A CRITICAL LOOK AT THE

THEORY OF RELATIVITY

By

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October 1976
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This is dedicated to all scientists who have kept an open mind about the Theory of Relativity and, in particular, to those named below and 111 others on record who have contributed to the didactic exchange during the early formative years, many of whom are only with us in memory.

Prof. Dr. Walter Del-Negro ..... Salzburg
Prof. Dr. Hans Driesch..... Leipzig
Dr. S. Friedlaender..... Halensee
Dr. I.K. Geissler..... Ringgenberg
Armin Gimmerthal..... Bonn
Prof. Dr. Ludwig Goldschmidt ..... Jena
Prof. Dr. A.H. DeHartog..... Amsterdam
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Prof. Dr. W. Walte ..... Hamburg
Dr. Rudolf Weinmann..... Berlin
Georg Wendel ..... Liebstadt

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CONCLUSIONS

1. THE THEORY OF RELATIVITY (TR) HAS NO FUNCTIONALLY AND TECHNICALLY ACCEPTABLE ANSWER TO THE FOLLOWING PROBLEM:

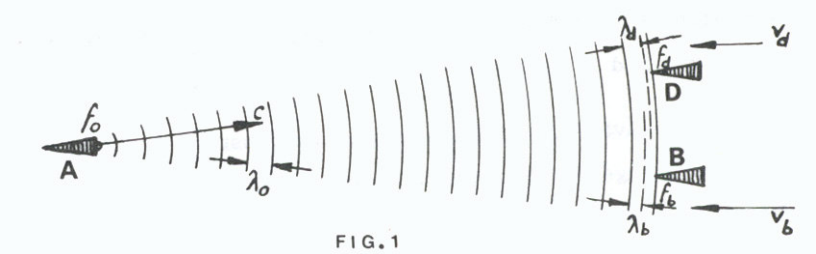

FIG. 1

Space Vehicle A (Fig. 1) is pursued by Vehicles B and D at different closing velocities v_b and v_d. (For lack of any superior reference system in empty space the absolute velocity of the group of vehicles is not known.)

Vehicle A sends out a signal at frequency f_o which is received by B and D with the appropriate Doppler shifts as f_b and f_d where

$$f_{b(d)} = f_\circ + f_\circ \frac{v_{b(d)}}{c}$$

So far everybody agrees that A sends out a wavetrain of wave length $\lambda_\circ = \frac{c}{f_\circ}$ where c, the velocity of propagation is measured relative to A. One might expect to see the received frequencies derived as

$$f_{b(d)} = \frac{c + v_{b(d)}}{\lambda_\circ}$$

According to TR, however, the incoming velocity of the radiation received by B and D is "c" and therefore

$$f_{b(d)} = \frac{c}{\lambda_{b(d)}}$$

In other words, the wavelength radiated from A has changed somewhere along the path from $\lambda_\circ$ to $\lambda_{b(d)}$, and differently at that, for B and D according to their closing velocities.

A change of wavelength and frequency (at constant c) is equivalent to a change of energy which has to come from somewhere. (Planck's quantum energy hv)

An interaction with some kind of matter on the way to B and D would be required to accomplish this. Short of considering a "deus ex machina" some unknown field would have to surround each vehicle and derive the energy from the vehicles' momentum. However, this would only put the action a few feet ahead of the vehicles B and D. The problem remains the same: The speed difference of both vehicles A and B (D) has to be known at some common interface in order to derive the proper Doppler shift. Without reference to any vehicle A, B or D, the only defined quantity of the propagating radiation is the wavelength $\lambda_\circ$. Obviously then, at the interface of space and antennas B or D the propagation velocity is still c, relative to A, hence must be $c+v_{b(d)}$ when entering the antenna of B or D.

After being absorbed by antenna B or D the energy in the antenna cable is transformed into an AC current of frequency $f_{b(d)}$ and loses all relation to the incident wavelength or

velocity. Any measurement of wavelength or velocity of propagation thereafter inside B or D would yield only the local velocity c and $\lambda_{b(d)}$ accordingly.

The same applies to the wavelength and velocity of light after having passed through the surface of a transparent solid or liquid.

Quote:

".....an external electromagnetic disturbance travelling with the velocity of light in vacuum is exactly cancelled out and replaced in the substance by the secondary disturbance travelling with an appropriate smaller velocity."[1] (carried by mutual coupling of molecular dipoles in the substance.)

2. A LOOK BACK IN TIME

The TR has not always been accepted as the gospel truth, as it is today. When I went to college around 1930, Einstein was severely criticized. ("logically untenable fiction"[2])

With the collapse of the "German Empire" after World War I, and with it the collapse of the monetary and social structure of Germany, the TR was readily seized upon to explain that actually nothing was of absolute and permanent value but everything was "relative". Any number of jokes circulated about what was "relative". Understandably, at the

[1] Ewald & Oseen, Extinction Theorem. Principles of Optics, Born & Wolf. Pergamon Press, NY 1959. PP. 70 ff.

[2] Hans Israel "Hundert Autoren Gegen Einstein", R. Voigtlaender Verlag Leipzig 1931. (Hundred Authors Against Einstein)

colleges the TR was treated as another of the many more or less useful theories which an engineer in his lifetime would probably never have to be concerned with.

Fifteen years later in 1947, while working on Doppler navigation systems, the first doubt was aroused and now, after another thirty years, the search is over – at least for me.

