in the above (c) case.

(f). *The luminiferous ether does not carry or propagate gravitation.* The opposite is true, gravity of the massive heaven bodies, attracts luminiferous ether [see next C. 2.].

C. MODELS OF ETHER

1. FRESNEL'S-ETHER AND ANNUAL-STARLIGHT-ABERRATION MODEL, ITS EXCLUSION BY MICHELSON-MORLEY EXPERIMENT.

Lorentz in [35] mentions two quite opposite models of luminiferous ether, which had been proposed respectively by Fresnel in 1818 and by Stokes in 1845, for the explanation of the annual starlight aberration.

Fresnel's model of the ether: *The ether is assumed to complete the Universe and to be immovable. The moving Earth is assumed as impregnated with ether and as perfectly permeable to it.*

Fresnel's model of ether names and the homonymous model of explanation of the annual starlight aberration; Fresnel's aberration model resembles very much the aberration of the falling rain as its apparent direction changes with the motion of the observer (Fig. 11).

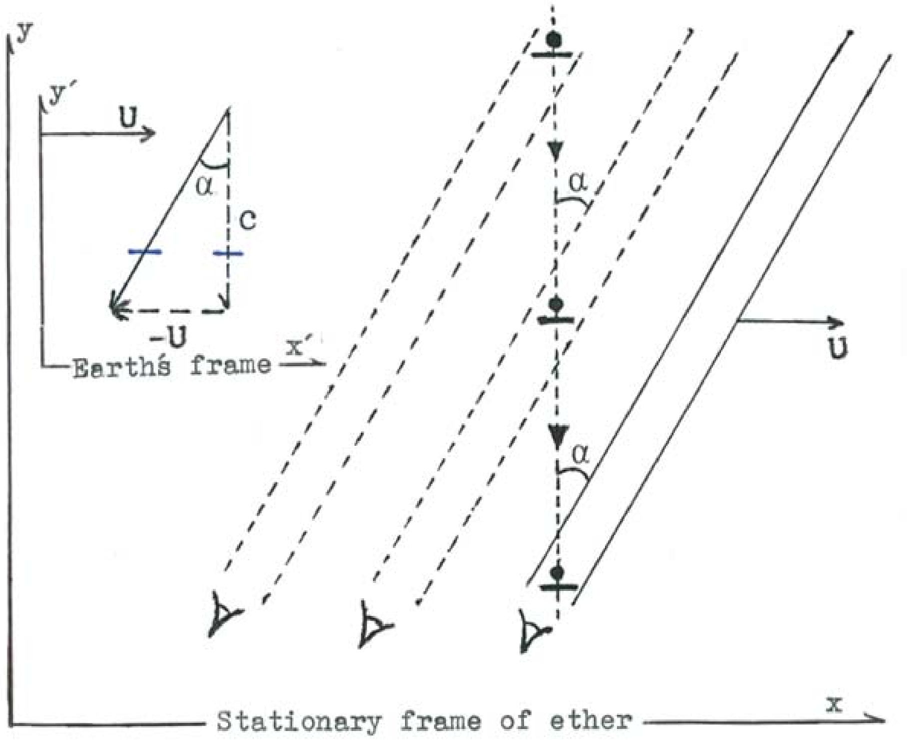


FIG. 11. Fresnel's ether and annual starlight aberration

For an observer standing over the South Pole and with the Sun at the lower side of the page, Earth is seen moving around Sun to the right side with velocity υ. Earth and the telescope are perfectly transparent to ether; thus the surrounding resting ether and the vertically propagating light ray are left untroubled in their initial state of motion. Relative to the stationary –in ether- observer the moving telescope has to be titled by an angle α, relative the vertical line, in order the light pass through. Relative to the Earth-telescope moving frame there have to be present on Earth an ether-wind or 'ether-drift' of velocity $-\upsilon$; and, thus relative to the moving frame, the light wave acquires an (apparent) velocity component opposite to the velocity of the telescope making the apparent propagation of light, -relative to the telescope-, to change by the same angle α. In Fresnel's model it takes place non-good validity of laws of wave-Optics relative to moving frame; because the wave-fronds are not normal to the new apparent velocity vector of light (here the wave-frond is parallel to x'- axis while the velocity vector of light ray is not normal to it).

Fresnel's model is described essentially in all the textbooks of physics and of astronomy (with the difference: that in place of the term 'ether' the term *stationary frame* is used)!

According to this model there had to be present a continuous *ether-drift* or *ether-wind* on Earth's surface. The Michelson-Morley (M-M) experiment (1887) had been performed exactly to measure the magnitude of this cosmic ether-wind. The failure of M-M experiment to detect any reasonable cosmic ether-drift means simply: The disproof of Fresnel's model for the annual starlight aberration!

It was then historically big mistake our own tacit keeping: of Fresnel's model of annual starlight aberration, combined necessarily with some additional -ad hoc- mathematical complications, in order the evidently expected M-M **non-null** result, to be zeroed by mathematics!

Such *ad hoc* assumptions zeroing the M-M result were: 1) The FitzGerald-Lorentz assumption: "*of the absolute contraction of moving rods*", 2) The Einstein's assumption: "*of the invariance of the one-way speed of light*", leading to the introduction of the symmetric LT, and 3) The assumption: "*of the constancy of the mean forth – back velocity of light*", leading to the invention of various non-symmetric non-Galilean [17, 18, 19, 20] transformations.

2. STOKES'-ETHER AND ANNUAL-STARLIGHT-ABERRATION MODEL. THE REAL TURNING OF THE STARLIGHT-WAVE-FRONTS

Stokes' (1845) ether model (Lorentz in [35] had wrote about it): "*The ether is assumed to be carried by Earth completely by its translational motion; i.e. ether is assumed to be at rest on Earth's surface. The instruments of an observatory are at rest relatively to surrounding ether. It is clear that under these circumstances the direction in which a heavenly body is observed must depend on the direction of the waves, such as it is immediately before light enters our instruments. Now on account of the supposed motion of the ether, this direction of the waves may differ from the direction of the waves at some distance from the Earth; this is the reason why the apparent position of a star will be different from the real one…*".

(a). ***Earth's gravity forms the terrestrial -Stokes'- ether.*** It is reasonable, one to assume: (1) if luminiferous ether exists it must be attracted by Earth and other heavenly massive bodies by the same law as ordinary matter, (2) the universal ether is assumed to be a kind of liquid of constant density showing also a suppefluidity character. Gravity doesn't seem to change the density of the universal ether but only changes locally its state of motion (dragging it locally by the relatively strong Newtonian attraction forces of the heavenly massive bodies).

In the Sun-Earth rotating system, Stokes ether, can be formed safely by capturing of the bulk close-to-Earth-ether into the inner –central- regions of *Roche lobe* of the Earth; ie Earth's 'Roche lobe' -of the Sun-Earth rotating system- represents the maximum possible extension of Stokes' ether being in a hydrostatic equilibrium around Earth. As terrestrial - Stokes'- ether (TSE) and Earth are moving together around the center of mass of the Sun-Earth system, the remaining ether, being around at various distances from Earth (and TSE), can flow relative to TSE according to the laws of fluid-mechanics for the incompressible supper fluids.

The annual starlight aberration phenomenon is, according to Stoke's model of ether, a result of the propagation of light through the velocity gradient region (VGR), being formed between, TSE and the 'far non-rotating stationary ether of Sun' (FNRSSE); the propagation of light-wave through the said VGR produces a real turning of the wave-fronts of light creating the annual starlight aberration phenomenon (see Fig. 12). It has to be noted that this '*Stokes' ether model and annual starlight aberration*' maintain the laws of the wave-Optics exceedingly good (since the wave-frond of light remains always normal to the local velocity vector of light). The existence of Terrestrial - Stokes'- ether on Earth should imply the absence of any *cosmic ether-drift* on Earth; which otherwise – in Fresnel's ether-model - was expected to be present, either due to Earth's motion around Sun, or due to Earth's motion around the galactic center, etc. On the other hand, due to the combined action: (i) of the Newtonian forces (from Earth and Sun) and (ii) of the centrifugal forces (acting away from the center of mass of the Sun-Earth rotating system), on the volume of TSE (Fig. 12), it means that entire the TSE maintains always its orientation to the Sun (this is a kind of enormous compass-locked to the Sun). According to the Fig.12, and due to the revolution of the Earth around Sun, TSE tends to rotate, –relative to the sidereal frame-, with an angular speed: $\omega_S = 1$ (rotation/year); but the ether-closest-to-Earth (ECE) is similarly be locked by the presence of Moon, and thus it tends to rotate, –relative to the sidereal frame-, with an angular speed: $\omega_M = 1$ (rotation/month); and thus finally the ECE rotates, –relative to the sidereal frame-, with a mean-effective angular speed: $\omega_{eff} \approx 0.026$ (rotations/sidereal day) [see next E.2.]. All these mean that TSE does not-participate in Earth's rotation around its axis; Earth is spinning into one essentially non-rotating ether creating only low velocity ether drifts (smaller than 0.5 km/sec) on its surface. The no-participation of TSE to the rotation of the Earth around its axis, leads us to accept as true a Fresnel-type model, for the explanation of the '*daily starlight aberration*' phenomenon on Earth.

(b). ***The turning of the momentary levels of ether***. Let us consider two well defined (well separated)' 'ether areas' (EAs), the EA-1 and EA-2, created around the corresponding heavenly massive bodies "1" and "2". These two heavenly bodies are in relative motion the one relative to the other and their own EAs i.e. the EA-1 and EA-2 are in relative motion too; between the EA-1 and EA-2 there exists entire a velocity field $\vec{g}$ because of the relative flowing of the parts of the «semi-free» ether (which don't belongs to EA-1 or to EA-2).

Stokes had made the very probable assumption: that the (relative) flow of the «semi-bounded» or «semi-free» ether, being between EA-1 and EA-2, is *irrotational* (non-turbulent).

It is assumed, for the propagation of light, the validity of Huygens Principle, *«every point of the present wave front σ of light acts as a secondary source of elementary spherical waves, and their enveloping surface is the new wave front σ' of light and s.o.n.»*. Of course relative to the ether the said elementary spherical waves (of duration dt) have the known speed c; but as the ether is moving any «momentary level» of it participates in a differential translation (due of the existence of the Velocity Gratient Region –VGR-) and this exactly changes its orientation, creating also a real turning to the wave crests of light.

Let us consider a small momentary level of ether (SMLE) -at the moment t-. We will follow here Lorentz's description or reasoning found in [35]. Let us consider the system of coordinate axes OX,OΨ,OZ which is fixed to one «particle» of the ether of the velocity field between the EA-1 and EA-2 and oriented so that the axis OX to be initially perpendicular to the said SMLE. The differential motion of the ether between its parts along the extension of the momentary SMLE is responsible for the turning of that SMLE and which finally turns the wave front of the propagated light.

If the coordinates of a 'molecule' of ether are x, y, z (relative to OX, OΨ, OZ) in the moment t, then its coordinates in the moment $t + dt$ will be

$$x' = x + g_x dt \ , \qquad y' = y + g_y dt \ , \qquad z' = z + g_z dt$$

Since we are interested here for the SMLE we may accept without error that the velocity components of the ether are linear functions of x, y, z so that, for example, we can write:

$$g_x = \alpha + \beta x + \gamma y + \delta z \qquad \text{or we can also write} \qquad g_x = \alpha + \beta x' + \gamma y' + \delta z'$$

Let us see now the motion of the SMLE; evidently its initial equation, -in OX, OΨ, OZ-, is

$$x = k \tag{3.2}$$

and after a time dt it will have reach at the level:

$$x' = k + (\alpha + \beta x' + \gamma y' + \delta z')dt \qquad \text{or} \qquad (1-\beta dt)x' - \beta dty' - \delta dtz' = k + \alpha dt \tag{3.3}$$

(Evidently here we don't be interested about the translation of the SMLE into its level owed to the existence of the velocity components g_y and g_z).

The distance of the level (3.3) from the origin of the coordinates is proportional to the magnitude of the second member $k + \alpha dt$, while the orientation of the level depends from the relative analogies of the coefficients:

$$1 - \beta dt\,, \quad -\gamma dt\,, \quad -\delta dt \tag{3.4}$$

These coefficients can be written in the form:

$$1-\frac{\partial g_x}{\partial x}dt, \quad -\frac{\partial g_x}{\partial y}, \quad -\frac{\partial g_x}{\partial z} \qquad (3.5)$$

The coefficients (3.4) or (3.5) may be taken as the directional cosines of the normal of the new position (3.3) of the SMLE. Summarizing we see that the initially SMLE has its normal unit vector along OX (3.2) i.e. it has directional cosines: [1, 0, 0]; after a time interval dt the said SMLE will possess a different orientation and its normal unit vector will possess as directional cosines the coefficients (3.5). We see that the new normal unit vector has projections (=cosines) on the axes OX, OΨ, OZ, the coefficients (3.5), which are the result of the composition of the original normal unit vector with the the so called *deviating vector* with projections:

$$-\frac{\partial g_x}{\partial x}dt \ , \ -\frac{\partial g_x}{\partial y}dt, \quad -\frac{\partial g_x}{\partial z}dt \qquad (3.6)$$

The *deviating vector* determines the turning of the original small momentary level of the ether. Now since it was assumed that the velocity field $\vec{g}$ of ether is *irrotational* this means mathematically that the following relations must be valid:

$$\frac{\partial g_x}{\partial y}=\frac{\partial g_y}{\partial x} \quad , \qquad \frac{\partial g_x}{\partial z}=\frac{\partial g_z}{\partial x}$$

With the help thus of above relations we can write for the components of the *deviating vector*

$$-\frac{\partial g_x}{\partial x}dt, \quad -\frac{\partial g_y}{\partial x}dt, \quad -\frac{\partial g_z}{\partial x}dt \qquad (3.7)$$

These coefficients are the projections of the following *deviating vector* :

$$-\frac{\partial \vec{g}}{\partial x}dt \qquad (3.8)$$

Since for relatively small velocities of the EA-1and EA-2, ($|\vec{g}| << c$) the propagation of the light becomes essentially along the direction of the OX axis and since we are interested here for the first order effects only (relative to the ratios $|U|/c$ or $|\vec{g}|/c$) we may write down without error that $\frac{dx}{dt} \approx c$ and thus the elementary deviating vector becomes equal to:

$$\textit{Elementary deviating vector} \approx -\frac{1}{c}d\vec{g} \qquad (3.9)$$

This expression is independent from any system of coordinate axes. Integrating relation (3.9) we get

$$\text{Total deviating vector} \approx -\frac{1}{c}\left(\vec{g}_{EA-\mathrm{Receiver}} - \vec{g}_{EA-Source}\right) \tag{3.10}$$

We see that the total deviating vector is quite independent from the selection of the coordinate axes and also is independent of the real form of the velocity field $\vec{g}$ of the ether between «EA-Receiver» and «EA-Source» and is depended from the difference of the velocities of the EA-Receiver and EA-Source only.

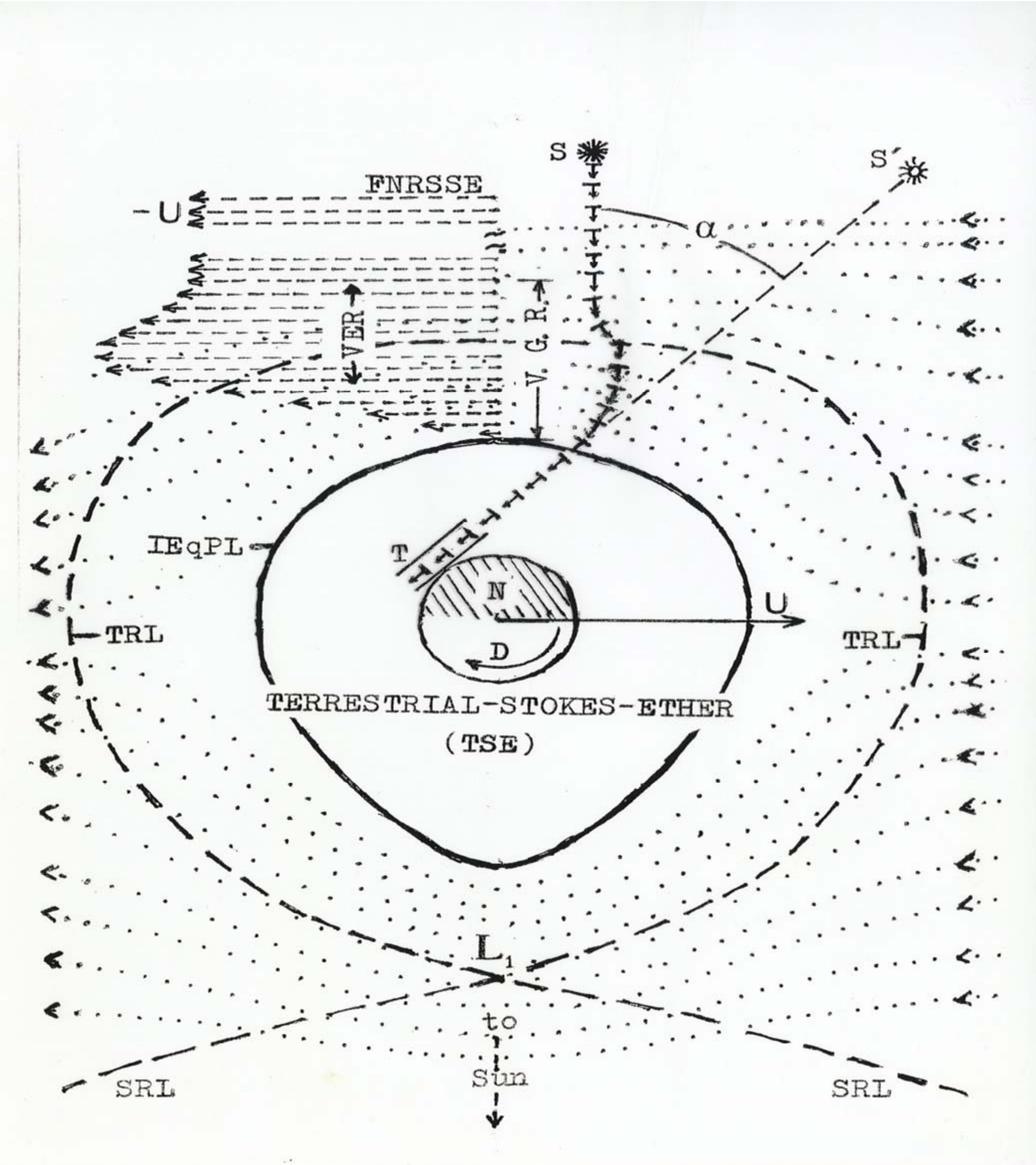


FIG. 12 Terrestrial – Stokes- ether and annual starlight aberration

FIG. 12 Terrestrial – Stokes- ether and annual starlight aberration

This –out of scale- drawing is author's representation for 'terrestrial-Stokes'-ether' (TSE) and annual starlight aberration. For an observer standing over the South Pole the Sun-Earth system appears to rotate clock-wise; and with Sun being at the lower side of the page, Earth is seen moving (around Sun) to the right side of page with velocity U. L_1 is Lagrange's point (between Earth and Sun) of the Sun-Earth rotating system; SRL is Roche lobe of Sun, TRL is terrestrial Roche lobe (always of the Sun-Earth rotating system); IEqPL is an inner equi-potential line, where terrestrial-Stokes'-ether (TSE) can safely be gravitationally-bound by Earth, resting hydrostatically as an ocean due to Earth's locally strong attraction (under the presence of the centrifugal forces due to the rotation of Sun-Earth system). Earth is surrounded by TSE and moves through the bulk ether of the solar system; since the distance of L_1 from Earth is nearly 1.5 (10^6 km) this mean that TSE may very well extent farther than Moon's orbit. Sufficiently far from Earth is the 'far non-rotating-stationary ether of Sun' (FNRSSE) having relative to Earth a velocity –U. Between the FNRSSE and TSE there is a velocity gradient region (VGR). N and D denote Earth's night and day. S is the real position of a star and S' is its position after the aberration. Stokes had proved mathematically [see C.2.(b),(Part III)] that, as the wave-frond of light passes through the VGR, it changes really and gradually its orientation, and thus when it reaches at the outer limit of TSE, there the wave-frond of light acquires its final orientation (different from its original one); and finally the light arrives into the telescope which simply remains parallelized to the incoming light ray. Stokes had proved that the total aberrational effect is **independent** of the form of the velocity profile of the flowing ether, i.e. from the existence of any 'velocity excess region' (VER) –due to the laws of flow for incompressible ether medium-, but aberration depends only from the difference of the (apparent) velocity vectors at the extremes of the VGR. The complicated form line, from S (real star) to T (telescope), is **not at all** a path of light ray; it simply represents an **observational sequence** of the orientations of the wave-fronts of starlight as they can be perceived by the **local observers** -each one resting inside the corresponding regions of ether-velocity-field-; in this manner the local stationary observer on the star sees the wave-front to be directed vertically down, while the local observer inside TSE sees the really turned wave-front to be directed to the tilted-parallelized telescope; of course relative to a concrete observer, to say the-stationary-on-S-star-observer, the light ray describes approximately a straight -here vertical- line; it becomes evident if we go in the last ether-region ie in TSE, then because of the real turning of the wave-front, the light is directed to the left side of the page (with a velocity component –U relative to star) but as the TSE is transferred to the right side of the page, (with velocity +U relative to the star), it means that light ray moves approximately vertically relative to the star. It is very interesting to be noted that the passing of light through the first-half of VER, forces it to be subjected initially an "inverse aberration", which is compensated when light passes through the second-half of VER; finally the light is subjected its ordinary aberration as it goes to the extreme of VGR. It has to be noted that this Stokes' model of ether and annual starlight aberration maintain the laws of the wave-Optics exceedingly well (since the wave-frond of light remains always normal to the velocity vector of light). The existence of Stokes' ether on Earth should imply the absence of any *cosmic ether-drift* on Earth. Cosmic ether drift was expected to be present in Fresnel's-ether-aberration model only. Due to the combined action: (i) of the Newtonian forces (from Earth and Sun) and (ii) of the centrifugal forces (acting away from the center of mass of the Sun-Earth rotating system), on the volume of IEqPL, it acquires a somewhat elongated symmetric form and it means that entire the TSE maintains always its orientation to the Sun (this is a kind of enormous compass-locked to the Sun). According to this figure, and due to the revolution of the Earth around Sun, TSE tends to rotate, –relative to the sidereal frame-, with an angular speed: $\omega_S = 1$ (rotation/year); but the closest-to-Earth ether (CEE) is similarly be locked by the presence of Moon, and thus it tends to rotate, –relative to the sidereal frame-, with an angular speed: $\omega_M = 1$ (rotation/month); and thus finally the CEE rotates, –relative to the sidereal frame-, with a mean-effective angular speed: $\omega_{eff} \approx 0.026$ (rotations/sidereal day) (see Text). All these mean that TSE does not-participate in Earth's rotation around its axis; Earth is spinning into one essentially non-rotating ether creating only low velocity ether drifts (smaller than 0.5 km/sec) on its surface. The no-participation of TSE to the rotation of the Earth around its axis, leads us to accept as true a Fresnel-type model, for the explanation of the '*daily starlight aberration*' phenomenon on Earth.

