ISSN 1916-9639 (Print)
ISSN 1916-9647 (Online)

APPLIED PHYSICS RESEARCH

CANADIAN CENTER OF SCIENCE AND EDUCATION®

Vol. 9, No. 3 June 2017

Contents

Applied Physics Research; Vol. 9, No. 3; 2017
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

Connecting dark matter particles with the primary, obscure and normal particles through implicit causality

Josip Śoln[1]

[1] JZS Phys-Tech, Vienna, Virginia 22182, USA

Correspondence: Josip Śoln, JZS Phys-Tech, Vienna, Virginia 22182, USA. E-mail: jurasoln@yahoo.com

Received: April 11, 2017 Accepted: April 26, 2017 Online Published: May 10, 2017

doi:10.5539/apr.v9n3p1 URL: https://doi.org/10.5539/apr.v9n3p1

Abstract

The primary, obscure and normal particles with respective limiting velocities c_1, c_2 and c_3,solutions from bicubic equation, offer comfortable venues to tackle the newly emergent dark matter particles. Particular emphasis is given to particles with velocities of $O(10^{-3}c)$ (with c the velocity of light) and whose energies are from $1eV$ to over $100GeV$ for which the congruent parameter $z = 3\sqrt{3}mv^2/2E$ assumes values of 10^{-6} and 10^{-7}. At $z = 10^{-6}$ with $mc^2 = 100GeV$ one can have $E = 260GeV$ or with $E = 1eV$ one can have $mc^2 = 0.38eV$; while at $z = 10^{-7}$ with $mc^2 = 100GeV$ one can have $E = 2.6TeV$ or with $E = 1eV$ one can have $mc^2 = 0.038eV$. The small values of the congruent parameter z allow the limiting velocities c_1, c_2 and c_3 as well as the resulting energy expressions be written down perturbatevly in terms of the congruent parameter z.

It is shown that for $mc^2 = 100GeV$ particle in the Milky Way Dark Matter Velocity Profile (Laha, 2016), the derived limiting velocities of primary, obscure and normal particles as dark matter particles are: $c_1 = 1,7c$ ($z = 10^{-7}$), $1.34c$, $2.15c$ ($z = 10^{-6}$); $c_2 = \pm i1,7c$ ($z = 10^{-7}$), $\pm i1.34c$, $\pm i2.15c$ ($z = 10^{-6}$), and $c_3 = v$ ($z = 10^{-7}, 10^{-6}$). Perturbatively, for a very small common primary and obscure particle velocity v compared to the absolute values of their limiting velocities, one shows that the obscure particle acquires $(-mv^2)$ intrinsic negative energy with respect to the primary particle,with m being their common mass.

Keywords: Dark matter particles, Implicit causality, Prime, Obscure and Normal particle limiting velocities

1. Introduction

The particle limiting velocity solutions of primary c_1, obscure c_2 and normal c_3 (Soln, 2014, 2015, 2016, [1, 2, 3]), repeated bellow with (2.0, 1, 2, 3), cathegorize particles respectively into the primary, obscure and normal particles with the help of dimensionless congruent particle parameter

$$z = \frac{3\sqrt{3}mv^2}{2E}; \ -1 \leq z \leq 1 \tag{1.0}$$

where m, v and E are respectively particle mass, velocity and energy. For a given value of z , relation (1.0) indicates that m, v and E are in an implicit causality relation with each other,which is affecting their allowed values, depending on the specific value of z. Some of these may or may not change as z changes from one value to another, but always respecting that $-1 \leq z \leq 1$. The values of c_1, c_2 and c_3 change only if the congruent parameter as a whole changes, as can be seen from relations (2) bellow. That is, the changes in m, v and E must be such that they change the value of z within allowed limits, which in turn, will change the respective values of c_1, c_2 and c_3. Of course, although the fixed value of z fixes the values of c_1, c_2 and c_3 it does not mean that all these values are observable with particles; what it means is that they are allowed to be created. Perhaps what one observes could be a particle with c_3 or particles with c_1 and c_2.

Complete description of a dark matter particle requires also the knowledge of m, v and E for a given value of its congruent parameter z. Unfortunately the attributes of dark matter particles are not very well known. The velocities of dark matter particles appear to be the easiesr to estimate. For instance, Fan, Reece and Wang (2010) as well as Bezrukov and Gorbunov (2015) found that dark matter particles with $v \approx 10^{-3}c$ (with c the velocity of light) and small energy of $E \approx 1eV$ are likely to exist. From (4), that follows, one sees that with given v and E the maximum mass is achieved at $z = 1$ which in Śoln (2016),was treated as a test particle. Dealing with this kind of test particles,one finds that at $z = 1$, $v \approx 10^{-3}c$ and $E \approx 1eV$, the corresponding primary, obscure and normal limiting velocity self energies to be $m(1)c_{1,3}^2 \approx 0.58eV, m(1)\left(-c_2^2\right) \approx 1.15eV$. As each of these particles has $E \approx 1eV$, the obscure particle has to go through intrinsic self-annihilation so that $m(1)\left(-c_2^2\right) \approx 1.15eV$ is sufficiently decreased so that its energy ends up with $E \approx 1eV$ as shown in Śoln (2016). Here this self-annihilation phenomenon for the obscure particle is pointed up perturbatively at the end of Section 2.

One will have to move away from $z = 1$ in order to be able to discuss dark matter particles with mc^2 say, from bellow $1eV$ to above $100GeV$ as advocated recently by Laha (2016), however with velocities that cover the range: $(1/4)10^{-3} \le v \le (4/3)10^{-3}c$. In fact, the congruent parameter will assume values of $z = 10^{-6}$ and $10^{-7}$for the energies, from less than $1eV$ to over $100eV$. Specifically,with $z = 10^{-6}$,the implicit causality requires that for $mc^2 = 100GeV$ one has to have at least $E = 260GeV$,or for $E = 1eV$ one has to have at least $mc^2 = 0.38eV$; while at $z = 10^{-7}$ the implicit causality demands that for $mc^2 = 100GeV$ one has to have at least $E = 2.6TeV$ or with $E = 1eV$ one has tohave at least $mc^2 = 0.038eV$, etc. Of course, one notices that the congruent parameters values here for possible dark matter particles are different from $z = 10^{-11}$ like when calculating in Śoln (2014, 2015, 2016) the limiting velocity for OPERA muon electron experiment from Adam et al. (2012), and the Crab Nebula Flare 2010 observation Stecker (2014) of the superluminal electron limiting velocity (Śoln, 2014, 2015, 2016).

In Section 2 one starts with exact forms of limiting velocities c_1, c_2 and c_3 which depend on inverse trigonometric functions and the dimensionless congruent parameter z (1). At $10^{-2} \le z \le 1$ the exact limiting velocity forms in calculations have to be used, while at $z \le 10^{-2}$ either exact or perturbative forms can be used in calculations, where perturbative forms are approximations from the Taylor series with the algebraic function forms in z. Also for small z, if necessary, other relevant relations involving E, v and m will be expressed as algebraic functions in z, utilizing a new established symmetry between c_1 and c_2 under reflection of z, $z \to -z$. Also in Section 2, from Śoln (2016) two different energy expressions for primary, obscure and normal particles are presented. These are then used to exhibit the self annihilating property of the obscure particle relative to the primary particle for very small particle velocity compared to respective absolute values of limiting velocities.

Section 3 is devoted to numerical results associated with proposed dark matter particle velocity $v \sim 10^{-3}c$, where c is the velocity of light (Fan, Reece, & Wang, 2010; Bezrukov & Gorbunov, 2015; Laha, 2016). First, a general approach is given for $v \sim 10^{-3}c$ dark matter particle observability through primary and normal particles with respect to related limiting velocities c_1 and c_3 as well as through possible effects of obscure particle with imaginary limiting velocity c_2 . On a more specific level, Laha,s results (Laha, 2016) on the Milky Way dark matter velocity profiles is dissected into three segments with velocity values: initial, $v = (1/3)10^{-3}$, middle, $v = (2.5/3)10^{-3}$, and the end, $v = (4/3)10^{-3}c$. Each of these velocities is associated formally with a respective particle. These way, one can follow much easier with more precise values of the corresponding congruent parameters and energies and other things. In fact, in the calculations with these velocities z is selected with implicit causality from acustomary requirement $mc^2 < E$ plus a must requirement $-1 \le z \le 1$ yielding allowed values $z \lesssim 10^{-6}, 10^{-7}$. Although the requirement $mc^2 < E$ seems to be working, so far satisfactory, out of curiosity, one should be open to possibility to replace c with c_1, c_2 or even with $c_3 \neq c$ to see whether that would make a difference.

2. Particle limiting velocity expressions with different ranges of the congruent parameter z

It has been shown in Śoln (2014, 2015) and particularly in Śoln (2016) that combining the particle nass-shell condition with the particle momentum, one ends up for c, identified as a limiting velocity, with the bicubic equation

$$m^2\left(c^2\right)^3 - E^2c^2 + E^2v^2 = 0 \tag{1.1}$$

whose three solutions, according to Śoln (2014, 2015, 2016), are squares of the primary c_1 ,obscure c_2 ,and normal c_3,limiting velocities, which with z from (1.0),are written as,

$$D = \frac{1}{4}\left(\frac{3\sqrt{3}}{2z}\right)^4\left[1 - \frac{4}{27}\left(\frac{3\sqrt{3}}{2z}\right)^2\right] = \left(\frac{3}{2}\right)^6\frac{1}{z^4}\left(1 - \frac{1}{z^2}\right) \le 0, \tag{2.0}$$

$$z = \frac{3\sqrt{3}mv^2}{2E}; \quad -1 \le z \le 1, \frac{c_1^2}{v^2} = \frac{3}{z}\sin\left(\frac{\pi}{3} - \frac{1}{3}\sin^{-1}(z)\right) > 0, \tag{2.1}$$

$$\frac{c_2^2}{v^2} = -\frac{3}{z}\cos\left(\frac{1}{3}\sin^{-1}(z) - \frac{\pi}{6}\right) < 0, \tag{2.2}$$

$$\frac{c_3^2}{v^2} = \frac{3}{z}\sin\left(\frac{1}{3}\sin^{-1}(z)\right) > 0 \tag{2.3}$$

With identities, (3.0) where α is a real quantity, one obtains from (2. 2)

$$\sin\left(\alpha + \frac{\pi}{3}\right) = \cos\left(\alpha - \frac{\pi}{6}\right) = \cos\left(-\alpha + \frac{\pi}{6}\right) \tag{3.0}$$

$$(2.2): \frac{c_2^2}{v^2} = -\frac{3}{z}\sin\left(\frac{1}{3}\sin^{-1}(z) + \frac{\pi}{3}\right) < 0 \tag{3.1}$$

From comparison of (2,1) and (3.1) it is easily seen the interesting connection between c_1^2 and c_2^2 under reflection of the congruent parameter $z \to -z$, while c_3^2 remains the same,

$$(2.1)\frac{c_1^2}{v^2}(z \to -z) \to (3.1)\frac{c_2^2}{v^2}(z)\,;\ (2.3)\frac{c_3^2}{v^2}(z \to -z) \to (2.3)\frac{c_3^2}{v^2}(z) \tag{3.2}$$

The meaning of (3.2) is imposing itself through z; If, for instance, the energy E becomes negative in the primary particle, then the primary particle transitions into the obscure one, but treating E as its positive energy. Of course, by the same token the reflection $z \to -z$ can change the obscure particle in (3.1) into the primary particle in (2.1). Now,as the normal particle is even under $z \to -z$, it simply remains the normal particle as c_3^2 recognizes effectively only $|z|$. Furthermore if these transitions between dark matter primary and obscure particles occur causally, one can see difficulties in pin-pointing a dark matter particle since the basic difference between primary, with real c_1, and obscure, with imaginary c_2 ,are in their limiting velocities.

The Taylor series expansions of (2.1, 2, 3)) and of (3.1) for limiting velocities in terms of $z \leq 10^{-2}$, explicitly demonstrates relations (3.2) in this approximation.

$$(2.1): \frac{c_1^2}{v^2}(z) = \frac{3\sqrt{3}}{2z} - \frac{1}{2} - \frac{\sqrt{3}z}{12} - \frac{2z^2}{27} + O(\left(z^3\right), \tag{4.1}$$

$$(3.1): \frac{c_2^2}{v^2}(z) = -\frac{3\sqrt{3}}{2z} - \frac{1}{2} + \frac{\sqrt{3}z}{12} - \frac{2z^2}{27} - O(\left(z^3\right), \tag{4.2}$$

$$(2.3): \frac{c_3^2}{v^2}(z) = 1 + \frac{4z^2}{27} + O(\left(z^4\right). \tag{4.3}$$

These relations show more clearly the interrelationship between primary, obscure and normal limiting velocities c_1, c_2 and c_3 at small z values. One notices that at small z values $c_3^2 \simeq v^2$ while the same is not true for either c_1^2 or c_2^2.

The zero square sum rule of limiting velocities (Śoln, 2014, 2015, 2015), written here as $c_3^2(z) = -c_1^2(z) - c_2^2(z)$ and valid for any congruent parameter z value, shows deep interrelationship between c_1^2, c_2^2 and c_3^2. Here, of course this is explicitly seen for $z \leq 10^{-2}$ from (4.1, 2, 3). However, the perturbation relations (4) will be very useful in evaluating ranges of limiting velocities when $v \sim 10^{-3}c$ as advocated in Fan, Reece and Wang (2010), Bezukov and Gorbunov (2015) and more recently by B. Laha in Laha (2016).

For the sake of completeness, according to Śoln (2016) one writes down two different energy expressions for each of primary, obscure and normal particle whose respective limiting velocities satisfy, $c_1^2 > 0$, $c_2^2 < 0$ and $c_3^2 > 0$,

$$E(c_1) = \frac{3\sqrt{3}mv^2}{2z} = \frac{\sqrt{3}mc_1^2}{2\sin\left[\frac{1}{3}\left(\pi - \sin^{-1}(z)\right)\right]} = mc_1^2\left(1 - \frac{v^2}{c_1^2}\right)^{-\frac{1}{2}} \tag{5.1,2}$$

$$= mc_1^2 + \frac{mv^2}{2} + \frac{3}{8}mc_1^2\left(\frac{v^2}{c_1^2}\right)^2 + mc_1^2 O\left[\left(\frac{v^2}{c_1^2}\right)^3\right], \tag{5.3.}$$

$$E(c_2) = \frac{3\sqrt{3}mv^2}{2z} = \frac{\sqrt{3}m\left(-c_2^2\right)}{2\sin\left[\frac{1}{3}\sin^{-1}(z) + \frac{\pi}{3}\right]} = m\left(-c_2^2\right)\left(1 + \frac{v^2}{\left(-c_2^2\right)}\right)^{-\frac{1}{2}} \tag{5.4,5}$$

$$= m\left(-c_2^2\right) - \frac{mv^2}{2} + \frac{3}{8}m\left|c_2^2\right|\left(\frac{v^2}{\left|c_2^2\right|}\right)^2 + m\left|c_2^2\right| O\left[\left(\frac{v^2}{\left|c_2^2\right|}\right)^3\right], \tag{5.6}$$

$$E(c_3) = \frac{3\sqrt{3}mv^2}{2z} = \frac{\sqrt{3}mc_3^2}{2\sin\left[\frac{1}{3}\sin^{-1}(z)\right]} = mc_3^2\left(1 - \frac{v^2}{c_3^2}\right)^{-\frac{1}{2}} \tag{5.7,8}$$

$$= mc_3^2 + \frac{mv^2}{2} + \frac{3}{8}mc_3^2\left(\frac{v^2}{c_3^2}\right)^2 + ... \tag{5.9}$$

The series expansion for $E(c_3)$ is not saturated, indicating slow convergence. Subtracting (5.3) from (5.6) and taking into account from the Table that $c_1^2 \approx -c_2^2$, then with the same mass m, same v, same z, one obtains perturbatively, generally very small difference between $E(c_1)$ and $E(c_2)$,

$$E(c_2) - E(c_1) = -mv^2 + m\left|c_2^2\right| O\left[\left(\frac{v^2}{\left|c_2^2\right|}\right)^3\right] - mc_1^2 O\left[\left(\frac{v^2}{c_1^2}\right)^3\right] \approx -mv^2 \tag{5.10}$$

Relation (.2) indicates that globally $E(c_2)$ relative to $E(c_1)$ exhibits self annihilation properties of the obscure particle relative to the primary particle. Presently, at very low $z = 10^{-7}$ with $mv^2 \ll mc_1^2$, $m\left(-c_2^2\right)$,then $(-mv^2)$ is rather small compared to $E(c_2$ and $E(c_1)$. The importance of (5.10) is in the fact that the negative relative energy $E(c_2) - E(c_1)$ under the circumstances of very large congruent parameter z, may become even more negative indicating deeper physical differences between obscure and primary particle

3. Limiting velocities for (dark matter) particles with small ordinary velocities

A number of authors, such as Fan, Reece, and Wang (2010), Bezrukov and Gorbunov (2015) and Laha (2016) believe that an ordinary velocity of $v \sim 10^{-3}c$ would be a natural representative velocity for a bunch of dark matter particles, either with small mass and energy , $mc^2 \leq E \leq 1eV$ (Fan, Reece, & Wang, 2010; Bezukov & Gorbunov, 2015) or with large energy and mass, $E \geq mc^2 \geq 100GeV$ (Laha, 2016). These relatively small velocities of $O(10^{-3}c$) facilitate bunching of these particles and their observation.

The Milky Way Dark Matter Velocity Profiles can be cast in a variety of VDF's (Velocity Distribution Functions) (Laha, 2016) of which the simplest is the one like the standard Maxwellian distribution (Laha, 2016),

$$f(v) = A\exp\left[-\left(\frac{v}{v_0}\right)^2\right],\ v = \left|\overrightarrow{v}\right| \tag{6.0}$$

The VDF $f(v)$ has maximum at v_0, and v is significantly different from 0 between $v_{mn}$and v_{mx} , with numerical values as follows,

$$kms^{-1} = (1/3)\,10^{-3}c:\ v_{mn} = 0\ kms^{-1} = 0\ c,$$
$$v_0 = 250\ kms^{-1} = (5/6)\,10^{-3}c, v_{mx} = 500\ kms^{-1} = \left(\frac{4}{3}\right)10^{-3}c \tag{6.1}$$

The constant A in the Dark Matter Velocity Profile is the normalization factor chosen such that the intergral

$$\int_{v_{mn}}^{v_{mx}} d^3v\ f(v) = 4\pi\int_{v_{mn}}^{v_{mx}} v^2\ dv\ f(v)$$

equals the number of dark matter particles in a region of interest (Mao et al., 2013).

An important thing that this Milky Way Dark Matter Velocity Profile offers is a number of particles with velocities that are close to $10^{-3}c$ and which kinematically, through primary, obscure and normal particles, could shed important light on the nature of dark matter particles. To this end, the choice of three different ordinary velocities between v_{mn} and v_{mx} are assigned to three hypothetical dark matter particles from which then the corresponding primary, obscure or normal limiting velocities are to be calculated,

$$v = 100\ kms^{-1} = \frac{1}{3}10^{-3}c, \tag{6.2}$$

$$v = v_0 = 250\ kms^{-1} = \frac{5}{6}10^{-3}c, \tag{6.3}$$

$$v = 400\ kms^{-1} = \frac{4}{3}10^{-3}c \tag{6.4}$$

The question now is: What kind of limiting velocities one can expect from ordinary velocities from (6.2, 3, 4) ? In order to use them in the implicit causality relations, one first combines $mc^2/E, \leq 1$ with $0 \leq z < 1$ to obtain

$$z = \frac{3\sqrt{3}v^2}{2c^2}\frac{mc^2}{E} \leq 1;\ \ \frac{mc^2}{E} \leq 1; \tag{7.1, 2}$$

$$\frac{2c^2}{3\sqrt{3}v^2}z \leq 1 : z \leq \frac{3\sqrt{3}v^2}{2c^2} \tag{7.3, 4}$$

Since the ordinary velocities are assigned , one simply applies the implicit causality on (7. 4) in order to deduce the most appropriate values for z .

$$v = \frac{1}{3}10^{-3}c,\ z < \frac{3\sqrt{3}}{2\cdot 9}10^{-6} = 0.29\ \cdot 10^{-6};\ z \sim 10^{-7} \tag{7.5}$$

$$v = \frac{5}{6}10^{-3}c,\ z < \frac{3\sqrt{3}}{2}\left(\frac{5}{6}\right)^2 10^{-6} = 1.8\ \cdot 10^{-6};\ z \sim 10^{-6} \tag{7.6}$$

$$v = \frac{4}{3}10^{-3}c,\ z < \frac{3\sqrt{3}}{2}\left(\frac{4}{3}\right)^2 10^{-6} = 4.62\ \cdot 10^{-6};\ z \sim 10^{-6} \tag{7.7}$$

In relations (7.5, 6, 7) the choices of $z \sim 10^{-7}$ and $z \sim 10^{-6}$ are made with the largest $z's$ that comfortably satisfy (7.5, 6, 7) for each particular v . As such they define models that likely will describe the realistic physics of the possible primary, obscure or even normal dark matter particles. The choices of $z \sim 10^{-7}, 10^{-6}$ cover cases from references (Fan, Reece, & Wang, 2010; Bezukov & Gorbunov, 2015; Laha, 2016) as long as $mc^2 \leq E$, despite the fact that in Fan, Reece, and Wang (2010) and Bezukov and Gorbunov (2015), $E \sim 1eV$, while in Laha (2016) $E \geq 100GeV$. It is interesting to compare for these assumed dark matter particles their congruent parameter values of $z \sim 10^{-7}, 10^{-6}$ with $z \sim 10^{-11}$ of the OPERA muon-neutrino velocity experiment (Adam et al., 2012) as shown in Śoln (2016), as well as, with $z \sim 10^{-10}$ of the Crab Nebula Flare 2010 observation of the superluminal electron velocity (Adam et al., 2012) as shown in Śoln (2014, 2015, 2016). In both of these experiments, $v \sim O(c)$ while in present cases $v \sim O(10^{-3}c)$, lowering z from 10^{-10} or 10^{-11} to 10^{-6} or 10^{-7}.