The problem then was: A radio station emits a frequency f_o which is received by a space vehicle at velocity v as

$$f_1 = f_\circ + f_\circ \frac{v}{c}$$

The vehicle retransmits f_1 which is received back by the radio station after another Doppler shift as

$$f_2 = f_1 + f_1 \frac{v}{c} = f_\circ + 2f_\circ \frac{v}{c} + f_\circ \frac{v^2}{c^2} = f_\circ \left(1 + \frac{v}{c}\right)^2$$

The part $2f_0 \frac{v}{c}$ in the above equation is the usually used Doppler shift of the return signal while $f_0 \frac{v^2}{c^2}$ can always be neglected for present day vehicle velocities of $v < 10^{-5} c$, being in the order of $10^{-10} f_\circ \frac{v}{c}$. This "square shift" or relativistic Doppler shift is generally taken as proof of the TR (See, for instance, in Ives and Stilwell's[5] experiments which will be discussed later.)

IN THE ABOVE CASE HOWEVER, THE SQUARE SHIFT SIMPLY APPEARS AS A RESULT OF A DOUBLE TRANSMISSION TO AND FROM A VEHICLE.

Recognizing the above facts has kept me alert for other different possible interpretations of the so-called classical experiments.

3. MEASUREMENTS OF THE VELOCITY OF LIGHT.

During the past 300 years since Roemer calculated the speed of light from observation of the moons of Jupiter, it has been measured with increasing accuracy. Since Michelson's measurements in 1876, we have observations of sufficient accuracy.

TABLE 1

NAME	YEAR	METHOD	KM/SEC RESULT	±Δ	DEVIATION FROM 299,792.5
1. Roemer	1676	Jupiter Moon	301 500		+ 1708
2. Bradley	1700	Aberration	299 700		- 92
3. Fizeau	1849	Tooth Wheel	313 300		+ 13508
4. Fizeau	1850	Tooth Wheel	301 400		+ 1608
5. Foucault	1860	Rot. Mirror	248 000		- 1792
6. Cornu Helmert	1875	Tooth Wheel	299 990	300	+ 198
7. Michelson	1879	Rot. Mirror	299 910	75	+ 118
8. Newcomb	1883	Rot. Mirror	299 860	45	+ 68
9. Michelson	1883	Rot. Mirror	299 853	90	+ 61
10. Parrotin	1902	Tooth Wheel	299 901	104	+ 109
11. Rosa Dersey	1906		299 784	15	- 8
12. Mercier	1923	Standing Wave	299 782	15	- 10
13. Michelson	1927	Rot. Mirror	299 798	22	+ 6
14. Mittelstaedt	1928	Kerr Cell	299 786	15	- 6
15. Michels, Pease, Pearson	1933	Rot. Mirror	299 774	6	- 18
16. Anderson (Huettel)	1937	Kerr Cell	299 771	15	- 21
17. Anderson	1941	Kerr Cell	299 776	9	- 16
18. Aslakson	1949	Shoran	299 792	3.5	- 0.5
19. Hansen Bol	1950	Fixed Cavity	299 789	1.2	- 3.5
20. Essen	1950	Var. Cavity	299 792.5	1.0	0
21. Bergstrand	1951	Kerr Cell	299 793.1	.3	+ 0.6
22. Froome	1952	Intfermtr.	299 792.6	.7	+ 0.1
23. Mackenzie	1953	Kerr Cell	299 792.4	.5	- 0.1
24. Froome	1954	Intfermtr.	299 793	.3	+ 0.5
25. Plyler, Blaine, Comer	1955	Infra Red	299 792	6.0	- 0.5
26. Florman	1955	Intfermtr.	299 795	1.9	+ 2.5
27. Nat. Bur. Stand.	1972	Laser	299 792.45	±lm	- .05

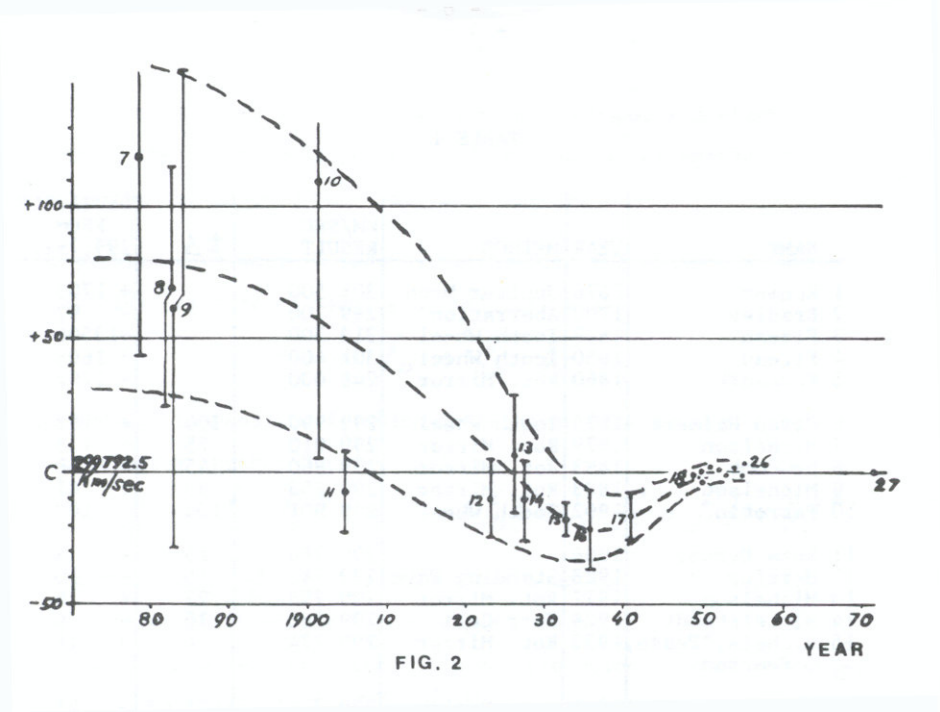

FIG. 2

The results are shown in Fig. 2. Provided that the different investigators have not been biased by one another and have not estimated the accuracy limits of their measurements far too narrow, we must conclude that the velocity of light as measured within the reference system of our earth has changed by as much as ±50 Km/sec. or .017% during the past century.