3. A STOKES'-LIKE AND ALSO CORIOLIS-LIKE MODEL FOR THE ANNUAL STARLIGHT ABERRATION

Aberration as a Coriolis-like declination of photon through VGR.. In this model of the annual astronomical aberration of light are used: 1) Stokes' primitive idea about theformation of the Terrestrial –Stokes's- ether (TSE) around Earth, 2) the existed velocity gradient region (VGR) between the relatively moving TSE and the FNRSSE and 3) the consideration of the Coriolis phenomena along the path of the propagating photon through the VGR. Let us study the propagation of a photon through the velocity gradient region (VGR) which lies between the far-non-rotating-stationary-Sun-ether (FNRSSE) and the TSE which revolves around Sun. Consider two successive layers Σ_r and Σ_{r+1} of the VGR. These layers of ether are in motion relative to each other; let their relative velocity be $d\bar{u}$ (Fig. 13). For the sake of simplicity and with no substantial error, we assume in this chapter that the speed of light in both of these layers, as well as in the entire VGR and gravitational field, is the constant c; similarly we neglect for the moment any possible gravitational effect on the other quantities of the photon (h, ν) i.e. it is assumed here that gravity has not any influence on the light.

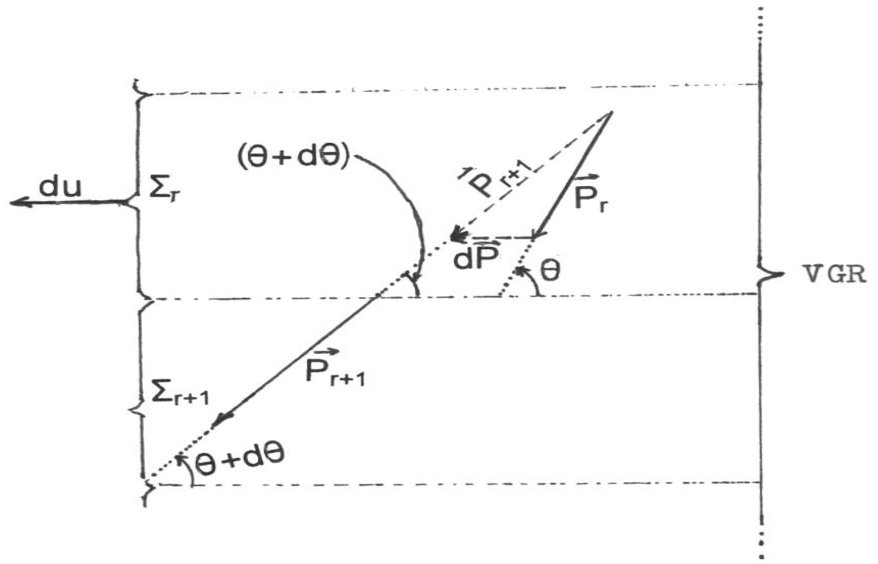


FIG. 13. Starlight aberration as a Coriolis-type effect

Consider two successive layers Σ_r and Σ_{r+1} of the VGR. These layers of ether are in motion relative to each other; let their relative velocity be $d\bar{u}$. As the photon passes through two, relatively moving successive layers of the ether -of the velocity gradient region (VGR)-, it appears as to keep its previous momentum $\vec{P}_r$ plus it's apparent momentum $d\vec{P}$ (due to relative motion of layers); as a result the photon appears to be propagated into the next-layer with a new momentum: $\vec{P}_{r+1} = \vec{P}_r + d\vec{P}$; this has the effect the direction of the photon to appear a Coriolis-type declination relative to the new-local layer of ether. By integration we get the formulas for the annual starlight aberration and the astronomical Doppler effect.

Let the momentum of the photon inside the Σ_r-layer be $\vec{P}_r$ (forming an angle θ with the velocity vector $d\vec{u}$ or x-axis); if the frequency of the photon inside the Σ_r-layer is ν, then its mass, in the same layer, is: $h\nu/c^2$. Now as the photon propagates inside the Σ_r - layer, it has the following momentum components relative to the Σ_{r+1} - layer:

$P_r = \left(\frac{h\nu}{c^2}\right)c = \frac{h\nu}{c}$ (= the momentum of photon along its direction in Σ_r-layer) and $d\vec{P} = \left(\frac{h\nu}{c^2}\right)d\vec{u}$ (= momentum component of the photon due to the apparent motion of Σ_r - layer relative to Σ_{r+1} - one)

As seen from an observer fixed on Σ_{r+1}-layer, the photon, when still inside the Σ_r - layer, has a total momentum equal to the vector sum of $\vec{P}_r$ and $d\vec{P}$; this also is the momentum of the photon when it leaves the Σ_r -layer and enters the Σ_{r+1}-layer. The photon keeps propagating throughout the Σ_{r+1}-layer with the same momentum:

$$\vec{P}_{r+1} = \vec{P}_r + d\vec{P} \qquad (3.11)$$

But since the speed of the photon, inside the ether layers, is constant and equal to c, we expect that its frequency will change from ν to $\nu + d\nu$. Thus, when passing from one layer into the next one, the photon changes its frequency in addition to its angle of incidence.

Taking now the projections of the equation (3.11) along and perpendicularly to the vector $d\vec{u}$ (=x-axis) (Fig. 13) we have:

$$\frac{h(\nu+d\nu)}{c}\cos(\theta+d\theta) = \frac{h\nu}{c}du + \frac{h\nu}{c}\cos\theta \qquad (3.12)$$

$$\frac{h(\nu+d\nu)}{c}\sin(\theta+d\theta) = \frac{h\nu}{c}\sin\theta \qquad (3.13)$$

But from (3.13) we immediately see the conservation of the normal (to the layers Σ_r, , Σ_{r+1} and to the vector $d\vec{u}$) momentum component of the photon; thus we have:

$$\nu\sin\theta = \nu_{(o)}\sin\theta_{(o)} \qquad (3.14)$$

the indices (o) are referred to the data (emitted frequency and angle) of photon at the initial position. Now since $\cos(\theta+d\theta) \approx \cos\theta - \sin\theta d\theta$ and $\sin(\theta+d\theta) \approx \sin\theta + \cos\theta d\theta$] the relations (3.12), and (3.13) are written respectively:

$$\left(1+\frac{d\nu}{\nu}\right)(\cos\theta - \sin\theta d\theta) = \frac{du}{c} + \cos\theta \qquad (3.15)$$

$$\left(1+\frac{d\nu}{\nu}\right)(\sin\theta + \cos\theta d\theta) = \sin\theta \qquad (3.16)$$

By dividing in members and ignoring the second order terms (containing products of differentials), we finally get the differential equation for the aberration of light ray:

$$d\theta = -\frac{du}{c}\sin\theta \qquad (3.17)$$

Integrating the relation (3.17) from lower limits $\theta = \theta_o$ and $u = 0$ and upper ones the $\theta = \theta$ and $u = \upsilon$, we have:

$$\int_{\theta_o}^{\theta} \frac{d\theta}{\sin\theta} = -\int_0^{\upsilon} \frac{du}{c} \qquad (3.18)$$

$$\tan\left(\frac{\theta}{2}\right) = \tan\left(\frac{\theta_o}{2}\right)e^{-\frac{\upsilon}{c}} \qquad (3.19),$$

relation (3.19) gives the total aberration phenomenon between two, relatively moving, EAs. For the special case where the light is emitted perpendicularly to the velocity vector of the EA-source ($\theta_o = \frac{\pi}{2}$) we have at the EA-Receiver an angle of incidence θ given by the following relation:

$$\tan\left(\frac{\theta}{2}\right) = e^{-\frac{\upsilon}{c}} \qquad (3.20)$$

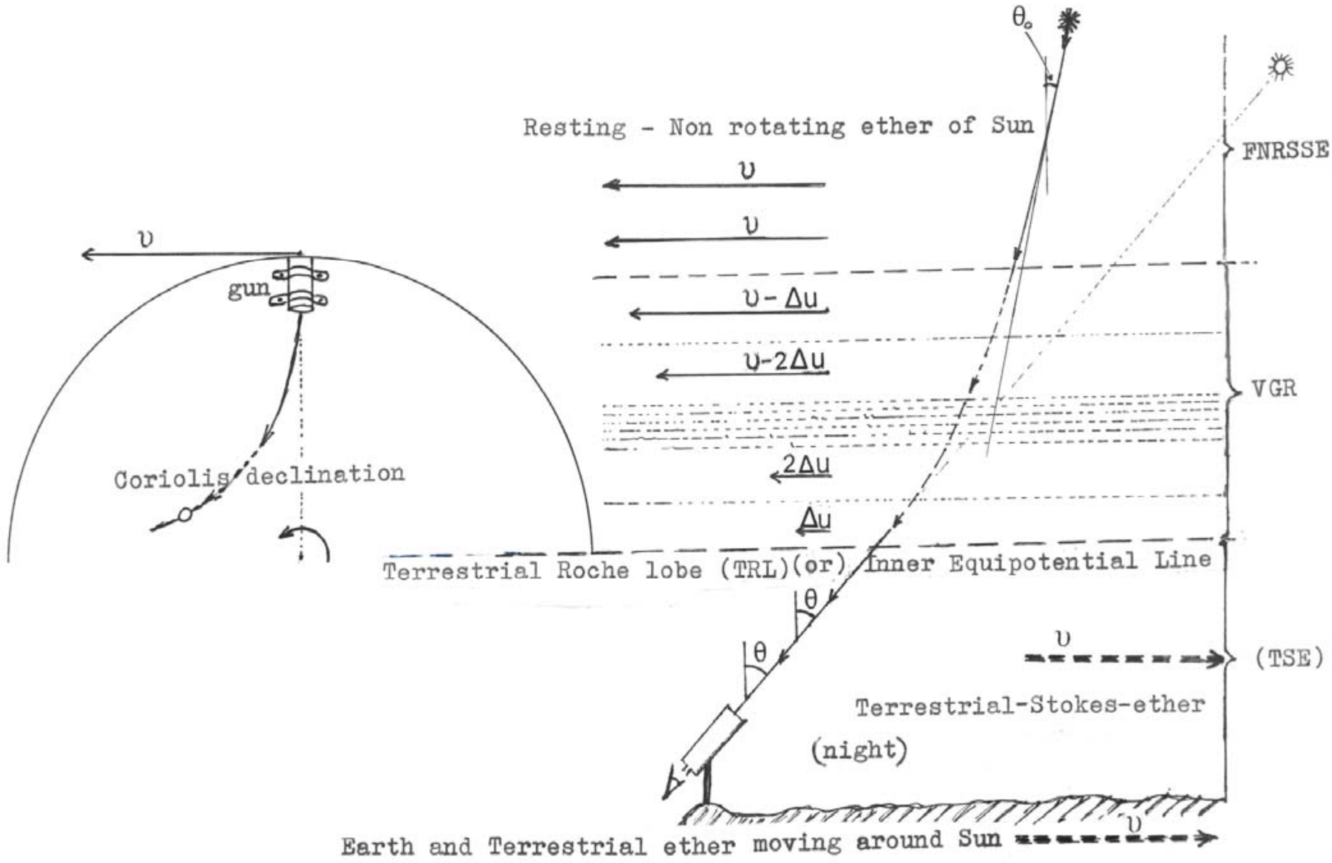


FIG. 14. A Stokes'-like and also Coriolis-like model for the annual starlight aberration and astronomical Doppler.

For an observer standing over the South Pole and with the Sun at the lower side of the page, Earth is seen moving around Sun to the right side (clockwise) with velocity υ . Left: the appearance of Coriolis phenomena as the bullet moves through the velocity gradient region VGR of the rotating disk. Right: in an analogous manner the photon, as it passes through velocity gradient region (VGR) is subjected to a Coriolis-like declination and Doppler effect, -both phenomena are described by the law of conservation of momentum of photon as it passes through the layers VGR-. The VGR is between the 'far-non-rotating-stationary-ether-of-Sun' (FNRSSE) and inner equi-potential line i.e. the upper limit of Terrestrial Stokes ether (TSE); inside TSE the light ray acquires its final direction straight way to the tilted-parallelized telescope. In this model there is not any cosmic-type ether-drift due to the translation of the Earth around Sun or around the galactic center etc.

TABLE III. Vertical-starlight-ray aberration

$\beta \equiv \dfrac{\upsilon}{c}$	ANNUAL STARLIGHT ABERRATION MODELS		
	'STOKES – CORIOLIS' – LIKE MODEL	FRESNEL – TYPE MODEL	
	$\tan\left(\dfrac{\frac{\pi}{2}-\alpha}{2}\right) = e^{-\beta}$	LT $\sin\alpha = \beta$	GT $\tan\alpha = \beta$
	$\alpha_{(S-C)}$	$\alpha_{(LT)}$	$\alpha_{(GT)}$
0.0001	20. 62648044”	20.62648065”	20.62648055”
0.001	3. 43774619’	3.437747343’	3.437745624’
0.01	34. 37689476’	34.37804069’	34.37632186’
0.1	5. 72005245^{o}	5.73917^{o}	5.71059^{o}
0.3	16. 9366^{o}	17.4576^{o}	16.6992^{o}
0.5	27. 5238^{o}	30^{o}	26.5651^{o}
0.7	37. 1834^{o}	44. 427^{o}	34.992^{o}
0.9	45. 7496^{o}	64. 1581^{o}	41.9872^{o}
0.999	49. 5678^{o}	87. 4374^{o}	44.9713^{o}
1.	49. 605^{o}	------	45^{o}
2	74. 5854^{o}	------	63.435^{o}

4. A SHORT SIGHT in HISTORY

Today we can look back in order to see how Lorentz [35] had made his own erroneous destructive assumption for Stokes's ether-and-annual-starlight-aberration-model (in spite of Planck's instructions [35] to him: *don't be hurry to reject the news theories*).

(a) *First Lorentz' calculation against Stokes'-ether-model.* First, Lorentz in [35], had regarded tacitly and destructively the height of Stokes'ether equal to zero (!), while the ether was assumed to be incompressible. Lorentz' calculation and result: The surrounding the Earth, flowing ether, was proved to flow on Earth's surface at a speed 1.5 times faster than the velocity of the Earth in space. This calculation, which was based essentially on the zero height of Stokes' ether, had destroyed-by-definition, the "Stokes' ether-and-aberration-model".

(b) *Second Lorentz'-(1899)- calculation against Stokes'- ether-model.* Again Lorentz in [35] had made his own basic destructive assumption: the *height of Stokes' ether had been taken equal to zero* (!), while this time the ether was assumed to be compressible. Lorentz' thinking-line: since the surface of the Earth was surrounded by the flowing *gaseous compressible ether* it was asked then to be fulfilled the following flow-conditions: '*the gaseous compressible ether to slow down its relative velocity, on Earth's surface, up to the lower limits 0.011 or 0.0056 times the velocity of the Earth in space*'. Lorentz' calculation and result: The calculation showed that this 'slowing down' of the velocity of the compressible ether on Earth's surface was permissible if the ether could be condensed greatly e^{10} or e^{11} respectively (and Lorentz added): *but instead the speed of light doesn't seem to be varied (!). Thus Planck will agree that only Fresnel's ether model is valid.* Lorentz, by means of this second calculation, -(essentially based on his own destructive assumption and on second erroneous one – about the gaseous compressibility of ether-)-, managed to detach Planck's attention and protection (..*don't be hurry to reject the news theories*..) from Stokes'- model. This is the story of rejection of "*Stokes' ether and of the related annual starlight aberration model*".

It is self-evident that after Lorentz's destructive rejection, of Stokes'ether-and-aberration-model, only the Fresnel's-ether-model -[C.*1.* (Part III)]- had assumed to be in rule. This forced the theoreticians of the epoch to introduce mathematics so to change the *Time* and *Space* of the moving reference frames and so to "stabilize" mathematically the speed of light on Earth's surface (which speed naturally was expected to be variable on Earth according to Fresnel's model only). I personally believe that Lorentz had tried to maintain the glory of the homonymous LT -through "Fresnel's ether"- and so he had ignored any possible effect of gravity to form a Terrestrial-Stokes'-ether inside-and-around the Earth.

D. TERRESTRIAL -STOKES'- ETHER IS CARRIED TRANSLATIONALLY BY EARTH

1. THE MICHELSON – MORLEY NULL RESULT

Terrestrial -Stokes'- ether (TSE) is carried along translationally by Earth; this had been proved theoretically in [C. 2. (Part III)]**.** Then M-M experiment should give a clear and natural zero result; {without any '*ad hoc*' FitzGerald -Lorentz "rod-contraction", or without the '*ad hoc*' mathematics, -of the symmetric LT-, to maintain the '*one-way*' speed of light *invariant* on Earth, or finally without the '*ad hoc*' mathematics, -of the asymmetric transformations [17, 18, 19, 20]-, to maintain constant the *mean* '*forth-back*' speed of light on Earth}.

2. NO 'COSMIC' ETHER-DRIFT ON EARTH

Terrestrial -Stokes'- (TSE) ether is carried along translationally by Earth; this explains easily and collectively the failures of the diverse experiments to detect a *cosmic ether-drift* due to the real cosmic velocity of the Earth in space. {The magnitude of the cosmic velocity of the Earth is much greater than 30 km/sec, as it starts from about 300 km/s, -due to the rotation of Sun around the center of galaxy-, and reaches the 400 or more km/sec, (after the Doppler-asymmetry measurements on CMBR)}.

The important tests performed –but-failed-to-detect-the-cosmic-ether-drift-on-Earth are: (i) The Michelson-Morley (equal-arm-interferometer) experiment, (ii) The Kennedy-Thorndike [2] (unequal-arm-interferometer) experiment, (iii) The Trouton-Noble [36] (electromagnetic force) experiment, (iv) The Cendarholm-Townes, *et al* [37] frequency-beating experiment (two masers with their beams opposite), (v) The Jaseja *et al* [38] frequency-beating experiment (two lasers being placed in a Michelson-Morley-type arrangement), (vi) The Turner-Hill [24] experiment (a gammas emitter and a Mossbauer absorber of gammas on fast rotor), (vii) The Riis-Lee-Hall *et al* [39] experiment (to measure any variation of the '*one-way*' speed of light), and (viii) The Brillet-Hall [25] experiment (the frequency beating of a rotating laser with a non-rotating one).