Now, because $z \sim 10^{-6}, 10^{-7} \ll 1$, in place of exact limiting velocity solutions (2), one can use the small congruent parameter z limiting velocity solution expressions (4,1, 2, 3) to $O(z^0)$. Next, the three limiting velocities c_1, c_2 and c_3, calculations are done within three respective (z, v) combinations (7.5, 6, 7) according to (4,1, 2, 3). Furthermore, consistent with Laha (2016), the mass value of $mc^2 \approx 100GeV$ is assumed. Then as seen from exact energy expressions (5.1, 4, 7) (compare with Śoln, 2016) the calculated energy expressions satisfy, $E(c_1, z) = E(c_2, z) = E(c_3 z)$. Limiting velocities with the energies are presened in two tables that follow.

In the Table terms with v^2/c are negligible for cases from relations (7). They are here for the sake of completeness and if it is desired to increase v's to higher values. Each normal limiting velocity c_3,as relation (4.3) indicates is for the values of $z = 10^{-6}$ and 10^{-7}, just slightly larger than v, which is the reason for keeping the same value as v. In the Table a velocity v can be understood as a velocity of just created or instantaneously interacting particle; which is the reason that in such situations real v goes with every particle.

The energy E, calculated from non-perturbative relations (5.1), (5. 4) and (5.7) show the same value for each c_1, c_2 and c_3 with fixed values of v and z. What one sees here is that after the creation or engagement a particle becomes free and assumes limiting velocity, real c_1 for the primary particle, imaginary c_2 for the obscure particle and real

c_3 for the normal particle. These limiting velocity values are not universal but rather reflect from which specific v value, that is to say, z value they started.

As shown in Śoln (2016), the energy of every kind of particle, primary, obscure or normal particle is globally governed with implicit causality from the congruent parameter z through the expression (1), $E = 3\sqrt{3}mv^2/2z$. This expression changes into forms with which one emphasizes differences between primary, obscure and normal particles through respective limiting velocities c_1, c_2 and c_3. Globally, primary, obscure and normal particles with the same m, v and z will have the same energy. For instance, a difference for the obscure particle is that perturbativelly the lower order terms of energy expression will yield negative contribution as compared to the primary particle, which is due to the fact that the obscure limiting velocity c_2 is imaginary.

Tables 1. Limiting velocities and energies of dark matter particles of selected model velocities from the Milky Way Dark Matter Velocity Profile (Laha, 2016)

$$\begin{pmatrix} z: & 10^{-7}, & 10^{-6} \\ v: & \frac{1}{3}10^{-3}c, & \frac{5}{6}10^{-3}c \\ c_1: & 1.7c - 0.15(v^2/c), & 1.34c - 0.19(v^2/c) \\ c_2 & \pm i[1.7c + 0.15(v^2/c)], & \pm i[1.34c + 0.19(v^2/c)] \\ c_3 & \frac{1}{3}10^{-3}c, & \frac{5}{6}10^{-3}c \\ E/GeV & 289, & 180 \end{pmatrix}$$

$$\begin{pmatrix} z: & 10^{-6} \\ v: & \frac{4}{3}10^{-3}c \\ c_1: & 2.15c - 0.12(v^2/c) \\ c_2 & \pm i[2.15c + 0.12(v^2/c)] \\ c_3 & \frac{4}{3}10^{-3}c \\ E/GeV & 462 \end{pmatrix}$$

4. Conclusion

Three particle limiting velocities c_1, c_2 and c_3 either in the original analytical forms (Śoln, 2014, 2015, 2016) or in the present perturbative forms for very small congruent parameters $z \sim 10^{-6}, 10^{-7}$, suggest that the corresponding primary (c_1), obscure (c_2) and normal (c_3) particles be good candidates for dark matter particles for the velocities of $O(10^{-3}c)$ and energies from $1eV$ through $100GeV$. These facts agree with evaluations and analyses of Fan, Reece, and Wang (2010), Bezrukov and Gordunov (2015) and Laha (2016) with his formulation of the Milky Way Dark Matter Velocity Profiles. The analysis consists of casting these Profiles in a variety of VDF's from which, as here pursued, one could extract "dark matter particles" with velocities of $O(10^{-3}c)$ as it was done here.

References

Adam, T., Agafonova, N., Aleksandrov, A., Altinok, O., Sanchez, P. A., Anokhina, A., ... & Badertscher, A. (2012). Measurement of the neutrino velocity with the OPERA detector in the CNGS beam. *Journal of High Energy Physics, 2012*(10), 1-37.

Bezukov, F., & Gorbunov, D. (2015). *On the applicability of approximations used in calculation of spectrum of dark matter particles produced in particle decays*.

Fan, J., Reece, M., & Wang, L. T. (2010). Non-relativistic effective theory of dark matter direct detection. *Journal of Cosmology and Astroparticle Physics, 2010*(11), 042.

Śoln, J. (2014). Theoretical particle limiting velocity from the bicubic equation: Neutrino example. *Physics Essays, 27*(3), 448-453.

Śoln, J. (2015). Particle limiting velocities from the bicubic equation derived from Einstein's kinematics: PeV electron case. *Applied Physics Research, 7*(4), 37.

Śoln, J. (2016). Limiting Velocities of Primary, Obscure and Normal Particles: Self-Annihilating Obscure Particle as an Example of Dark Matter Particle. *Applied Physics Research, 8*(5), 1.

Laha, R. (2016). *The effect of dark matter velocity profile on directional detection of dark matter*.

Mao, Y. Y., Strigari, L. E., Wechsler, R. H., Wu, H. Y., Hahn, O. (2013). Halo-to-halo similarity and scatter in the velocity distribution of dark matter. *The Astrophysical Journal, 764*(1), 35.

Stecker, F. W. (2014). Limiting superluminal electron and neutrino velocities using the 2010 Crab Nebula flare and the IceCube PeV neutrino events. *Astroparticle Physics, 56*, 16-18.

Applied Physics Research; Vol. 9, No. 3; 2017
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

Research on Kinetic Waves and Applications

Luciano Rota[1]

[1] Sportmark 104; 1355 KH Almere (NL), the Netherlands

Correspondence: Luciano Rota, Sportmark 104; 1355 KH Almere (NL), the Netherlands. Tel: 316-4143-0644. E-mail: lmrrota@live.nl

Received: March 20, 2017 Accepted: April 26, 2017 Online Published: May 12, 2017

doi:10.5539/apr.v9n3p8 URL: https://doi.org/10.5539/apr.v9n3p8

Abstract

The duality waves/particle and the dynamic of propagation of electromagnetic emanations suggest the existence of a natural kind of waves, which differently from de classic ones, are originating by kinetic thrust and propagating, also though vacuum, by inertial force. The model taken into consideration, to which has been given the name of "*kinetic waves"* is, like the classic one, a concretely existing natural phenomenon which can also be visually perceived if produced on molecular scale. Results suggest, by giving consistent mathematical proof, that *kinetic waves* offer many more points of similarity, in dynamic and behavior, than the classic ones, which were taken, since the discovery of electromagnetic waves, as basic model.

Applying the obtained results relatively to this model, to the astrophysical red-shift, taking as example the quasar 3C-273 and the recently found, most far galaxy GN-z11, we could find a mathematical sustainable and logic answer about still unsolved problems with regard to the origin and the dynamic of the universe.

In the appendix, a suggested and accurately described experiment on base of Radar Astronomy to possibly confirm the validity of this model.

Keywords: light propagation, classic waves, kinetic waves, particles, Doppler-shift, redshift

1. Introduction

1.1 About Waves

Around the end of the17th century Isaac Newton argued that light consists of small particles or corpuscles. By his "Corpuscular Theory" he sustained that those particles were literally shouted from the source in the form of beams. Basically a ballistic theory, as we should call it today.

Christian Huygens (1629-1695), the Dutch mathematician, physicist and astronomer, in the same time, formulated the "Huygens principle", nowadays better known as Huygens–Fresnel principle, and generally argued that light consists of waves. He connected the dynamics of light-waves to that of sound-waves.

In 1865 the Scottish physicist James Maxwell, arrived by experiment to the formulation of the Theory of the Magnetic Fields, concluding that light propagates in form of waves through space. This discovery sustained Huygens's theory, so that Newton's Corpuscular Theory, was finally disregarded.

The common concept of "waves" is connected to vibrations of matter through the matter itself. So we could without doubt state that, in the classical concept of waves, these must necessarily make use of a basic material – liquid, solid, gassy, etheric (as it was speculated before 1887) or finally in de form of magnetic fields (as theorized today) - to be able to propagate; since the very concept of "waves" contains a dynamic of vibration of matter through matter itself. It is understood that the conclusions of Maxwell naturally referred to the classic concept of waves as above described (according to the Huygens-Fresnel hypothesis), that also include the principle of Doppler Effect as a result of variation of frequencies caused by the movement of the light source through space, with respect to an observer.

It is a fact that all theories of Modern Physics and quantum mechanics that have followed till nowadays, are – originally - based and further developed, on the wavy dynamics connected to the sound-waves model of propagation. That means: constancy of the speed of propagation and variation of the wavelength as an increase or decrease of the originally emitted frequencies, when the source moves through space.

In other words, the whole modern physics is sustained by the pillars of the constancy of the speed of light and the fact that this remains unchanged regardless the movements of the source with respect to the observers.

The path of scientific research that has followed during the last century to the present day, has certainly not been free of contradictions and doubts on the validity/consistency of mathematical-physics theories that have gradually met in the course of more than a century. Many problems have been solved by means of quantum theories and by the "Standard Model" with regard to the Particles Physics, but certainly not all of them. Especially those with regard to Astrophysics and Cosmology, where some important interrogatives are still without an answer.

Of course, as long as the non-constancy of light-speed won't be finally proven, things remain unchanged and the theoretical research must go on, although, we may consider that Science, till date, has never taken into consideration that electromagnetic waves may not be connected to the classic ones. As previously announced, there is in nature a different kind of waves with a strong similarity in structure, behavior and dynamic of propagation with the electromagnetic ones, that concretely could explain all unsolved problems, especially with regard to Astrophysics and Cosmology, in a logic and sustainable way.

This research aims to give of it an analytical description and mathematical proof.

2. Doppler Shift on Base of Sound Waves

Regarding the classic Doppler, we consider two different aspects: a) when an emitting source is moving to or from a stationary observer or: b) when an observer is moving to or from a stationary emitting source. Just for clarity, we shall call a) Doppler 1 and b) Doppler 2

Doppler 1

Treating of classical waves (sound waves), we have to consider that an objective variation of the wavelength can be registered when a source is moving through a matter. Let us take a look at the following figure (1):

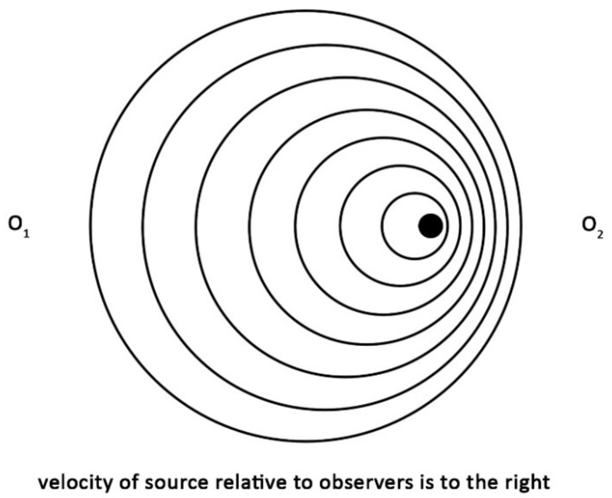

Figure 1. Doppler-shift 1: source moves to/from observers

As we can see, the movements of the source through the matter produce a real, objective increasing or decreasing of the wavelength, so that the observer, at a constant speed of propagation, receives an increased or decreased frequency.

In case of increase or decrease of wavelength, the observer will receive a frequency:

$$f_o = f_e\left(\frac{v_u}{v_u \pm v}\right) \tag{1}$$

(f_o = observed frequency; f_e = original emitted; v_u = velocity of waves through matter; v = velocity of source with regard to observers.)

Doppler 2

We examine the case when the observer is moving to a stationary source of waves (Figure 2):

When the emitting source is stationary, we see that there is no difference between wavelength emitted and wavelength observed:

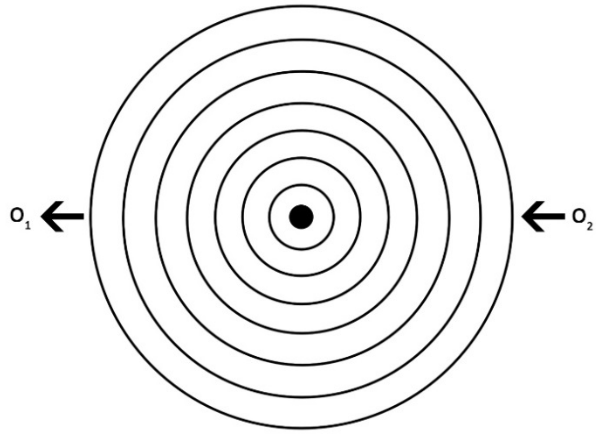

Figure 2. Doppler-shift 2:observers move to/from source

By observing this last figure, it is evident that we are dealing with a completely different phenomenon than that described in Figure 1 What we can see in Figure 2 is that when a source is stationary there is no variation of wavelength, but a difference in frequency the observer subjectively records due to the relative motion between the latter and the source. In this case the frequency observed has been calculated by:

$$f_o = f_e(1-\frac{v}{v_u}) \quad \text{when the observer is regressing from source.} \tag{2}$$

And:
$$f_o = f_e(1+\frac{v}{v_u}) \quad \text{when is approaching.} \tag{3}$$

Or:
$$f_o = f_e(\frac{v_u \pm v)}{v_u} \tag{4}$$

(f_e = frequency original emitted; f_o=frequency obs.;v_u = speed of waves through matter; v = speed of the observers with regard to source)

a) Speaking of sound waves, in this case the source emits a constant wavelength (Figure2) which is proportional to the speed- or frequency - of vibrations of the source (a wire, for example.) = f_v and the constant speed of propagation (v_u). The moving observer at velocity v receives a frequency, which is the number of wave-tops, transmitted through the atmosphere, the observer receives in a measure of time at constant speed of propagation:

$$\lambda_e = \frac{1}{f_v} v_u \rightarrow f_o = \frac{1}{\lambda} v_u \tag{5}$$

in absence of relative motion between source and observer, at constant speed of propagation:

$$f_v = f_o \text{ and } \lambda_e = \lambda_o \tag{6}$$

To make it more clear, let us see the following example:

Let's say that a wire is vibrating at a frequency f_v *= 500/s;* Constant speed of propagation v_u *=300m/s; v = 0:*

$$\lambda_e = \frac{1}{500}300 = 0,6 \rightarrow f_o = \frac{1}{0,6}300 = 500$$

b) By relative motion between source and observer the wavelength remains constant (Figure2) but the frequency undergoes a variation relatively to the value of the speed v:

$$f_o = \frac{1}{\lambda_e}(v_u \pm v) \text{ and: } \lambda_e = \lambda_o = \lambda \tag{7}$$

Now, the observer moves towards the source at a speed *v = 20m/s:*

$$f_o = \frac{1}{0,6}(300 + 20) = 533,33$$

The difference in observed frequency calculated by Doppler 1 (eq. 1) and Doppler 2 (eq. 2, 3 or 4) is very small when dealing with a low speed *v*, but **it grows quadratic** the more the difference between *v* and v_u, decreases:

By Doppler 1, using Equation 1, when the source is moving towards a stationary observer at the same speed *v* = $20_{m/s:}$

$$f_o = f_e(\frac{v_u}{v_u - v}) = f_o = 500(\frac{300}{300-20}) = 535,71$$

As already mentioned the difference between the results in observed frequency by Doppler 1 and Doppler 2 increases the more the speed *v* approaches that of v_u. Taking in the same example a velocity *v* = 40m/s*,* by Doppler 2: $f_o = 566,66$; and by Doppler 1: $f_o = 576,92$. Increasing the speed *v* to 80m/s, by D2: $f_o = 633,33$; by D1: $f_o = 681,81$.

To resume: Doppler 1 modifies the frequency on base of the variation of the value of wavelength. Doppler 2 modifies the frequency on base of the value of relative motion (*v*) between source and observer.

3. Kinetic Waves and Duality Waves/Particles

The original Corpuscular Theory of Newton is, as told, basically a ballistic theory. Newton argued that light was made up of particle beams projected from the source. He, in his time, had not the notion of the fact, found a century later by Maxwell, that the light propagated in the form of waves. For over a century it is known that the composition of the light beams consists in a duality of waves and particles.

In classical physics the principle of "waves" is connected to the concept of rippling of the material by the material itself; sound, movements of water which propagate across its surface or the vibrations that run along a wire.

What the three kinds of waves described above have in common is the fact that they need a material substance through which to propagate, be it in a gassy, liquid or solid state. The speed of these waves is, therefore, calculated in relation to the material substance in which they occur.

Electromagnetic waves, in several aspects, are not similar to the above-mentioned waves. There are some important differences, like:

1) It appears that they do not need a field of any kind in which to propagate:

When we speak about "Doppler-shift" we implicitly speak of rippling of material substances through the matter self. Any theorizing referring to the Doppler 1 must be connected to classical waves in the sense above explained.

2) Electromagnetic emanation consists of both waves and particles.

The structure of magnetic waves on the field of research can never be considered as a synthetic phenomenological context. Research can just be made on particles or, separately, on waves, treating (on field of research) the two parts of the same energy emanation as two different phenomena.

Differently, classical waves can be contained in a single context: there is a matter and rippling of the matter self.

3) Regarding the Doppler Effect, there is not any difference in observed frequency, when the source is moving from the observer or vice versa.

3.1 Method.

We integrate those data in a single context, in order to obtain an image of what the structure and the nature of magnetic waves concretely could be on ground of Newton's Theory and the model of Doppler 2:

The most relevant data which we can use is the knowledge of the fact that the particles making up matter contain a vibratory motion. It is also well-known that the speed of these vibrations is directly proportional to the degree of heat of the matter in a relation that in rough synthesis we may define thus: the hotter the matter the faster its particles vibrate, the higher the frequencies it emanates.

Now let us imagine that, due to kinetic thrust, these particles are literally fired from electrons into space in the form of continuous jets, at the original constant speed - in relation to the source - of approx. 300 thousand Km/s. With regard to the fact that the electrons have a vibratory movement, the result that we would obtain is that of rippling fluxes, or better of particle waves, whose original wavelength would vary in relation to the degree of heating of the source emitting them. (as solved by eq. 5)

This figure shows what a vibrating electron would look like:

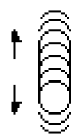

Figure 3. add a title here

It is already well known that each electron sends photons. Let us imagine that those small particles together have been shot in a continuing flux from vibrating electrons. Then we see something like this:

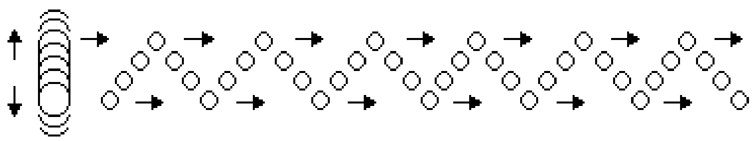

Figure 4. add a title here

$$\lambda_e = \frac{1}{f_v} c$$

Although each small particle follows a straight line, all parts together give the flux a waving motion. This would give a concrete explanation of the fact that research on the field of electromagnetic emission have to consider waves and particles separately from each other: if we take a look at figure 4 we clearly see that every single particle follows a straight line, so that when researching particles, it is impossible to get an idea of a wavy structure. If not, when researching waves, we must synthetize the particle emission in a global wavy flux.