The median curve in Fig. 2 is approximately the inverse of the 22 year averages of the sunspot activities and the earth magnetic field in the same time interval.

4. THE "CLASSICAL" EXPERIMENTS

A. MICHELSON-MORLEY

In the early 19th century when the wave nature of light was detected, a carrier seemed to be necessary and was invented as the "ether" something

penetrating all matter and being at rest in the Universe or dragged along by moving matter at somewhat less speed than matter itself. Obviously, light, propagating with and against or across this "ether wind" should show measurable differences in its propagation velocity.

The experiment was expected to yield a second order effect $\frac{v^2}{c^2}$ where v is the velocity of the earth surface (test location) relative to the Universe.

The perplexing null result was interpreted as a contraction of the test equipment in the direction of motion. (Lorentz)

Later, in the 1920s, the ether theory was abandoned and at this point the Lorentz contraction should have been abandoned, too, because there was no more reason to assume that the light was carried by a medium at rest in a different reference system, other than that of the laboratory in which the measurements had been taken and that this medium was traveling at a certain (high) speed past the earth. But by then it was too late since a large amount of theory had been built and continues to be built on this basis. The abandonment of the TR would mean that a good 50% or more of our theory of physics of today would have to be rewritten and this is certainly hard to accept.

B. MICHELSON'S MOVING MIRROR EXPERIMENT.[3]

In this report, Michelson describes an experiment in which he attempted to determine which of the three theories of the propagation of light holds true. This report merits a closer look, especially in relation to the Doppler effect. QUOTE: "According to the undulatory (ether) theory of light, the velocity of light is

independent of the velocity of the source, and of the velocity of a mirror at which it is reflected. (Case 1)

According to the emission theory, the resultant velocity from a moving source is increased by the component of the velocity of the source. (Case 2)

But it appears that different forms of emission theory require different results on reflection from a moving mirror. If the light corpuscules are reflected as projectiles from an elastic wall, then the velocity of light should be increased by twice the component of the velocity of the mirror." (Case 3)

Michelson built equipment as shown in Figure 3.

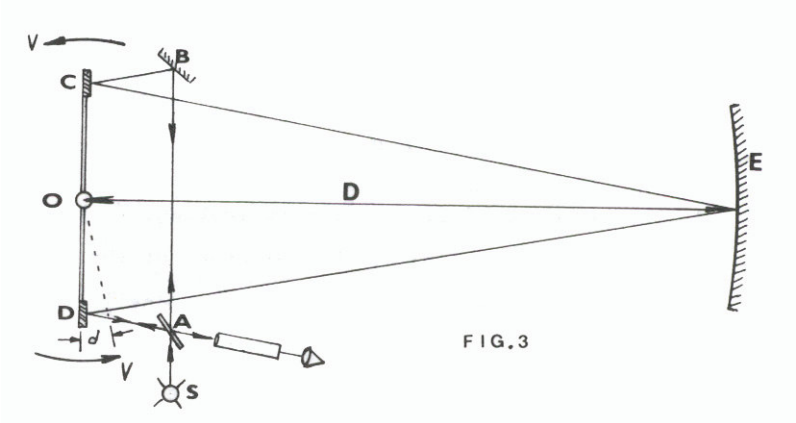

FIG. 3

The light beam from a source S was split by a semi-transparent mirror A. The one beam continued through mirror A to mirror B, and was reflected to mirrors C, E and back via mirror D to A. The other beam was reflected from mirror A to mirror D and then in opposite direction via D E C B to mirror A, at which point it was superimposed on the first beam to obtain a fringe pattern when the mirrors were properly adjusted.

[3] Michelson, Astrophysical Journal 37. (1913) PP. 190-193

Mirrors C and D were mounted on a common carrier which could be rotated around axis O. When mirror D, as indicated by an arrow, moved toward mirror E the mirror C would move away from E by the same distance. The distance between mirrors C and D was 26.5 cm. The distance D between the centerpoint 0 of the mirrors C and D and the fixed spherical mirror E was 608 cm. Michelson says:

QUOTE: "According to the undulatory theory, the velocity of light is unaffected by the velocity of the mirror while the emission theory requires that

$$\overline{V} = V + rv \qquad 1.$$

where $\overline{V}$ is the velocity of light after reflection, V, the velocity before reflection and v, the component of the velocity of the mirror in the direction of the pencil (beam), and r = 2 according to the elastic impact theory; while r = 1 if the mirror surface acts as a new source.

The time occupied by the pencil (beam) D E C is

$$T_1 = \frac{2(D+d)}{V_1} \qquad 2.$$

while that taken by the pencil C E D is

$$T_2 = \frac{2(D-d)}{V_2} \qquad 3.$$

where D is the distance O E, d = distance the revolving mirror moves while light passes over D E C, and V_1 the resultant velocity of the first pencil, V_2 that of the second."