A more detailed study of all above important experiments becomes in next chapters. At this point it is noted only the lack of the bulk cosmic-ether-drift due to the umbrella of TSE around Earth.

3. ON THE “INVARIANCE” OF TERRESTRIAL LAWS OF OPTICS AND PHYSICS

As luminiferous ether remains fixed with Earth in its translational journey in space, the laws of Optics (and entire the Physics) are well valid in our Earth, which is in reality a S –stationary—in-ether system. In other words our own long discussions and interest how to construct “*space and time transformations* (STT) in order to secure the invariance of Maxwell’s equations and the rest laws of physics on Earth’s-moving-in-ether-reference frame”, are simply without any meaning. All above explain the long living of the concepts of SRT and of the Relativity Principle!

4. AIRY’S (STARLIGHT - ABERRATION) EXPERIMENT

As the light ray travels close to Earth through the lower TSE until our own telescope with its final slope, (clearly different than its initial one), it makes no difference with what material has been filled the telescope; the telescope simply must by pointed to the direction of the incoming light-wave [5, 20]. This is the best and the simplest explanation of Airy’s result! (i.e. the constancy of the annual starlight aberration measured with a water-filled telescope)!

E. ETHER-DRIFTS OF THE TERRESTRIAL -STOKES’- ETHER

We have seen in [C.2. (Part II)] that the gravitation of Sun-Earth-rotating system keeps and forms inside-and-around the Earth the so called ‘Terrestrial-Stokes’-ether’ (TSE). Although TSE is transferred translationally by the Earth in space, yet it expected to appear into it small-velocity ether-drifts. Certainly these ether-drifts have to appear every time an object is moving relative to the TSE; i.e. when: 1) a Sagnac-type [8] interferometer rotates about an axis perpendicular to its level, 2) a Michelson-Gale (M-G) [9] interferometer, –i.e. a big Sagnac-, rotates, -due to the rotation of the Earth about its axis-, 3) an atom or atomic-clock is moving in TSE, (either the atomic-clock is (a) stationary on the ground, -rotating about Earth’s axis-, or (b) it be flying aboard on an airplane or (c) it be orbiting around Earth), the (a,b) cases occur in the Hafele-Keating [13] experiment and the (c) in GPS (the Global Positioning System); and 4) a slowly rotating laser is frequency beating with a non-rotating one as it occurs in Brillet-Hall [25] experiment.

Note. Although the arrangement of the Turner-Hill [24] experiment does move into the ether (TSE), yet this experiment is proved (see bellow) to be neutral (as it really is) relative to any ether-drift.

1. SAGNAC AND MICHELSON-GALE EFFECTS REVEAL A GALILEAN VARIATION OF THE SPEED OF LIGHT

The Sagnac [8] and M-G [9] experiments are of extreme importance in Physics; these create *first order effects* (in ratio υ / c) and of course these easily have been explained in terms of the classical-ether-wave-theory-of-light (CEWTL)! These classical explanations can be presented just in two or three lines with high school algebra. [The situation is exactly similar with the speed of the sound in resting air-atmosphere since: (1) the speed of the sound remains independent from the motion of the sound-source but (2) a moving observer being in an-open-in-air frame does really find a Galilean change of the (apparent) speed of the sound in air].

The classical-ether-wave-theory-of-light (CEWTL) teaches that at any point, in free space (filled by ether), the speed of light have to be: (i) independent of the direction of propagation (= differential homogeneity of ether), (ii) independent of the traveled distance or any "prehistory" of light ray, and (iii) independent of the velocity of the emitting source [2]**.** Above (i) to (iii) CEWTL- propositions are completed with one more one: (iv) the validity of Huygens Principle.

Rectangular version of Sagnac and M-G experiments: We give here four physically equivalent calculations of these effects: Two equivalent calculations made by an absolutely stationary, –in ether-, observer (ASO) and other two equivalent calculations made by the co-rotating observer (CRO). We note with (+) the direction of rotation of Sagnac apparatus (or of M-G arrangement) and with (-) the opposite one

a). ASO's calculation for Sagnac based on changes of wavelengths:

We have to remember the two classically distinct and different Doppler effects under the presence of ether:

(a). If a light source moves in ether with a (very small) velocity υ, then relative to this stationary ether, the radiation which be emitted to an angle Θ (measured from vector $\bar{\upsilon}$), acquires a frequency (relative to ether) equal to:

$$\nu_{(\upsilon,\Theta)} = \frac{\nu_o}{1 - \frac{\upsilon}{c} \cdot \cos\Theta}$$

ν_o is the frequency of the source when it is resting in ether.

(b) If a frequency $\overline{\nu}_o$ is traveling in ether and if the receiver of light be moving relative to ether with (a very small) velocity $\bar{\upsilon}$ forming an angle Θ with the direction of propagation of light radiation, then the receiver finds the arriving wave to have an apparent frequency:

$$\nu'_{(\upsilon,\Theta)} = \overline{\nu}_o \cdot (1 - \frac{\upsilon}{c} \cdot \cos\Theta)$$

$\bar{\nu}_o$ is evidently the frequency of the arriving wave when the receiver rests in ether.
When the Sagnac apparatus rests the light follows the sides of the square ΗΑΒΓΗ (Η is the beam splitter). In rotating apparatus is selected (automatically) at Η among the rays that one which is directed not at Α but at Α′ i.e. a more front than ΗΑ in a very small angle ε.

Relative to ASO the emitted ray ΗΑ′ acquires, from moving beam splitter Η, a frequency

$$[\nu_+]_{EM} = \frac{\nu_o}{1 - \frac{\omega \cdot (\alpha/\sqrt{2})}{c} \cdot \cos(45^o + \varepsilon_+)}$$

where ν_o is the frequency of the source at rest and
$\omega(\alpha/\sqrt{2})$ is the linear frequency of the points Η,Α,Β,Γ of the Sagnac optical square.
This emitted frequency $[\nu_+]_{EM}$, is received by the mirror A as:

$$[\nu_+]_{RE} = [\nu_+]_{EM} \cdot \left[1 - \frac{\omega \cdot (\alpha/\sqrt{2})}{c} \cdot \cos(45^o + \varepsilon_+)\right] = \nu_o$$

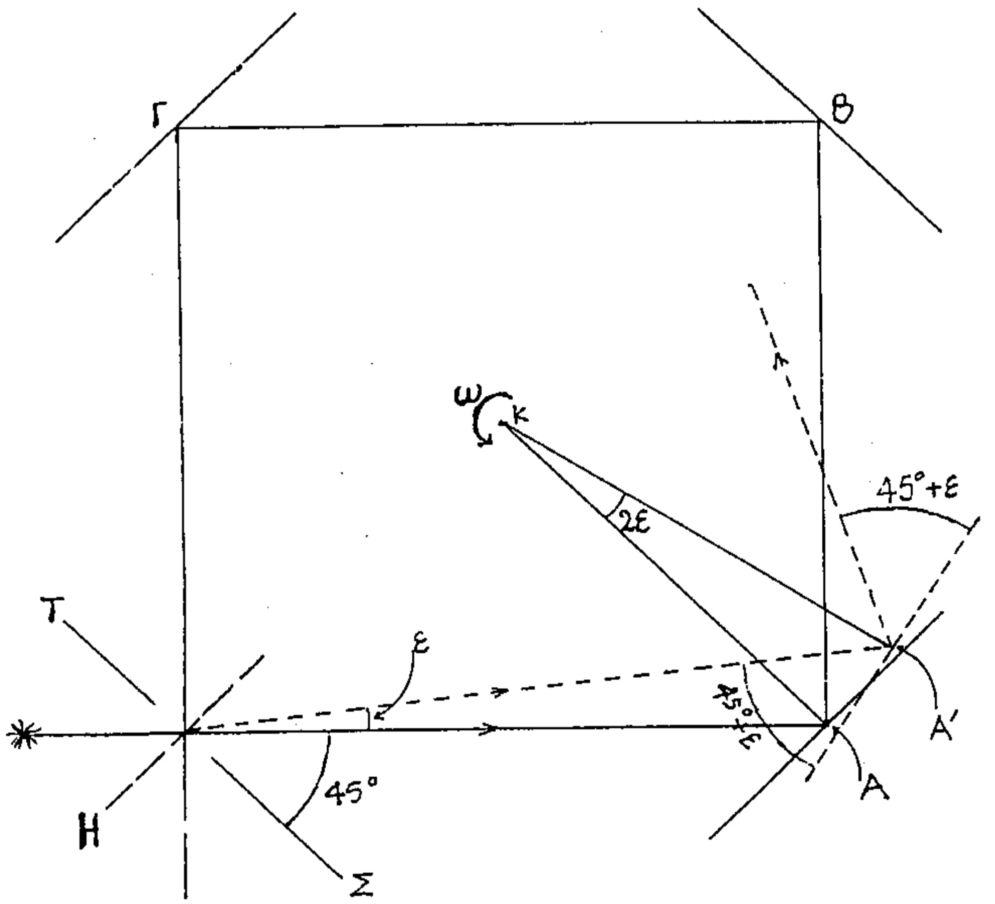


Fig. 15 Path of rays relative to ASO

In case the angle with line TΣ (normal to beam-splitter H) is $45^o + \varepsilon_+$ and this angle is conserved and in all next reflections. Finally this ray will interfere with the oppositely propagating ray. These aberrations create and higher order increments of the light - path which do create really higher than the first order (υ / c) effects and for that we take in our calculations only the zero order path i.e. $4a$.
i.e. every receiver finds the frequency of the radiation constant equal to the initial ν_o (this same conclusion is valid for both the oppositely propagating rays).
For the homo-circulating ray -with the apparatus- ASO "sees" a shortened wave-length:

$$\lambda_+ = \frac{c}{[\nu_+]_{EM}} = \frac{c}{\nu_o} \cdot \left[1 - \frac{\omega \cdot \alpha}{c\sqrt{2}} \cdot \cos(45^o + \varepsilon_+)\right] \qquad (3.21)$$

This shortened wavelength is contained into the zero order path $4a$ of Sagnac arrangement. The number thus of the contained wavelengths for the homo-circulating ray in Sagnac arrangement is:

$$N_+ = \frac{4\alpha}{\lambda_+} = \frac{4a}{c} \frac{\nu_o}{\left[1 - \frac{\omega \cdot a}{c\sqrt{2}} \cos(45^o + \varepsilon_+)\right]}$$

In a similar way we find for ASO the number of contained wavelengths for the anti-circulating ray:

$$N_- = \frac{4\alpha}{\lambda_-} = \frac{4a}{c} \frac{\nu_o}{\left[1 + \frac{\omega \cdot a}{c\sqrt{2}} \cos(45^o + \varepsilon_-)\right]}$$

ASO calculates the Sagnac result (in first order terms in ratio υ / c):

$$N_+ - N_- \approx \frac{4a}{c} \nu_o \frac{2\omega \cdot a}{c\sqrt{2}} \cos(45^o + \varepsilon) = \frac{4a^2 \omega}{c^2} \nu_o$$

[we used the relation $\cos(45^o + \varepsilon) \approx \frac{\sqrt{2}}{2}$ ($\varepsilon_+ \approx \varepsilon_- \approx \varepsilon \approx 0$)]

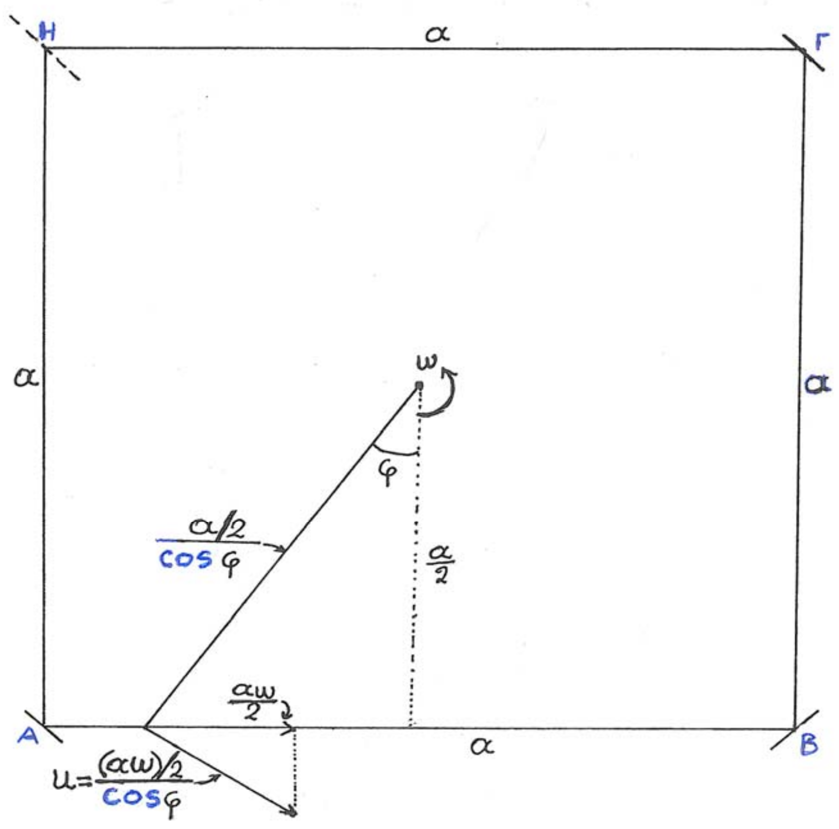
b). ASO's calculation for Sagnac based on fly-time-differences of the interfering rays:

In order to calculate Sagnac effect, ASO apply the above (i) to (iv) sentences. In Sagnac rectangular interferometer (Fig. 16) the light ray from source falls on beam splitter H. Here the light ray is divided in two: the first is propagated CW and the second CCW; these two rays interfere again at H. The interference fringes are suitably photographed. The whole apparatus is rotated about a vertical axis. When the apparatus rests in ether the two rays "fly" for equal times: $4\alpha/c$ The rotation of the apparatus creates differences in the times of propagation of the two rays. Let us assume that the rotation of the apparatus becomes CCW with an angular speed ω (Fig. 16)

The ASO easily understands that the points of rotating table acquire a velocity component $\alpha\omega/2$ along the zero order path of light (in ratio υ/c), thus the homo-circulating –(CCW) –propagating ray needs more time to complete the path HABΓH. The time interval t_+ (= first order approximation in ratio υ/c) is given by the high-school equation:

$$c\cdot t_+ \approx 4a+\left(\frac{a}{2}\cdot\omega\right)\cdot t_+ \quad \text{which gives} \qquad t_+ \approx \frac{4a}{c-\frac{a}{2}\cdot\omega}$$

This formula will be found below and by co-rotating observer –CRO- which does feel an ether-wind velocity component of magnitude $\left(\frac{\alpha}{2}\cdot\omega\right)$ flowing oppositely to the direction of propagation of homo-circulating ray HABΓH decreasing in case the apparent speed of light: $c'_+ = c-\upsilon = c-\frac{a}{2}\omega = c\left(1-\frac{\alpha\omega}{2c}\right)$



. **Fig. 16**

In a similar manner the ASO easily understands that the anti-circulating –(CW) – propagating ray needs a smaller time to complete the path HΓBAH. The time interval t_- (first order approximation in ratio υ / c) for this is given by the high-school equation:

$$c \cdot t_- \approx 4a - \left(\frac{a}{2} \cdot \omega \right) \cdot t_- \qquad \text{which gives} \qquad t_- \approx \frac{4\alpha}{c + \frac{\alpha}{2} \cdot \omega}$$

This formula will be found below by CRO which do feels an ether-wind velocity component of magnitude $\left(\frac{\alpha}{2} \cdot \omega \right)$ flowing in parallel to the direction of propagation of anti-circulating ray HΓBAH increasing in case the apparent speed of light:

$$c'_- = c + \upsilon = c + \frac{a}{2}\omega = c\left(1 + \frac{\alpha\omega}{2c}\right)$$

and the result of fringe transposition is according to ASO:

$$\Delta N = \nu_o \cdot (t_+ - t_-) = \nu_o \left(\frac{4a}{c_+} - \frac{4a}{c_-}\right) \approx \frac{4a^2 \cdot \omega}{c^2} \cdot \nu_o$$

ν_o is the frequency at rest of the source

c). CRO's calculation for Sagnac based on variable speed of light:

According the CRO with Sagnac apparatus (or M-G one) an 'ether-wind' flows to the opposite sense! CRO finds the total path of light ray equal to $4a$, while he feels an oppositely flowing ether-wind of velocity $\left(\frac{a}{2}\omega \right)$ along the side of the rectangle; this wind decreases the speed of light, homo-circulating –CCW- from c to the value:

$$c_+ = \left(c - \frac{\alpha}{2}\omega \right) = c\left(1 - \frac{\alpha\omega}{2c}\right) \qquad (3.22a)$$

and of course this wind increases the speed of light, anti-circulating –CW- from c to the value:

$$c_- = \left(c + \frac{\alpha}{2}\omega \right) = c\left(1 + \frac{\alpha\omega}{2c}\right) \qquad (3.22b)$$

i.e. CRO feels the oppositely flowing ether-wind creating a Galilean composition of speeds for light, he calculates the Sagnac effect:

$$N = \nu_o (t_+ - t_-) = \nu_o \left(\frac{4a}{c_+} - \frac{4a}{c_-}\right) \approx \frac{4a^2 \cdot \omega}{c^2} \cdot \nu_o$$

d). CRO's calculation for Sagnac based on changes of wavelengths:

Relative to CRO there exist an oppositely flowing ether-wind creating an apparent change in the speeds of light given by (3.22a) and (3.22b); thus CRO can calculate the corresponding wavelengths:

$$\lambda_+ = \frac{c_+}{\nu_o} = \lambda_o\left(1 - \frac{\alpha\omega}{2c}\right), \qquad \lambda_- = \frac{c_-}{\nu_o} = \lambda_o\left(1 + \frac{\alpha\omega}{2c}\right)$$

CRO "sees" the above wavelengths to occupy entire the circuit $4a$ creating again the Sagnac (M-G) effect:

$$N \approx \left(\frac{4a}{\lambda_+} - \frac{4a}{\lambda_-}\right) = \frac{4a^2 \cdot \omega}{\lambda_o \cdot c} = \frac{4a^2 \cdot \omega}{c^2} \cdot \nu_o$$

2. THE M-G EXPERIMENT PROVES THE GRAVITATIONAL-TIDAL LOCKING OF TERRESTRIAL –STOKES- ETHER.

If the TSE be gravitationally attracted, by our own planet and Sun, this mean, that the ether being closest to Earth (CEE), have also to be locked and by the presence of the Moon (as Earth-Moon is another rotating system attracting ether). Exactly like Earth's atmosphere or oceans, CEE have to be subjected to the ordinary Newtonian perturbations or tidal-gravitational forces by Sun and Moon. It is known from astronomical data that the tidal force of the Moon on Earth's surface is 2.1826 times greater than the one of the Sun; if thus the tidal force of the Sun on Earth's surface be characterized of magnitude "1", the tidal force of the Moon on Earth is of magnitude "2.1826". Since now the absolute –relative to the fixed stars- angular speeds of the Sun and Moon, "revolving around Earth", are respectively: $\omega_{Sun} = 2\pi / 366.2568$ (rads/ sidereal day) and $\omega_{Moon} = 2\pi / 27.3965$ (rads/sidereal day), then the 'mean-effective' angular speed of CEE (relative to the fixed stars) must be:

$$\omega_{CEE/\,stars} = \frac{1\omega_{\mathrm{Sun}} + 2.1816\omega_{\mathrm{Moon}}}{1 + 2.1816} = 0.02589 \cdot 2\pi = 0.02589 \text{ (rotations/sidereal day)} \qquad (3.23)$$

This is exactly the mean-effective angular speed with which CEE rotates eastwards, relative to the fixed stars i.e. in the same sense of the rotation of the Earth about its axis; and thus Earth, rotating about its axis, has a daily angular-speed-excess, relative to its own CEE, equal to:

$$\Omega - \omega_{CEE} = 2\pi(1 - 0.02589) \approx 0.974 \cdot 2\pi = 0.974 \text{ (rotations/sidereal day)} \qquad (3.24)$$

and is this exactly 'Earth's angular speed excess' (relative to CEE) which is responsible for the observed fringe-shift (= 0.230 of the fringe-width) of Michelson-Gale [9] experimental effect; and thus is explained the slight difference of M-G effect from the then -1925- calculated effect (= 0.236 of the fringe-width) which was based on the rotation of the Earth about its axis with the angular speed Ω (= 2π rads/sidereal day):

$$\frac{\Omega - \omega_{CEE}}{\Omega} = \left[\frac{[0.230]_{obs}}{[0.236]_{calc(1925)}} \right]_{M-G} = 0.974 \qquad (3.25)$$

The last relation proves that the ether exists and be attracted gravitationally by Earth, Sun and Moon and that also the CEE is tidally locked by Sun and Moon (the situation is exactly similar to the Newtonian tidal phenomena on Earth). **Conclusively:** The TSE is carried totally with the Earth, along its journey in space; and the CEE is also gravitationally-tidally locked to the Sun and Moon and thus CEE rotates eastwards with a mean-effective angular speed of about 0.026 rotations per sidereal day**.**

Thus on Earth's surface there exist only a perpetual ether-drift encircling Earth from East to West due to the rotation about its axis; the linear (Eastward) velocity of the ground through CEE is

$$V_{gr/CEE} = 0.974 \cdot \Omega R \cos\Phi = 0.974 \cdot \Omega r \approx \Omega r \qquad (3.26)$$

(Ω is Earth's angular speed due to its rotation about its axis, r is the distance of the ground from Earth's axis, R is Earth's radius, and Φ is the latitude).