Heated matter is never heated uniformly: usually the nucleus is the part most heated. The temperature gradually decreases towards the external parts of the matter. Making a relation between thermic degree and speed of the particles' vibration, we would logically find that the highest frequencies would be emanated from the hottest layers while the lowest from the coldest.

That means, the hotter the matter, the faster the electrons vibrate, the shorter the wavelength of the waving flux, so that the distance between two wave tops becomes smaller:

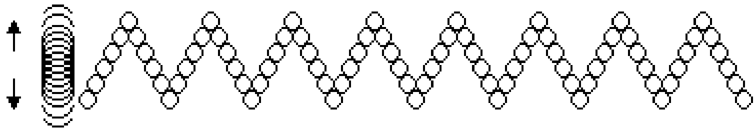

Figure 5. add a title here

$$\lambda'_e = \frac{1}{f_v'}c \qquad\qquad (f_v' > f_v)$$

This model offers us the following conclusions:

1) Waves do not need any material substance in which to propagate. Since they originate from the source that produces them, they can propagate even through vacuum and proceed by inertial force. In the absence of gravity and agents of attrition, we could suppose that the speed originally imparted and so the wavelength remains unvaried (constant) to the infinite.

2) From this point of view we can see how the duality of emission regarding waves and particles can be totally and concretely explained: looking at this structure we can easily conclude that we are dealing with waves and with particles emanation as well. In fact, the particles are making_up a wavy flux. This would be a concrete way to connect waves and particles emission in a synthetic phenomenological context conform to Newton's Corpuscular Theory and Maxwell's field equations.

3) Regarding Doppler 2, in this hypothesis the behavior of the waves in relation to the frequency variations ascribable to the relative motion is perfectly coherent with the premise: the variation of frequency recorded in relation to the source's movements with respect to the observer, or vice versa, are not a consequence of Doppler 1 effect: in the sense that they do not represent a variation of wavelength, but a variation of the registered frequency, caused by the relative increase or decrease in relative speed of the flux between source and observer.

Frequency is depending on movements of the source with regard to an observer. Which means that every variation of the emission speed – due to a performing relative speed - will be perceived by an observer as a variation of frequency.

Dealing with electromagnetic waves, using the formulas relative to Doppler 2 we can observe:

a) The wavelength emitted is related to the frequency of vibrations of the electrons and the constant speed of propagation:
(f_v= frequency of vibrations)

$$\lambda = \frac{1}{f_v}c$$

b) The stationary observer receives a frequency:

$$f_o = \frac{1}{\lambda}c$$

c) The moving source relatively to the observer or the moving observer with regards to the source at a relative velocity v receives a frequency:

$$f_o = \frac{1}{\lambda}(c \pm v) \tag{8}$$

Comparing electromagnetic waves to kinetic waves, as above explained, we expect that the variation in frequency we register when the source moves to a stationary observer, or when the latter moves to a stationary source, are exactly the same, as we can show by these results:

a) The observer is moving away from the source: speed of vibration = f/**s**. Speed of the flux = v_u. velocity of the observer= v. The distance between two wave-tops is: $d = \frac{1}{f}$ of v_u

$$d = \frac{v_u}{f}$$
$$O = a_o + vt$$
$$W_1 = b_o + v_u t$$
$$W_2 = b_o - d + v_u t$$
$$W_{2(\Delta t)} = O_{\Delta t} \Rightarrow b_o - d + v_u \Delta t = a_o + v_{\Delta t}$$
$$W_{1(o)} = O_{(o)} \Rightarrow b_o = a_o$$
$$W_{2(\Delta t)} = O_{\Delta t} \Rightarrow b_o - d + v_u \Delta t = a_o + v_{\Delta t}$$
$$-d = v_{\Delta t} - v_{u(\Delta t)} = (v - v_u)\Delta t \Rightarrow \Delta t = \frac{-d}{v - v_u}$$
$$\Delta t = \frac{v_u}{(v_u - v) f}$$
$$f_o = \frac{1}{\Delta t} = \frac{(v_u - v) f}{v_u}$$

b) The source is moving away from the observer:

Speed of the flux + distance

$$d' = \frac{v_u - v}{f} + \frac{v}{f}$$
$$d' = \frac{v_u - dv + v}{f} = \frac{v_u}{f}$$
$$W_1' = a_o + (v_u - v)t$$
$$W_2' = a_o - d' + (v_u - v)t$$
$$O' = 0$$

$$\begin{pmatrix} W'_{1(o)} = O'_{(o)} \Rightarrow a_o = 0 \\ W'_{o(\Delta t)} = O'_{(\Delta t)} \Rightarrow a_o - d' + (v_u - v)\Delta t = 0 \end{pmatrix} \rightarrow$$
$$\rightarrow d' + (v_u - v)\Delta t = 0$$
$$\Delta t (v_u - v) = d'$$
$$\Delta t = \frac{d'}{(v_u - v)}$$
$$f_o' = \frac{1}{\Delta t} = \frac{(v_u - v)}{d'} \Rightarrow f_o' = \frac{(v_u - v)}{v_u} f$$

If the source approaches the observer the sign will be (+)

In both cases (source moves to observer or vice versa, approaching or moving away) will be as solved in (4).

c) In absence of relative motion between source and observer the wavelength is constant and at constant speed of propagation the frequency observed will be the same of the original emitted vibration frequency:

$$f_o = \frac{1}{\lambda} c = f_v \tag{9}$$

To resume:

1) Sound waves are originating by the vibrations of a source (a wire for example) which emits a wavelength that is directly proportional to the speed of the vibration. Sound waves propagate trough a matter - at a constant speed - which can change the structure of the wavelength by moving through the atmosphere. The wavelength remains constant when the source is stationary, but an observer can receive a lower or higher number of wave-tops in the same measure of time, as consequence of the relative motion between source and observer. The frequency observed, in the two cases, is different. A difference which is very small, when dealing with low relative speed, but increasing on square scale the more the difference between speed of propagation and that of relative motion become smaller.

2) Kinetic waves (by original model) are beams of particles originating by kinetic thrust, from a vibrating source (think of the wavy effect of a flow of water produced by a vibrating garden hose), which emit a wavelength that is directly proportional to the speed of vibration. Kinetic waves propagate at constant speed through matter (atmosphere) and trough vacuum as well, by inertial thrust. The wavelength remains constant even when the source is moving through space, but the observed frequency changes by effect of the relative motion between source and observer (eq. 8). Kinetic waves make no difference in observed frequency whether the source moves to the observer or vice versa.

3.2 Experimental Results

The following mentioned experimental results:

Michelson-Morley

Fizeau convection coefficient

Kennedy-Thorndike

Moving sources and Mirrors

Aberration

since they are performed on ground of the movements of sources through space, in absence of relative motion between source and observer, did not register any different observed frequency than that original emitted. (as solved by eq. 7) On this point we can also take into account the calculations made by Walther Ritz in his ballistic Emission Theory, published in 1908 (Ritz, 1908; Ritz, 1908; Tolman, 1910).

By kinetic waves, as we have seen, the constancy of the speed of emitted wavy light-beams and the constancy of the wavelength, give as result that the frequency remains unchanged in observation (as solved by eq. 9).

Experimental results like **De Sitter Spectroscopic Binaries** which disagree with ballistic theories, are starting from the ground of Doppler 1 which is based on the constancy of propagation speed of electromagnetic waves, and the variations of wavelength.

De Sitter Spectroscopic Binaries is the most mentioned experimental result in disagree with Ritz emission theory. Just to remind:

"According to simple emission theory, light thrown off by an object should move at a speed of c with respect to the emitting object. If there are no complicating dragging effects, the light would then be expected to move at this same speed until it eventually reached an observer. For an object moving directly towards (or away from) the observer at v meters per second, this light would still be expected to be travelling at (c+v) or (c-v) at the time it reached us.

In 1913, Willem de Sitter argued that if this was true, a star in a double-star system would usually have an orbit that caused it to have alternating approach and recession velocities, and light emitted from different parts of the orbital path would then travel towards us at different speeds. De Sitter made a study of double stars and found no cases where the stars' computed orbits appeared. Since the total flight-time difference between "fast" and "slow" light-signals would be expected to scale linearly with distance in simple emission theory, and the study would (statistically) have included stars with a reasonable spread of distances and orbital speeds and orientations, De Sitter concluded that the effect should have been seen if the model was correct, and its absence meant that the emission theory was almost certainly wrong."

(Figure 6 and italics text are taken from Wikipedia.org as referred in De Sitter double star experiment (2016))

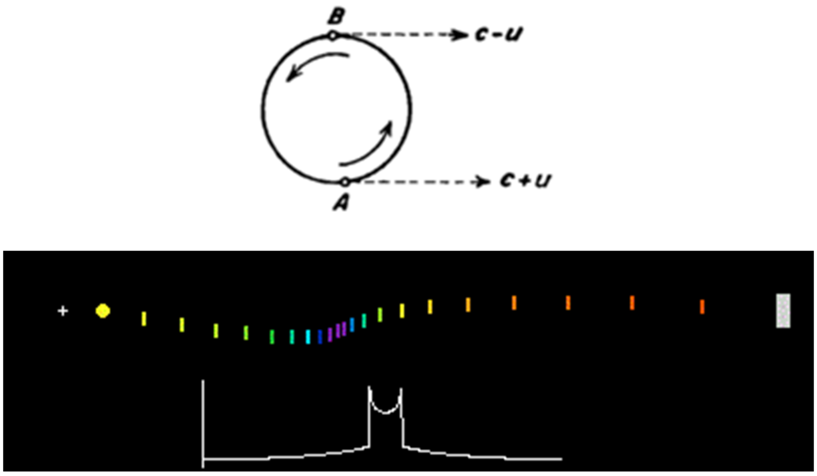

Figure 6

Comparing electromagnetic waves to classic waves the arguments deducted by De Sitter's astronomical observation, would be certainly correct. It won't be correct whether we connect them to the model of kinetic waves and Doppler 2.

As we take a look at Figure 6, the expected extra increasing of frequency due to the relative speed of approaching of the source is calculated on decreasing of the wavelength (Doppler 1), adding the increasing of relative speed v (Doppler 2) so that the conclusion deducted by this experiment is calculated by a measuring made on ground of variations of wavelength due to approaching speed plus that of increased relative speed:

$$f_o = f_e(\frac{c}{c-v}) + \frac{v}{c} f_e$$

Which was not in line to the expected results by Ritz's model, because, on base of Doppler 2 and kinetic waves, the variation in frequency must be calculated just on ground of the variation of the observed speed of emission: ($c + v$) or ($c - v$). So that we expect that when the source is moving to/from us the observed frequency will be given by:

When the source is approaching:
$$f_o = \frac{1}{\lambda}(c+v) \tag{11}$$

when the source is regressing:
$$f'_o = \frac{1}{\lambda}(c-v) \tag{12}$$

From this angle we also expect that these two results will be constantly alternate each other in approach and recession velocities. We don't expect any ulterior increasing or decreasing of speed of the fluxes, just because the variations in speed is already taken into account as only consequence of the differences in observed frequency between approaching of de source and regressing of it.

4. Redshift as Progressive Decreasing of Light-Speed on Travelled Distance

We make use of Doppler 2 model to recalculate the redshift, starting from the premise that the emitting sources finding them self at very great distances from us are stationary and the frequency we observe registers a decreasing with regard to the original emitted, due to a decreased original emitted light-speed, proportionally to the travelled distance. Whether light-beams travel by inertial force through great distances, the original kinetic thrust could be decreased by effect of gravity fields they have to cross or scattered atomic waste present in space that crossed at very high speed (that of light) can offer a substantial material consistency.

4.1 Results

Let us consider the following examples:

Example 1:

We take as first the quasar known as 3C-273:

(*for these calculations has been used a round light-speed of c = 300.000Km/s)*

Calculation of the redshift of 3C-273 on base of Doppler 1

Doppler 1 fixes the constant factor in the value of speed of propagation and the variable one in the value of wavelength.

The hydrogen Ballmer-alpha line in stationary stand registers a wavelength of $656_{n.m.}$ The observed wavelength of this body in $760_{n.m.}$ Calculating redshift and recession velocity on base of Doppler 1:

$$\lambda_e = 656_{n.m}\ ;\ \lambda_o = 760_{n.m}\ ;\ z = \frac{\lambda_o - \lambda_e}{\lambda_e} = 0{,}1585 \rightarrow v = (cz) = 47550 km/s \quad \text{(recession speed on base of wavelength)}$$

$$f_e = 457_{THz}\ ;f_o = 394_{THz}\ ;\ z = \frac{f_e - f_o}{f_o} = 0{,}1585 \rightarrow v = (cz) = 47550 km/s \quad \text{(on base of frequency)}$$

The calculation of the redshift this way, would be possible till $z < 1$. When $z > 1$, the regression speed will be greater than that of light. If we take the quasar 5C 02.56 discovered in 1970 (Illingworth, 1999), it shows a redshift of: *z= 2,399*, corresponding to a regression speed of: *v= 719.700km/s;* GB1428+4217 (Space Daily, 2012) =z= 4,72 and recession speed = *1.416.000km/s;* GRB090423 (NASA, 2009) = z= 8,2 and recession speed = *2.460.000km/s*. Going on to the most recent time, the galaxy GN-z11 (Drake, 2016), which shows a redshift calculated in z = 11,09, on base of Doppler 1, it would pretend to move away from us at a speed of more than 3,5 million km/s.

The Law of Hubble, which is based on the calculations of Doppler 1, is grounded on the astronomical observations and relative spectrum analysis made since 1929. At the time of Hubble's publication, the most distant observable body was the galaxy NGC-7619 (Trimble, 1996) which registered a redshift of 0,012 and a regression speed of about 3.700km/s: a surprising result, at that time, but still contained in the limits allowed by Relativity.

4.2 Calculation of the Redshift of 3C-273 on Base of Doppler 2.

Doppler 2, differently from Doppler 1, considers the observed result of frequency, based on constancy of the wavelength and progressive decreasing of light-speed. In other terms and according to what explained about the original Doppler 2 model: the source produces a wavelength and the observer receives a frequency, which is directly proportional to the value of decreased light-speed. This way, is to understand that the redshift would not be consequence of a progressive regression of light-sources on distance, relatively to the observer, but to a decreasing of the observed light-speed which results in a decreased frequency.

According to that, we have to suppose that $656_{n.m.}$ remains constant in emission as in observation. In stationary stand and at constant speed of emission, an observer will receive a frequency:

$$f = \frac{1}{\lambda}c = 457_{THz} \quad \text{and} \quad \lambda_e = \lambda_o = \lambda = 656_{n.m}$$

In case of decreasing of original emission-speed to (*c-v*):

$$f = \frac{1}{\lambda}(c - v) \tag{14}$$

Now we don't know yet the value of *v*, so we have to fix it on base of which we think to be an observed wavelength. As told, the Hydrogen Ballmer-alpha line relative to this body is on $760_{n.m.}$. which correspond to a decreased observed frequency of 394_{THz}. It means that when on spectrum appears the line on $760_{n.m.}$, in fact we are receiving a frequency of 394_{THz}. Since the calculations are programmed on base of Doppler 1, the result on frequency is automatically translated into a value of increased wavelength, although the frequency effectively observed is the value we really register and in this model, we need to reach the value of decreasing in velocity (*v*). So we can state: the original emitted wavelength (656) is the same observed and the corresponding emitted frequency (457) is decreased by effect of decreased original emission speed to *c-v*:

$$z = \frac{f_o - f_e}{f_e} = \frac{394 - 457}{457} = -0{,}1378 \rightarrow v = cz = -41.340 km/s \tag{15}$$

In this case the negative sign of the shift doesn't mean *blue-shift*, but the value that must be detracted from the original emitted speed. This way:

$$c_{obs} = (c - v) = 300.000 - 41340 = 258.660 km/s \tag{16}$$

Now we obtained the value of *v,* we can complete the eq. 14 with the missing value:

$$f_o = \frac{1}{\lambda}(c - v) = \frac{1}{656}(258660) = 394_{THz} \tag{17}$$

As already explained, this value of decreased observed frequency (394_{THz}) which by Doppler 1 will be automatically interpreted as an increased wavelength of $760_{n.m.}$ from this angle it expresses a value of decreased light-speed.

Example 2:

4.3 Calculation of the Redshift of the Galaxy GN-z11, on Base of Doppler 2.

The redshift of this body is calculated in z = 11,09:

$$\lambda = 656 \rightarrow f = 457$$

The Hydrogen-Ballmer-alpha-line signs a wavelength on $8.462_{n.m.}$ which corresponds to a frequency:

$$f_o = \frac{c}{\lambda_o} = \frac{300.000}{8462} = 35{,}5_{THz}$$

$$z = \frac{f_o - f_e}{f_e} = \frac{35{,}5 - 457}{457} = -0{,}9223 \quad ; \quad v = cz = (300.000)(-0{,}9223) = -276.695$$

$$f_o = \frac{1}{\lambda}(c - v) = \frac{1}{656}(300.000 - 276695) = 35{,}5_{THz} \tag{18}$$

Whit regard to the galaxy GN-z11, is to suppose that objects finding them self on distances >30Gly would be impossible to be optical perceived, because the observed frequency will be decreased below the optical frequency limit.

The results obtained by the calculations on base of Doppler 2 model, taking as example 3C-273 and GN-z11, would give theoretical proof that none of the cosmic objects we can optically perceive is regressing.

5. Conclusion

The model of kinetic waves (KW), we have described and analyzed in the present theoretical research, in addition to a correct mathematical analysis based on classic mechanics, offers many more points of similarity with the behavior of electromagnetic waves and correct results than the waves model offered by the classic model.

1) KW are expected to behave in full agreement with the experimental results which confirm there is no difference in variation of frequency whether a source is moving to a stationary observer or vice versa.

2) KW could give a concrete explanation about the duality particles/waves, in the way that wavy fluxes consist in particles beams

3) KW do not need any material substance or magnetic field through which propagate, since they are sent by kinetic thrust and proceeding by inertia through vacuum.

4) KW, as basically connected with a ballistic emission theory, agree with all experimental results performed on this field. KW offers a correct, sustainable and logical answer about the causes of the redshift, next to the classic physical laws we know.

The relation *travelled distance/redshift*, in the described and analyzed way would give us the image of a globally static universe and as consequence, the indication that light coming from the most distant celestial bodies undergoes a slowdown which is directly proportional to the distance from us: the bigger the distance that light have to travel to reach us, the stronger the slowdown, the sharper the redshift.

The "Big-Bang Theory" is grounded on the statement made by Hubble in 1929, about the principle of universal expansion. When this ground would be missing, there will not be any other reason to sustain the universe originated by an enormous explosion of a concentrated cosmic matter. However, it will exonerate us to find or imagine explanations with regard to where and how each cosmic object finds the necessary energy to move from all others in a constant, progressive acceleration to all direction and find a way to meet again at a common point . Besides, through this way would be useless to try giving an age to our Universe or fix an origin of it, which probably never took place.

Suggested experiment:

Assuming that variations between emitted and observed frequencies are consequence of variations of emitted light-speed and not of those of wavelength it would be possible to perform the following experiment, based on the speed of revolution of earth around the sun, with regard to an external body. In this example has been taken Jupiter as model. Our planet, related to the orbit of Jupiter presents two phases: one with sign plus (+) when the earth is approaching Jupiter, for example in March, and one with sign minus (-), when the earth is regressing from it, in September.

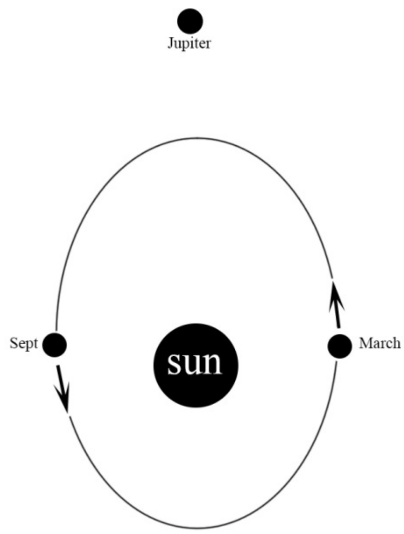

Figure 7

5. Results

C = 299.792,458

Velocity of earth's revolution (v) = 30 km/s

Average distance Earth/Jupiter (s) = 588.000.000 Km.