With the mirrors D and C at rest (not rotating) and at approximately the same distance from mirror E, both lightbeams travel the same distance of 2D on

their way D E C respectively C E D. With rotating mirrors the beam has to travel the additional distance 2d which the mirror C moves while the light is on its way. The distance in opposite direction is shorter by 2d due to the movement of mirror D. The distance d is computed from

$$\frac{d}{2D}=\frac{v}{V}\ ;\ \frac{2vD}{V}=d \qquad 4.$$

Michelson arrives at the final equation for the displacement of the interference fringes

$$\Delta=\frac{V(T_1-T_2)}{\lambda}=4\frac{D}{\lambda}(2-r)\frac{v}{V}$$

For: $r=0\ ;\ \Delta=8\frac{Dv}{\lambda \mathrm{V}}$

$r=1\ ;\ \Delta=4\frac{Dv}{\lambda \mathrm{V}}$

$r=2\ ;\ \Delta=0$ 5.

For r = 0, that is $\Delta=8\frac{Dv}{\lambda \mathrm{V}}$, the wave length of the light $\lambda=0.60\mu$ and 1000 revolutions per minute of mirrors C D, the computed fringe shift was 3.76 fringes which coincided very well with the measured mean shift of 3.81 fringes.

Michelson concludes therefore, that within the limit of error of experiment (say 2 percent), the velocity of a moving mirror is without influence on the velocity of light reflected from its surface.

It is possible to obtain the same results without taking the time into account (dilatation?), merely by counting the number N of wavelengths in both

directions between the mirrors D E C. The number of wavelengths in the path D E C is

$$N_1 = \frac{2(D+d)}{\lambda} \tag{6.}$$

in path C E D, the wave number is

$$N_2 = \frac{2(D-d)}{\lambda} \tag{7.}$$

The fringe shift is

$$\Delta = N_1 - N_2 = \frac{4d}{\lambda} \tag{8.}$$

and since the small distance d which the mirrors travel while the light is propagating between D E C is given by Michelson (4) as

$$\frac{d}{2D} = \frac{v}{V} \; ; \; d = \frac{2vD}{\mathrm{V}}$$

The result is the same as in (5) for r = 0.

$$\Delta = 8\frac{Dv}{\lambda \mathrm{V}} \tag{9.}$$

Michelson, in equation 5 writes

$$\Delta = \frac{\mathrm{V}(T_1 - T_2)}{\lambda} \tag{10.}$$

This equation implies

$$\Delta = \mathrm{V}\left(\frac{T_1}{\lambda} - \frac{T_2}{\lambda}\right) \tag{11.}$$

hence Michelson's measurements require that the wavelength of the light has not changed while propagating between the moving mirrors C E D or D E C.

We arrive at the same result with equations (6) and (7) and may write

$$N_1 = \frac{2(D+d)}{\lambda_\circ} \qquad 12.$$

$$N_2 = \frac{2(D-d)}{\lambda_\circ} \qquad 13.$$

$$\Delta = 8\frac{Dv}{\lambda_\circ \mathrm{V}} \qquad 14.$$

However: Michelson has not taken into account the Doppler shift.

TODAY IT IS OBVIOUS THAT A DOPPLER SHIFT IS ALWAYS ASSOCIATED WITH A VELOCITY DIFFERENCE BETWEEN REFERENCES. IT IS EITHER CARRIED BY A CHANGE OF WAVELENGTH WHEN THE WAVE VELOCITY IS CONSTANT, AND VICE VERSA, OR BOTH COULD BE CHANGED PARTIALLY BY THE PROPER AMOUNT.

If the light velocity is constant (undulatory theory), we have to expect that the wavelength has not remained the same on the path D E C.

For the three cases discussed before, the wavelength for constant light velocity is:

1) $$\lambda = \lambda_\circ \left(1 \pm \frac{2v}{c}\right) \qquad 15.$$

for the mirror as new source:

2) $$\lambda = \lambda_\circ \left(1 \pm \frac{v}{c}\right) \qquad 16.$$

for half the path and for the other half equation (15) for the elastic reflection:

3) $$\lambda = \lambda_\circ \qquad 17.$$

(second order effects can be disregarded.)

Therefore, considering the Doppler shift, we arrive at a completely different picture. In this case, Michelson's experiment proves that the light is elastically reflected from a mirror because (see case 3) and the above calculations 12, 13, 14 hold true. This being the case, equation (17) applies and the wavelength is $\lambda = \lambda_\circ$ throughout the whole path C E D. In the calculations, we do not treat time or frequency, but rather wavelengths only.[4]

For comparison, the expected fringe shift for the two other cases is calculated:

for constant light velocity $\lambda = \lambda_\circ \left(1 \pm \frac{2v}{c}\right)$

$$N_1 = \frac{2(D+d)}{\lambda_\circ \left(1 - \frac{2v}{c}\right)}$$

$$N_2 = \frac{2(D-d)}{\lambda_\circ \left(1 + \frac{2v}{c}\right)}$$

$$\Delta = N_1 - N_2 = \frac{8Dv}{\lambda_\circ C} + \frac{4d}{\lambda_\circ} \; ; \; d = \frac{2Dv}{c}$$

$$\Delta = 16\frac{Dv}{\lambda_\circ c} \; = \; 7.52 \text{ FRINGES}$$

for the mirror as new source with

$$\lambda = \lambda_\circ \left(1 \pm \frac{v}{c}\right)$$

[4] Maxwell's theory states that no tangential field component shall be generated by total reflection. This is the case only upon total cancellation of incident and exit wave which requires that both are exactly equal in length, hence case 3. (17)

The above equation applies only to the first half of the path C E respectively D E, while for the other half of the path E C respectively E D, the full Doppler shift of

$$\lambda = \lambda_{\circ}\left(1 \pm \frac{2v}{c}\right)$$

has to be considered. The reason for this is that mirror E as new but stationary source will reflect the light with velocity c and the full Doppler shift.