The M-G effect is created exactly from the 'linear-velocity-differences' of the optical arrangement, due to Earth's rotation about its axis into the CEE. The different linear velocities of the ground create and different apparent speeds of the light to the East and West; and the corresponding wavelength differences:

$$C'_E = c\left(1 - \frac{0.974\Omega R}{c}\cos\Phi\right) \approx c\left(1 - \frac{\Omega r}{c}\right) (3.27)$$,

$$|C'_W| = c\left(1 + \frac{0.974\Omega R}{c}\cos\Phi\right) \approx c\left(1 + \frac{\Omega r}{c}\right) \quad (3.28)$$

$$\lambda'_E = \frac{C'_E}{\nu} = \lambda\left(1 - \frac{0.974\Omega R}{c}\cos\Phi\right) \approx \lambda\left(1 - \frac{\Omega r}{c}\right) \quad (3.29)$$

$$\lambda'_W = \frac{|C'_W|}{\nu} = \lambda\left(1 + \frac{0.974\Omega R}{c}\cos\Phi\right) \approx \lambda\left(1 + \frac{\Omega r}{c}\right) \quad (3.30)$$

As in Sagnac: either (1) the variation of the speed of light, relative to the CRO –on Earth-, or (2) the variation of wavelengths of light to the East and West, (again relative to CRO), can explain classically and equivalently the appearance of M-G effect [9].

3. RE-INTERPRETED TESTS UNSUITABLE TO DETECT THE ETHER-DRIFT OF TSE!

(a) Re-interpreted Trouton-Noble experiment. Trouton and Noble [36] had tried to detect the ether-wind (of velocity υ) by means of a charged condenser. The charged condenser were hanged from a thin thread and initially was oriented (in an equilibrium state) to a random direction. The Earth were rotated about its axis but the angle between the polarization vector of the condenser and the velocity vector of the ether-wind in our LAB remains unchanged; as Earth rotates into the Terrestrial-Stokes'-ether (TSE) the velocity vector of the ether-wind is directed constantly from East to West in our LAB. The T-N experiment had had to show an absolutely zero effect.

(b) Re-interpreted Centarholm-Townes experiment [37].

two masers having opposite their molecular-beams were frequency-beating. the two masers were mounted on a table and they left to the rotation of the earth (about its axis) to change their orientation relative the assumed 'cosmic ether wind'. this experiment was unsuitable to detect any ether drift for the following two reasons: (i) the east-west ether drift on the lab was constant all the time of the experiment and the two masers had also constant orientation relative to the said ether wind. (ii) even if the masers could change their mutual orientation into the cosmic-ether-wind, then the fourth order (in ratio υ/c) frequency-differences of the two masers don't permit at all any sensible result of the experiment. this is proved as follows: by applying two times the emission formula (2.34) and under the condition of their parallel emissions fig. 17. we put in (2.34) for the first maser:

$$u_1 = \upsilon + u' \quad \cos\theta_1 = \frac{\upsilon}{c}$$

and for the second maser, we put in relation (2.34):

$$u_2 = \upsilon - u' \qquad \cos\theta_2 = \frac{\upsilon}{c}$$

it was $u' \approx 0.6$ km/s and $\nu = 2.4$ (10^{10} Hz)

After the substitution of the corresponding values, in relation (2.34), the differences of the emitted frequencies are found to be of fourth order (in ratio υ/c):

$$|\nu_1 - \nu_2| = \nu \left| \frac{\sqrt{1-\frac{u_1^2}{c^2}}}{1-\frac{u_1}{c}\cos\theta_1} - \frac{\sqrt{1-\frac{u_2^2}{c^2}}}{1-\frac{u_2}{c}\sigma\upsilon\nu\theta_2} \right| \approx 2\frac{(u')^3\upsilon}{c^4}\nu$$

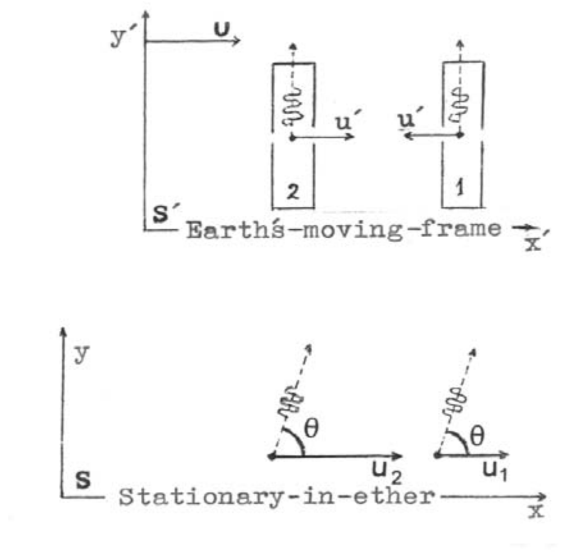


FIG. 17. The Centarholm-Townes et *al* test [37]

(c) ***Jaseya et al* [38] *expriment*.** In this experiment two lasers were beating mounted on a rotating table; these lasers were arranged perpendicularly the one to other, (similarity with Michelson-Morley). It could really be very difficult to detect the from-East-to-West ether-drift -of velocity 0.35 km/sec at mean latitudes- on the Earth, since:

$$2\Delta\nu \approx \nu \frac{\upsilon^2}{c^2} = 550\text{Hz}$$

This relatively small effect was much bellow the stability of lasers inside the magnetic field of the Earth [38].

(d) ***Re-interpreted Riis –Lee-Hall experiment*** (R-L-H)ri. By the Riis-Lee-Hall *et al* [39] experiment it was checked the constancy or more accurately the variation of the 'single-direction-speed of light'; it was found the result that the 'single-direction-speed of light' was varied as slightly as

$$\Delta c/c \leq 3(10^{-9}) \qquad (3.31)$$

i.e. it was found, for the speed of light on Earth, a variation smaller than 1m/s and thus the following question arises! How it can be explained the above (3.31) slight variation with our results (3.27) and (3.28) due to the ether-drift from-East-to-West (creating changes in the speed of light as large as 0.35 km/sec for the mean latitudes): $C'_E = c - 0.35$ km/sec and $C'_W = c + 0.35$ km/sec)?

Answer: There is not any opposition between this experiment and our theory of the East-to-West ether-drift on Earth; this happens because the said experimenters (R-L-H) had checked the changes of the speed of light along a definite-single-direction being all the time <u>into the meridian level of their LAB</u>; we know that the North-South speed of light have to be absolutely constant on the Earth; this explain why the result (3.31) co-exists (!) with the much greater variations of the speed of light to the East and West.

(e) Re-interpreted Turner-Hill experiment (T-H)ri. Turner and Hill in [24] had used a gamma emitter being close to the rim of a fast rotating rotor and a Mossbauer absorber near the center of the rotor (both of them being on the same geometric radius of the rotor). Their proper phenomenon was the 'transverse' Doppler effect (directing from the rim to the "central" absorber on rotor); but they had properly interested to detect and verify and the expected relativistic –SRT or GRT- '*coupling*' of the two velocity components of the 'emitting atom', i.e.: (i) of the linear one around the center of rotor ($\vec{\omega}\times\vec{R}$) and, (ii) of the cosmic one $\vec{V}$ (relative to the 'far-distant-mater-frame' FDMF). It was calculated [24] the projection of the cosmic velocity of the Earth on its equatorial plane equal to $\vec{V}_{eq}\approx 220$ km/sec. Turner-Hill (T-H) [24] had considered (erroneously) their experiment as a variation of Einstein's E-RACM method -[B.3 (b).(Part I)]- and thus they had expected to detect the said equatorial velocity component of the Earth $\{\vec{V}_{eq}\approx 220$ km/sec$\}$. But unfortunately for them T-H had found a greatly reduced result (<10^{-5} times) than the expected; thus T-H had forced to present the observed '*coupling*' of the two velocity vectors ($\vec{\omega}\times\vec{R}$) and $\vec{V}_{eq}$ by means of the identity-equation:

$$\frac{\Delta\nu}{\nu_o}\equiv-\frac{(\omega R)^2}{2c^2}\mp\frac{(\omega R)(\gamma V_{eq})}{c^2} \qquad (3.32)$$

In (3.32) the symbol $\equiv$ denotes here that T-H had assumed the existence of some theoretical "coupling" -(the term with $\mp$ symbols)-; T-H had found instead of the magnitude of $\vec{V}_{eq}$ the much smaller magnitudes: $\gamma V_x=\gamma V_y\approx 1.5\pm 7$ m/s, on the equatorial plane; i.e. they spoke about a "*very week coupling*", $\gamma<(1\pm 4)(10^{-5})$.

Certainly such a theoretical conclusion is misleading for the following two reasons:

First. If the '*ether*' of the '*privileged frame*' or any other '*cosmological fluid*' [40] of any '*far-distant-matter*', was influenced the Earth, then these influences have to interact on our atoms-clocks only by the unique strong coefficient $\gamma=1$, (as it was happened with Earth's, from-East-to-West, ether-drift –detected by Michelson-Gale [9] experiment), and not by the assumed [24, 40] '*weak- coupling-coefficients*' (which in reality are senseless), Second. The exposed bellow detailed theoretical study and re-interpretation of the T-H experiment –(T-H)ri- proves that it is simply unsuitable to detect the translation of the T-H rotor -(to the East)- in TSE; (i.e. it is not a **E**.RACM –which is applicable on rotating atomic clocks only- and not to the Mossbauer effect).

In trying to study accurately the T-H experiment, we will use: 1) the 'atomic emission formula' (2.34), 2) the 'atomic absorption one' (2.47), and 3) the necessarily 'Fresnel's –type aberration triangles of light' due to the ether-drift -or the same thing- due to the motion of the apparatus through the ether.

The emitter E is placed at the distance R=10 cm from the center O of rotation (ω=250 r/sec) and the absorber A is placed at the distance r = 1.14 cm from the axis O of the rotor; both emitter and absorber are on the same geometrical radius of rotor (Fig. 18).

Due to the translation of our LAB, -with velocity $\vec{V}$ - in TSE, the gamma ray doesn't be directed at A but it must be directed more eastern ('Fresnel's-type aberration triangle'). The aberration angle ε is given by the relation (Fig. 18):

$$\sin\varepsilon = \frac{r\sin(\omega t) + (Vt)\sin\Theta}{ct} \approx \frac{(r\omega)}{c} + \frac{V}{c}\sin\Theta \qquad (3.33)$$

It is sufficient to put $\sin(\omega t) \approx \omega t$ in order to avoid the appearance of terms higher than the 2[nd] order, in the description of the T-H experiment.

In order to find the Doppler-shift of the emitted line we apply the relation (2.34):

$$\frac{\nu_{em}}{\nu_{(\upsilon=0)}} = \frac{\sqrt{1-\frac{\upsilon_1^2}{c^2}}}{1-\frac{\upsilon_1}{c}\cos\theta_1} \approx \left(1-\frac{\upsilon_1^2}{2c^2}\right)\left[1+\frac{\upsilon_1}{c}\cos\theta_1 + \frac{\upsilon_1^2}{c^2}\cos^2\theta_1\right] \approx \left[1+\frac{\upsilon_1}{c}\cos\theta_1 + \frac{\upsilon_1^2}{c^2}\cos^2\theta_1 - \frac{\upsilon_1^2}{2c^2}\right] \qquad (3.34)$$

While in order to find the Doppler-shift of the line of the moving absorber we apply the relation (2.47):

$$\frac{\nu_{ab}}{\nu_{(\upsilon=0)}} = \frac{\sqrt{1-\frac{\upsilon_2^2}{c^2}}}{1-\frac{\upsilon_2}{c}\cos\theta_2} \approx \left(1-\frac{\upsilon_2^2}{2c^2}\right)\left[1+\frac{\upsilon_2}{c}\cos\theta_2 + \frac{\upsilon_2^2}{c^2}\cos^2\theta_2\right] \approx 1+\frac{\upsilon_2}{c}\cos\theta_2 + \frac{\upsilon_2^2}{c^2}\cos^2\theta_2 - \frac{\upsilon_2^2}{2c^2} \qquad (3.35)$$

{the absolute velocity of the emitter –relative to TSE- is υ_1 and its angle with the direction of the emitted ray is θ_1, while the absolute velocity of the absorber is υ_2 and its angle with the direction of the flying ray is θ_2, (Fig. 18)}

Subtracting (3.35) from (3.34) we get the relative shift between the lines of the emitter and the absorber:

$$\frac{\nu_{em}-\nu_{ab}}{\nu_{(\upsilon=0)}} \approx \left(-\frac{\upsilon_1^2}{2c}+\frac{\upsilon_2^2}{2c}\right)+\left(\frac{\upsilon_1}{c}\cos\theta_1-\frac{\upsilon_2}{c}\cos\theta_2\right)+\left(\frac{\upsilon_1^2}{c^2}\cos^2\theta_1-\frac{\upsilon_2^2}{c^2}\cos^2\theta_2\right) \tag{3.36}$$

The emitter has an absolute velocity (square) into ether (TSE):

$$\frac{\upsilon_1^2}{c^2}=\frac{(R\omega)^2}{c^2}+\frac{V^2}{c^2}+2\frac{(R\omega)V}{c^2}\sin\Theta \tag{3.37}$$

while the absorber has an absolute velocity (square) at the position M:

$$\frac{\upsilon_2^2}{c^2}=\frac{(r\omega)^2}{c^2}+\frac{V^2}{c^2}+2\frac{(r\omega)V}{c^2}\sigma\upsilon\nu\left[\pi-\Theta-\left(\frac{\pi}{2}-\omega t\right)\right]\approx\frac{(r\omega)^2}{c^2}+\frac{V^2}{c^2}-2\frac{(r\omega)V}{c^2}\sin\Theta \tag{3.38}$$

(we confine ourselves only in 2nd order terms)

Now we will calculate the projections of the velocities υ_1 and υ_2 on the direction of the emitted gamma ray (the dotted line of the aberration triangle), From Fig.18 we get:

$$\begin{aligned}\frac{\upsilon_1}{c}\cos\theta_1 &= \frac{\upsilon_1}{c}\cos[(\theta_1+\varepsilon)-\varepsilon]\approx\frac{\upsilon_1}{c}\cos(\theta_1+\varepsilon)+\frac{\upsilon_1}{c}\sin(\theta_1+\varepsilon)\sin\varepsilon\approx\\ &\approx-\frac{V}{c}\cos\Theta+\left[\frac{V}{c}\sin\Theta+\frac{R\omega}{c}\right]\left[\frac{V}{c}\sin\Theta+\frac{r\omega}{c}\right]\end{aligned} \tag{3.39}$$

and

$$\begin{aligned}\frac{\upsilon_2}{c}\sigma\upsilon\nu\theta_2 &= \frac{\upsilon_2}{c}\cos[(\theta_2+\varepsilon)-\varepsilon]\approx\frac{\upsilon_2}{c}\cos(\theta_2+\varepsilon)+\frac{\upsilon_2}{c}\sin(\theta_2+\varepsilon)\sin\varepsilon\approx\\ &\approx\frac{(r\omega)}{c}\sin(\omega t)-\frac{V}{c}\cos\Theta+\left[\frac{(r\omega)}{c}+\frac{V}{c}\sin\Theta\right]^2\approx\frac{r\omega^2(R-r)}{c^2}-\frac{V}{c}\cos\Theta+\left[\frac{r\omega}{c}+\frac{V}{c}\sin\Theta\right]^2\end{aligned} \tag{3.40}$$

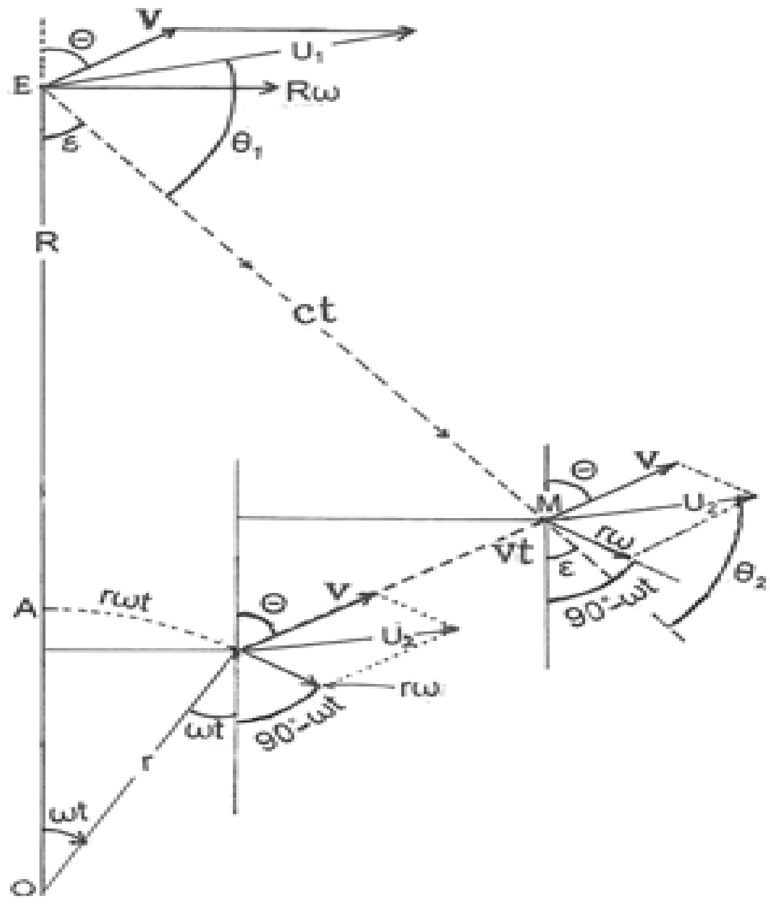


FIG. 18 Re-calculation of Turner-Hill [24] experiment

A point γ-emitter at E and a point-absorber at A, both of them were strengthened on the same geometrical radius of a fast rotor; the axis of rotation is at point O. It was OE $= R =10$ cm, and OA $= r =1.14$ cm; the angular speed $\omega = 250$ rps. Due to the motion of the apparatus in ether, -(with translational velocity V)-, a Fresnel-type aberrational "triangle" have to be taken into consideration: The γ-photon is emitted East-wards forming an angle ε with line OAE; during the time t, the photon covers the distance (ct) reaching at M, meanwhile the absorber A is subjected to two transpositions: (1) it describes an arc equal to ($r\omega t$), (2) it translates along the distance Vt, reaching finally at point M. Due to this manner of performance of the T-H experiment, it is proved (see Text), that the experiment is quite unsuitable for the detection of any coupling between the velocity-vectors $(\vec{\omega} \times \vec{R})$ and $\vec{V}$.

We have used above only the 'zero order time-interval' of flying ray

$$t \approx t_o \equiv \frac{R-r}{c}$$

since the use of the first order –more accurate- one:

$$t \approx t_1 \equiv \frac{(R-r)}{c}\left[1-\frac{V}{c}\cos\Theta\right]$$

it should introduce 3rd order terms which are out of our study.