Using radar astronomy by sending a beam of microwaves in March in direction of Jupiter, the distance we have to calculate it to reach Jupiter and reflecting back will be:

S = 1.173.000.000 km.

To recover this distance at light-speed *(C)* the signal would take:

$$\frac{s}{c} = \frac{1.173.000.000}{299.792.458} = 3922'', 7137$$

If we add the average rotation's speed of Earth around the sun in March, we obtain:

$$\frac{s}{(c+v)} = \frac{1.173.000.000}{299.822,458} = 3922'', 3212$$

Corresponding to a frequency variation calculated by:

$$f_o = \frac{1}{\lambda}(c+v)$$

Repeating the same experiment on September:

$$\frac{s}{(c-v)} = \frac{1.173.000.000}{299.762,458} = 3923'', 1063$$

And a frequency variation:

$$f_o = \frac{1}{\lambda}(c-v)$$

The difference in terms of time between March and September would be 8/10th of a second: when this result would support the expectation, will confirm that the differences of frequency produced by the movements of a source are ascribable to the relative motion between source and observer. This kind of experiments, meant to a direct measuring of the speed of light on base on distance and time taken to cover it, in the age of Modern Physics, has never been performed.

References

Tolman, R. C. (1910). The second postulate of relativity. *Physical Review (Series I)*, *31*(1), 26.

De Sitter double star experiment. (2016). In *Wikipedia, the free encyclopedi*a. Retrieved from https://en.wikipedia.org/wiki/De_Sitter_double_star_experiment

Drake, N. (2016). *Astronomers Spot Most Distant Galaxy—At Least For Now*. National Geographic.

Illingworth, G. (1999). Galaxies at high redshift. *Astrophysics and Space Science*, *269*, 165-181.

NASA. (2009). New Gamma-Ray Burst Smashes Cosmic Distance Record.

Ritz, W. (1908). Recherches critiques sur l'électrodynamique générale. *Annales de Chimie et de Physique, 13*, 145–275.

Ritz, W. (1908). Recherches Critiques sur les Théories Électrodynamiques de Cl. Maxwell and de H.–A. Lorentz. *Archives des Sciences physique et naturelles*, *26*, 209-36.

Space Daily. (2012). *Record-Setting X-ray Jet Discovered*.

Trimble, V. (1996). H0: The incredible shrinking constant, 1925-1975. *Publications of the Astronomical Society of the Pacific*, *108*(730), 1073-1082.

Copyrights

Applied Physics Research; Vol. 9, No. 3; 2017
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

The Ether Theory Unifying the Relativistic Gravito-Electromagnetism Including also the Gravitons and the Gravitational Waves

David Zareski[1]

[1] I.A.I, Israel Aerospace Industries, Yehud, Israel

Correspondence: David Zareski, I.A.I, Israel Aerospace Industries, Yehud, Israel. E-mail: zareski@inter.net.il

Received: April 18, 2017 Accepted: April 28, 2017 Online Published: May 12, 2017

doi:10.5539/apr.v9n3p21 URL: https://doi.org/10.5539/apr.v9n3p21

Abstract

In previous publications, we showed that Maxwell's equations are an approximation to those of General Relativity when $V \ll c$, where $\boldsymbol{V}$ is the velocity of the particle submitted to the electromagnetic field. This was demonstrated by showing that the Lienard-Wiechert potential four-vector A_μ created by an electric charge is the equivalent of the gravitational four-vector G_μ created by a massive neutral point when $V \ll c$.

In the present paper, we generalize these results for $\boldsymbol{V}$ non-restricted to be small. To this purpose, we show first that the exact Lagrange-Einstein function of an electric charge q submitted to the field due an immobile charge q_0 is of the same form as that of a particle of mass m submitted to the field created by an immobile particle of mass m_0. Maxwell's electrostatics is then generalized as a case of the Einstein's general relativity. In particular, it appears that an immobile q_0 creates also an electromagnetic horizon that behaves like a Schwarzschild horizon. Then, there exist ether gravitational waves constituted by gravitons in the same way as the electromagnetic waves are constituted by photons.

Now, since A_μ and G_μ, are equivalent, and as we show, G_μ produces the approximation, for $V \ll c$, of $g_{\mu 4}$ created by m_0 mobile, where the $g_{\mu\nu}$ are the components of Einstein's fundamental tensor, it follows that $A_\mu + G_\mu$ produces the approximation, for $V \ll c$, of $\beth_{\mu 4}$, where the $\beth_{\mu\nu}$ created by m_0 and by q_0, generalize the $g_{\mu\nu}$.

Résumé. Dans des publications antérieures nous montrâmes que l'électromagnétisme de Maxwell est une approximation de la Relativité Générale quand $V \ll c$, ou $\boldsymbol{V}$ est la vitesse de la particule soumise au champ électromagnétique. Ceci a été prouvé en montrant que le quatre-vecteur potentiel de Lienard-Wiechert A_μ créé par une charge électrique est l'équivalent du quatre-vecteur gravitationnel G_μ créé par une masse ponctuelle neutre quand $V \ll c$.

Dans le présent article, nous généralisons ces résultats pour $\boldsymbol{V}$ non-restreinte à être petite. A cette fin, nous montrons d'abord que la fonction exacte de Lagrange-Einstein créé par une charge électrique q soumise au champ créé par une charge électrique q_0 immobile est de la même forme que celle d'une particule de masse m soumise au champ créé par une particule immobile de masse m_0. L'électrostatique de Maxwell est donc généralisée comme étant un cas de la relativité générale d'Einstein. En particulier, il apparait qu'une q_0 immobile crée aussi un horizon électromagnétique qui se conduit comme un horizon de Schwarzschild. Puis qu'il existe des ondes gravitationnelles constituées de gravitons de la même façon que les ondes électromagnétiques sont constituées de photons.

Or, puisque A_μ and G_μ sont équivalents, et que, comme nous le montrons, G_μ produit l'approximation de $g_{\mu 4}$ pour $V \ll c$, due a m_0 mobile, ou les $g_{\mu\nu}$ sont les composants du tenseur fondamental d'Einstein, il s'en suit que $A_\mu + G_\mu$ produit l'approximation de $\beth_{\mu 4}$, pour $V \ll c$, ou les $\beth_{\mu\nu}$ créés par m_0 et par q_0 généralisent les $g_{\mu\nu}$.

Keywords: Relativistic electromagnetism, completion of Einstein's relativity theory, gravitons and photons

I. Introduction

In Zareski (2014) and in Sec. IX of Zareski (2015), we showed, in particular, that from the elastic ether theory it appears that the form of Maxwell's Electromagnetism emerges as an approximation of General Relativity. The main lines of this demonstration were the following. Einstein's fundamental tensor of components $g_{\mu\nu}$, is the solution of the system of equations (44) of Einstein (1916) obtained from pure mathematical reasoning not related a priori only to gravitation. This is the reason why, in my opinion, the title of his famous paper: "The foundation of the general theory of relativity", do not comport the word 'gravitation'. Therefore, one can suppose that these equations are more general than defining only the gravitational field, and could define also other fields as the electromagnetic field.

Indeed, in Zareski (2014) and in Sec. IX of Zareski (2015), we have shown this fact in the case where the velocity $\boldsymbol{V}$ of the particle is such that $V \ll c$, that is to say that we have shown that Maxwell's electromagnetism is of the same form as Newton's gravitation. This was shown as following.

a) First, we showed that Coulomb's electrostatic potential $A_{4,S}$, (s for static), created by an immobile electric charge, is of the same form as the Newton gravitostatic potential $G_{4,S}$ created by an immobile neutral massive particle.

b)Then, we generalized the result a) for $V \ll c$, by showing that the Lienard-Wiechert potential four-vector A_μ created by a moving electric charge, differs from the gravitational four-vector G_μ created by a moving massive point by only a constant multiplicative coefficient.

From a) and b), it appears that for non-small V, Maxwell's electromagnetism could be generalized as a case of Einstein's general relativity. In the present paper, the result a) is indeed generalized for V non-restricted to be small. That is to say that we show that the exact Lagrange-Einstein function of an electric charge q submitted to the field due an immobile charge q_0 and its motion equation are the same as those of a particle of mass m submitted to only the field created by an immobile particle of mass m_0. That is, we generalized Maxwell's electrostatic to a case of Einstein's general relativity. In particular, it appears that an immobile q_0 creates also an electromagnetic horizon that behaves like a Schwarzschild horizon, that is, when another electric charge q is attracted by q_0 and reaches this electromagnetic horizon, then its velocity is there null. Then that there exist ether gravitational waves constituted of gravitons in the same way as the electromagnetic waves are constituted by photons.

Then we arrive to the conclusion that, since in the approximation $V \ll c$, A_μ and G_μ differs by only a constant multiplicative coefficient and since as we show, G_μ produces then the approximation of $g_{\mu 4}$, where one recalls that the $g_{\mu\nu}$ are the components of Einstein's fundamental tensor created by m_0 whether it moves or not, it follows that $A_\mu + G_\mu$ produces the approximation for $V \ll c$ of $\beth_{\mu 4}$, where the $\beth_{\mu\nu}$ are the components of a tensor that generalizes Einstein's fundamental tensor $g_{\mu\nu}$ by taking into account the contribution of the electrical charge q_0.

2. Notations and Recalls

2.1 Some Generalities

The Greek indexes take the values 1,2,3,4 and the Latin the values 1,2,3 the index 4 corresponding to ct. The low indexes are covariant while the high are contravariant. We use the Einstein summation, the time derivative dy/dt of y is denoted simply $\dot{y}$. A particle of mass m and electric charge q will be denoted $P(m,q)$. $g_{\mu\nu}$ denotes Einstein's tensor which is a solution of the system of equations (44) of Einstein (1916). In the present paper, we do not take into account dark matter since we consider only individual particles. The velocity of the free light is denoted c, and the constant of gravitation is denoted k. The coordinates origin is denoted **O**.

The Lagrange-Einstein function L_G of a $P(m,0)$ submitted to a field $g_{\mu\nu}$ is

$$L_G = -mc\dot{s} \tag{1}$$

where

$$\dot{s} = \sqrt{g_{\mu\nu}\dot{x}^\mu \dot{x}^\nu} \tag{2}$$

and the motion equation of this particle Cf. e.g., Zareski (2012), or Eq. (3.3) of Zareski (2015), is

$$\frac{d}{dt}\left(\frac{\partial}{\partial \dot{x}^\mu} L_G\right) - \partial_\mu L_G = 0 \ . \tag{3}$$

The field created by an immobile $P(m_0,0)$ located at **O**, is of Schwarzschild, and L_G denoted then L_{GSG} the indexes SG referring to static-gravitation, is then

$$L_{GSG} = -mc\sqrt{c^2\gamma^2 - V^2\gamma_\vartheta{}^2} \ , \tag{4}$$

where, Cf., e.g., Zareski (2012), or Eq. (3.62) and (3.63) of Zareski (2015),

$$\gamma^2 \equiv 1 - \alpha/r, \tag{5}$$

$$\gamma_\vartheta{}^2 \equiv 1 + \alpha\,(\cos^2\vartheta)/(r\gamma^2), \tag{6}$$

where α is the constant defined by

$$\alpha = 2m_0 k/c^2 \ , \tag{7}$$

and ϑ denotes the angle made by the velocity V of this $P(m,0)$ and the radius vector r issued from O. Inserting (6) into (4), one obtains

$$L_{GSG} = -mc\sqrt{c^2(1-\alpha/r) - V^2(1+\alpha(\cos^2\vartheta)/(r-\alpha))} \tag{8}$$

and, Cf. Eq. (3.68) of Zareski (2015), the expression for the absolute value of the velocity V of this $P(m,0)$ of total energy E_T is

$$V = c(\gamma/\gamma_\vartheta)\sqrt{1-(\gamma mc^2/E_T)^2}. \tag{9}$$

The motion equation is then given by Eq. (3) with L_{GSG} instead of L_G. Furthermore, Eq. (9) shows that $V = 0$ at $r = \alpha$, i.e., the $P(m,0)$ stops on the Schwarzschild horizon (SH).

Now, if $V_r(r)$ denotes the expression for V when the trajectory of this $P(m,0)$ is a ray issued from **O**, that is, when $\vartheta = 0$, then (9) becomes

$$V_r(r) = c(1-\alpha/r)\sqrt{1-(1-\alpha/r)(mc^2/E_T)^2}\,. \tag{10}$$

2.2 Dirac's Considerations Regarding the $P(m,0)$ in a Schwarzschild Field

Expression (10) is of the same form as the absolute Dirac expression for the radial velocity of this $P(m,0)$ as it appears in **the fifth equation of page 33 of Dirac's book.** Cf. Dirac (1975). Indeed, he wrote there that the expression dr/dt for the radial velocity directed toward the SH, of this $P(m,0)$ is

$$dr/dt = -c\left(1-\tfrac{2M}{r}\right)\sqrt{1-\left(1-\tfrac{2M}{r}\right)/k_D{}^2}\,. \tag{11}$$

In this equation I use the notation M and k_D instead of m and of k used by Dirac, and add c that missed in its original expression, the sign $(-)$ is due to the fact that Dirac considered that the motion is directed toward the origin. We see that, if one writes

$$2M \equiv \alpha, \qquad M \equiv m_0 k/c^2 \ , \qquad mc^2/E_T \equiv 1/k_D,$$

the expression for $|dr/dt|$ is identical to that for $V_r(r)$. Furthermore, using Dirac's reasoning, let us demonstrate that the time taken by the $P(m,0)$ to reach the SH is infinite, i.e., near the SH, the velocity of the particle is very small, and null on it.

Indeed, **near the SH**, the term $(1-\alpha/r)(mc^2/E_T)^2$ is negligible in front of 1 since $(1-\alpha/r)$ tends then toward 0, that is to say that in this case, Eq. (11) yelds

$$dt \cong -\alpha dr/[c(r-\alpha)],$$

which yields, after integration:

$$t \cong (\alpha/c)log[1/(r-\alpha)] + const. \tag{12}$$

Equation (12) shows that the $P(m,0)$ reaches the SH after an infinitely long time measured by an immobile clock.

It appears that our unifying ether theory englobes the Dirac theory regarding the behavior of the particle in a Schwarzschild field for $r \geq \alpha$. In the frame of this unification we do not treat the case where particles could be located into the black hole.

2.3 The Newton Motion Equation as Approximation of the Real Motion Equation

The exact motion equation of the $P(m,0)$ in the Schwarzschild field is given by Eq. (3) in which L_G is replaced by L_{GSG} defined in Eq. (8). That is, this exact motion equation is

$$-mc\left\{\frac{d}{dt}\left[\frac{\partial}{\partial \dot{x}^\mu}\sqrt{c^2\gamma^2 - V^2\gamma_\vartheta{}^2}\right] - \partial_\mu\sqrt{c^2\gamma^2 - V^2\gamma_\vartheta{}^2}\right\} = 0 \tag{13}$$

where γ^2 and $\gamma_\vartheta{}^2$ are given by (5)-(7). Now, with an evident notation, it appears from (8) that

$$L_{GSG}(V \ll c \; and \; r \gg \alpha) = -mc\sqrt{c^2 - V^2} + mc^2\,\alpha/(2r) \ , \tag{14}$$

and when one inserts $L_{GSG}(V \ll c \; and \; r \gg \alpha)$ in (3) instead of L_G one obtains instead of (13), the following approximated motion equation

$$m\ddot{\mathbf{r}} \cong -mc^2\alpha\mathbf{r}/(2r^3) \equiv -mm_0k\,\mathbf{r}/r^3 \ , \tag{15}$$

Equation (15) is the approximated motion equation of a $P(m,0)$ submitted to the gravitational field due to an immobile $P(m_0,0)$.

2.4 Some Recalls on the Elastic Interpretation of Maxwell's Equations

Let us first recall Maxwell's opinion on the elastic interpretation of electromagnetism, he wrote in Art. 866 of Maxwell (1954)

"*Hence all these theories lead to the conception of a medium in which the propagation takes place, and* ***if we admit this medium as an hypothesis, I think it ought to occupy a prominent place in our investigations***.".

And Einstein wrote Cf. Einstein (1920):

"*According to the general theory of relativity* ***space without ether is unthinkable****……*"

We recall now some results regarding the elastic interpretation of Maxwell's equations, presented in Zareski (2001), (rewritten in Zareski, 2015). There we considered a particular elastic medium, the 'ether', governed by the continuity equation (2) of Zareski (2001) and by the following equation of elasticity

$$\boldsymbol{curl}(\boldsymbol{C}/2-\eta_0\boldsymbol{curl\xi})=\rho_0\partial_{tt}\boldsymbol{\xi}, \tag{16}$$

that defines the elastic changes $\boldsymbol{\xi}$ in the ether due to the density of couples of forces $\boldsymbol{C}$ applied to it, and from which one deduces the Maxwell equations of electromagnetism as recalled he below. In Eq. (16), η_0 denotes the inverse of the free induction coefficient, which, in the elastic interpretation, is the free elastic restoring rotation coefficient, and η_0 is related to c by the relation

$$\eta_0=\rho_0c^2 \tag{17}$$

where ρ_0 denotes the ether density. We recall in particular that by introducing the new variables , $\boldsymbol{H}$, $\boldsymbol{B}$, $\boldsymbol{J_e}$, and $\rho_{\boldsymbol{e}}$, defined by

$$\boldsymbol{E}=\eta_0\boldsymbol{curl\xi}-\boldsymbol{C}/(2) \tag{18}$$

$$\boldsymbol{H}=\partial_t\boldsymbol{\xi},\qquad \boldsymbol{B}=\rho_0\partial_{tt}\boldsymbol{\xi}\ , \tag{19)(20}$$

$$\boldsymbol{J_e}=\boldsymbol{\partial_t C}/(\boldsymbol{2}\eta_0),\qquad \rho_{\boldsymbol{e}}=-\,div\,\boldsymbol{C}/(\boldsymbol{2}\eta_0), \tag{21)(22}$$

and by eliminating $\boldsymbol{\xi}$ and $\boldsymbol{C}$ between these equations, one obtains the Maxwell equations.

For example, from Eqs. (16), (18) and (20), one obtains

$$\boldsymbol{curlE}+\partial_t\boldsymbol{B}=\boldsymbol{0}\ , \tag{23}$$

and by differentiating Eq. (18) with respect of the time and taking into account Eqs. (19) and (21), one obtains

$$curl\,\boldsymbol{H}-\partial_t\,\boldsymbol{E}/\eta_0=\boldsymbol{J_e}\ . \tag{24}$$

Equations (23) and (24) are Maxwell's equations, the others being obtained in the same way.

Remark. Since an electrically charged particle musts possess a mass, it follows that the results of this Sec. 2.4, i.e., Maxwell's electromagnetism is only an approximation. In the exact case one has to take into account the mass of this electrically charged particle that is to say one has to take into account the General Relativity as done here below.

3. Relativistic Electromagnetism and Gravitation Equivalence for a $P(m,q)$ in the Field Due to an Immobile $P(m_0,q_0)$

3.1 Generalities

One recalls that since Einstein's Eqs. (44) of Einstein (1916) were obtained by pure mathematical reasoning, one can suppose that these equations are more general than defining only the gravitational field. Indeed, as we show now, they define also the exact electromagnetic equations that complete the Maxwell equations shown to be an approximation, by taking into account the general relativity.

We generalize now first Maxwell's electrostatic as a case of the Einstein's static general relativity and show that, in particular, an immobile q_0 creates also an 'electromagnetic horizon' that behaves like a SH, that is to say that, when another electric charge q is attracted by q_0 and reaches this electromagnetic horizon, then its velocity is there null. In that context, we generalize first the value of the constant α.

Remark. From here on, we use the notation α_G, γ_G, $\gamma_{G\vartheta}$ instead of α, γ, γ_ϑ, the index G referring to gravitation.