Hence –

$$N_1 = \frac{2(D+d)}{\lambda_{\circ}\left(1-\frac{3v}{2c}\right)}$$

$$N_2 = \frac{2(D-d)}{\lambda_{\circ}\left(1+\frac{3v}{2c}\right)}$$

$$\Delta = N_1 - N_2 = \frac{6Dv}{\lambda_{\circ}C} + \frac{4d}{\lambda_{\circ}}$$

$$\Delta = 14\frac{Dv}{\lambda_{\circ}c} \;=\; 6.58 \text{ FRINGES}$$

A small difference has been disregarded, that is, at the second half of the small path difference 2d, the wavelength has changed back to $\lambda_{\circ}$ upon reflection from the second moving mirror. However, this difference is so small that it may be disregarded, like the other second-order effects.

It would appear that the introduction of the Doppler shift into our calculation results in disagreement of Michelson's experiment with the constant light velocity hypothesis and the "elastic reflection theory" gives the correct results.

C. THE IVES AND STILWELL EXPERIMENT.[5]

Ives and Stilwell measured the wavelengths of light emitted from moving and non-moving ionized hydrogen gas.

A beam of hydrogen ions in a vacuum tube was accelerated to a velocity which would yield a large enough Doppler shift of the spectrum to allow observation of the much smaller square shift.

The light from the ionized gas at rest, that from the approaching beam and that from the receding beam reflected by a mirror at the tube entrance was observed through a window at the end of the tube.

The photographed line spectrum showed the three lines of $\lambda_\circ + \Delta\lambda$, $\lambda_\circ$ and $\lambda_\circ - \Delta\lambda$ with $\lambda_\circ$ displaced by the expected square shift from its exact location halfway between the Doppler shifted lines.

Remembering now that according to Ewald & Oseen[1] the incident radiation is absorbed and the energy which passes through the glass loses its relation to the incident wavelength and velocity, then:

At the inner face of the window, all three waves $\lambda_\circ + \Delta\lambda$, $\lambda_\circ$ and $\lambda_\circ - \Delta\lambda$ are absorbed and passed through the surface as

$$f_\circ = \frac{c}{\lambda_\circ}$$

$$f_1 = \frac{c+v}{\lambda_\circ}$$

[5] H. E. Ives & G. R. Stilwell, J. Opt. Soc. Am. 28:215 (1938), 31.369 (1941)
H. P. Robertson: Revs. Mod. Phys. 21:374 (1949)

$$f_2 = \frac{c - v}{\lambda_\circ}$$

At the outer face of the window, the light is emitted again but this time with the same local velocity, c, for all three cases.

$$\lambda_\circ = \frac{c}{f_\circ} = \lambda_\circ$$

$$\lambda_1 = \frac{c}{f_1} = \lambda_\circ \frac{c}{c + v} = \lambda_\circ \left(1 - \frac{v}{c} + \frac{v^2}{c^2} \cdots \right)$$

$$\lambda_2 = \frac{c}{f_2} = \lambda_\circ \frac{c}{c - v} = \lambda_\circ \left(1 + \frac{v}{c} + \frac{v^2}{c^2} \cdots \right)$$

Again, like in the case of the re-transmitted radio wave (item 2), the square shift is simply the result of an absorption of the free space wave by matter and retransmission where the change of wavelength, hence, change of energy, is obtained from the momentum of the matter.

5. CONCLUSIONS FROM 1 - 4

From the previous paragraphs we cannot help but conclude the fact that the relativistic point of view (constancy of the speed of light and that of radio waves, x and γ rays relative to all and every reference system no matter what its state of motion) is simply untenable.

Basically, time and space are abstracts, not related to any material matter.

Space exists with and without matter and a set of coordinates can be defined from one basic reference system only which will stretch through three dimensional empty space without limits and without distortion.

Similarly, time is running out at a fixed rate in a single direction (forward) without relation to any material matter and it cannot be influenced by the existence of matter in any state of motion. If somewhere in the Universe an event happens, it will happen at the same time instant (simultaneously) relative to any and all observers in any state of motion. Yet, the information (of this happening) may not arrive at the distant observer for a long time. This, however, does not mean that the event did not happen at the time when it happened relative to this particular observer.

Theoretically, we certainly can conceive of any number of dimensions and let space warp and return into itself or develop a space-time continuum where space and time may interact and substitute for each other. However, all this will have to remain mathematical fiction. We may use those systems for gaining insight into certain natural relations but should not try to beat nature into those systems.

(For instance: If one takes a single electrical discharge which results in a pulse of energy, it could be interpreted (Fourier) as constructive interference of a whole spectrum of frequencies existing from $-\infty$ to $+\infty$, -- that is, long time before and after that capacitor had been fabricated and destroyed. Nobody would expect that nature had aimed at this

pulse since the beginning of the world. However, I have seen a theoretical treatise where this possibility was sincerely discussed.)

Light is carrying a certain mass and can be influenced by gravitation. This causes gravitational Doppler shifts as well as deflection of the light by gravitation from its straight path. Again, not space is warped in the vicinity of large masses but light is deflected by gravitational forces as well as by the accumulation of gasses which surround the mass (sun).