From (3.39) and (3.40) by squaring and omitting the terms of order higher than 2nd , we get respectively

$$\frac{\upsilon_1^2}{c^2}\cos^2\theta_1 \approx \frac{V^2}{c^2}\cos^2\Theta \qquad (3.41)$$

$$\frac{\upsilon_2^2}{c^2}\cos^2\theta_2 \approx \frac{V^2}{c^2}\cos^2\Theta \qquad (3.42)$$

Substituting now (3.37), (3.38), (3.39), (3.40), (3-41), and (3.42) into (3.36) we finally get:

$$\frac{\nu_{em}-\nu_{ab}}{\nu_{(\upsilon=0)}} \approx -\frac{(R\omega)^2}{2c^2}+\frac{(r\omega)^2}{2c^2} \qquad (3.43)$$

i.e. we have find a clear difference between two transverse Doppler effects: that one of the emitter (with minus sign), minus (the minus sign) of the moving absorber.

Comparing (3.43) with the basic –by definition- relation (3.32), set by Turner and Hill, we see that they had endeavored essentially with the 'residual' Doppler term: $\frac{(r\omega)^2}{2c^2}$ (certainly into the uncertainties of the experiment); that is why it seems not accidental the following equality emerging from the T-H experiment data:

$$\frac{(r\omega)^2}{2c^2}=\left(\frac{17.9^2}{2c^2}\right)=\frac{160}{c^2}\equiv\left|\pm\frac{(\gamma V_x)(R\omega)}{c^2}\right|=\frac{(1.)(157)}{c^2}$$

(It was $R\omega$= 157 m/sec, $r\omega$= 17.9 m/sec at ω=250 rps and $\gamma V_x=\gamma V_y \approx 1.5\pm 7$ m/s).

Conclusively the T-H experiment (based on Mossbauer) was unsuitable to detect any coupling between the velocity vector $(\vec{\omega}\times\vec{R})$ of the emitter and the velocity $\vec{V}$ of rotor in the ether (TSE).

4. THE ATOMIC-CLOCKS "FEEL" THEIR MOTION THROUGH TSE; RE-INTERPRETED HAFELE-KEATING -(H-K)RI- EXPERIMENT AND GPS' 'TIME-KEEPING'.

The function of the atomic-clocks is based on the phenomenon of the absorption by a moving atom (Cs). A beam of Cs-atoms intersects (normally) a wave-guide through which an (electronically generated) resonant radiation is propagated. We will now see how a Cs-atomic-clock can reveal in general its motion through the TSE.

(a) ***Cs-atoms intersecting a horizontal wave-guide***. Fig. 19 shows a Cs-atom being inside a horizontal wave-guide forming an angle Θ with the direction of the East; let the velocity of the Cs-beam be the horizontal vector $\vec{u}$ which is always perpendicular to the wave-guide. Vector $\vec{w}$ points to the East and is the linear (horizontal) velocity of the surface of the Earth due to the rotation about its axis. According to relation (3.26), the vector: $(0.974\vec{w})$, represents the velocity of Earth's surface relative to TSE (more accurately relative to CEE –the ether being closest to Earth-); we don't do thus significant error if we consider here the vector $\vec{w}$ as the net velocity of Earth's surface through the CEE or TSE; vector $\vec{\upsilon}_\alpha$ is the (horizontal) velocity of the airplane relative to the ground (vector $\vec{\upsilon}_\alpha$ forms an angle φ with the East i.e. with vector $\vec{w}$). In order to calculate now the rate of the moving-in-TSE atomic-clock, we have to take in mind the following:

1). Inside the jet-airplane the Cs-atom (Fig. 19) has a total velocity $\vec{\upsilon} = \vec{w} + \vec{\upsilon}_\alpha + \vec{u}$ relative to TSE and the absorbed frequency of the Cs-atom is given by relation (2.47) which becomes (here $\nu_{(\upsilon=0)}$ is the proper frequency of Cs atom):

$$\nu_\upsilon = \nu_{(\upsilon=0)} \frac{\sqrt{1-\frac{\left|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}\right|^2}{c^2}}}{1-\frac{\left|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}\right|}{c}\cos\theta} \tag{3.44}$$

2). Relative to the clock or jet-airplane, the bulk of the electromagnetic wave is flying along the guide-line, but relative to an observer resting in ether (TSE) the wave-crest must be directed at an angle ε forward [i.e. we have, as it expected, a Fresnel-type aberration of the generated radiation into the wave-guide due to the velocity $(\vec{w}+\vec{\upsilon}_\alpha)$ of the apparatus through TSE]. Meanwhile the electronically generated (by the electronic circuit) resonant electromagnetic oscillation of frequency ν_r, is propagated in the space around as a Doppler-shifted radiation of frequency ν_r':

$$\nu_r' = \nu_r \frac{1}{1-\frac{\left|\vec{w}+\vec{\upsilon}_\alpha\right|}{c}\cos\vartheta} \tag{3.45}$$

[here ϑ is the angle (Fig. 19) between the velocity $(\vec{w}+\vec{\upsilon}_\alpha)$ of the wave-guide in TSE and the direction of the propagated resonant radiation relative to stationary ether (TSE)]. And is this very frequency ν_r' that is absorbed by Cs-atom i.e.

$$\nu_r' = \nu_\upsilon \tag{3.46}$$

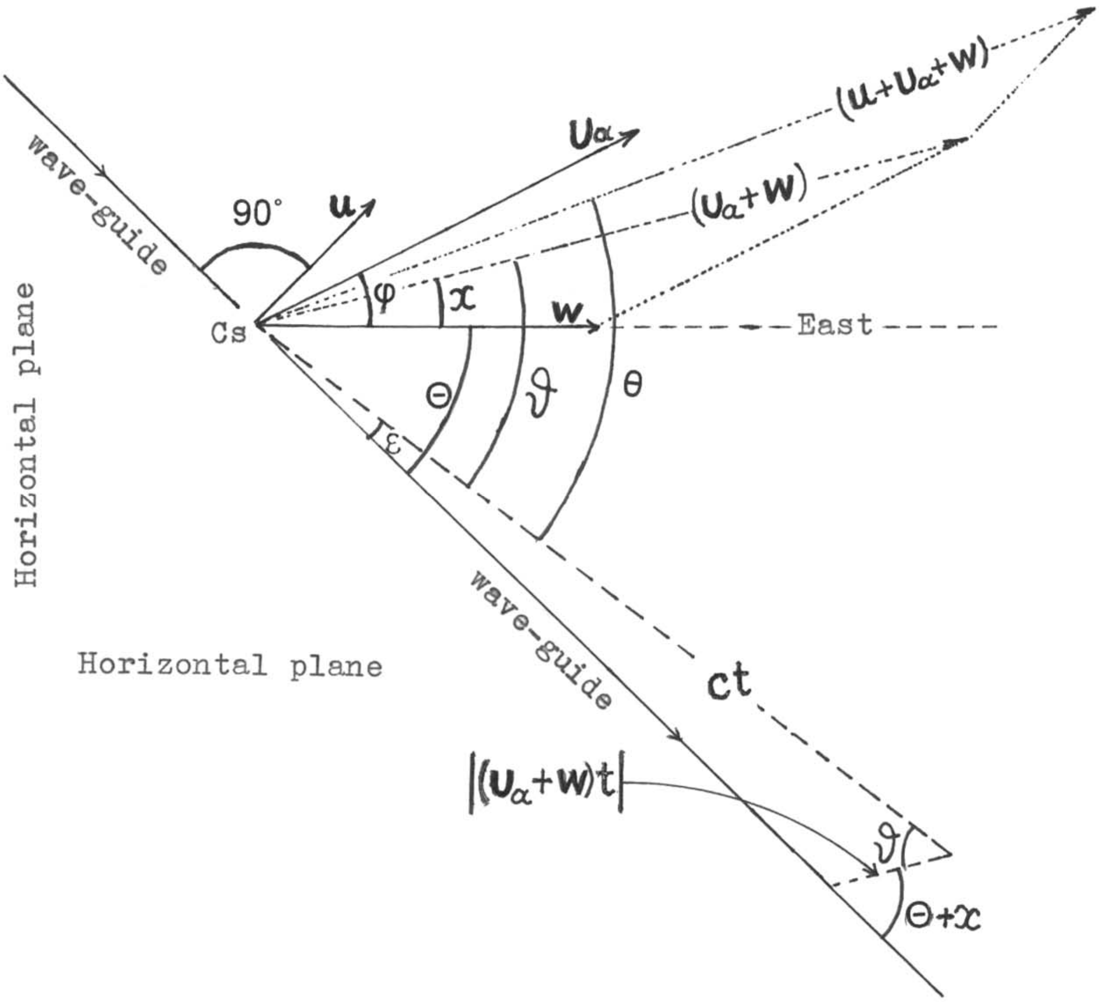


FIG. 19. Re-interpreted Hafele-Keating experiment (H-K)ri (and GPS) -horizontal wave guide-

The Figure 19 shows a Cs-atom inside a horizontal wave-guide forming an angle Θ with the direction of the East; the horizontal vector u is the velocity of the Cs-beam, which is always perpendicular to the wave guide. Vector w points to the East and is the linear (horizontal) velocity of the surface of the Earth due to the rotation about its axis, vector υ_α is the (horizontal) velocity of the (jet) airplane relative to the ground (vector υ_α forms an angle φ with the East i.e. with vector w). Relative to the clock aboard airplane, the bulk electromagnetic wave is flying along the guide-line, but relative to an observer resting in ether (TSE) the wave-front must be directed at an angle ε forward [i.e. we have, a Fresnel-type aberration of the propagated radiation into the wave-guide due to the vector velocity ($w+\upsilon_\alpha$) of the apparatus through TSE]. Terrestrial -Stokes'- ether (TSE) forms a protective shelter around Earth, protecting Earth from the appearance of any cosmic ether-drift in our Labs. Into this TSE the moving- absorbing Cs-atoms do feel the existence of the ether-drift obeying to the absorption formula (2.47). That is why, in agreement with H-K data (and GPS), the time-differences between the flying and ground-based clocks are really depended from their linear velocities relative to Earth's non-rotating frame only. {According the GRT and SRT there has to occur a "coupling" of Earth's cosmic velocity V , -around Sun or the center of our galaxy,- with the known linear velocities of the clocks circumnavigating (or orbiting) Earth; and this "coupling" –relations (1.33),(1.34)- should entirely blur the H-K results and should create a different behavior of GPS's clocks during the period of the orbit}.

Substituting (3.44) and (3.45) into (3.46) we get the relation between the resonant frequency ν_r, of the electronic circuit of the clock, and the proper frequency $\nu_{(\upsilon=0)}$ of Cs-atom:

$$\nu_r = \nu_{(\upsilon=0)} \frac{1-\frac{|\vec{w}+\vec{\upsilon}_\alpha|}{c}\cos\vartheta}{1-\frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|}{c}\cos\theta}\sqrt{1-\frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|^2}{c^2}} \qquad (3.47)$$

And this exactly the resonant frequency ν_r is the rate at which the atomic-clock operates; to say it somewhat differently 'the atomic-clocks go as their resonant frequencies'.

In order now to simplify the relation (3.47) we omit the terms higher than the second order (in ratio υ / c)

$$\frac{\nu_r}{\nu_{(\upsilon=0)}} \approx 1-\frac{|\vec{w}+\vec{\upsilon}_\alpha|}{c}\cos\vartheta+\frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|}{c}\cos\theta+\frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|^2}{c^2}\cos^2\theta-\frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|^2}{2c^2}-\frac{|w+\upsilon_\alpha|}{c}\cos\vartheta\frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|}{c}\cos\theta \qquad (3.48)$$

By looking at Fig.19, we have

$$\sin\varepsilon = \frac{|\vec{w}+\vec{\upsilon}_\alpha|}{c}\sin(\Theta + x) = \frac{w}{c}\sin\Theta + \frac{\upsilon_\alpha}{c}\sin(\Theta+\varphi) \qquad (3.49)$$

and

$$\frac{|\vec{w}+\vec{\upsilon}_\alpha|}{c}\cos\vartheta = \frac{|\vec{w}+\vec{\upsilon}_\alpha|}{c}\cos[(\vartheta+\varepsilon)-\varepsilon] \approx \frac{|\vec{w}+\vec{\upsilon}_\alpha|}{c}\cos(\vartheta+\varepsilon)+\frac{|\vec{w}+\vec{\upsilon}_\alpha|}{c}\sin(\vartheta+\varepsilon)\sin\varepsilon \approx$$

$$\approx \frac{|\vec{w}+\vec{\upsilon}_\alpha|}{c}\cos(\Theta+x)+\frac{|\vec{w}+\vec{\upsilon}_\alpha|}{c}\sin(\Theta+x)\sin\varepsilon = \frac{w}{c}\cos\Theta+\frac{\upsilon_\alpha}{c}\cos(\Theta+\varphi)+\sin^2\varepsilon \qquad (3.50)$$

and

$$\frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|}{c}\cos\theta = \frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|}{c}\cos[(\theta+\varepsilon)-\varepsilon] \approx \frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|}{c}\cos(\theta+\varepsilon)+\frac{|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}|}{c}\sin(\theta+\varepsilon)\sin\varepsilon$$

$$\approx \frac{w}{c}\cos\Theta+\frac{\upsilon_\alpha}{c}\cos(\Theta+\varphi)+\left[\frac{u}{c}+\frac{\upsilon_\alpha}{c}\sin(\Theta+\varphi)+\frac{w}{c}\sin\Theta\right]\left[\frac{w}{c}\sin\Theta+\frac{\upsilon_\alpha}{c}\sin(\Theta+\varphi)\right] \qquad (3.51)$$

and by squaring the relation (3.51) and omitting the terms higher than the second order, we get

$$\frac{\left|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}\right|^2}{c^2}\cos^2\theta=\frac{w^2}{c^2}\cos^2\Theta+\frac{\upsilon^2{}_\alpha}{c^2}\cos^2(\Theta+\varphi)+2\frac{w\upsilon_\alpha}{c^2}\cos\Theta\cos(\Theta+\varphi) \tag{3.52}$$

and also

$$\left|\vec{w}+\vec{\upsilon}_\alpha+\vec{u}\right|^2=\left[w+\upsilon_\alpha\cos\varphi+u\sin\Theta\right]^2+\left[u\cos\Theta+\upsilon_\alpha\sin\varphi\right]^2 \tag{3.53}$$

Substituting now (3.49), (3.50), (3.51) (3.52) and (3.53) into (3.48) it becomes finally:

$$\frac{\nu_r}{\nu_{(\upsilon=0)}}\approx 1-\frac{u^2}{2c^2}-\frac{w^2}{2c^2}-\frac{\upsilon_\alpha^2}{2c^2}-\frac{w\upsilon_\alpha}{c^2}\cos\varphi \tag{3.54}$$

The result (3.54) is independent of the orientation of the atomic-clock. Relation (3.54) relates the resonant ν_r frequency of the electronic circuit of the atomic-clock with the proper frequency $\nu_{(\upsilon=0)}$ of Cs-atom; this exactly the resonant frequency ν_r is the rate at which the atomic-clock operates.

Now for the atomic clock aboard the flying airplane we have: $\upsilon_\alpha\neq 0$ and the resonant frequency is noted as $\nu_{(R+H),(\alpha)}$, and for the fixed clock on the ground we have: $\upsilon_\alpha=0$ and the resonant frequency is noted as $\nu_{R,(gr)}$; the sub indices R and H are to denote Earth's radius and the height of the airplane respectively.

We have the following relation between the time-indications of the said atomic-clocks:

$$\frac{\tau_\alpha-\tau_{gr}}{\tau_{gr}}=\frac{\nu_{(R+H),(\alpha)}}{\nu_{R,(gr)}}-1 \tag{3.55}$$

The resonant frequency of the flying clock is given (the kinematical terms only), by (3.54) (for $\upsilon_\alpha\neq 0$), while the same relation for $\upsilon_\alpha=0$ gives the resonant frequency for the clock fixed on the ground:

$$\frac{\nu_{R,(gr)}}{\nu_{(\upsilon=0)}}\approx 1-\frac{u^2}{2c^2}-\frac{w^2}{2c^2} \tag{3.56}$$

Substituting now (3.54) and (3.56) in (3.55) we obtain the "kinematical terms" of H-K experiment

$$\tau_\alpha-\tau_{gr}\approx\tau_{gr}\left(-\frac{\upsilon_\alpha{}^2}{2c^2}-\frac{w\upsilon_\alpha}{c^2}\cos\varphi\right) \tag{3.57}$$

The terms due to the gravity potential differences are taken from the relations **(**2.128**)** and (2.129) and the relation (3.55) is completed:

$$\tau_\alpha - \tau_{gr} \approx \tau_{gr}\left(-\frac{\upsilon_\alpha^{\ 2}}{2c^2} - \frac{w\upsilon_\alpha}{c^2}\cos\varphi + \frac{g\mathrm{H}}{c^2} \right) \qquad (3.58)$$

The relation (3.58) is identical to that one verified experimentally by Hafele and Keating [13]. The experimental verification of the relation (3.58) in [13] shows that the atomic-clocks fixed on ground "do feel" the East-to-West ether-drift, while the flying ones, "do feel" the resultant ether-drift of TSE due to Earth's rotation about its axis and the simultaneous motion of the airplane. TSE forms a protective shelter around Earth, protecting Earth from the appearance of any cosmic ether-drift in our Labs. That is why, in agreement with H-K result, the time-differences between flying and ground-based clocks are really depended from their linear velocities relative to Earth's non-rotating frame only. {According the GRT there have to be a coupling of Earth's cosmic velocity $\vec{V}$, -around Sun or the center of our galaxy,- with the known linear velocities of the clocks circumnavigating Earth –relation (1.33)-; this coupling should entirely blur the H-K results}.-

(b) ***Cs-atoms intersecting a vertical wave-guide.*** Fig. 20 shows a Cs-atom inside a vertical wave-guide. The Cs-atom is moving with a horizontal velocity $\vec{u}$ relative to the guide and perpendicular to it; $\vec{w}$**(**horizontal vector pointing to the East) is the linear velocity of the surface of the Earth, relative to TSE, due to the rotation of Earth about its axis; $\vec{\upsilon}_a$(horizontal vector) is the velocity of the jet air-plane relative to the ground (it forms an angle φ with $\vec{w}$). A Cs-atom inside the air-plane has a velocity vector: ($\vec{u}+\vec{w}+\vec{\upsilon}_\alpha$**)** and the wave-guide has a velocity: ($\vec{w}+\vec{\upsilon}_\alpha$) relative to TSE. The bulk of E/M-wave is guided along the vertical line zz' **;** but because of a Fresnel-type aberration it really be directed at an angle ε forward relative to an observer resting in ether; this angle ε is drew in the vertical plane that is determined by the horizontal vector ($\vec{\upsilon}_\alpha + \vec{w}$) and by the vertical wave-guide zz' (Fig. 20). It is

$$\sin\varepsilon = \frac{|\vec{\upsilon}_\alpha + \vec{w}|}{c} \qquad (3.59)$$

The angles θ and $\vartheta = 90^{\,o} - \varepsilon$ are depicted in Fig.20; from the spherical triangle DFG we have [41] the relation:

$$\cos\theta = \cos\vartheta\cos\mu = \sin\varepsilon\cos\mu \qquad (3.60)$$

$$\cos\theta = \frac{|\vec{\upsilon}_\alpha + \vec{w}|}{c}\cos\mu \qquad (3.61)$$

Substituting relations (3.59), (3.60) and (3.61) into (3.48) and neglecting the terms of higher than second order it becomes

$$\nu_r \approx \nu_{(\upsilon=0)}\left[1-\frac{\left|\vec{\upsilon}_\alpha+\vec{w}\right|^2}{c^2}+\frac{\left|\vec{u}+\vec{\upsilon}_\alpha+\vec{w}\right|\left|\vec{\upsilon}_\alpha+\vec{w}\right|}{c^2}\cos\mu-\frac{\left|\vec{u}+\vec{\upsilon}_\alpha+\vec{w}\right|^2}{2c^2}\right] \qquad (3.62)$$