3.2 Generalization of the Constant α_G *for the Static Gravito-Electromagnetic Case*

When a $P(m,q)$ is submitted to an electrostatic field created by a q_0, it is also submitted to a gravitational field due to the mass m_0 of the charge q_0, since an electric particle possess also a mass. It follows that, when a $P(m,q)$ is submitted to the total field due to the immobile $P(m_0,q_0)$, that is, to the sum of the gravitational field due to m_0 and of the electrostatic field due to q_0, then, the approximation $L_{GST}(V \ll c \; and \; r \gg \alpha_T)$ of the Lagrange-Einstein L_{GST}, the index ST referring to static total fields, is then

$$L_{GST}(V \ll c \; and \; r \gg \alpha_T) = -mc\sqrt{c^2 - V^2} + \left(-\frac{qq_0}{4\pi\varepsilon_0} + mm_0k\right)\frac{1}{r} \; . \tag{25}$$

Now, let the constant α_E be defined by

$$\alpha_E = -\frac{2}{c^2(m/q)}\frac{q_0}{4\pi\varepsilon_0} \; , \tag{26}$$

the constant α be denoted now α_G that is Cf. Eq. (7),

$$\alpha_G = 2m_0k/c^2, \tag{27}$$

and let the constant α_T be defined by

$$\alpha_T = \alpha_G + \alpha_E. \tag{28}$$

With these notations, (25) and the non-relativistic motion equation can be written

$$L_{GST}(V \ll c \; and \; r \gg \alpha_T) = -mc\sqrt{c^2 - V^2} + \frac{mc^2}{2}\alpha_T\frac{1}{r} \; , \tag{29}$$

$$m\ddot{\boldsymbol{r}} \cong -\frac{mc^2}{2}\alpha_T\frac{1}{r^3}\boldsymbol{r} \; . \tag{30}$$

Note: For elementary electrically charged particles, then in general, as shown, e.g., in Zareski (2015), $mm_0k \ll |qq_0|/4\pi\varepsilon_0$, therefore, in this non-relativistic electrostatic case, (30) can be written. $m\ddot{\mathbf{r}} \cong \frac{qq_0}{4\pi\varepsilon_0}\frac{1}{r^3}\boldsymbol{r} \equiv q\boldsymbol{E}$, where $\boldsymbol{E} = \frac{q_0}{4\pi\varepsilon_0}\frac{1}{r^3}\boldsymbol{r}$ denotes the electrical field created by q_0.

3.3 Exact Motion Equation and Velocity of a $P(m,q)$ *due to an Immobile* $P(m_0,q_0)$

This exact relativistic motion equation of a $P(m,q)$ in the field of an immobile $P(m_0,q_0)$ is

$$\left(\frac{d}{dt}\frac{\partial}{\partial \dot{x}^j} - \frac{\partial}{\partial x^j}\right)L_{GST} = 0 \; , \tag{31}$$

the Lagrange-Einstein function L_{GST} being defined by

$$L_{GST} = -mc\dot{s}_{ST}, \tag{32}$$

where $\dot{s}_{ST}$ is defined by

$$\dot{s}_{ST} = \sqrt{c^2{\gamma_T}^2 - V^2{\gamma_{\vartheta T}}^2} \; , \tag{33}$$

and, γ_T and $\gamma_{\vartheta T}$ by

$${\gamma_T}^2 \equiv 1 - \alpha_T/r, \quad {\gamma_{\vartheta T}}^2 \equiv 1 + \alpha_T(\cos^2\vartheta)/(r{\gamma_T}^2) \tag{34}$$

In this generalized Schwarzschild case, the expression for the velocity V given in Eq. (9) is generalized by V_T defined by

$$V_T = c(\gamma_T/\gamma_{\vartheta T})\sqrt{1 - (\gamma_T mc^2/E_T)^2} \; . \tag{35}$$

From Eq. (35) it appears that $V_T = 0$ at $r = \alpha_T$, that is, the $P(m,q)$ submitted to the static field due to $P(m_0,q_0)$ stops on the '**generalized Schwarzschild horizon**', (GSH). When $m = 0$, then, Cf. Eq. (3.12) and Eq. (3.14) of Zareski (2015) where g_{44} is ${\gamma_T}^2$,

$$\lim_{m\to 0}(m/\dot{s}_{ST}) = h\nu/(c^3{\gamma_T}^2) \; . \tag{36}$$

and Eq. (35) becomes

$$\lim_{m\to 0}(V_T) = c\,\gamma_T/\gamma_{\vartheta T}. \tag{37}$$

Equation (35) shows that even the photons stop on the GSH**.** In fact even V_T defined in (35) does not depend upon m near to the GSH since there $(\gamma_T mc^2/E_T)^2$ is infinitly small.

3.4 Ether Changes, General Waves Due to an Immobile $P(m_0, q_0)$ and to Mobile $P(m, q)s$ that are Gravitons or Photons when $m = q = 0$

Equation (16) refers to the particular case where we considered that the density of couples of forces $\boldsymbol{C}$ is due to only electric charges that create the electromagnetic field to which is submitted another electric charge. But here we generalize this case to the one where $\boldsymbol{C}$ denoted now $\boldsymbol{C_T}$ is due also to the mass of massive neutral or electrically charged particles, remembering that an electrically charged particle must have a mass. That is, in presence of $\boldsymbol{C_T}$**,** the ether is such that the phase velocity V_P propagated in it, is different from the light velocity c. Therefore in presence $\boldsymbol{C_T}$, Eq. (16) has to be completed into the following

$$\boldsymbol{curl}(C_T/2 - \eta\,\boldsymbol{curl\xi}) = \rho_0 \partial_{tt}\boldsymbol{\xi}, \tag{38}$$

where now

$$\eta = \rho_0 {V_P}^2 \ . \tag{39}$$

η being the non-free η_0 since the phase velocity V_P is different from c. From (38) and (39), one can obtain the generalized Maxwell equations as in Sec. 2.4.

In that context, let us first consider the field created by an immobile $P(m_0, q_0)$. The expression for the velocity $\boldsymbol{V_T}$ of a $P(m, q)$ submitted to this field is given in (35) and the expression for the phase velocity V_P associated to it, is, Cf. Eq. (3.69) of Zareski (2015),

$$V_p = c\gamma_T/(\gamma_{\vartheta T} B_T) \ . \tag{40}$$

where

$$B_T \equiv \sqrt{1 - (\gamma_T mc^2/E_T)^2} \ . \tag{41}$$

In particular, for $m = 0$, then $B = 1$, and (35) and (40) are identical, that is, the velocity of the photon, i.e., of the group velocity is identical to the phase velocity, i.e.,

$$V_P(m = 0) = V_T(m = 0) = c\gamma_T/\gamma_{\vartheta T} \ . \tag{42}$$

Since here one considers that the $P(m_0, q_0)$ is immobile at **O**, it follows that at any point not situated at **O**, (38) becomes

$$-\boldsymbol{curl}\left({V_P}^2 \boldsymbol{curl\xi}\right) = \partial_{tt}\boldsymbol{\xi} \ . \tag{43}$$

where V_P is defined in (40) when $m \neq 0$ or in (42) when $m = 0$. In the monochromatic case of pulsation ω, (43) becomes

$$\boldsymbol{curl}[(c\gamma_T)^2/(\gamma_{\vartheta T} B_T)^2\, \boldsymbol{curl\xi}] = \omega^2 \boldsymbol{\xi}, \tag{44}$$

in which, for the graviton, $m = 0$, and $\alpha_E = 0$, and for the photon, $m = 0$, and $\alpha_G = 0$.

We consider now the solutions of the equations of the ether changes (44) due to an immobile $P(m_0, q_0)$ in the two following cases: to $P(m_0, q_0)$ is submitted a $P(m, q), or\ a\ P(0, 0)$. To this purpose, let us consider the vector $\boldsymbol{\xi}$ for which the expression is

$$\boldsymbol{\xi} = \boldsymbol{\xi_0} e^{i\phi}, \tag{45}$$

where, when $m \neq 0$, ϕ is defined by

$$\phi = (E_T/\hbar)(-t + \textstyle\int d\ell/V_P), \tag{46}$$

or by

$$\phi = (E_T/\hbar)[-t + \textstyle\int d\ell/V(m = 0)] \ , \tag{47}$$

when $m = 0$, and where $\boldsymbol{\xi_0}$ is a vector depending only upon the spatial coordinates, Cf. Zareski (2012).

In Zareski (2016), we have shown that $\boldsymbol{\xi}$ is the solution of Eq. (44) when the $P(m, q)$ describes a circle around $P(m_0, q_0)$, or a rectilinear trajectory directed toward it.

In Zareski (2013), and in Zareski (2015), Sec. IV. 2, we proved that, for sufficiently large E_T, then $\boldsymbol{\xi}$ is the solution of Eq. (44) for any trajectory of the particle in the field created by a $P(m_0, q_0)$.

The complete demonstration being laborious, one may suppose that $\boldsymbol{\xi}$ defined in (45) and (46) is very close to the exact solution of (44) and might be the exact solution.

Now it appears that $\boldsymbol{\xi}$, defined by (44) where one imposes $(c\gamma_G)^2/(\gamma_{\vartheta G}B)^2$ instead of $(c\gamma_T)^2/(\gamma_{\vartheta T}B_T)^2$, by (45), and by (47), is a gravitational wave defined by

$$\boldsymbol{\xi} = \boldsymbol{\xi}_0 exp\{i\omega[-t + \int d\ell \gamma_{\vartheta G} B/c\gamma_G]\} \ . \quad (48)$$

If in order to fix the idea, one considers that the trajectory is rectilinear and passes by the immobile $P(m_0, q_0)$, then (48) becomes for large r

$$\boldsymbol{\xi} = \boldsymbol{\xi}_0 exp\left[i\omega\left(-t + \frac{1}{c}\int \frac{dr}{1-\frac{2m_0k}{c^2r}}\right)\right] \ . \quad (49)$$

Now, for very large r, then

$$\boldsymbol{\xi} \cong \boldsymbol{\xi}_0 exp\left[i\omega\left(-t + \frac{r}{c}\right)\right]. \quad (50)$$

Equation (49) is a gravitation wave that for very very large r becomes Eq. (50) which is of the same form as a free electromagnetic ether wave. From these equations (49) and (50), one deduces the equivalent Maxwell's equations for gravitation as done in Zareski (2001).

3.5 Ether Globule Associated to the Particle and Creation of the Schwarzschild Field

3.5.1 Some General Recalls on the Ether Globule Associated to the Particle

To fix the idea, let us consider a $P(M, Q)$ of constant velocity $\boldsymbol{V}(M, Q)$ directed along the x-axe, to which is associated the phase velocity $\boldsymbol{V_P}(M, Q)$, Cf. Eq. (21) of Zareski (2013), or Eq. (3.43) of Zareski (2015). Considering our above development, to this $P(M, Q)$ is associated a "single particle wave" $\hat{\boldsymbol{\xi}}(\Delta\omega)$ for which the expression is, Cf. Eq. (17) of Zareski (2014),

$$\hat{\boldsymbol{\xi}}(\Delta\omega) = \boldsymbol{\xi}_0 exp\left[i\omega\left(-t + \frac{x}{\boldsymbol{V_P}(M,Q)}\right)\right] SINC\left[\frac{\Delta\omega}{2}\left(-t + \frac{x}{\boldsymbol{V}(M,Q)}\right)\right] \quad (51)$$

where $SINC(y) \equiv (siny)/y$, and $\boldsymbol{\xi_0}$ denotes a vector depending of only upon the spatial coordinates. This equation is another form of the following wave packet Cf. Eq. (18) of Zareski (2014),

$$\hat{\boldsymbol{\xi}}(\Delta\omega) = \int_{\omega-\Delta\omega/2}^{\omega+\Delta\omega/2} \boldsymbol{\xi}_0 exp\left[i\varpi\left(-t + \frac{x}{\boldsymbol{V_P}(M,Q)}\right)\right] d\varpi. \quad (52)$$

Equation (51) shows that:

> $\hat{\boldsymbol{\xi}}(\Delta\omega)$ *is a packet of waves, i.e., is a globule that moves with the velocity* $\boldsymbol{V}(M, Q)$. *In this globule, the ether vibrates at the frequency* $\nu = \omega/(2\pi)$, *and a wave moves with the phase velocity* $\boldsymbol{V_P}(M, Q)$.

3.5.2 The Globule Associated to the Free Gravitons or Photons

The photon and the graviton are $P(0,0)$, when they are free, (51) becomes

$$\hat{\boldsymbol{\xi}}(\Delta\omega)_{\boldsymbol{grav\,or\,phot}} = \boldsymbol{\xi}_0 exp\left[i\omega\left(-t + \frac{x}{\boldsymbol{c}}\right)\right] SINC\left[\frac{\Delta\omega}{2}\left(-t + \frac{x}{c}\right)\right] \quad (53)$$

This shows that the free graviton and the free photon move with the same velocity c which is also the phase velocity of the waves associated to them.

3.5.3 Behaviour of the Immobile $\boldsymbol{P}(M, Q)$

Let us consider what happens when the $\boldsymbol{P}(M, Q)$ is immobile, that is when $\boldsymbol{V}(M, Q) = 0$. In this case $\boldsymbol{V_P}(M, Q)$ is infinite, $E_T = m_0c^2$, and Cf. Eq. (22) of Zareski (2014), and Eq. (3.43) of Zareski (2015), (51) becomes

$$\lim_{\boldsymbol{V}(M,Q)\to \boldsymbol{0}}\left[\hat{\boldsymbol{\xi}}(\Delta\omega)\right] = \boldsymbol{\xi}_0 exp\left(-i\frac{2\pi}{h}mc^2t\right) SINC\left[\frac{\Delta\omega}{2}\left(-t + \frac{x}{0}\right)\right]. \quad (54)$$

Now, since $SINC(\infty) = 0$ because $SINC\left[\frac{\Delta\omega}{2}\left(-t + \frac{x}{0}\right)\right] = 0$, it follows that

$$\lim_{\boldsymbol{V}(M,Q)\to \boldsymbol{0}}\left[\hat{\boldsymbol{\xi}}(\Delta\omega)\right] = 0, \quad (55)$$

that is to say that when the globule $\hat{\boldsymbol{\xi}}(\Delta\omega)$ becomes immobile, it loses its form and becomes a Schwarzschild field since an immobile particle creates such a field.

4. Relativistic Electromagnetism and Gravitation Equivalence for a $P(m,q)$ in the Field Due to a $P(m_0,q_0)$ of Given Motion

4.1 Approximation of the Lagrange-Einstein function of the $P(m,q)$ Submitted to the Field Due to a $P(m_0,q_0)$ of Given Motion

Let $\boldsymbol{V_0}$ denote the given velocity of a $P(m_0,q_0)$ that creates the field to which is submitted a $P(m,q)$, and let W_μ denote the tensor defined by

$$W_\mu \equiv V_{0,\mu}/(rc - \boldsymbol{r}\cdot\boldsymbol{V_0}), \tag{56}$$

where the $V_{0,j}$ are the covariant components of $\boldsymbol{V_0}$ and $V_{0,4}=c$. Let $L_G(V \ll c \; and \; r \gg \alpha)$ denote the approximation of the Lagrange-Einstein function L_G of a $P(m,q)$ submitted to the field created by this $P(m_0,q_0)$ where α denotes a certain length such that, in the static case it is simply α_T. From the consideration of Sec. V of Zareski (2014), or of Eq. (9.23) of Zareski (2015), and of Eqs.

(9.1)-(9.11) of Zareski (2015) it follows that in this case, one has

$$L_G(V \ll c \; and \; r \gg \alpha) = -mc\sqrt{c^2 - V^2} + \frac{mc}{2}\alpha_T W_\mu \dot{x}^\mu \ , \tag{57}$$

where α_T is defined in Sec. 3.2. One sees that when $\boldsymbol{V_0}=0$, then Eq. (57) becomes Eq. (25).

Conclusion regarding Maxwell's electrodynamics: Since, when $\boldsymbol{V_0}=\boldsymbol{0}$ and when one imposes theoretically $k=0$ then Eq. (57) becomes Eq. (14) with α_E instead of α, it follows that (57) produces only an approximation of the exact motion equation of the $P(m,q)$ submitted to the field created by the charge q_0 of velocity $\boldsymbol{V_0}$. It appears therefore that Maxwell's electrodynamics theory is a <u>non-relativistic approximation</u> of the exact electrodynamics theory, and the Lienard-Wiechert potential A_μ defined by

$$A_\mu = -[q_0/(4\pi\varepsilon_0)]W_\mu \ . \tag{59}$$

yields only an approximation of the motion equation.

Conclusion regarding classical gravitation: Since, when $\boldsymbol{V_0}=\boldsymbol{0}$, and $q=0$, Eq. (57) becomes Eq. (14) which is an approximation of Eq. (3), it follows that (57) can produce only an approximation of the exact motion equation of the $P(m,q)$ submitted to the field created by the mass m_0 of velocity $\boldsymbol{V_0}$. This confirms as we know that <u>classical gravitation is an approximation of the relativistic gravitation</u>, i.e., the gravitational Lienard-Wiechert potential G_μ defined by

$$G_\mu \equiv m_0 k W_\mu, \tag{60}$$

yields only an approximation of the motion equation. One recalls that G_μ is a gravitational Lienard-Wiechert potential tensor seen at an observation point $\boldsymbol{R}_{ob}$ due to the particle of mass m_0 that moves with the velocity $\boldsymbol{V_0}$, and r is the distance between the position of m_0 at the time t' where the signal was emitted and reaches the point $\boldsymbol{R}_{ob}$ at the time t such that $(t-t')c = r$. It follows that the Lagrange-Einstein function $L_{GG}(V \ll c \; and \; r \gg \alpha)$ is obtained from (57) by inserting $qq_0 = 0$.

> *One sees the similarity of the effects of the ether perturbations on the $P(m,q)$ of velocity $V \ll c \; and \; r \gg \alpha$, due to the electric charge q_0 of velocity $\boldsymbol{V_0}$ or due to the massive particle m_0 of same $\boldsymbol{V}_0$, that is to say, the similarity of the electromagnetic Lienard-Wiechert potential tensor (59) with the gravitational tensor (60). But, Maxwell's equations do not take into account Einstein's General Relativity. That is to say that these equations are only an approximation for $V \ll c \; and \; r \gg \alpha$ of the exact electromagnetism equations that takes into account general relativity.*

4.2 Analogy of the Known Approximated Gravitation Tensor due to a $\boldsymbol{P(m_0,0)}$ of Given Motion with the Electromagnetic Tensor due to an Electric Charge of Same Motion

Let $g_{\mu\nu}$ be the gravitational field created by $P(m_0,o)$ of given velocity $\boldsymbol{V_0}$ to which is submitted a $P(m,0)$ of velocity $\boldsymbol{V}$. What we know about these components $g_{\mu\nu}$ is that: from Eqs. (7) and (60), one deduces that, far from the source that creates the field $g_{\mu\nu}$, and for not large velocity of $P(m,q)$ in front of c, we know the approximate values of the $g_{\mu 4}$ denoted specifically by $g_{\mu 4}(V \ll c \; and \; r \gg \alpha)$ for which the expression is, considering (60),

$$g_{4\mu}(V \ll c \; and \; r \gg \alpha) = \delta_{4\mu} - (\delta_{4\mu}+1)m_0 k W_\mu / c^2 \tag{61}$$

where $\delta_{\nu\mu}$ is the Kronecker delta.

Indeed, Cf. Zareski (2014) & Zareski (2015), when a $P(m,0)$ is submitted to a gravitational field $g_{\mu\nu}$, we consider L_G defined by (1) and (2), now $g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu$ can be written

$$g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu = g_{\mu\mu}\dot{x}^\mu\dot{x}^\mu + 2g_{4j}\dot{x}^4\dot{x}^j + 2\Delta_{i\neq j}, \tag{62}$$

where $\Delta_{i\neq j}$ is defined by

$$\Delta_{i\neq j} \equiv g_{12}\dot{x}^1\dot{x}^2 + g_{13}\dot{x}^1\dot{x}^3 + g_{23}\dot{x}^2\dot{x}^3 \tag{63}$$

and $g_{\mu\mu}$, as following

$$g_{\mu\mu} = g_{0,\mu\mu} + \delta g_{\mu\mu}, \tag{64}$$

where $g_{0,\mu\mu}$ denotes the free value of $g_{\mu\mu}$. With these notations (62) can be written:

$$g_{\mu\nu}\dot{x}^\mu\dot{x}^\nu = c^2 - V^2 + \delta g_{\mu\mu}\dot{x}^\mu\dot{x}^\mu + 2g_{4j}\dot{x}^4\dot{x}^j + 2\Delta_{i\neq j} \tag{65}$$

and (1) as following

$$L_G = -mc\sqrt{c^2 - V^2} - mc\frac{(\delta g_{\mu\mu}\dot{x}^\mu\dot{x}^\mu + 2g_{4j}\dot{x}^4\dot{x}^j + 2\Delta_{i\neq j})}{2\sqrt{c^2-V^2}} + \cdots \tag{66}$$

We now define the NA, $L_{G,NA}$ of L_G, considering (66), one sees that

$$L_{G,NA} = -mc\sqrt{c^2 - V^2} + mG_\mu\dot{x}^\mu/c \tag{67}$$

where G_μ is the tensor defined by

$$G_4 \cong -c^2\,\delta g_{44}/2, \quad G_j \cong -c^2 g_{4j}. \tag{68}$$

That is to say where (61)is verified.