6. THE RELATIVISTIC MASS

According to the TR "the mass becomes infinite at the velocity of light therefore any particle (or mass) cannot be accelerated to a velocity of c or beyond. The velocity of light is the absolute upper limit of any propagation including gravitational fields and waves."

QUOTE:[6] "For a particle of mass m the Newtonian classical equations of motion are $m\frac{dv}{dt} = F$ where F is the force acting . . . and $v\frac{dv}{dt}$ is the ordinary velocity vector.... The so-called relativistic variations of mass, m with velocity arises if the time t of a particular Lorentz frame is used as the independent variable instead of the proper time τ. The equation of motion . . . becomes

$$\frac{d}{dt}\left(\frac{mv}{\sqrt{1-\beta^2}}\right) = F$$

[6] Condon and Odishaw, Handbook of Physics, 2-18. McGraw-Hill, 1958.

This is usually described by saying that the mass of the particle is variable with velocity so that the mass at velocity v is $\frac{m}{\sqrt{1-\beta^2}}$ ".

We can easily turn this around, state like before and explain:

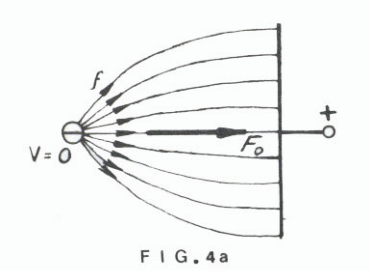

FIG. 4a

$$m\frac{dv}{dt} = F\sqrt{1-\beta^2}$$

A charged particle at rest in an electrical field will be exposed to an accelerating force F_o which is the vector sum of the forces f of all field components acting on the particle. Fig. 4a

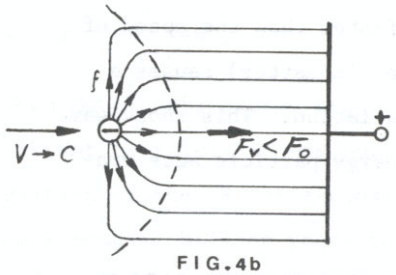

FIG.4b

At velocity v, approaching c, the field, as compared to the previous condition, will be distorted due to the fact that the information that the particle is coming can only travel with velocity c relative to the field (field distortion) in the fixed reference system and therefore when $v \to c; F_v < F_\circ$.

Fig. 4b.

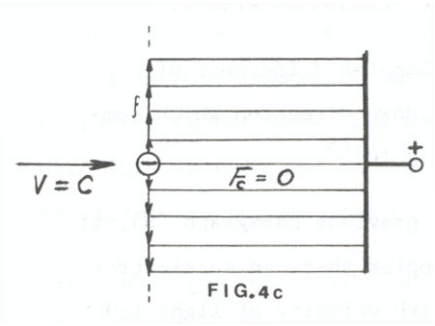

FIG.4c

At v = c, $F_c = 0$ because, Fig. 4c, no field distortion can travel ahead of the particle. All field lines remain straight up to the particle location and then distort to a shock wave with all force components in perpendicular direction to the particle motion. Hence, $F_c = 0$. Fig. 4c.

Obviously, if the driving field has a maximum propagation velocity a particle driven by this field cannot exceed this velocity, not because the particle obtains an infinite mass, but because the driving field cannot assert any force to accelerate a particle beyond its own velocity. This is the same as when a railroad car cannot be accelerated beyond the velocity of the locomotive, not because it becomes infinitely heavy, but because the locomotive reaches its maximum speed.

Also, a charged particle traveling faster than the speed of light in a particular reference frame (in matter) causes a shock wave and associated Çerenkow-radiation. This shock wave effect is readily observed in high energy particle accelerations.

7. GRAVITATIONAL DOPPLER SHIFT AND PROPAGATION VELOCITY OF GRAVITATIONAL FIELDS.

In 1959-60, R. V. Pound and G. A. Rebka, Jr. [7] measured the gravitational Doppler shift using the MOESSBAUER effect.

On a 74-foot high tower they found a Doppler difference of $(5.13 \pm 0.51) \times 10^{-15}$ between up and down direction which compares well with the theoretical 4.92×10^{-15}.

Consequently to what was said in the previous paragraph (6), if a gravitational field can cause a Doppler shift on an electromagnetic energy quantum traveling with velocity of light (c) then its own velocity of propagation (gravitational) must be in excess of c (by at least a factor of 10 or probably more than 100).

Particles (TACHYONS)[8] have been found which travel with a velocity in excess of c. In the light of (6) and (7) the explanation is obvious.

CONCLUSIONS.

8. THE BIG BANG.

When Hubble discovered the red shift of spectra taken from distant galaxies, it was obvious to explain this under the stipulation of the TR as explosion of the Universe and to

[7] R. V. Pound and G. A. Rebka, Jr. (Phys. Rev. Letters, Vol. 4, No. 7, 337-41 Apr. 1, 60)
[8] For a comprehensive list of publications see "Physics Abstracts" subject index under Tachyons" 1970 and following years.

calculate back some 12 billion years to a time when the whole mass of the Universe was one single black hole which exploded with a big bang.

Thus, in full consequence of the TR, individuals living on planets at the fringes of the Universe (moving with >99% C) are flat like mail stamps, weigh a million pounds and live a million years but do not know this and, in turn, think the same about us. This is only one of the many paradoxes which the modern physicist has become used to living with.

Take away the requirement of the universal constancy of the velocity of light and let the light lose energy by interacting with gaseous matter on its travel over a few billion years and we end up with Fred Hoyle's steady state theory and no paradoxes.