On the other hand with the help of Fig. 20 we have:

$$\begin{aligned}\left|\vec{u}+\vec{\upsilon}_\alpha+\vec{w}\right|\cos\mu &= \left|\vec{u}+\vec{\upsilon}_\alpha+\vec{w}\right|\cos\left[(x+\mu)-x\right]=\left|\vec{u}+\vec{\upsilon}_\alpha+\vec{w}\right|\left[\cos(x+\mu)\cos x+\sin(x+\mu)\sin x\right]\\ &=(w+\upsilon_\alpha\cos\varphi+u\cos\psi)\cos x+(\upsilon_\alpha\sin\varphi+u\sin\psi)\sin x\end{aligned} \qquad (3.63)$$

$$\begin{aligned}\left|\vec{u}+\vec{\upsilon}_\alpha+\vec{w}\right|\left|\vec{\upsilon}_\alpha+\vec{w}\right|\cos\mu &= (w+\upsilon_\alpha\cos\varphi+u\cos\psi)\left|\vec{\upsilon}_\alpha+\vec{w}\right|\cos x+(\upsilon_\alpha\sin\varphi+u\sin\psi)\left|\vec{\upsilon}_\alpha+\vec{w}\right|\sin x\\ &=(w+\upsilon_\alpha\cos\varphi+u\cos\psi)(w+\upsilon_\alpha\cos\varphi)+(\upsilon_\alpha\sin\varphi+u\sin\psi)\upsilon_\alpha\sin\varphi\end{aligned} \qquad (3.64)$$

and also

$$\left|\vec{\upsilon}_\alpha+\vec{w}\right|^2=\upsilon_\alpha^2+w^2+2\upsilon_\alpha w\cos\varphi \qquad (3.65)$$

$$\left|\vec{u}+\vec{\upsilon}_\alpha+\vec{w}\right|^2=(w+\upsilon_\alpha\cos\varphi+u\cos\psi)^2+(\upsilon_\alpha\sin\varphi+u\sin\psi)^2 \qquad (3.66)$$

Substituting (3.63), (3.64), (3.65) and (3.66) into (3.62) it becomes

$$\frac{\nu_r}{\nu_{(\upsilon=0)}}\approx 1-\frac{u^2}{2c^2}-\frac{w^2}{2c^2}-\frac{\upsilon_\alpha^2}{2c^2}-\frac{w\upsilon_\alpha}{c^2}\cos\varphi \qquad (3.67)$$

The rest procedure is similar to that followed in case (a). The atomic clocks of GPS orbiting around Earth obey the same formula (3.58) with the evident substitution: $w=0$

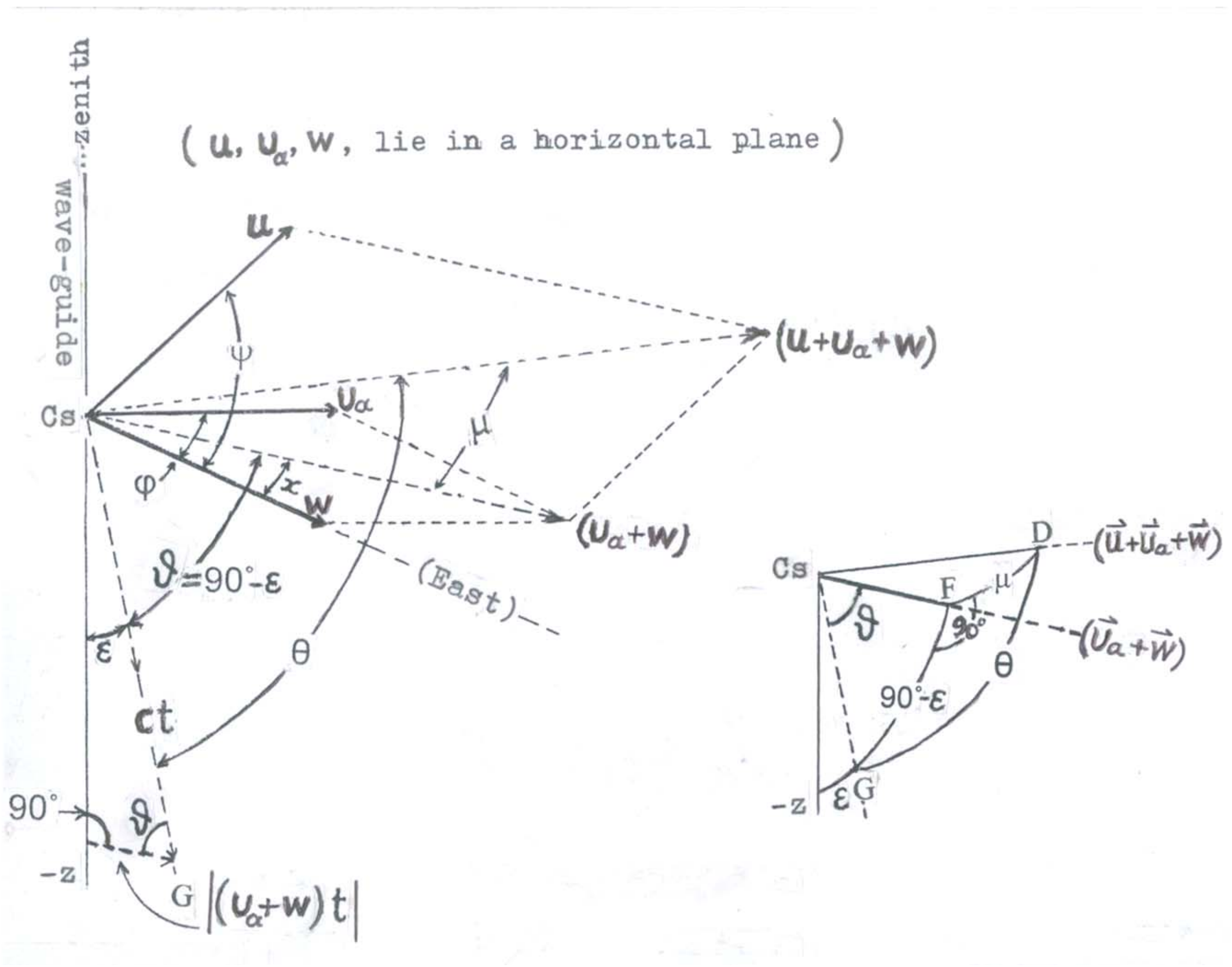


FIG. 20 Re-interpreted Hafele-Keating experiment (and GPS) -vertical wave guide-

This figure shows a Cs-atom inside a vertical wave-guide. The horizontal vector u is the velocity of the Cs-beam which is always perpendicular to the wave-guide. Vector w points to the East and is the linear (horizontal) velocity of the surface of the Earth due to the rotation about its axis; vector υ_α is the (horizontal) velocity of the (jet) airplane relative to the ground (vector υ_α forms an angle φ with the East ie with vector w). Relative to the clock or airplane, the bulk electromagnetic wave is guided along the vertical guide, but relative to an observer resting in ether (TSE) the wave-front must be directed at an angle ε forward [ie we have, a Fresnel-type aberration of the propagated radiation into the wave-guide due to the velocity ($\boldsymbol{w}+\upsilon_\alpha$) of the apparatus through TSE]. Terrestrial- Stokes'-ether (TSE) forms a protective shelter around Earth, protecting Earth from the appearance of any cosmic ether-drift in our Labs. Into this TSE the moving-absorbing Cs-atoms are obeying to the absorption formula (2.47). That is why, in agreement with H-K result (and GPS data), the time-differences between flying and ground-based clocks are really depended from their linear velocities relative to Earth's non-rotating frame only. {According the GRT (and SRT) there has to occur a "coupling" of Earth's cosmic velocity V, around Sun or the center of our galaxy-, with the known linear velocities of the clocks circumnavigating (or orbiting) Earth; this "coupling" -relations (1.33), (1.34)- should entirely blur the H-K results and should create a different behavior in some of GPS clocks during a period of the orbit}.

5. BRILLET-HALL RE-INTERPRETED -(B-H)RI- EXPERIMENT DETERMINES THE VELOCITY OF OUR LAB THROUGH TSE

After the introduction of the Terrestrial Stokes's-ether (TSE) on Earth, the spinning of the Earth about its axis, forces Earth (and Earth-based Labs), to become transparent to a continuous -from-East-to-West, low-velocity ether-drift; although Brillet and Hall in [25] had claimed a 'high-degree-isotropy' of cosmic space relative to the speed of light, yet their experiment have really been revealed a Fresnel-type low-velocity ether-drift due to the rotation of the Earth about its axis.

Aspden in [42] very rightly suspects that the amplitude signal of '17 Hz', at the 2nd harmonics (2Θ) -of the table rotation- found by B-H [25], is due to the rotation of the Earth around its axis but unfortunately for him his proof and calculations are not-correct. He erroneously introduces frequency changes between some mirrors of the arrangement due to the 'translational' motion of the LAB; but if such a case was really in rule we would have the concrete mirror to receive ν_{re} wavelengths and emit ν_{em} wavelengths per second; and any relation of the form: $\nu_{re} > \nu_{em}$ or $\nu_{re} < \nu_{em}$, in our Lab, should leads to a direct catastrophe of the constancy of the optics on Earth since the space before or after the said mirror would have to be evacuated entirely or infinitely be condensed with wave-crests of light.

Under the spirit now of our theory of TSE, the Brillet-Hall (B-H) [25] experimental data, can very accurately be calculated on the basis of the principles classical optics applied on circuits of light or arrangements moving –from-the-West-to-the-East-through the stationary TSE.

In order to analyze in details the B-H result we have to study first three partial and auxiliary (related) problems: (a) A rod AB, is moving translationally in ether, which is the time needed for the light to cover the distance AB? (b) About the "reflection of a plane-wave of light by a mirror moving in ether" - application to Brillet-Hall open-rectangular arrangement. (c) About the "optical standing-wave conditions at the end-mirrors of a moving-in-ether Fabry-Perrot interferometer" - application to B-H experiment.

(a) *A rod AB, is moving translationally, with a velocity $\vec{V}$ in ether, which is the time needed for the light to cover the distance AB?* We will calculate the time in terms of a stationary observer in ether. As the classical-ether wave-theory of light (CEWTL) imposes, the speed of light in ether remains independent from the velocity of the emitting source. Due to the real motion of our Labs, from the West to the East in TSE, the light ray has to be emitted not accurately from A to B, but more Eastern, in an angle ε (Fresnel – type aberration triangle –Fig. 21). From Fig. 21 we have:

$$S = ct\cos\varepsilon + Vt\cos\theta \qquad (3.68)$$

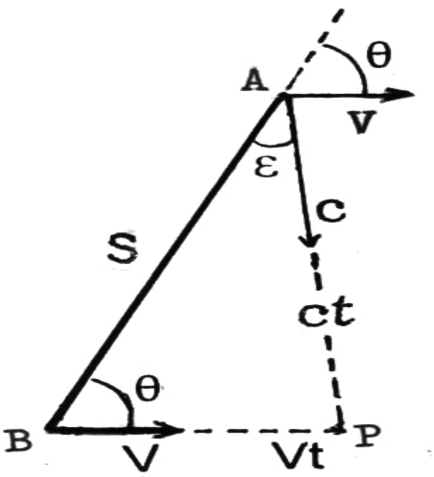


FIG. 21 Fresnel – type aberration in Terrestrial –Stokes- ether

As the classical-ether wave-theory of light (CEWTL) imposes, the speed of light in ether remains independent from the velocity of the emitting source. From the point of view of a stationary observer, in the Terrestrial Stokes ether (TSE), the light ray have to be emitted from A, not accurately to point B, but more Eastern, at an angle ε (Fresnel – type aberration triangle).

Solving for time we get

$$t_{A->B} = \frac{S}{c\left(\cos\varepsilon + \frac{V}{c}\cos\theta\right)} \qquad (3.69)$$

From Fig. 21 we also have:

$$\sin\varepsilon = \frac{V}{c}\sin\theta \qquad (3.70)$$

and $$\cos\varepsilon = \sqrt{1-\sin^2\varepsilon} \approx 1 - \frac{V^2}{2c^2}\sin^2\theta \qquad (3.71)$$

With the help of (3.71), and by omitting the terms of higher order than the second (in the ratio V/c), we get from (3.69) relation:

$$t_{A->B} \approx \frac{S}{c}\left[1 - \frac{V}{c}\cos\theta + \frac{3V^2}{4c^2} + \frac{V^2}{4c^2}\cos 2\theta\right] \qquad (3.72)$$

The number of contained wavelengths between A and B is

$$N_{(\theta,V)} = \frac{S}{c}\nu\left[1 - \frac{V}{c}\cos\theta + \frac{3V^2}{4c^2} + \frac{V^2}{4c^2}\cos 2\theta\right] \qquad (3.73)$$

here ν is the frequency of the light as it perceived on AB (proper frequency).

(b1) *About the "reflection of a plane-wave of light by a mirror moving in ether"* In, Fig. 22, the plane wave-front AB is coming from the left side of the page and hits the mirror for the first time ($t = 0$) at the point A. The other end of the wave-front will hit the moving mirror after a time t; we thus have: $BD = ct$. But at the same time, the first elementary spherical wave, emitted from the point A at the moment $t = 0$, travels a distance ct. Thus the new wave-front is found by drawing the tangent from the point D to the circle of radius ct. If the emerging wave-front is ED we also have $AE = ct$; and angle $AED = \pi/2$, it also is angle $ABD = \pi/2$. Suppose that the straight lines BD and ED intersect the initial position of the mirror at the points H and G respectively. The transverse displacement of the mirror is $FD = Vt\cos\varphi$; α_1 is the angle of incidence α_2 is the angle of reflection; we have from Fig. 22:

$$AH\sin\alpha_1 = BD + \frac{DF}{\cos\alpha_1} = ct + \frac{(V\cos\varphi)t}{\cos\alpha_1} \qquad (3.74),$$

$$FH = DF\tan\alpha_1 = (V\cos\varphi)t\tan\alpha_1 \qquad (3.75)$$

and also

$$AG\sin\alpha_2 = AE = ct \qquad (3.76)$$

$$FG = \frac{DF}{\tan\alpha_2} = \frac{(V\cos\varphi)t}{\tan\alpha_2} \qquad (3.77)$$

but from (3.74) and (3.75) we get

$$AF = AH - FH = \frac{ct}{\sin\alpha_1} + \frac{(V\cos\varphi)\cdot t}{\tan\alpha_1}$$

and from (3.76) and (3.77) we have

$$AF = AG - FG = \frac{ct}{\sin\alpha_2} - \frac{(V\cos\varphi)\cdot t}{\tan\alpha_2}$$

Equating the right-hand parts of the above two last relations we finally get the law of reflection of light by a moving plane mirror with a transverse velocity component (parallel to its surface normal) equal to $(V\cos\varphi)$:

$$\sin\alpha_2 - \sin\alpha_1 = -\frac{(V\cos\varphi)}{c}\cdot\sin(\alpha_2+\alpha_1) \tag{3.78}$$

From this relation we can get some important results:

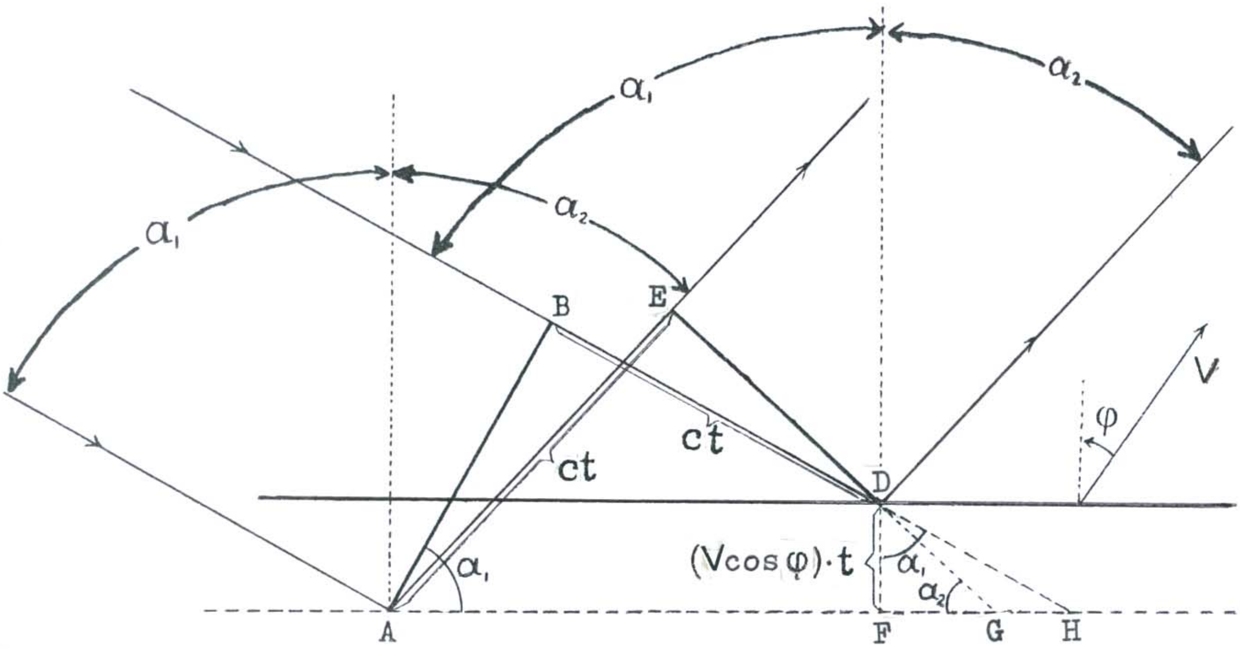


FIG. 22. Reflection of a plane wave of light by a mirror moving in ether

Huygens Principle rules the reflection of light; while the speed of light in ether remains always independent, from the velocity of the emitting (primary or secondary) source. The plane wave-front AB is coming from the left side of the page and hits the mirror for the first time ($t=0$) at the point A. The other end of the wave-front will hit the moving mirror after a time t; we thus have $BD=ct$. But at the same time, the first elementary spherical wave, emitted from the point A at the moment $t=0$, travels a distance ct. Thus the new wave-front is found by drawing the tangent from the point D to the circle of radius ct. If the emerging wave-front is ED we also have $AE=ct$ and angle $AED=\pi/2$, it is also angle $ABD=\pi/2$. The angle of reflection α_2 is generally different than the angle of incidence α_1.

1) When $V=0$, we have the ordinary law of reflection: $\alpha_2=\alpha_1$.

2) When $\alpha_1=0$, then $\alpha_2=0$ for all V.

3) When $V\cos\varphi = 0$, i.e. when the mirror slides in its own plane we have also $\alpha_2 = \alpha_1$; in other words the effect $\alpha_2 \neq \alpha_1$ is produced only by the velocity component $V\cos\varphi$ normal to the plane of the mirror. As Fig. 22 shows, we take $V\cos\varphi > 0$ if the mirror moves toward the part of space where the light rays are. The angle is measured counterclockwise from vector V to the normal on the mirror.

4) For the case where $V\cos\varphi > 0$, we have: $\alpha_2 < \alpha_1$.

5) For a light ray propagating along this line (to the right side of the page) and a mirror, forming 45^o with the line of propagation, also moving to the right side of the page (with velocity V), the reflected ray excess the 90^o angle (with incident ray) in an angle: V/c (rads); this exactly is a theoretical explanation why, in the Text books, are drawed thus the rays which are reflected from the central mirror of a moving Michelson-Morley interferometer.

(b2) *Application of (3.78) to Brillet-Hall open-rectangular arrangement.* In Fig 23 is represented the path of light rays in the -slowly rotating- table of B-H [25] arrangement. For a stationary-in-ether (no-translating) arrangement the light starts from A and falls on the mirror B (solid line) with an angle of incidence 45^o and then is reflected at right angle (solid line) directing to the mirror D with an angle of incidence 45^o and then is reflected at right angle (solid line) directing to the perpendicular mirrors K of the Fabry-Perrot.

Now we will apply the relation (3.78) for the reflected rays, when the B-H arrangement is translating in TSE with velocity V to the East (Fig. 23).

1) The light ray from A to B (Fig. 23) has to be emitted more Eastern in an aberrational angle η, we have:

$$\sin\eta = \frac{V}{c}\sin\Theta \qquad (3.79)$$

2) The light ray falls on mirror B with an angle of incidence $\beta_1 = (\frac{\pi}{4} + \eta)$ and is reflected by it at a reflecting angle $\beta_2 = (\frac{\pi}{4} - \rho)$; applying the formula (3.78) for this case of reflection at B mirror, where $\varphi = (\Theta - \frac{\pi}{4})$, we get

$$\sin(\frac{\pi}{4} - \rho) - \sin(\frac{\pi}{4} + \eta) \approx -\frac{V}{c}\cos(\Theta - \frac{\pi}{4})$$

from this relation and relation (3.79) we get -in terms of first order in ratio (V/c)-:

$$\sin\rho = \frac{V}{c}\cos\Theta = \frac{V}{c}\sin(90^o + \Theta) \qquad (3.80)$$

The relation (3.80) means that the law (3.78) of reflections is compatible with the ruling of the second aberrational triangle BDD' (of Fig. 23).