Now, one sees that G_μ and A_μ differ only by a constant multiplicative coefficient, furthermore considering (57) one see that that these two coefficients are added therefore a more general form of $g_{4\mu}(V \ll c\ and\ r \gg \alpha)$ that takes into account gravitation and electromagnetism, will be denoted $\beth_{4\mu}(V \ll c\ and\ r \gg \alpha)$, for which the expression is

$$\beth_{4\mu}(V \ll c\ and\ r \gg \alpha) = \delta_{4\mu} - (\delta_{4\mu} + 1)\alpha_T W_\mu/2\ . \tag{69}$$

Now since in absence of electromagnetism the $g_{4\mu}(V \ll c\ and\ r \gg \alpha)$ are the approximation of $g_{4\mu}$, it follows that the $\beth_{4\mu}(V \ll c\ and\ r \gg \alpha)$ are the approximations of the exact components $\beth_{4\mu}$ of the field $\beth_{\nu\mu}$ which is the exact solution of Einstein's general relativity equations, and since the $\beth_{4\mu}(V \ll c\ and\ r \gg \alpha)$ differ from the components $g_{\mu 4}(V \ll c\ and\ r \gg \alpha)$ only by a constant coefficient, i.e., by the fact that $m_0 k/c^2$ becomes $\alpha_T/2$, it follows one can determine a tensor of components $\beth_{\nu\mu}$ such that these components will differ from the components $g_{\mu\nu}$ only by the fact that $m_0 k/c^2$ will becomes $\alpha_T/2$; therefore this tensor $\beth_{\nu\mu}$ is a solution of Einstein's general relativity equations.

5. Conclusion

It appears that Maxwell's electromagnetism can be generalized as to be a case of the General Relativity, that is, the exact Lagrange-Einstein function of an electric charge q submitted to the field due an immobile charge q_0 and its motion equation are the same as those of a particle of mass m submitted to only the field created by an immobile particle of mass m_0. In particular, it appears that an immobile q_0 creates also an electromagnetic horizon that behaves like a Schwarzschild horizon on which the velocity is null. Then that it exists ether gravitational waves constituted by gravitons in the same way as electromagnetic waves are constituted by photons.

Then we arrive to the conclusion that, since in the approximation $V \ll c$, A_μ and G_μ differs by only a constant multiplicative coefficient and since as we show, G_μ produces then the approximation of $g_{\mu 4}$, it follows that $A_\mu + G_\mu$ produces the approximation for $V \ll c$ of $\beth_{\mu 4}$, where the $\beth_{\mu\nu}$ are the components of a tensor that generalizes Einstein's fundamental tensor $g_{\mu\nu}$ by taking into account the contribution of the electrical charge q_0 whether it moves or not.

Acknowledgements

I thank Professor Lawrence Horwitz from Tel Aviv University for his advice and encouragement.

References

Dirac, P. A. M. (1975). *General Theory of Relativity*. John Wiley & Sons, Inc.

Einstein, A. (1916). The Foundation of the General Theory of Relativity. *Annalen der Physik, 49*, 1916. reprinted in Lorentz, Einstein, Minkowski & Weyl, here below precised , VII, pp. 109-164.

Einstein, A. (1920). Ether and the theory of relativity: The collected papers of Albert Einstein. Berlin: Springer.

Lorentz, H. A., Einstein, A., Minkowski, H., & Weyl, H. (1923). *The Principle of Relativity: A Collection or Original Memoirs on the Special and General Theory of Relativity*. Dover.

Maxwell, J. C. (1954). *A Treatise on Electricity and Magnetism.* New-York: Dover.

Zareski, D. (2001). The elastic interpretation of electrodynamics. *Foundations of Physics Letters*, *14*(5), 447-469.

Zareski, D. (2012). On the elasto-undulatory interpretation of fields and particles. *Physics Essays*, *25*(2).

Zareski, D. (2013). Fields and wave-particle reciprocity as changes in an elastic medium: The ether. *Physics Essays*, *26*(2), 288-295.

Zareski, D. (2014). The ether theory as implying that electromagnetism is the Newtonian approximation of general relativity. *Physics Essays*, *27*(4), 517-522.

Zareski, D. (2015). Unification of Physics by the Ether Elasticity Theory. LAP LAMBERT Academic Publshing, 102 pages.

Zareski, D. (2016). On particle waves solutions of the equation of the ether. *Journal of Advances in Physics (JAP), 9*(2).

Applied Physics Research; Vol. 9, No. 3; 2017
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

An Elucidation of the Symmetry of Length Contraction Predicted by the Special Theory of Relativity

Koshun Suto[1]

[1] Chudaiji Buddhist Temple, Isesaki, Japan

Correspondence: Koshun Suto, Chudaiji Buddhist Temple, Isesaki, Japan. Tel: 81-270-23-9980. E-mail: koshun_suto129@mbr.nifty.com

Received: April 17, 2017 Accepted: April 28, 2017 Online Published: May 31, 2017

doi:10.5539/apr.v9n3p31 URL: https://doi.org/10.5539/apr.v9n3p31

Abstract

In this paper, consider a rod A (inertial frame A) and rod B (inertial frame B) moving at constant velocity relative to each other. Assume that the lengths of two rods are equal when they are stationary. According to the STR, when length in the direction of motion of rod B, moving at constant velocity, is measured from inertial frame A, the rod contracts in the direction of motion. Also, the time which elapses on clock in inertial frame B is delayed compared to the time which elapses on clock in inertial frame A. If, conversely, inertial frame A is measured from inertial frame B, rod A contracts in the direction of motion, and the time which elapses on clock is delayed. However, according to classical common sense, if rod B contracts when measured from inertial frame A, then rod A measured from rod B must be longer than rod B. Thus, this paper discusses the symmetry of rod contraction, and elucidates this problem. It is found, based on the discussion in this paper, that the contraction of a rod includes true physical contraction, and relativistic contraction obtained due to measurement using the method indicated by Einstein. However, in the STR, any two inertial frames are equivalent, and therefore is not possible to accept points such as the fact that reasons for contraction are different. This paper concludes that STR is not a theory which describes the objective state of reality.

Keywords: Special Theory of Relativity, Classical Stationary System, Classical Moving System, Relativistic Stationary System, Length Contraction, Velocity Vector

1. Introduction

In the era of classical physics, as exemplified by Newtonian mechanics, it was thought that physical laws exist independently of the existence of human beings. The role of physics was to discover physical laws, and describe them in the language of mathematics.

Now, consider a rod A (inertial frame A) and rod B (inertial frame B) moving at constant velocity relative to each other. Assume that the lengths of two rods are equal when they are stationary.

According to the STR, when length in the direction of motion of rod B, moving at constant velocity, is measured from inertial frame A, the rod contracts in the direction of motion. Also, the time which elapses on clock B in inertial frame B is delayed compared to the time which elapses on clock A in inertial frame A.

If, conversely, inertial frame A is measured from inertial frame B, rod A contracts in the direction of motion, and the time which elapses on clock A is delayed.

According to Einstein's "principle of relativity," the two inertial frames are equivalent, and thus the same results are obtained no matter which inertial frame measurement is carried out from. The essence of STR is the symmetry of the theory.

However, according to classical common sense, if rod B contracts when measured from inertial frame A, then rod A measured from rod B must be longer than rod B.

The author has already discussed the symmetry of time delay in another paper (Suto, 2016-2017): The symmetry of length contraction is derived quantitatively from the formula for Lorentz transformations. However, the STR does not explain the reason why the rod contracts. Thus, this paper discusses the symmetry of rod contraction, and elucidates this problem.

Sections 2 to 5 are preparatory stages for section 6. Section 2 discusses the "principle of constancy of light speed" adopted by Einstein. Section 3 explains the method of discriminating between a "classical stationary system" and "classical moving system." Sections 4 and 5 discuss the contraction which can be predicted from a classical perspective. Here, the term "classical" is used when discussing objective reality which exists regardless of the observer. Section 6 employs the method of clock synchronization proposed by Einstein. It also elucidates the symmetry of rod contraction by applying the principle of relativity.

2. The "Principle of Constancy of Light Speed E" Introduced by Einstein

When Einstein developed the STR, he assumed the "principle of relativity" and the "principle of constancy of light speed." The latter includes the following two principles.

"Any ray of light moves in the "stationary" system of coordinates with the determined velocity c, whether the ray be emitted by a stationary or by a moving body." (Einstein, 1923):

"Let a ray of light start at the "A time" t_{A} from A towards B, let it at the "B time" t_{B} be reflected at B in the direction of A, and arrive again at A at the "A time" t'_{A}.

In agreement with experience we further assume the quantity

$$\frac{2\,\mathrm{AB}}{t'_{\mathrm{A}}-t_{\mathrm{A}}}=c,$$

to be a universal constant — the velocity of light in empty space." (Einstein, 1923):

In this paper, we distinguish between the former principle as the "principle of constancy of light speed I" and the latter principle as the "principle of constancy of light speed II." The "principle of constancy of light speed I" asserts that the light speed in vacuum does not depend on the speed of the light source. The "principle of constancy of light speed II" asserts that the light speed calculated from the round-trip travel time is constant.

Let there be a given stationary rigid rod of length L as measured by a ruler which is stationary, and assume that the rod is placed along the positive direction of the stationary system's x-axis.

Assume that clocks A and B of the same type are set up at points A and B on the rear and front end of this rod. Here clock A will be abbreviated as C_{A}, and clock B as C_{B}.

Suppose a ray of light is emitted in the direction of B from A at time t_{A} of C_{A}, reaches and is reflected at B at time t_{B} of C_{B}, and then returns to A at time $t_{\mathrm{A'}}$ of C_{A}. Einstein determined that if the following relationships hold between these times, then the two clocks represent the same time by definition (Einstein, 1923):

$$t_{\mathrm{B}}-t_{\mathrm{A}}=t_{\mathrm{A'}}-t_{\mathrm{B}}. \tag{1}$$

$$\frac{1}{2}\left(t_{\mathrm{A}}+t_{\mathrm{A'}}\right)=t_{\mathrm{B}}. \tag{2}$$

If the relationship in Equation (1) does not hold for the times of C_{A} and C_{B}, then it is necessary to adjust the time of C_{B} so that the relationship in (1) holds. (Actually, either clock can be adjusted.)

Next, assume that the stationary rod has been accelerated, and has attained the constant velocity $\boldsymbol{v}$ (see Figure 1).

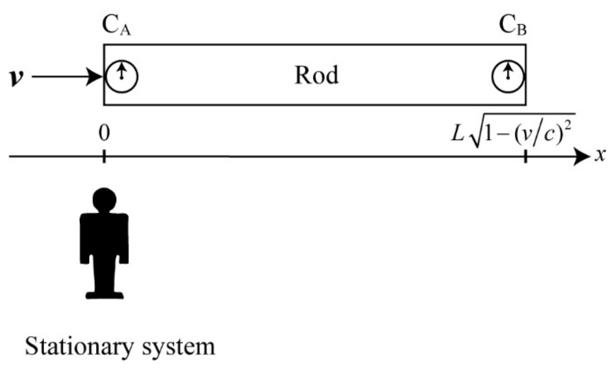

Figure 1. A rod is moving at constant velocity $\boldsymbol{v}$ relative to stationary system. Clock A and B are set up at A and B at each end of this rod, and the times of each of these clocks are synchronized while the system is stationary

Then the time C_B must be adjusted again so that the relationship in Equation (1) holds between the times C_A and C_B. Due to this operation, the light speed on the outward and return paths measured in the moving system of the rod is measured as c on both paths.

Considered classically, an inertial frame in which light propagates isotropically is a stationary system, and an inertial frame in which light propagates anisotropically is a moving system.

However, if clock time is adjusted according to the requirements of Einstein, light propagates isotropically at the same speed in all inertial frames. (Relativistic isotropic propagation).

Also, all inertial frames become stationary systems in the sense of the theory of relativity.

In this paper, the principle introduced by Einstein is called the "principle of constancy of light speed E." (where "E" stands for Einstein.) That is,

Principle of constancy of light speed E: In all inertial frames, light speed of the outward path and return path is constant (c).

This principle is not a universal principle, but a personal principle introduced by Einstein. To maintain this principle, the observer in a stationary system must adjust the time on a clock each time the velocity of a moving system changes. If the observer neglects this task, the principle of constancy of light speed E is no longer a principle.

3. Classical Length Contraction Derived by Applying Principle of Constancy of Light Speed I and II

Let us imagine that times $t_{\mathrm{A}}, t_{\mathrm{B}}, t_{\mathrm{A'}}$ of this moving system corresponds to times $t'_{\mathrm{A}}, t'_{\mathrm{B}}, t'_{\mathrm{A'}}$ of the stationary system.

Now when the time required for the light signal emitted from point A at the rear of the rod to travel from point A to point B is measured with the clock in moving system, it is $(t_{\mathrm{B}} - t_{\mathrm{A}})$. Also, if this time is measured with the clock in the stationary system, it is expressed as $(t'_{\mathrm{B}} - t'_{\mathrm{A}})$.

According to the STR, the rod seen from stationary system contracts by $1/\gamma$ times in the direction of motion. Also, the observer in stationary system applies the "principle of constancy of light speed I" to the propagation of light emitted from moving system, and thus $(t'_{\mathrm{B}} - t'_{\mathrm{A}})$ is given by the following equation.

$$t'_{\mathrm{B}} - t'_{\mathrm{A}} = \frac{L}{\gamma(c-v)} \text{ (s)}, \qquad \gamma = \left(1 - v^2/c^2\right)^{-1/2}. \tag{3}$$

Also, the time $(t'_{\mathrm{A'}} - t'_{\mathrm{B}})$ required for the light signal to return from point B to point A is given by the following equation.

$$t'_{\mathrm{A'}} - t'_{\mathrm{B}} = \frac{L}{\gamma(c+v)} \text{ (s)}. \tag{4}$$

However, the denominator on the right side of Equations (3) and (4) does not signify that the light speed changes. According to the STR, the relationship of $(t_{\mathrm{B}} - t_{\mathrm{A}})$ and $(t'_{\mathrm{B}} - t'_{\mathrm{A}})$ is:

$$t_{\mathrm{B}} - t_{\mathrm{A}} = \frac{1}{\gamma}(t'_{\mathrm{B}} - t'_{\mathrm{A}}). \tag{5}$$

Here, if the right side of Equation (3) is substituted for $(t'_{\mathrm{B}} - t'_{\mathrm{A}})$ in Equation (5),

$$t_{\mathrm{B}} - t_{\mathrm{A}} = \frac{L(c+v)}{c^2} \text{ (s)}. \tag{6}$$

Similarly, if the time $(t_{\mathrm{A'}} - t_{\mathrm{B}})$ which passes on the clock in moving system while the light signal returns from point B to point A is,

$$t_{\mathrm{A'}} - t_{\mathrm{B}} = \frac{L(c-v)}{c^2} \text{ (s)}. \tag{7}$$

If we set $t_{\mathrm{A}} = 0$ to simplify the equation, $t_{\mathrm{A'}}$ becomes the time which passes in moving system while the light signal makes a round trip between A and B. Thus, the observer in moving system determines that the time of C_B when the light has arrived at B is $t_{\mathrm{A'}}/2$. This time can be found from Equations (6) and (7). That is,

$$\frac{1}{2}t_{\mathrm{A'}} = \frac{1}{2}\left[(t_{\mathrm{B}} - t_{\mathrm{A}}) + (t_{\mathrm{A'}} - t_{\mathrm{B}})\right] \tag{8a}$$

$$= \frac{L}{c} \text{ (s)}. \tag{8b}$$

However, since $L(c+v)/c^2 > L/c$, the time on C_B must be later than the time on C_A to resolve this discrepancy. If this adjustment time is taken to be Δt,

$$\Delta t = (t_B - t_A) - \frac{1}{2}t_{A'} \tag{9a}$$

$$= \frac{Lv}{c^2}\ (\mathrm{s}). \tag{9b}$$

If the time of C_B is delayed by $Lv/c^2(\mathrm{s})$, then a state is achieved where the times of C_A and C_B can be said to be simultaneous in moving system.

At the time $\Delta t = Lv/c^2(\mathrm{s})$, it can be determined that the coordinate system where the rod was initially stationary was the coordinate system where light propagates isotropically.

In this paper, this coordinate system is defined as the classical stationary system S_{cl}. The cl subscript of S_{cl} is taken to mean a classical inertial frame. Two clocks whose times have been synchronized in S_{cl} match in an absolute sense.

On the other hand, at the time $\Delta t \neq Lv/c^2(\mathrm{s})$, it can be determined that the coordinate system where the rod was initially stationary was the coordinate system where light propagates anisotropically (Suto, 2010):

In this coordinate system, the principle of constancy of light speed II holds, but the principle of constancy of light speed E does not hold. In this paper, this coordinate system is defined as the classical moving system S'_{cl} .The cause of anisotropic propagation of light in S'_{cl} is the velocity vector attached to this coordinate system (Suto, 2015):

The author has previously presented a thought experiment for discriminating between S_{cl} and S'_{cl}. However, Einstein believed it was impossible to discriminate these inertial frames through experiment. Also, Einstein proposed that the time on two clocks in an inertial frame be adjusted so that the relationship in Equation (1) holds. As a result, the speed of light became c for both the outward path and return path, even in S'_{cl}. Also, all inertial frames became equivalent in the sense of the theory of relativity (a stationary system S_{re} in the sense of the theory of relativity). The following summarizes the above:

Classical physics Special theory of relativity

$$\left.\begin{cases}\text{Classical stationary system } S_{\mathrm{cl}} \\ \text{Classical moving system } S'_{\mathrm{cl}}\end{cases}\right\} \rightarrow \text{Relativistic stationary system } S_{\mathrm{re}}$$

Now, how should we imagine S_{cl}? In the latter half of the 19th century, it was thought that a medium was needed for light to propagate as a wave. The physicists at the time called this medium the "aether." However, Einstein eliminated the aether from the STR, and thus discussion of the existence of this hypothetical substance gradually disappeared. However, if the principle of constancy of light speed I holds, then there needs to be a medium for transmitting light as a wave. Thus, this paper looks at the pairs of virtual particles and antiparticles which constitute the vacuum. The countless relative velocities between the S_{cl} coordinate system and the countless virtual particle pairs in the vicinity are indicated as vectors, and then composed. If the size of the vector becomes zero at this time, then the coordinate system is S_{cl} where light propagates isotropically. On the other hand, if the composed vector has magnitude, then the coordinate system is S'_{cl} where light propagates anisotropically.

4. Length Contraction and Time Delay Explainable using Classical Considerations

Consider a laboratory whose interior floor is a square. The Michelson interferometer is placed in this laboratory (see Figure 2). At the center of the room, there is a glass plate (beam splitter) P with a semi-transparent metal coating on its front face. The angle between this glass plate and the x-axis is 45°. Light emitted from the light source S strikes this glass at an angle, and the light is split in two. One beam passes through the plate, strikes a mirror M_x, is reflected, and retraces its path to the splitting point P. On the second light path, the beam is reflected by the glass plate P, arrives at mirror M_y, is reflected there, and returns to the splitting point P. (Only the essential parts of the experimental instrument are shown here. Equipment not needed for the discussion in this paper has been omitted.)

This laboratory is moving at constant velocity $\boldsymbol{v}$ along the x-axis of S_{cl}. The light path length PM_x measured indoors is taken to be L_x and the path length PM_y is taken to be L_y. (However, in measurements in the laboratory, L_x and L_y are equal.) In addition, the light path length when L_x is measured from S_{cl} is taken to be L'_x, and the light path length when L_y is measured from S_{cl} is taken to be L'_y. (However, L_y and L'_y are equal.)