Quasars show a 90+% red shift, which, according to Hubble's law, puts them into the outer fringes of the Universe. With the unexplainable high amount of energy output required to be visible at these distances, they would have to outshine 200 whole galaxies.

Astronomers slowly come to accept the fact that this is not so and that the more acceptable explanation is their gravitational Doppler shift which puts these stars much closer to us.

Neutron stars should also be expected to show a gravitational Doppler shift and the ultimate stage of mass concentration, the black hole (if it exists), would have a 100+% gravitational shift, i.e., the velocity of light is zero or negative.

9. A SMALL BANG

On June 30, 1908, some unexplained explosion in Siberia uprooted the forest to a radius of 50 Km and scorched it to 20 Km distance from center. Observers reported a column of fire or a flash but no meteorite matter was found in the expected impact area.[9] Speculations about the cause have been running from a nuclear explosion or a spaceship blown up, to a black hole that went through the earth. More recent tests did not show any unusual residual radiation which would have been indicative of a nuclear explosion on or near the ground.

The following observations were reported on June 30, 1908 and the following days:

1. The object was first seen over western China traveling north.
2. A "pillar of fire" in the clear, blue sky, visible several hundred miles away.
3. Shock waves in the air heard up to 500 miles away.
4. Trees uprooted up to 50 Km and scorched to 20 Km around the impact area.
5. In western Europe, remarkable lights were observed in the northern heavens during two nights.
6. Five hours after the impact, unusual air pressure waves were recorded in London.
7. Seismic shock waves and magnetic disturbances were recorded.

[9] For a summary report and bibliography see John Baxter and Thomas Atkins "The Fire Came By," Doubleday 1976.

8. Silvery clouds were blanketing Siberia and northern Europe. The light was so intense during the next few nights that in some places it was possible to take photographs and ships could be clearly seen for miles out at sea. A Russian scientist describes the thick layer of glowing clouds as lit up by some kind of yellowish-green light that changed to a rosy hue.
9. On June 30, a scientist in Holland observed an "undulating mass" passing across the northwestern horizon. It was not a cloud but the blue sky itself seemed to undulate.

All this indicates that a large amount of radioactive matter was suspended in the upper atmosphere which caused ionization and subsequent light emission from the area.

Trees in the center of the impact area were not uprooted but scorched and stripped of their branches. This definitely indicates that there could not have been an impact of any large mass and that all destruction was caused by the heat and shock wave from the atmosphere.

Concluding from the above, we may offer another less speculative explanation.

In a gravitational field, a particle, or even a large chunk of material, can be accelerated to and beyond the speed of light if given enough time; i.e., to fall for a few million or billion years through the gravitational field of our galaxy.

In normal chemistry, materials which are able to react exothermically usually need to be heated in order to start the reaction. For instance, one can mix $2H_2$ and O_2 and keep the mixture in a container indefinitely. Raise the temperature within any minute volume inside the mixture and we get an explosive reaction. In the cold mixture the molecules are kept apart by the repelling negative electric charges of their electron shells.

Heat is but another expression for particle velocity (BROWNIAN movement). If this velocity increases the particles can approach each other more closely until they reach a velocity at which they can penetrate their repellant fields and start the reaction.

The same applies to a nuclear fusion reaction except that, in this case, the positive charge of the nucleus is the much stronger repellant force to be overcome by very high particle velocities equivalent to temperatures in the 10 to 100 million degree range. However, even at these temperatures the particle velocities are well below the speed of light.

Now take a chunk of matter (of 10 to 100 kg) at a velocity near or above the speed of light entering the earth's atmosphere.

Due to the high velocity, the normal repelling process – air molecules being deflected by the electronic shells of the molecules at the surface of the chunk of matter – does not work (see paragraph 6). There would be no shock wave in front of the chunk, but the air molecules will penetrate right into the whole chunk immediately, that is:

At this interface most or all air molecules will already have disintegrated and the atoms will have been stripped of their electrons so that nuclei and electrons are the (air) components to penetrate the material.

Since the velocity also exceeds the fusion velocity, the repelling force of the positive nuclear charges does not work either and all kinds of fusion and fission reactions will take place.

As a result, the chunk of material will disintegrate during its approximately 20 milliseconds or less dive through some 6000 Km of atmosphere on the way from the Indian Ocean to Siberia and – besides the kinetic energy of some 10^{18} Joules – will release a large additional amount of nuclear energy. Since this process takes place immediately throughout the whole chunk of matter and without the need for heat transport from one molecule to the next, the whole chunk evaporates before it reaches the ground. The fusion and fission products are slowed down and remain in the atmosphere so that very little residual radioactive matter will be found on the ground in the impact area.

The amount of energy of this blast was calculated to be 10^{23} erg. This is the kinetic energy of a 10 to 100 Kg chunk of matter moving at or close to the velocity of light.

One million years acceleration in a gravitational field of 10^{-6}g would suffice to reach the velocity of light. Therefore, the above explanation seems to be plausible.

On an intergalactic scale, a chunk of matter, thrown clear of the gravitational field of its own galaxy by a supernova explosion could take a few billion years to travel to another galaxy. Even a very weak gravitational field would have time to accomplish such acceleration.

Fortunately for us, not too many chunks of matter fly around at such speed, and our earth is a small target compared to our galaxy else we may have encountered those catastrophes more often.

There are stories in the Bible and other ancient records that fire fell from the sky and destroyed whole cities. Since meteorites are a fairly common occurrence, these events must have been extraordinary and may point to similar events. It would be of interest to collect those stories, to find how often the earth has encountered such events and to estimate how many missiles of that kind are approaching our galaxy.