3) The light ray falls on mirror D with an angle of incidence $d_1 = (\frac{\pi}{4} + \rho)$ and is reflected by it at an angle of reflection $d_2 = (\frac{\pi}{4} + \kappa_1)$; applying the formula (3.78) for this case of reflection at the mirror D, with $\varphi = (\Theta + \frac{\pi}{4})$, we get:

$$\sin(\frac{\pi}{4} + \kappa_1) - \sin(\frac{\pi}{4} + \rho) \approx -\frac{V}{c}\cos(\Theta + \frac{\pi}{4})$$

from this relation and the relation (3.80) we get, in terms of first order in the ratio (V/c), the relation: $\sin\kappa_1 = \frac{V}{c}\sin\Theta \quad (3.81)$

The relation (3.81) means that the law (3.78) of reflections is compatible with the ruling of the third aberrational triangle DKK' (of Fig. 23).

4) Finally the light falls on the end-mirror K of the Fabry-Perrot with the angle κ_1 of incidence, of course the relation (3.78) for the reflection predicts an equal angle of reflection κ_2 (Fig. 23), since it is $\sin\kappa_2 = \sin\kappa_1 = \frac{V}{c}\sin\Theta = \sin\eta$ i.e.

$$\kappa_2 = \kappa_1 = \eta \qquad (3.82)$$

All above mean that we can very well apply separately for the light pencils AB, BD and DK etc, of the B-H arrangement, the related aberrational triangles and the corresponding formulas (3.72) for the travel-time of light.

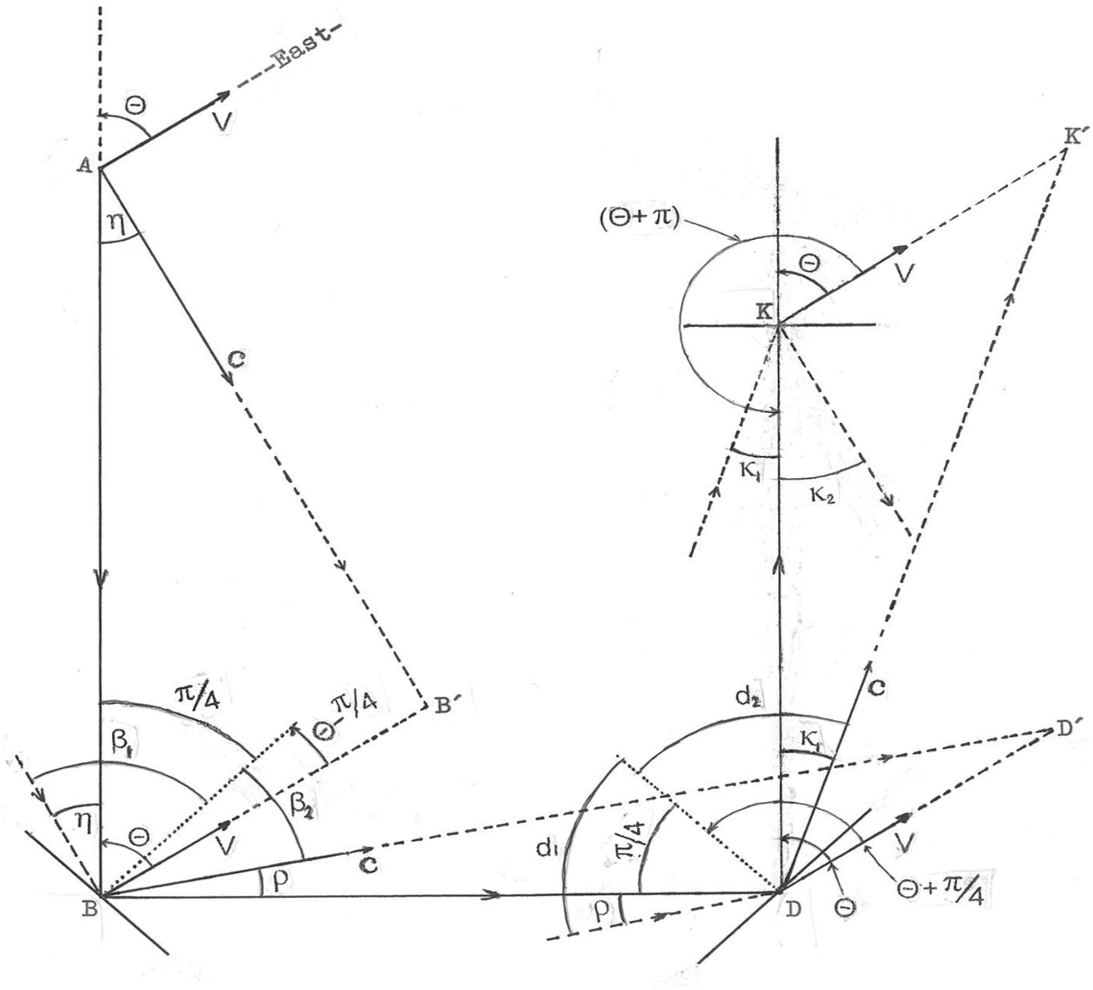


FIG. 23 Successive reflections and aberration-triangles, in Brillet-Hall rectangular, arrangement.

If the B-H apparatus was absolutely stationary, in Terrestrial Stokes ether, the light should accurately be propagated along the straight segments AB , BD , and DK , reflected at right angles by the mirrors B and D . Relative (again) to the stationary observer in ether, the translation of the arrangement with velocity V to the East, forces the light to start from A and to be directed more Eastern in an angle η –aberration triangle ABB' - and this introduces a first change in the angle of incidence on mirror B ; but additionally, *i.e.* relative to the same resting observer in ether, the motion of the mirrors –in ether- changes and the reflection-angles by them, introducing thus the aberration triangles BDD' and DKK' etc. The final result is that (see Text), relative to the translating apparatus (and observer) and with first order (V/c) approximation, the light is "seen" to follow the path along the segments: AB , BD , and DK etc, reflecting apparently at right angles, i.e. **relative to the co-translating observer and with first order approximation (V/c), the "apparent laws of reflection" remain the same (as they were in rule with the arrangement being at rest in ether).**

(c) *About the "Optical standing-wave conditions" at the end-mirrors of a moving-in-ether Fabry-Perrot interferometer; application to B-H experiment.*

If the Fabry-Perrot (F-P) interferometer, which was used in B-H experiment, could remain absolutely stationary in ether then into this *etalon of length* (L_o = 30.5 cm), there should be contained accurately N_o= 179941 half wavelengths of the used He-Ne laser radiation (λ = 3.39 μm); then and only then (i.e. when the F-P rests in ether), there should be obtainable theoretically a simultaneous appearance of *nodes*–at-both-end-mirrors of the F-P to obtain the ideal *standing-wave conditions* in F-P. But the situation alters radically even at the smaller motion in ether. The Boulder (latitude 40°) moves around Earth's axis with a velocity 355 m/s and thus the velocity of the Boulder through the CEE (the closest to Earth ether) is given accurately by the relation (3.26):

$$V = 355 \cdot 0.974 = 345.77 \text{ m/s} \tag{3.83}$$

This velocity of the Lab in ether creates a corresponding increase and decrease of the propagated light wavelength around the source. According to the classical-ether wave-theory of light (CEWTL) , the light propagating in front of the source i.e. to the direction of the motion of the source, should acquire its shortest wavelength in ether, while the light propagating backwards should acquire its longest wavelength. This Doppler changing of the wavelength ($\lambda V / c$) makes the said group of N_o= 179941 half-wavelengths to be expanded (or contracted) as a whole at about $N_o \frac{V}{c}\left(\frac{\lambda}{2}\right) = 0.2$ (of λ/2); and is this exactly, the fractional expansion or contraction of the N_o half-wavelengths, which forbids the simultaneous establishment of "the standing-wave-conditions" at both end-mirrors of the F-P except for the moments where the orientation of the F-P in space is such that its motion in ether becomes perpendicularly to its length (Θ = 90°). Of course due of the physical reasons just exposed (ether-drift and Doppler changing of wavelength) even the use of any servomechanism, acting to change suitably the frequency of the used He-Ne laser source so to obtain appearance of a *node* to say at the one mirror of the F-P, have to destroy the *node* at the second mirror; because the motion in ether, with the above velocity –relation (3.83)-, introduces necessarily a fractional number of half-wavelengths, between the mirrors of the F-P, (ranging from 179940.8 half-wavelengths when light propagates anti-parallel and 179941.2 half-wavelengths when light propagates parallel to the motion of the Lab). That is why the B-H frequency-servomechanism was (automatically) shared its function-time in two equal halves so to satisfy two different and excluding-each-other 'node-conditions' (Fig 24):

'node-condition I'. The total number of the wavelengths contained along the beams: 1) from A to B (AB – length L_1 - including the body of emitting He-Ne laser), 2) from mirror B to mirror D (BD – length L_2-), and 3) from mirror D up to the H the reflecting surface of the first mirror of the F-P interferometer (DH -length L_3 –), to be constant; this is written mathematically:

$$\left(t_1 + t_2 + t_3\right)\left(v_I(\Theta)\right) = K_I \approx (L_1 + L_2 + L_3)\frac{N_o}{2L_o} \tag{3.84}$$

<u>'node-condition II'.</u> The number of the wavelengths contained in the beams: 1) from A to B (AB – length L_1- including the body of emitting He-Ne laser), 2) from mirror B to mirror D (BD –length L_2 –), 3) from mirror D up to the reflecting surface H of the first mirror of the F-P interferometer (DH -length L_3 –), and 4) from H -the first mirror surface - up to -the second mirror surface- K of the F-P interferometer (HK – length L_o-), to be constant; this is written mathematically:

$$\left(t_1 + t_2 + t_3 + t_o\right)\left(v_{II}(\Theta)\right) = K_{II} \approx (L_1 + L_2 + L_3 + L_o)\frac{N_o}{2L_o} \tag{3.85}$$

The angle Θ is measured from the velocity vector of our Lab –in ether- until the axis of the F-P (or the axis of the He-Ne laser).

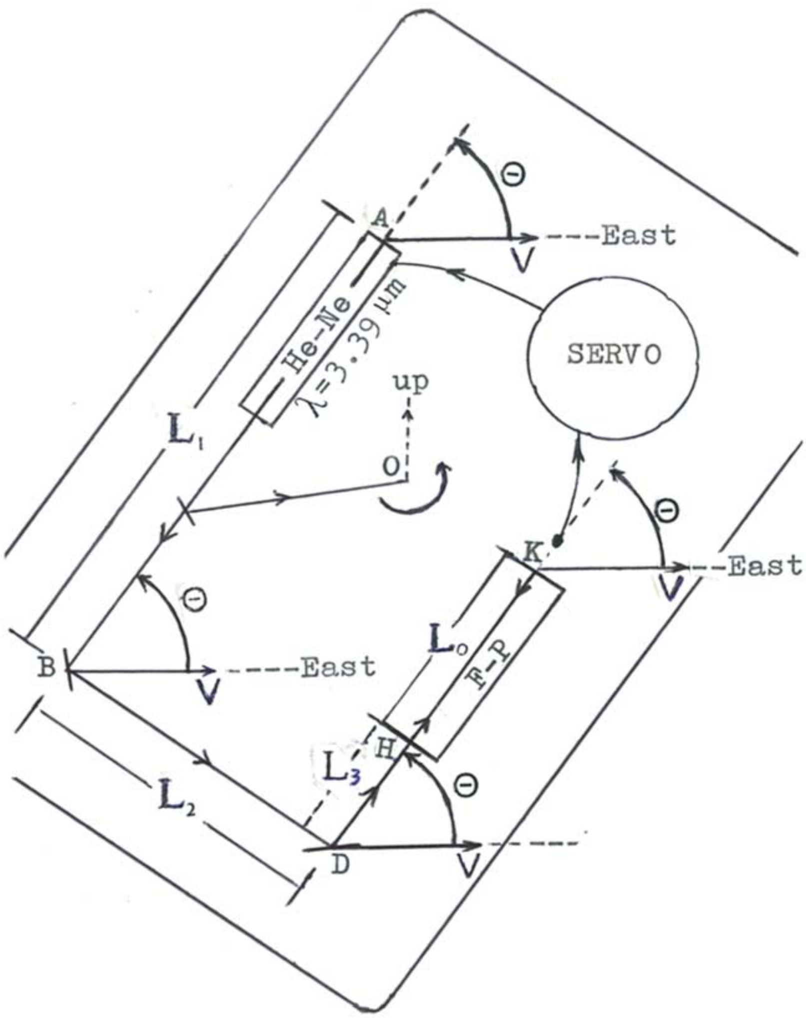


FIG. 24 The Brillet-Hall [25] rotating arrangement

Brillet and Hall (B-H) had used a (slowly rotating) heavy slab with dimensions 95 x 40 x 12 cm. The angle Θ is measured from the velocity vector of our Lab –in ether- until the axis of the F-P (or the axis of the He-Ne laser). Our Lab (Boulder) moves around Earth's axis with a velocity 355m/s, but relative to TSE our Lab has a velocity V = 355 x 0.974 =345.77 m/s (to the East). The accurate calculation -amplitude and phase- in Text, of B-H '17-Hz /(2Θ)' signal, means that our theory, of the Terrestrial-Stokes-ether (TSE) is correct.

Applying three (or four) times the relation (3.72) to the Fig. 24 we get for the times of light traveling along the said beams AB, BD, DH, and HK, we have respectively:

$$t_1 = \frac{L_1}{c}\left[1 - \frac{V}{c}\cos\Theta + \frac{3V^2}{4c^2} + \frac{V^2}{4c^2}\cos 2\Theta\right] \qquad (3.86)$$

$$t_2 = \frac{L_2}{c}\left[1 + \frac{V}{c}\sin\Theta + \frac{3V^2}{4c^2} - \frac{V^2}{4c^2}\cos 2\Theta\right] \qquad (3.87)$$

$$t_3 = \frac{L_3}{c}\left[1 + \frac{V}{c}\cos\Theta + \frac{3V^2}{4c^2} + \frac{V^2}{4c^2}\cos 2\Theta\right] \qquad (3.88)$$

$$t_o = \frac{L_o}{c}\left[1 + \frac{V}{c}\cos\Theta + \frac{3V^2}{4c^2} + \frac{V^2}{4c^2}\cos 2\Theta\right] \qquad (3.89)$$

Substituting the (3.86), (3.87), (3.88) into the relation (3.84), and by dividing in members with $\frac{L_1 + L_2 + L_3}{c}$ we finally get a relation – to satisfy the 'node-condition I':

$$\nu_I(\Theta)\left\{1 + \frac{V}{c}\left[\frac{(L_3 - L_1)\cos\Theta + L_2\sin\Theta}{L_1 + L_2 + L_3}\right] + \frac{3V^2}{4c^2} + \frac{V^2}{4c^2}\left(\frac{L_1 - L_2 + L_3}{L_1 + L_2 + L_3}\right)\cos 2\Theta\right\} = \nu \qquad (3.90)$$

($\nu =$constant $\approx$proper frequency) the generated frequency $\nu_I(\Theta)$ essentially be realized by the automatic function of the servomechanism when it be satisfying the 'node-condition I'.

If we should Fourier-analyze the generated frequency $\nu_I(\Theta)$, (imposed on the He-Ne laser by the servomechanism satisfying the 'node condition-I'), we should write down:

$$\nu_I(\Theta) \equiv A_o + A^I_{(1\Theta)}\frac{V}{c}\cos(\Theta + \Phi^I_1) + A^I_{(2\Theta)}\frac{V^2}{c^2}\cos(2\Theta + 2\Phi^I_2) \qquad (3.91)$$

Substituting the $\nu_I(\Theta)$ in the condition (3.90) and by omitting the terms of higher order than second (in the ratio V/c) we get the relation:

$$A_o\left(1+\frac{3V^2}{4c^2}\right)+\frac{V}{c}\left[A^I_{(1\Theta)}\cos(\Theta+\Phi^I_1)+A_o\left(\frac{(L_3-L_1)\cos\Theta+L_2\sin\Theta}{L_1+L_2+L_3}\right)\right]+$$

$$+\frac{V^2}{c^2}\left[A^I_{(2\Theta)}\cos(2\Theta+2\Phi^I_2)+A^I_{(1\Theta)}\left(\frac{(L_3-L_1)\cos\Theta+L_2\sin\Theta}{L_1+L_2+L_3}\right)\cos(\Theta+\Phi^I_1)+\frac{A_o}{4}\left(\frac{L_1+L_3-L_2}{L_1+L_2+L_3}\right)\cos 2\Theta\right]=v$$

(3.92) (v=constant$\approx$proper frequency)

By the action of the servomechanism, the first member of the above relation has to remain constant; thus we have to equate to zero the variable parts of the first member. Equating first to zero the coefficient of the 1st-harmonics (1Θ), we get:

$$A^I_{(1\Theta)}\cos(\Theta+\Phi^I_1)=-A_o\left(\frac{(L_3-L_1)\cos\Theta+L_2\sin\Theta}{L_1+L_2+L_3}\right) \qquad (3.93)$$

From which we get:

$$A^I_{(1\Theta)}\frac{V}{c}=A_o\frac{V}{c}\frac{\sqrt{(L_1-L_3)^2+L_2^2}}{L_1+L_2+L_3} \qquad (3.94) \qquad \text{and} \qquad \tan\Phi^I_1=\frac{L_2}{L_1-L_3} \qquad (3.95)$$

Substituting the relation (3.93) into the first member of (3.92), and by the help of the trigonometric relations:

$$2\sin\Theta\cos\Theta=\sin 2\Theta, \qquad \cos^2\Theta=0.5+0.5\cos 2\Theta, \qquad \sin^2\Theta=0.5-0.5\cos 2\Theta,$$

we can separate the variable 2Θ-terms from some constant ones (of order V^2/c^2); by zeroing thus and the variable coefficient of the 2nd-harmonics (2Θ), we get

$$A^I_{(2\Theta)}\cos(2\Theta+2\Phi^I_2)=\frac{A_o\left(\frac{(L_3-L_1)^2-L_2^2}{2}\cos 2\Theta+(L_3-L_1)L_2\sin 2\Theta\right)}{(L_1+L_2+L_3)^2}-\frac{A_o}{4}\left(\frac{L_1+L_3-L_2}{L_1+L_2+L_3}\right)\cos 2\Theta \qquad (3.96)$$

and after some algebra we get:

$$A^I_{(2\Theta)}\cos(2\Theta+2\Phi^I_2)=A_o\left(\frac{(L_1^2-L_2^2+L_3^2-6L_1L_3)}{4(L_1+L_2+L_3)^2}\cos 2\Theta+\frac{(L_3L_2-L_1L_2)}{(L_1+L_2+L_3)^2}\sin 2\Theta\right) \qquad (3.97)$$

From this last relation and since $A_o\approx v$, we get:

$$A^I_{(2\Theta)}\frac{V^2}{c^2}=v\frac{V^2}{c^2}\frac{\sqrt{\frac{\left(L_1^2-L_2^2+L_3^2-6L_1L_3\right)^2}{16}+\left(L_1L_2-L_2L_3\right)^2}}{(L_1+L_2+L_3)^2} \qquad (3.98)$$

and

$$\tan 2\Phi_2^I = \left[\frac{4(L_1L_2 - L_2L_3)}{L_1^2 - L_2^2 + L_3^2 - 6L_1L_3} \right] \tag{3.99}$$

The previously established formulas are all referred to the fulfillment of the ‘node-condition-I’. Thus the relation (3.94) gives the amplitude, and the (3.95) one, the phase of the 1st-harmonics-(1Θ)-signal; while the relation (3.98) gives the amplitude, and the (3.99) one, the phase of the 2nd-harmonics-(2Θ)-signal; both of these signals are created by the servomechanism by changing suitably the generated frequency $\nu_I(\Theta)$ (of the He-Ne laser) when the servomechanism works to satisfy the ‘node-condition I’.

We easily can get the corresponding formulas, emerging from the action of the servomechanism to satisfy the ‘node-condition-II’; by doing, in the above formulas (3.94), (3.95), (3.98), (3.99), the substitution:

in place of L_3 we put ($L_3 + L_o$)

thus we get for the ‘node-condition-II’:

$$A^{II}_{(1\Theta)}\frac{V}{c} = A_o\frac{V}{c}\frac{\sqrt{(L_1 - L_3 - L_o)^2 + L_2^2}}{L_1 + L_2 + L_3 + L_o} \tag{3.100}$$

and

$$\tan\Phi_1^{II} = \frac{L_2}{L_1 - L_3 - L_o} \tag{3.101}$$

$$A^{II}_{(2\Theta)}\frac{V^2}{c^2} = \nu\frac{V^2}{c^2}\frac{\sqrt{\frac{\left[L_1^2 - L_2^2 + (L_3 + L_o)^2 - 6L_1L_3 - 6L_1L_o\right]^2}{16} + \left(L_1L_2 - L_2L_3 - L_2L_o\right)^2}}{(L_1 + L_2 + L_3 + L_o)^2} \tag{3.102}$$

and

$$\tan 2\Phi_2^{II} = \left[\frac{4(L_1L_2 - L_2L_3 - L_2L_o)}{L_1^2 - L_2^2 + (L_3 + L_o)^2 - 6L_1L_3 - 6L_1L_o} \right] \tag{3.103}$$

The previously established four formulas (3.100-3.103) are all referred to the fulfillment of the ‘node-condition-II’. Thus the relation (3.100) gives the amplitude, and the (3.101), the phase of the 1st-harmonics-(1Θ)-signal; while the relation (3.102) gives the amplitude, and the (3.103), the phase of the 2nd-harmonics-(2Θ)-signal; both of these signals are created by the servomechanism by changing suitably the generated frequency $\nu_{II}(\Theta)$ (of the He-Ne laser source) when the servomechanism works to satisfy the ‘node-condition II’.