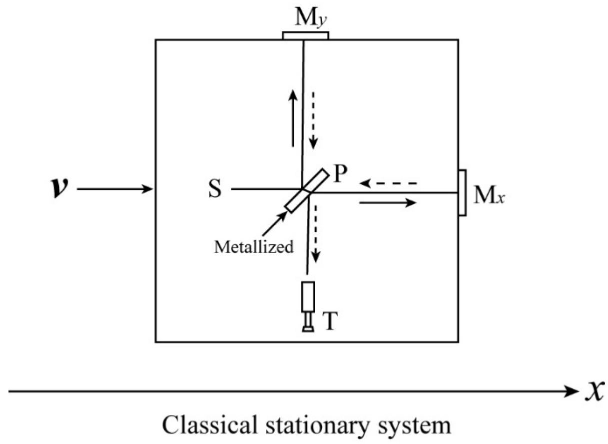

Figure 2. This figure shows the view from above of a laboratory moving at constant velocity with respect to S_{cl}

Here, the time required for light to make a round trip over PM$_x$ is measured from S_{cl}. If this round trip time is taken to be t'_x, then the observer in S_{cl} applies the principle of constancy of light speed I to this light propagation, and thus:

$$t'_x = \frac{L'_x}{c-v} + \frac{L'_x}{c+v} = \frac{2L'_x c}{c^2 - v^2} = \frac{2L'_x}{c\left(1 - v^2 / c^2\right)}. \tag{10}$$

Next, the time for light to make a round trip over PM$_y$ is measured. If this round trip time is measured in S_{cl} and taken to be t'_y, then:

$$t'_y = \frac{2L'_y}{c\left(1 - v^2 / c^2\right)^{1/2}}. \tag{11}$$

The method of deriving Equation (11) is explained in many textbooks so here it is omitted (Feynman, 1963; French, 1968):

Incidentally, the predicted effect could not be detected from the Michelson-Morley experiment. This means that t'_x and t'_y are equal. In the end, the following relationship can be derived from Equations (10) and (11).

$$L'_x = \frac{L'_y}{\gamma}. \tag{12}$$

Here, L'_y and L_x are equal, so Equation (12) can be written as follows.

$$L'_x = \frac{L_x}{\gamma}. \tag{13}$$

When measured from S_{cl}, the laboratory contracts by $1/\gamma$ times in the direction of motion. This contraction is physical contraction due to the fact that some force has acted on the laboratory, and this can be regarded as true contraction (contraction I).

Incidentally, an observer in the coordinate system S'_{cl} of the laboratory applies the principle of constancy of light speed II to this light propagation, and thus the round trip times of light t_x and t_y are predicted as follows:

$$t_x = \frac{2L_x}{c}. \tag{14}$$

$$t_y = \frac{2L_y}{c}. \tag{15}$$

In the end, t'_y elapses in S_{cl} while t_y elapses in S'_{cl}. In addition, $L_y = L'_y$ and thus Equation (11) can be written as follows:

$$t'_y = \frac{2\gamma L_y}{c}. \tag{16}$$

Next, if this is compared with Equations (15) and (16):

$$t'_y = \gamma t_y. \tag{17}$$

When observed from S_{cl}, the time which elapses in S'_{cl} is delayed compared to the time which elapses in S_{cl}. Actually, this prediction has been verified by experiments where the life of elementary particles is extended. In the end, space contraction and time delay in S'_{cl} can be predicted if the principles of constancy of light speed I and II are assumed.

5. Rod Contraction which can and cannot be Classically Explained

In this section, the lengths of rod A (inertial frame A) and B (inertial frame B) moving at constant velocity relative to each other are measured using two types of methods.

1) Two methods for an observer in inertial frame A (S_{cl}) to measure the length of rod B moving at constant velocity

Measurement 1. In this case, observer A_1 is at the rear end and observer A_2 is at the front end of rod A of length L placed on the x-axis of S_{cl}. Also, at an arbitrary time, a light signal is emitted from a point light source S placed in the center of rod A. That light signal propagates isotropically from S, and arrives at both ends of the rod with absolute simultaneity. At this time, observers A_1 and A_2 read off the position of both ends of rod A from the x'_{B} coordinates. (This x'_{B} -axis is parallel to the x-axis.)

Since rod B contracts by $1/\gamma$ times in the direction of motion, the length of rod A read off from the x'_{B} -axis becomes γL if we refer to Equation (15). From this,

$$\text{Length of rod A : Length of rod B,} \qquad \gamma L : L \to 1 : \frac{1}{\gamma}, \qquad \gamma > 1. \tag{18}$$

Here, if the length of rod B measured from S_{cl} is taken to be L', then Equation (18) can be written as follows;

$$L' = \frac{L}{\gamma}. \tag{19}$$

Contraction in this case is a result of the fact that some physical force acted on rod B, and this can be called true contraction (contraction I).

Measurement 2. First we consider rod B moving at constant velocity $\boldsymbol{v}$ along the x-axis of S_{cl}. (Length when the rod is at rest is L.) When the front end of the rod passes in front of observer A in S_{cl}, observer A starts the stopwatch, and measures the time t_{A} until the rear end of the rod passes. According to the STR, the rod B contracts by $1/\gamma$ times in the direction of motion at this time. That is,

$$L' = vt_{\mathrm{A}} = \frac{L}{\gamma}. \tag{20}$$

The results obtained from measurement 1 and 2 verify the contraction in Equation (13).

2) Two methods for an observer in inertial frame B (S'_{cl}) to measure the length of rod A.

Measurement 3a. In this case, contrary to measurement 1, observers at both ends of rod B compare the length of rod B and A with absolute simultaneity. The clocks are used at both ends of rod B have been synchronized when the rod was at rest in S_{cl} . If Equation (19) is taken into account, the length of rod B read off from the x coordinates by observers at both ends of rod B is shorter than rod A. That is,

$$\text{Length of rod B : Length of rod A,} \qquad \frac{L}{\gamma} : L \to 1 : \gamma. \tag{21}$$

Considered classically, if rod B contracts, then rod A is longer than rod B.

Measurement 4a. This case is the inverse of measurement method 2. Observer on rod B measures the length of rod A of length L placed on the x-axis of S_{cl} . If observer measures the time required to pass both ends of rod A, and this is taken to be t_{B} , then classically t_{B} is,

$$t_{\mathrm{B}} = \frac{L}{v}. \tag{22}$$

However, the time which passes in the coordinate system of rod B is delayed compared to the time which passes in S_{cl}. Therefore, the time t_{B} which passes in S'_{cl} becomes $1/\gamma$ times Equation (22). That is,

$$t_B = \frac{L}{\gamma v}. \tag{23}$$

Incidentally, it is impossible for rod A to contract because rod B began to move at constant velocity. Thus, the observer of rod B determines that time elapsing in his own coordinate system is delayed, and he does not regard rod A as having contracted. In classical measurement, contraction of rod A cannot be observed.

6. Contraction of Rod Interpreted by Borrowing Einstein's Measurement Method

The measurement in this section employs the following operation and principle used when developing the STR.

1) Times on the clocks at both ends of rod B moving at constant velocity are synchronized so that the relationship in Equation (1) holds.

2) The principle of relativity is applied to the coordinate system of rod B.

Measurement 3b. Next, the moving observer B uses the same method as measurement method 1, and reads off the position of both ends of rod B from the x coordinate in S_{cl}. Observer B_1 is at the rear end and observer B_2 is at the front end of the moving rod B.

At an arbitrary time, a light signal is emitted from S_B in the center of rod B. An observer in S_{cl} applies the principle of constancy of light speed I to this light propagation. When the light signal emitted from S_B has arrived at both ends of the rod, observers B_1 and B_2 read off the x coordinates in S_{cl}.

Then the two observers of rod B compare the length of the x coordinate they themselves read off, and the length of the stationary rod A.

Now, the observer in S_{cl} measures time until the light signals emitted from S_B arrives at the observers B_2 and B_1 at both ends of the rod. If these times are taken to be t'_2 and t'_1, then since the distance from S_B to the rod end is rod $L/2$,

$$t'_1 = \frac{L}{2\gamma(c+v)}. \tag{24}$$

$$t'_2 = \frac{L}{2\gamma(c-v)}. \tag{25}$$

Incidentally, the observer in S_{cl} determines the following values for the distance traveled by the light signal until it reaches both ends of the rod.

Travel distance x_- in the negative direction of the x-axis

$$x_- = ct'_1 = \frac{Lc}{2\gamma(c+v)}. \tag{26}$$

Travel distance x_+ in the positive direction of the x-axis

$$x_+ = ct'_2 = \frac{Lc}{2\gamma(c-v)}. \tag{27}$$

The observers at both ends of rod B obtain the following values as the length of the rod read off from the x-axis of the stationary system, based on Equations (26) and (27).

$$L' = x_+ + x_- = \gamma L, \qquad L < L'. \tag{28}$$

Contrary to Equation (21), the length of rod B in this case is longer than rod A. That is,

$$\text{Length of rod B : Length of rod A,} \quad \gamma L : L \to \gamma : 1. \tag{29}$$

Incidentally, if the principle of relativity is applied to the coordinate system of rod B, the length of A must match Equation (19).

Thus, the observers on rod B make the following judgment based on Equation (28).

$$\gamma L : L \to 1 : \frac{1}{\gamma}. \tag{30}$$

When the length of rod A is measured from the coordinate system of rod B, rod A is contracted by $1/\gamma$ times in the direction of motion (contraction II).

Measurement 4b. An observer of rod B who has applied the principle of relativity believes that his own coordinate system is a stationary system. Therefore, Equation (23) is explained using the contraction of rod A rather than a delay in the time of S'_{cl} (contraction III). If it is assumed that the principle of relativity holds in S'_{cl}, then the results of measurement 3b and 4b match the values of measurement 1 and 2.

7. Discussion

In section 4, an observer in S_{cl} applied the principle of constancy of light speed I, and an observer in S'_{cl} applied the principle of constancy of light speed II, to propagation of light emitted from a light source in S'_{cl}. At this time, the length of the laboratory measured by the observer in S_{cl} contracted in the direction of motion. This contraction is physical contraction which occurred as a result of some force having acted on the moving laboratory, and is true contraction (contraction I).

Next, in measurement 3a, clocks synchronized in S_{cl} were used as the two clocks in S'_{cl} used for measurement. Therefore, the times of the two clocks matched absolutely. The observer in S'_{cl} determined the rod B to be shorter than rod A (Equation (21)).

Thus, the method of clock synchronization proposed by Einstein was used in this paper. As a result, in measurement 3b, rod B was determined to be longer than rod A (Equation (29)).

However, even this is unacceptable, and therefore in this case the principle of relativity was applied to this coordinate system. According to the principle of relativity, any two inertial frames are equivalent, and thus measured values must match. In measurement 3b, the ratio of the lengths of rod B and rod A was interpreted as $1:1/\gamma$ (contraction II). However, actually it is not the case that rod A has physically contracted. This is relativistic contraction which occurs when measurement is done using the method indicated by Einstein.

The delay in time which elapses in the coordinate system of rod B was observed in measurement 4a, but it was not determined that rod A contracted based on Equation (23). However, in measurement 4b the principle of relativity was applied to inertial frame B, and therefore, observer B believed his own coordinate system to be a stationary system. With regard to the fact that Equation (23) was obtained, it was determined to be the result of rod A having contracted. This contraction is tentative contraction (contraction III) observed because the passage of time in inertial frame B was delayed. With this, the values for measurements 1 to 4 all match.

Now, how is this problem handled in the STR? The STR assumes the principle of relativity. If contraction of rod B is observed in measurement 1 and 2, then by definition contraction of rod A is also observed in measurement 3b and 4b. If physics is a science which pursues the nature of reality as it is, then contraction II and contraction III cannot be accepted. In the end, the STR should be regarded not as something which describes physical law existing in the natural world, but as a mathematical expression of the universe as imagined by Einstein. The velocity vectors present in the natural world are missing from the STR.

8. Conclusion

Through the discussion in this paper, it was determined that there are the following three types of contraction of a rod moving at constant velocity.

Contraction I (physical contraction): This is the contraction obtained from measurements 1 and 2, and it is true contraction due to fact that some physical force has acted on rod B which is moving at constant velocity. It was possible to explain this contraction with the classical discussion in section 5.

Contraction II (relativistic contraction): Reasons why contraction of rod A was observed in measurement 3b:

1) True contraction of rod B which is moving at constant velocity (contraction I)

2) Times of the clocks at both ends of rod B were adjusted to achieve simultaneity in the sense of the theory of relativity.

3) The principle of relativity was applied to inertial frame B.

It was possible to predict Equation (29) from 1) and 2). In addition, by applying the principle of relativity, it was possible to interpret Equation (29) like Equation (30), and explain the contraction of rod A.

Contraction III (relativistic contraction): The principle of relativity was applied to inertial frame B in measurement 4b. Therefore, with regard to the fact that Equation (23) was obtained, it was determined to be the result of rod A having contracted.

In measurement 1 and 3b, there was contraction I and II so results matching the predictions of the STR were obtained. Also, in measurement 2 and 4b, contraction I and III are the reason why symmetry of length contraction was observed.

In the end, the fact that symmetry of rod contraction, which is classically impossible, could be explained in this paper is due to the following three reasons.

1) The inertial frame A was assumed to be a classical stationary system.

2) An operational definition of simultaneity was used in measurement 3b.

3) In measurement 3b and measurement 4b, the principle of relativity was applied to inertial frame B.

As a result, relativistic contraction II and III occurred, and the measurement results in measurement 3b and measurement 4b matched the results of measurement 1 and measurement 2.

The STR is an astonishing theory in which rod A, undergoing no change in itself, is forced to contract. This paper concludes that there should be serious discussion of whether or not the STR can really be called a physical theory.

Acknowledgments

I would like to express my thanks to the staff at ACN Translation Services for their translation assistance. Also, I wish to express my gratitude to Mr. H. Shimada for drawing figures.

References

Einstein, A. (1923). *The Principle of Relativity* (pp. 40-41). New York: Dover Publication, Inc.

Feynman, R. P. (1963). *The Feynman Lectures on Physics* (pp. 15-4). Addison-Wesley Publishing Company.

French, A. P. (1968). *Special Relativity* (p. 55). New York & London: W.W.NORTON&COMPANY.

Suto, K. (2010). Violation of the special theory of relativity as proven by synchronization of clocks. *Physics Essays, 23*(3), 511-519. http://dx.doi.org/10.4006/1.3474836

Suto, K. (2015). Demonstration of the existence of a velocity vector missing from the special theory of relativity. *Physics Essays, 28*(3), 345-351. http://dx.doi.org/10.4006/0836-1398-28.3.345

Suto, K. (2016). Thought Experiment Revealing a Contradiction in the Special Theory of Relativity. *Applied Physics Research*, *8*(6), 70-74. http://dx.doi.org/10.5539/apr.v8n6p70

Suto, K. (2016). Elucidation of Time Symmetry Predicted by the Special Theory of Relativity. *IOSR Journal of Applied Physics*, *8*(6) IV, 20-27. http://dx.doi.org/10.9790/4861-0806042027

Suto, K. (2017). A New Problem with the Twin Paradox. *Applied Physics Research*, *9*(2), 77-86 https://doi.org/10.5539/apr.v9n2pxx

Applied Physics Research; Vol. 9, No. 3; 2017
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

Trigonometric Functions at a Crossroads

Jiří Stávek[1]

[1] Bazovského 1228, 163 00 Prague, Czech republic

Correspondence: Jiří Stávek, Bazovského 1228, 163 00 Prague, Czech republic. E-mail: stavek.jiri@seznam.cz

Received: May 9, 2017 Accepted: May 22, 2017 Online Published: May 31, 2017

doi:10.5539/apr.v9n3p40 URL: https://doi.org/10.5539/apr.v9n3p40

Abstract

In the history of physics trigonometric functions played several times a very critical role at crossroads. This time we are at a crossroads with the interpretation of correlation events of entangled particles. In this approach we propose to describe the experimental data of Alice and Bob using not so known trigonometric functions. Claudius Theorem (based on the trigonometric family of Sagitta and Cosagitta) evalutes the probabilistic occurrence of correlated and anticorrelated events. David Theorem (based on the trigonometric family of Hacoversine) describes the probability of the following identical events and gaps between the following identical events. In this trigonometric concept the Team of Alice, Bob, Claudius and David formulated a camouflage legend for Eve – "spooky action at a distance". Merlin (with unbounded computational ability) should verify the truth of this statement. Trent (a trusted arbitrator, who acts as a neutral third party) should analyze these data and this trigonometric concept. Victor (a verifier) should make his decision which way we should continue in our future research: either through the Niels Bohr avenue or through the Albert Einstein sidewalk.

Keywords: Trigonometric functions at a crossroads, Sagitta, Cosagitta, Hacoversine, a camouflage legend.

1. Introduction

The application of trigonometric functions played several times in the history of physics a very critical role. The analysis of experimental data with a chosen trigonometric function and its known precise value at that time determined the model explaining those phenomena.

E.g., Claudius Ptolemy described the experimental data of planet motions using the trigonometric function chord (at his time the only trigonometric function developed earlier by Hipparchus). During the following 1400 years trigonometric functions were intensively studied by Old Masters - the historical overview of the development of trigonometry can be found in the works of Von Braumühl (1900), Datta and Singh (1983), Matvievskaya (1990), Maor (1998), Van Brumelen (2009, 2013, 2014), and Smýkalová (2015). Johann Müller (called Regiomantus, 1436 - 1476) summarized the knowledge about trigonometric functions in his book "De triangulis Omnimodis" (On Triangles of Every Kind). This book served as "the foot of the ladder to the stars" and inspired Copernicus, Rheticus, Brahe, Kepler and many others. Nicolaus Copernicus created his model using the trigonometric function sine. Georg Rheticus (1514 – 1574) continued to further develop trigonometric functions in his "Opus Palatinum de Triangulis" (Canon of the Science of Triangles) which became the first printed publication of tables of all six trigonometric functions. Johannes Kepler analyzed the experimental data of Tycho Brahe using these more precise trigonometric functions and discovered the elliptical paths of planets around the Sun.

Today, we are again at a crossroads: we have available very precise experimental data of correlations of entangled particles that are excellently described by the trigonometric functions derived by the Quantum Mechanics. However, in this case we have to give up the concept of the local realism.

The latest experiments of leaders in this field closed all experimental loopholes for the local realism: Jan-Åke Larsson in 2014, Marissa Gustina et al. in 2015, Lynden K. Shalm et al. in 2015, Bradley G. Christensen et al. in 2015, Alain Aspect in 2015, Johannes Handsteiner et al. in 2017, Reinhold Bertlmann and Anton Zeilinger in 2017. Andrei Khrennikov organized in June 13 – 16, 2016 a great meeting with presentations about the state of the art in this field – see the video presentations on his website. Amir D. Aczel (2001) surveyed the complexity of this long research.

It seems it makes no sence to continue to protect the local realism. However, there remains one hidden door leading to the local realism – the realm of trigonometric functions. We have still a possibility to describe the correlation events of entangled particles by less known (partly forgotten and partly not yet discovered) trigonometric functions.

In the first stage we have to describe the known experimental data of Alice and Bob by some other trigonometric approach as was done by the Quantum Mechanics. For this case we will apply the Claudius Theorem based on the trigonometric family Sagitta and Cosagitta that describes probabilistically numbers of correlated and anticorrelated events. However, this Claudius Theorem does not meet the requirement of the Karl Popper´s concept of the falsification of data (1959) because it only reproduces the concept of Max Born – the Born rule. Moreover, we have to fulfill two conditions of Werner Heisenberg and Albert Einstein. Werner Heisenberg stated that any good theory must be based only on directly observable magnitudes. On the other hand Albert Einstein stated that it is the a good theory which decides what we can observe. We have to discover a new trigonometric function for the falsification of the existing concept and its interpretation. For this purpose we will use the David Theorem based on the trigonometric family of Hacoversine that enables newly to describe correlation events. In this case we will quantify the gaps between the following identical events. This concept could be accepted both by Werner Heisenberg and Albert Einstein.

In this trigonometric scenario the Team of Alice, Bob, Claudius and David formulate a camouflage legend for Eve –"spooky action at a distance". Merlin (with unbounded computational ability) should verify the truth of this statement. Trent (a trusted arbitrator, who acts as a neutral third party) should analyze these data and this trigonometric concept. Victor (a verifier) should make his decision which way we should continue in our future research: either through the Niels Bohr avenue or through the Albert Einstein sidewalk.