The following paragraphs must, of necessity, appear simplistic. They are more or less just thoughts and ideas which appeared while working on the previous part.

10. NEUTRON STARS AND BLACK HOLES

There are two forces – gravitational and electro-magnetic – driving all action in the Universe.

The gravitational force is a unipolar force, i.e., the mutual attraction of mass points on the macroscopic as well as the microscopic scale.

The electrical force is bipolar, attracting opposite and repelling same polarity.

Without gravitation, matter would be distributed equally throughout the Universe. Without electrical forces, all matter would have collapsed into black holes.

Two additional effects are caused by motion.

When a mass is accelerated, its inertia requires energy to be expended which is retained as $\frac{1}{2}mv^2$, in the acquired velocity of the mass.

When an electrical charge is moved, it creates a magnetic field and a magnetic field can move electrical charges taking energy from the mass inertia and so finally from gravitation.

In the formation of a star, debris left from (Super) Nova explosions and hydrogen gas clouds contract toward a new center of gravity.

Imbalances within the mass distribution and initial rotational motion of the galaxy cause the whole assembly to start rotating at an accelerated speed as it contracts.

The inertia of the matter which tends to maintain linear velocity (centrifugal force) and the gravitational force pulling towards the center create a disc-shaped assembly which finally breaks up into single units under their own gravitational forces but with the whole assembly rotating around the heaviest central body or a common center of gravity.

At a certain time during star formation, the particle density of the central body has reached a point where particles collide more often, the free path length becomes smaller and the whole mass starts heating up.

In a single H atom the mass is concentrated within a space probably smaller than the nucleus. It is surrounded by a positive charge together making up the proton and finally at a much larger distance by a negative charge the electron (with 5.5×10^{-4} of the mass). At larger distance from the atom its electrical field is zero because both charges are compensating for each other within the atom and its vicinity.

Two atoms colliding at a slow velocity will be bounced off each other by their negative fields. At higher velocities their electrons will be lifted into a higher state of energy which is acquired from the inertia of the colliding atoms. When electrons revert again to their lower energy state, they radiate an amount of electromagnetic energy equal to what was acquired before from inertia.

Again at higher speed the collisions become powerful enough to separate electrons and protons, to ionize the gas. The free electrons serve as carriers of electrical currents.

The next higher state of energy will require protons and nuclei of heavier elements to bounce off their positive charges and finally penetrate far enough to fuse. These velocities are equivalent to temperatures in the 10 to 100 million degrees range.

When a star has reached this stage, it starts burning up its hydrogen gas and forming heavier elements. This process is exothermic down to the formation of iron. Inside a larger star this process goes on farther to form higher elements to uranium and beyond by absorbing energy.

Finally, after going through all fusionable matter, the star cools down and under the pressure of the gravitational force a large enough mass may shrink to the size of a neutron star with protons absorbing the free electrons and being so densely packed as likely to form a single nucleus of a super atom.

Here we have to ask the question of how much of real solid matter does a mass center of a proton represent. Most probably not the diameter of the proton (which includes the positive electrical charge) but much less because the proton itself consists of smaller building blocks. It may not even come as a surprise when we finally find out that the mass center does not have a solid dimension at all but is only the center of a field of gravitational force surrounded by a similar field of electrical charge.

From this point of view, the black hole is a further contraction of matter below the size of a neutron star and possibly able to pack the whole mass of the sun into a sphere of a few meters diameter.

However, black holes seem to exist. If we cannot see them we can deduce their existence from the behavior of their surroundings, that is, of matter, which is located outside the sphere of no return, indicating that there is a strong gravitational pull acting on it from the inside.

What may be the ultimate fate of a black hole?

First of all, it has to grow continuously heavier while collecting matter from its environment. The speed of rotation goes up to several rotations per second. Could it be that the centrifugal force, plus fission reaction, will eventually blow it apart into a super nova explosion?

11. NUCLEAR POWER

In the attempt to create a controlled fusion reaction, researchers today try to emulate the hydrogen bomb in miniature.

In The Bomb, a fission reaction is used to heat up fusionable material to fusion temperature and contain it long enough within a heavy enclosure so that a considerable amount of the material has reacted before the whole assembly blows apart.

By heating a small pellet of fusionable material with powerful laser beams, the result is contrary to what is attempted by the experiment.

As discussed above, two nuclear particles will fuse when they collide head on at sufficient velocity to overcome the repulsion of their positive charges. By heating a pellet of solid material we will not obtain many head-on collisions but rather blow the pellet apart with all particles moving radially away from the center.

The same is true for many plasma experiments. A hot plasma being squeezed into a narrow space still moves in the same general direction.

A much higher probability of collisions would be created if one would be able to design a system whereby two particle streams move at high speed in opposite directions. For instance, in a ring with electrical fields arranged in such a way as to keep those two opposing flows confined within the ring, the particles will have a greatly enhanced chance of colliding at high speed.

If a pack of particles could be confined in the ring for say an average of three seconds, it would travel 10^5 to 10^6 Km. and encounter some 10^9 packs of particles moving in the opposite direction.

A barn is 10^{-24} cm^2, therefore, if the particle density in such pack could be maintained at 10^{15} per cm^2 (as seen in cross section) there would be a near 100% chance of collision.

It appears that this may be a possible way to obtain the long sought controlled nuclear fusion.

To conclude with a quotation of Dr. Walther Rauschenberger[2], "The acceptance of the TR will go down in history as one of the most remarkable errors of the human mind."