The servomechanism in B-H experiment essentially and automatically had spent its half-time to obtain and satisfy the 'node-condition I' and the other half of the time to obtain and satisfy the 'node-condition II'; that is why the statistics of the B-H experiment shows the mean values (of phases and of the amplitudes) emerging from the two 'node-conditions I and II':

$$\overline{A}_{(1\Theta)}\frac{V}{c}=\frac{1}{2}\left(A^{I}_{(1\Theta)}\frac{V}{c}+A^{II}_{(1\Theta)}\frac{V}{c}\right),\qquad \overline{\Phi}_1=\frac{1}{2}\left(\Phi^{I}_1+\Phi^{II}_1\right)$$

and

$$\overline{A}_{(2\Theta)}\frac{V}{c}=\frac{1}{2}\left(A^{I}_{(2\Theta)}\frac{V}{c}+A^{II}_{(2\Theta)}\frac{V}{c}\right)\qquad \overline{\Phi}_2=\frac{1}{2}\left(\Phi^{I}_2+\Phi^{II}_2\right)$$

This explain and the relatively broad range of the signal phases (for example in the case of 2Θ-signal which was studied by B-H [25], the mean-phase ranges statistically from 0^o until the -40^o degrees).

The theoretical Table V coincides surprisingly well with both: 1) the observed result of the mean "17 Hz" – amplitude signal at the second-harmonics -(2Θ)- of rotation of the apparatus, and 2) the experimentally found (-26^0 degrees) phase-difference of this second-harmonics vector!

MISINTERPRETATION OF B-H TEST**.** Brillet and Hall (B-H) [25] certainly, had observed and first-harmonics-(1Θ)-signals of rotation of their table. The amplitudes of the 1^{st} –harmonics, -according to the Table V-, have to present a higher and a lower component; the higher amplitude is calculated from 54 up to 62 MHz corresponding to the fulfillment of "Node Condition I", while the lower amplitude component is calculated from 24 up to 30 MHz corresponding to the fulfillment of the "Node Condition II".

We know that the presence of magnetism on Earth causes the appearance of spurious 1^{st}-harmonics-signals, as it was happened in Jaseja's *et al* [38] experiment, (where the spurious effect was at 275 kHz).

Brillet and Hall had found the appearance of some-decades MHz first-harmonics signal, but as it was one or two hundred times stronger than Jaseja's *et al* [38] one, -unexplained by them and non-consistent with their own theory about the "*isotropy of space*"-, they (B-H) had decided to kept silence about their 1^{st}-harmonics signals confining their reference into the single phrase [25]: "*…The about 35-MHz beat of this isolation laser with the cavity–stabilized laser is the measured quantity*". We deduce that our present calculations are correct because the higher amplitude- (54 – 62 MHz) -1^{st}-harmonics–sinusoidal-beating-signals if be averaged over a half period (multiplication by factor $2/\pi$) produce $\approx 35 - 39$ MHz the "higher averaged beating signal" (see *italics* just above). From this '*quantity of about 35-MHz beat*' B-H managed to extract and present only the (named) '17 Hz'- amplitude signal at the second-harmonics-(2Θ)-of rotation of their apparatus. B-H had not been interested (or were unable) to explain the cause of even such a feeble '17-Hz /(2Θ)' ether-drift appearing to point constantly to the East, -(with a declination of 26^o to South)-, in the Lab-frame. That is why –after ten months of experimentation- they had called it "persistent spurious signal"; and, in trying to eliminate its meaning and doing the best (in favor of SRT and their theory of the "*isotropy of space*"), they had spread the '17-Hz / (2Θ)' signal in the space around – i.e. to the corresponding points relative the sidereal frame-; after that they had subtracted the nearly symmetrical results (and averaged the differences) and thus they had obtained their very low final result of (0.67 Hz), -corresponding to $(\Delta\nu/\nu) = 0.76\ (10^{-14})$-, and supported their erroneous theory of the *isotropy of space;* (and thus they had claimed that their experiment is the most superb one as reaching nearly the 4000-fold improvement of the best previous measurement [38] etc). But, in spite of their theoretical conclusion, the '17-Hz / (2Θ)'-amplitude signal, still remains 25 times stronger in the Lab frame, than their (0.67 Hz) final result, on which, their null -space- anisotropy conclusion has been founded.

Conclusively it was proved above that, the linear velocity V = 345.77 m/s (3.26) of our Lab relative the terrestrial-Stokes'- ether (TSE) – (properly due to Earth's rotation about its axis and secondary in the very slow rotation of TSE relative to the sidereal frame –relation (3.23)-)-, explains very accurately the appearance of the B-H '17 Hz /(2Θ)' –amplitude signal and the experimentally found (-26^0) phase-difference of this 2^{nd} -harmonics vector.

The TSE forms a protective shelter around Earth, protecting Earth (and SRT!) from the appearance of any cosmic ether drift in our Labs. Table VI summarizes our conclusion of the existence of TSE-shelter inside-around the Earth with the help of the following six experiments: the Michelson-Gale experiment (M-G), the Michelson-Morley experiment (M-M), the re-interpreted Hafele-Keating experiment (H-K)ri and the GPS, the re-interpreted Brillet-Hall experiment (B-H)ri, and finally the re-interpreted Riis-Lee-Hall experiment (R-L-H)ri. These six experiments have been discussed in details in this chapter.

TABLE V. Calculated signals of Brillet-Hall experiment showing the velocity V of our Lab to East relative to TSE.

Velocity of the Laboratory relative to Terrestrial –Stokes'- Ether: V = 345.77 m/sec (Eastwards)													
$L_o = 30.5$ (cm)			First Fourier vectors				**Second Fourier vectors**						
			Node Condition I		Node Condition II		**Node Condition I**		**Node Condition II**		**Mean Arithmetic**		
L_3 cm	L_1 cm	L_2 cm	$A^{I}_{(1\Theta)}\dfrac{V}{c}$ **MHz**	Φ^{I}_{1} **(deg.)**	$A^{II}_{(1\Theta)}\dfrac{V}{c}$ **MHz**	Φ^{II}_{1} **(deg.)**	$A^{I}_{(2\Theta)}\dfrac{V^2}{c^2}$ **Hz**	Φ^{I}_{2} **(deg.)**	$A^{II}_{(2\Theta)}\dfrac{V^2}{c^2}$ **Hz**	Φ^{II}_{2} **(deg.)**	$\overline{A}_{(2\Theta)}\dfrac{V^2}{c^2}$ **Hz**	$\overline{\Phi}_{2}$ **(deg.)**
15	90	30	61.03	21.80	33.08	33.99	**14.56**	**-42.86**	**17.40**	**-9.62**	**15.98**	**-26.24**
		25	62.03	18.43	32.44	29.33	**13.07**	**-43.47**	**17.89**	**-8.25**	**15.48**	**-25.86**
	85	30	59.75	23.20	31.52	37.22	**14.74**	**-41.27**	**17.75**	**-8.87**	**16.25**	**-25.07**
		25	60.65	19.65	30.66	32.33	**13.27**	**-41.64**	**18.32**	**-7.60**	**15.79**	**-24.62**
	80	30	58.42	24.78	29.99	41.00	**14.94**	**-39.65**	**18.07**	**-8.09**	**16.51**	**-23.87**
		25	59.19	21.04	28.87	35.93	**13.50**	**-39.77**	**18.72**	**-6.92**	**15.11**	**-22.91**
	75	30	57.02	26.57	28.51	45.48	**15.16**	**-37.98**	**18.35**	**-7.25**	**16.75**	**-22.61**
		25	57.65	22.62	27.11	40.28	**13.77**	**-37.87**	**19.07**	**-6..21**	**16.42**	**-22.04**
	70	30	56.57	28.61	27.15	50.76	**15.39**	**-36.27**	**18.57**	**-6.35**	**16.98**	**-21.31**
		25	56.02	24.44	25.41	45.58	**14.07**	**-35.94**	**19.36**	**-5.43**	**16.72**	**-20.69**
	65	30	54.06	30.96	25.98	56.98	**15.62**	**-34.51**	**18.73**	**-5.36**	**17.17**	**-19.94**
		25	54.06	26.57	23.87	52.05	**14.39**	**-33.98**	**19.59**	**-4.59**	**16.99**	**-19.28**
10	70	30	62.20	26.57	30.54	45.48	**17.50**	**-44.60**	**17.74**	**-8.65**	**17.62**	**-26.62**
	65	30	60.86	28.61	29.15	50.76	**17.65**	**-42.94**	**17.98**	**-7.59**	**17.81**	**-25.26**
		25	61.62	24.44	27.36	45.58	**16.19**	**-43.96**	**18.71**	**-6.53**	**17.45**	**-25.25**

10	60	30	59.47	30.96	27.97	56.97	**17.80**	**-41.20**	**18.14**	**-6.44**	**17.97**	**-23.82**
		25	60.02	26.56	25.77	52.04	**16.38**	**-42.00**	**18.96**	**-5.54**	**17.67**	**-23.77**
		20	61.03	21.80	23.64	45.73	**14.56**	**-42.85**	**19.98**	**-4.55**	**17.27**	**-23.70**
	55	30	58.07	33.69	27.08	64.20	**17.94**	**-39.37**	**18.22**	**-5.14**	**18.08**	**-22.25**
		25	58.34	29.05	24.46	59.89	**16.60**	**-39.96**	**19.11**	**-4.42**	**17.85**	**-22.19**
		20	59.09	23.96	21.82	54.06	**14.84**	**-40.46**	**20.22**	**-3.63**	**17.53**	**-22.05**

TABLE VI

THE IMAGE OF TERRESTRIAL ETHER (STOKES 1845)

-ETHER GRAVITATIONALY BOUND IN THE INNER REGIONS OF THE TERRESTRIAL ROCHE LOBE (EARTH-SUN SYSTEM),
CARRIED TRANSLATIONALY BY EARTH, AND NO-PARTICIPATING IN EARTH'S ROTATION ABOUT ITS AXIS-

AS IT EMERGES FROM SIX EXPERIMENTS:

Michelson-Gale (M-G), Michelson-Morley (M-M), re-interpreted Hafele-Keating (H-K) ri, G.P.S. re-interpreted Brillet-Hall (B-H)ri , and re-interpreted Riis-Lee-Hall (R-L-H) ri

MOTIONS IN THE TERRESTRIAL ETHER

(Earth's rotation about its axis , flying airplanes, orbiting satellites)

GENERATE

LOW VELOCITY ETHER-DRIFTS IN LABS

VARIABILITY **OF THE SPEED OF LIGHT** (M-G), (B-H) ri,	**VARIABILITY** **OF ATOMIC CLOCK RATES** (H-K)ri, G.P.S.

TRANSLATORY MOTIONS OF THE EARTH IN COSMIC SPACE

(Around sun, around the galactic center, motion of galaxy in Universe)

GENERATE

NO COSMIC ETHER-DRIFT ON EARTH

INVARIANCE **OF THE SPEED OF LIGHT** RELATIVE TO EARTH'S COSMIC VELOCITY (M-M), (B-H)ri, (R-L-H)ri,	**INVARIANCE** **OF ATOMIC-CLOCK RATES** NO COSMIC INFLUENCE ON ATOMIC-CLOCK RATES NO COUPLING OF ATOMIC-CLOCK VELOCITIES WITH EARTH'S COSMIC VELOCITY (H-K) ri, G.P.S.

TABLE VI

THE IMAGE OF TERRESTRIAL ETHER (STOKES 1845)

-ETHER GRAVITATIONALY BOUND IN THE INNER REGIONS OF THE TERRESTRIAL ROCHE LOBE (EARTH-SUN SYSTEM), CARRIED TRANSLATIONALY BY EARTH, AND NO-PARTICIPATING IN EARTH'S ROTATION ABOUT ITS AXIS-

AS IT EMERGES FROM SIX EXPERIMENTS:

Michelson-Gale (M-G), Michelson-Morley (M-M), re-interpreted Hafele-Keating (H-K) ri, G.P.S. re-interpreted Brillet-Hall (B-H)ri, and re-interpreted Riis-Lee-Hall (R-L-H) ri

MOTIONS IN THE TERRESTRIAL ETHER

(Earth's rotation about its axis, flying airplanes, orbiting satellites)

GENERATE

LOW VELOCITY ETHER-DRIFTS IN LABS

VARIABILITY
OF THE SPEED OF LIGHT
(M-G), (B-H) ri,

VARIABILITY
OF ATOMIC CLOCK RATES
(H-K)ri, G.P.S.

TRANSLATORY MOTIONS OF THE EARTH IN COSMIC SPACE

(Around sun, around the galactic center, motion of galaxy in Universe)

GENERATE

NO COSMIC ETHER-DRIFT ON EARTH

INVARIANCE
OF THE SPEED OF LIGHT
RELATIVE TO EARTH'S COSMIC VELOCITY
(M-M), (B-H)ri, (R-L-H)ri,

INVARIANCE
OF ATOMIC-CLOCK RATES
NO COSMIC INFLUENCE ON ATOMIC-CLOCK RATES
NO COUPLING OF ATOMIC-CLOCK VELOCITIES WITH EARTH'S COSMIC VELOCITY
(H-K) ri, G.P.S.

F. ASTRONOMICAL AND COSMIC CONSEQUENCES OF THE GRAVITATIONALLY - BOUND ETHER AND ITS 'INTERNAL FRICTION';

A NON-EXPANDING UNIVERSE

1. ASTRONOMICAL DOPPLER EFFECT

Substituting the $d\theta$ from (3.17) to any of the two (3.15) or (3.16) we take the differential equation for the Doppler-effect related to the phenomenon of aberration:

$$\frac{d\nu}{\nu} = \frac{d\upsilon}{c}\cos\theta \qquad (3.104)$$

For the radial Doppler-effect we get

$$\frac{d\nu}{\nu} = \pm\frac{du}{c} \qquad \int_{\nu_o}^{\nu}\frac{d\nu}{\nu} = \pm\int_0^{\upsilon}\frac{du}{c} \qquad \frac{\lambda_o}{\lambda} = \frac{\nu}{\nu_o} = e^{\pm\frac{\upsilon}{c}} \qquad (3.105)$$

the (+) corresponds to the relative approach and the (-) to the relative recession between star and Earth.

ν, λ are the characteristics of the arriving photon (at Earth) while the $\nu_{(o)}, \lambda_{(o)}$ are the corresponding magnitudes of the spectral line at the ether area of the star (EAS) which is stationary relative to the star (or relative to an distant galaxy). For this reason, we on Earth, can measure the magnitudes $\nu_{(o)}, \lambda_{(o)}$ which although are of terrestrial origin yet they also correspond to those ones of any EAS.

In spectroscopy of the stars and galaxies the «red shift» z is defined by the relation:

$$z \equiv \frac{\lambda - \lambda_o}{\lambda_o} = \frac{\lambda}{\lambda_o} - 1 = \frac{\nu_o}{\nu} - 1 \qquad (3.106)$$

and thus

$$\frac{\nu}{\nu_o} = \frac{1}{z+1} \qquad (3.107)$$

In the case of a receding star or galaxy with a radial velocity υ, the red-shift is given by the relation

$$z = \frac{\lambda}{\lambda_o} - 1 = e^{\frac{\upsilon}{c}} - 1 \qquad (3.108)$$

TABLE IV. Comparison of astronomical Doppler red-shifts between Stokes'-Coriolis-ether-model (SCEM) and SRT

	SCEM	SRT
$\frac{\upsilon}{c} \equiv \beta$	$z = e^{\beta} - 1$	$z = \sqrt{\frac{1+\beta}{1-\beta}} - 1$
0.001	0.0010005002	0.0010005005
0.01	0.01005016	0.01005050
0.1	0.10517	0.10554
0.2	0.2214	0.2247
0.3	0.3498	0.3627
0.4	0.4918	0.5275
0.5	0.6487	0.7320
0.6	0.8221	1.
0.7	1.0137	1.3804
0.8	1.2255	2.
0.9	1.4596	3.3589
1.0	1.7182	∞
2.0	6.3890	------
3.0	18.0855	-----

Like SRT it is z >1 and for $\upsilon < c$ (!) But unlike SRT we see that there is nothing to limit the relative velocities of the EAS; these relative velocities may excess the relativistic limit of the local speed c of light.

G. NON-EXPANDING STEADY UNIVERSE

1. INTERNAL FRICTION OF ETHER CREATES 'TIRED'-LIGHT

We have proved the existence of the ether as the carrier of the waves of light. Then a 'friction-force' in the vibrators of the ether appears to be quite possible.
It is assumed here that the 'friction-force' f, on each one vibrator of the ether, is proportional to the momentary velocity of the vibrator: i.e.

$$f = \alpha \upsilon$$

The work of the friction force, of harmonic vibrator, is given by:

$$dW = f \circ ds = \alpha \upsilon (\upsilon dt)$$

The «friction work» per unit of time i.e. dW/dt is responsible for the energy loss of the vibrator (this friction-energy must be scattered around the proper vibrators of the ether. The "friction work" coming out from the "tired photons" is accumulated in ether and is the cause of production of "pairs of elementary particles".

In classical terms we have a decrease of the kinetic energy of the vibrator

$$-\frac{dE_{kinetic}}{dt} = \left| \frac{dW}{dt} = \alpha \upsilon^2 \right| = kE_{kinetic} \qquad (3.117)$$

This means that

$$-\frac{d(h\nu)}{dt} = -\frac{d(h\nu)}{dr} c = k(h\nu) \qquad (3.118)$$

and

$$-\frac{d\nu}{\nu} = Adr \qquad (3.119)$$

this relation express the variation of the frequency of the propagating photon; by integration we obtain

$$\nu = \nu_o e^{-Ar} \qquad (3.120)$$

ν_o is the frequency of the traveling photon at the source and ν is its frequency at the receiver, and r is the distance between source and receiver, A is constant.

Thus we get a «red shift» from the far distant galaxies, due to their own «tired light»:

$$z = \frac{\lambda}{\lambda_o} - 1 = \frac{\nu_o}{\nu} - 1 = e^{Ar} - 1 \qquad (3.121)$$

This relation is written in the form of a series:

$$z = Ar + \frac{1}{2}(Ar)^2 + \frac{1}{6}(Ar)^3 + ... \qquad (3.122)$$

According to this theory the constant A resembles Hubbles' constant (in the first power term) but its meaning has nothing to do with Doppler interpretations and expanding Universes. The formulas (3.121) and (3.122) seem to be consistent with observations [43, 44]; the terms over the first power in the relation (3.122) could be interpreted –erroneously-, by the "big-bang"- theorists, as creating an acceleration of the "expansion" of the Universe. {The case against the "Big-Bang" theory is exposed in [45]}.

From (3.121) we have

$$\ln(1 + z) = Ar \qquad (3.123)$$

Thus the constant A, is related to the friction forces inside the ether and by no means is referred to the assumed Doppler equivalent recession of the galaxies from the inhabitants of the Earth-Galaxy.

The systematic spectroscopic red shift observations of the far distant galaxies are due to the friction of the ether vibrators. The «friction energy» does 'heats' locally the ether and as suitable conditions are being in rule, this "heat of ether", can generate suitable particles (these suitable conditions might be: the mass – energy equivalence, spin or angular momentum conservation , charge conservation and many other constrains from particle physics).

It must be noted that the constant A is independent of the direction of the incoming rays

The total z of a galaxy being at the distance r and having a radial recession velocity $\dot{r}$ is given by the relation:

$$z_{Total} + 1 \equiv \frac{\lambda - \lambda_o}{\lambda_o} = \exp\left(\frac{\dot{r}}{c} + Ar\right) \qquad (3.124)$$

or

$$\ln(1+z) = \frac{\dot{r}}{c} + Ar \qquad (3.125)$$

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