2. Trigonometric Functions in Circles with Radius R = 1, R = 1/2, and R = 1/4

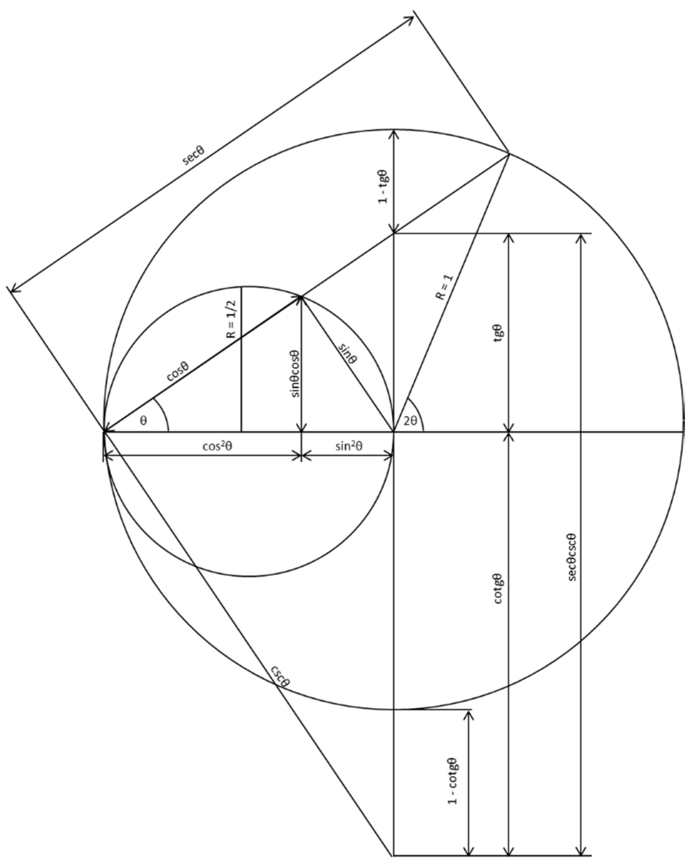

Figure 1 Three Rheticus triangles in the circles with radius R = 1 and R = 1/2 - the realm of trigonometric functions

The development of trigonometric functions has a very rich and long history. This knowledge was flowing from the ancient Egyptians, Babylonians and Greeks through India and Arabic countries back to Europe. The Old Masters related trigonometric functions to arcs of circles and lengths of chords subtending their arcs. Regiomantus determined values from right-triangle ratios. Modern scholars have been using mostly the unit circle with radius R = 1 for the analysis of properties of the main six trigonometric functions.

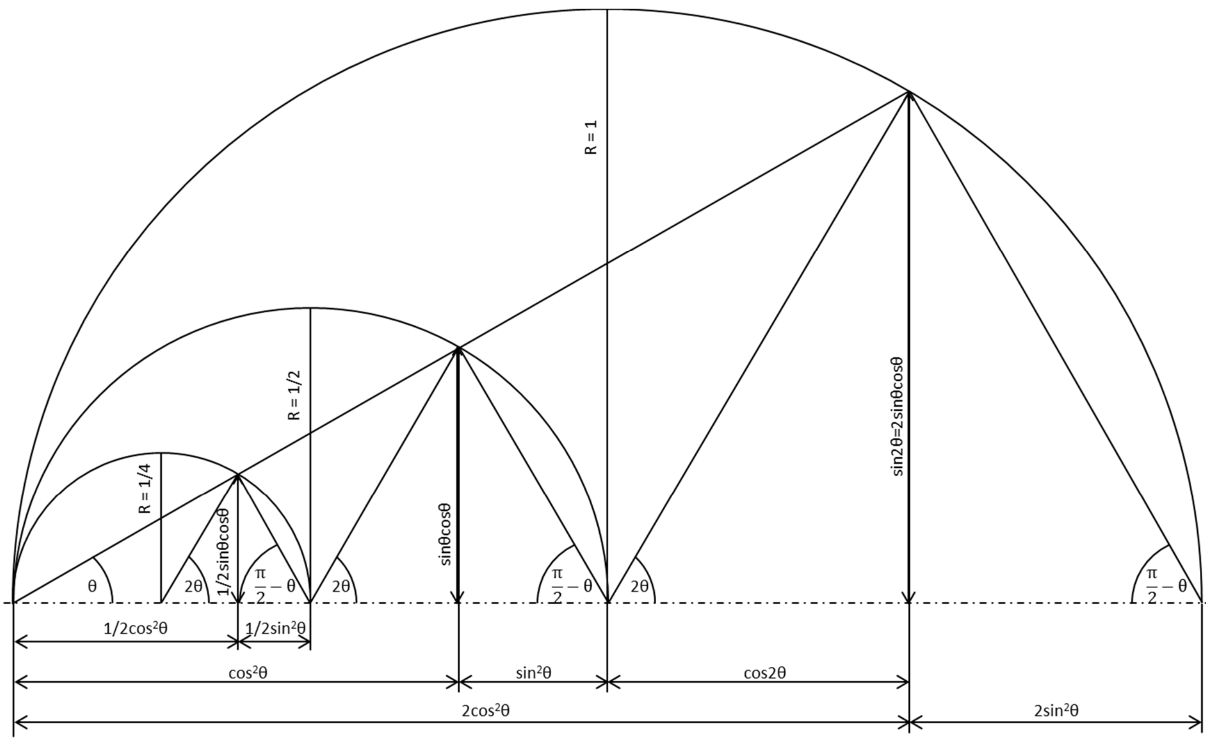

Figure 2. Trigonometric functions in circles with radius R = 1, R = 1/2 and R = 1/4

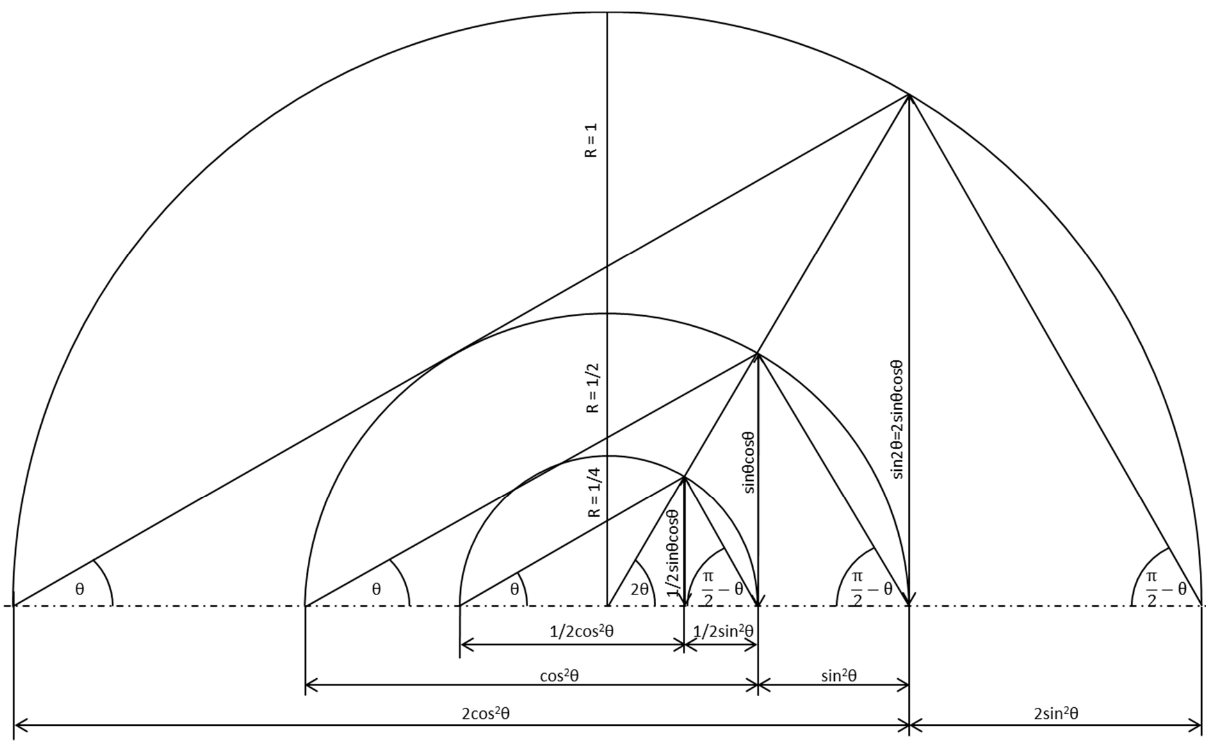

Figure 3. Orbits with radius R = 1, R = 1/2 and R = 1/4 and the trigonometric functions

Galileo gave to us his advice in Opere Il Saggiatore p. 171: "[The Universe] cannot be read until we have learnt the language and become familiar with the characters in which it is written. It is written in mathematical language, and the letters are triangles, circles and other geometrical figures, without which means it is humanly impossible to comprehend a single word."

This Galileo´s advice inspired us on one side to describe those circles and triangles with the existing known trigonometric relations, and on the other side to discover some new trigonometric relations that might be useful for the description of correlation events among entangled particles.

In our concept we are searching for the new trigonometric functions in circles with radius R = 1/2 and R = 1/4. In these circles we have found several new trigonometric functions that might be useful for the description of correlations among the entangled particles.

In Figure 1 we can see an opened door to the realm of trigonometric functions that prepared for us Georg Rheticus in his book "Canon of the Science of Triangles" in 1551 – see the video lecture of Glen van Brummelen in 2014 and the Figure 2.2. in Radka Smýkalová (2015).

Figure 2 and Figure 3 show circles with the radius R = 1, R = 1/2 and R = 1/4 and several triangles that reveal many trigonometric functions hidden in those lines. We will focuse our attention on trigonometric families Sagitta, Cosagitta and Hacoversine.

3. Claudius Theorem and David Theorem

Table 1. Claudius Theorem describing the total probabilities of joint detections and David Theorem describing probabilities of the following identical events and gaps between them

Claudius Theorem – probabilistic occurence of joint detections			
P++	P+-	P-+	P--
$\frac{1}{2}\cos^2\theta$	$\frac{1}{2}\sin^2\theta$	$\frac{1}{2}\cos^2\left(\frac{\pi}{2}-\theta\right)$	$\frac{1}{2}\sin^2\left(\frac{\pi}{2}-\theta\right)$
$\frac{1}{2}\cos^2\theta$	$\frac{1}{2}\sin^2\theta$	$\frac{1}{2}\sin^2\theta$	$\frac{1}{2}\cos^2\theta$
David Theorem – probabilities of the following identical detections			
P++ ↔ P++	P+- ↔ P+-	P-+ ↔ P-+	P-- ↔ P--
$\frac{1}{2}-\frac{1}{2}\sin\theta\cos\theta$	$\frac{1}{2}\sin\theta\cos\theta$	$\frac{1}{2}\sin\left(\frac{\pi}{2}-\theta\right)\cos\left(\frac{\pi}{2}-\theta\right)$	$\frac{1}{2}-\frac{1}{2}\sin\left(\frac{\pi}{2}-\theta\right)\cos\left(\frac{\pi}{2}-\theta\right)$
$\frac{1}{2}-\frac{1}{2}\sin\theta\cos\theta$	$\frac{1}{2}\sin\theta\cos\theta$	$\frac{1}{2}\cos\theta\sin\theta$	$\frac{1}{2}-\frac{1}{2}\cos(\theta)\sin(\theta)$
David Theorem – gaps between identical detections			
P++ ↔ P++	P+- ↔ P+-	P-+ ↔ P-+	P-- ↔ P--
$\frac{2}{1-\sin\theta\cos\theta}$	$\frac{2}{\sin\theta\cos\theta}$	$\frac{2}{\sin\left(\frac{\pi}{2}-\theta\right)\cos\left(\frac{\pi}{2}-\theta\right)}$	$\frac{2}{1-\sin\left(\frac{\pi}{2}-\theta\right)\cos\left(\frac{\pi}{2}-\theta\right)}$
$\frac{2}{1-\sin\theta\cos\theta}$	$\frac{2}{\sin\theta\cos\theta}$	$\frac{2}{\cos\theta\sin\theta}$	$\frac{2}{1-\cos\theta\sin\theta}$

The mathematical language of Quantum Mechanics perfectly describes probabilistically correlation events among entangled particles. This is the reason why most of researchers stated that this mathematical language completely characterizes those correlation events and that there is no hope to find anything better. A minority of researchers tries to discover another mathematical language that could bring more information from the microworld of correlated particles and to protect the local realism.

We propose to apply two Theorems for the description of correlation events among entagled particles:

1) Claudius Theorem describes the probabilities of joint correlated or anticorrelated detections. The hidden microworld sends to us these signals that are described by symmetric trigonometric functions Sagitta and Cosagitta. It could be a very clever trick of Nature to create a camouflage legend for Eve as "spooky action at a distance". Eve´s knowledge based on the mathematical language of Quantum Mechanics has to come to this camouflage legend. This trigonometric model documents that Nature has a great hiding power to protect Her secrets.

2) David Theorem brings a new additional concept for the description of the correlation of entangled particles. David (see the statue of Michelangelo) proposed to measure gaps between the following identical events in the SPDC Type I process where horizontally and vertically pairs have been created.

Table 1 summarizes our trigonometric model for the SPDC Type I (spontaneous parametric down-conversion type I) where pairs of entangled photons are created either horizontally or vertically polarized. The predictions of this David Theorem can be easily experimentally tested in the Laboratories of Leaders in this field. The probabilistic terminology P++, P+-, P-+, P-- describing the correlated and anticorrelated "clicks" was inspired by Alain Aspect.

Both Quantum Mechanics and Trigonometric Mechanics cannot with certainty predict the outcome of all single events, but instead they predict probabilities of outcomes. The mathematical language of Quantum Mechanics does not protect the local realism. The mathematical language of Trigonometric Mechanics protects the local realism. In the Trigonometric Mechanics quantum systems are probabilistically controlled by "hidden variables" coming form the realm of trigonometric functions that determine the outcomes of measurements.

Ladislav Kvasz (2008) discussed how the mathematical language influences the interpretation of observed phenomena.

6. Conclusions

1) In the circles with radius $R = 1/2$ and $R = 1/4$ several less known trigonometric functions were found and several new trigonometric relations were discovered.

2) Family of trigonometric functions based on Sagitta and Cosagitta was used for the description of probabilities of joint detections of entangled particles – Claudius Theorem.

3) Family of trigonometric functions based on Hacoversine was proposed as a new measure for the quantitative determination of gaps between the detections of identical events – David Theorem.

4) David Theorem can be easily tested in Laboratories of Leaders in this field.

Acknowledgments

This work was supported by the JP&FŠ Agency (Contract Number 25g/1963), by the VZ&MŠ Agency (Contract Number 16000/1989) and by the GMS Agency (Contract Number 69110/1992). The valuable inspiration to the Figure 3 was given by CU&OB from Patria Agency (Contract Number 314/1983). We have found the valuable support on the web site www.wolframalpha.com with the corrections of used formulae.

References

Aczel, A. D. (2001). *Entanglement. The Greatest Mystery of Physics*. Four Walls Eight Windows, New York.

Aspect, A. (2015). Viewpoint: Closing the Door on Einstein and Bohr´s Quantum Debate. *Physics, 8*, 123.

Bell, J. S. (1964). On the Einstein-Podolsky-Rosen Paradox. *Physics, 1*, 195.

Bell, J. S. (2004). *Speakable and Unspeakable in Quantum Mechanics*. Cambridge University Press, Cambridge.

Bertlmann, R., & Zeilinger, A. (2017). *Quantum [Un] Speakables II. Half a Century of Bell´s Theorem*. Springer, Swiss.

Bohr, N. (1935). Can Quantum-Mechanical Description of Physical Reality be Considered Complete? *Phys. Rev., 48*, 696.

Born, M. (1926). *Zur Quantemmechanik der Stoβvorgänge (On the Quantum Mechanics of Collisions).* In J. A. Wheeler, & W. H. Zurek (Ed.). Princeton University Press, Princeton. ISBN 0-691-08316-9.

Christensen, B. G. (2015). Exploring Limits of Quantum Nonlocality with Entagled Photons. *Phys. Rev., X 5*, 041052.

Datta, B., & Singh, A.N. (1983). Hindu Trigonometry. *Indian Journal Of History of Science, 18*, 39-108. Retrieved from www.insa.nic.in/writereaddata/.../IJHS/Vol18_1_5_BDatta.pdf

Einstein, A., Podolsky, B., & N. Rosen. (1935). *Can Quantum Mechanical Description of Physical Reality Be Considered Complete? Phys. Rev., 48*, 696.

Gustina, M. (2015). Significant-Loophole-Freee Test of Bell´s Theorem with Entangled Photons. *Phys. Rev. Lett., 115*, 250401.

Handsteiner, J. (2017). Cosmic Bell Test: Measurement Settings from Milky Way Stars. *Phys. Rev. Lett., 118*, 060401.

Heisenberg, W. (1989). *Encounters with Einstein: And Other Essays on People, Places, and Particles*. Princeton University Press, Princeton.

Khrennikov. A. (2016). *Quantum and Beyond (QB).* International Conference devoted to quantum theory and experiment. June 13-16, 2016. Retrieved from www.lnu.se/en/staff/andrei.khrennikov video presentations

Kvasz, L. (2008). *Patterns of Change. Linguistic Innovations in the Development of Classical Mathematics*. Birkhäuser, Basel.

Larsson, J. Å. (2014). Loopholes in Bell Inequality Tests of Local Realism. *J. Phys. A, 47*, 424003. https://doi.org/10.1088/1751-8113/47/42/424003

Maor, E. (1998). *Trigonometric Delights*. Princeton: Princeton University Press. Retrieved from http://freebooksdl.com/346564-trigonometric-delights-8.html/

Matvievskaya, G. P. (1990). *An outline of History of Trigonometry*. Tashkent: Fan. Retrieved from http://www.yellowpages.uz/company/11

Popper, K. (1959). *The Logic of Scientific Discovery*. New York, NY: Basic Books.

Shalm, L. K. (2015). Strong Loophole-Free Test of Local Realism. *Phys. Rev. Lett., 115*, 250402.

Smýkalová, R. (2015). *Goniometric Fuctions in Elementary Mathematics*. Akademické nakladatelství, Brno.

Van Brumelen, G. (2009). *The Mathematics of Heavens and Earth (The early history of trigonometry).* Princeton: Princeton University Press.

Van Brumelen, G. (2013). *Heavenly Mathematics (The forgotten art of spherical trigonometry).* Princeton, Princeton University Press.

Van Brummelen, G. (2014). *Triangles before Logarithms: Trigonometry in the Lost Century*. Retrieved from https://www.youtube.com/watch?v=-OoyZtwhGbY videopresentation.

Von Braumühl, A. (1900). *Vorlesungen über Geschichte der Trigonometrie*. Leipzig, Teubner. Retrieved from https://archive.org/details/vorlesungenber00brauuoft

Copyrights

Applied Physics Research; Vol. 9, No. 3; 2017
ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

On the Absoluteness of Time

Carmine Cataldo[1]

[1] Independent Researcher, PhD in Mechanical Engineering, Battipaglia (Salerno), Italy

Correspondence: Carmine Cataldo, Battipaglia (Salerno), Italy. E-mail: catcataldo@hotmail.it

Received: May 15, 2017 Accepted: May 28, 2017 Online Published: May 31, 2017

doi:10.5539/apr.v9n3p46 URL: https://doi.org/10.5539/apr.v9n3p46

Abstract

This paper aims to qualitatively summarize the results up until now obtained in investigating the compatibility between the absoluteness of time and several well-known phenomena, such as the alleged increase of the mean lifetime of muons and the so-called relativistic corrections for GPS, whose explanation is commonly provided by resorting to Einstein's Relativity. To make the discussion more flowing, we have herein preferred to completely avoid the writing of equations. All the analytical solutions, as well as several explicative figures, can be found in the first six articles cited in the references, drafted by the same author of this manuscript.

Keywords: Absoluteness of Time, Extra Dimensions, Relativistic Motion, Muons Mean Lifetime, General Relativity, GPS Relativistic Corrections, Gravitational Redshift

1. Introduction

All the models we have elsewhere discussed (Cataldo, 2016a, 2016b, 2017a, 2017b, 2017c, 2017d) start from hypothesizing a closed Universe, homogeneous and isotropic, belonging to the so-called oscillatory class (O_1 type in the Harrison classification) (Harrison, 1967). More precisely, we postulate a Universe that approximately evolves following a simple-harmonic motion, whose pulsation is equal to the ratio between the speed of light and the value of the mean radius, taken as reference (Cataldo, 2017b, 2017c). In spite of this, we consider the variations of cosmological distances as being exclusively metric: in other terms, we postulate that the amount of space between whatever couple of points remains the same with the passing of time. In particular, once hypothesized a variability over time of the Planck constant (Cataldo, 2017a; Seshavatharam et al., 2013a, 2013b), the Cosmological Redshift may be banally explained by taking into account the conservation of energy. The existence of at least a further spatial dimension is postulated: more precisely, the Universe in its entirety is imagined as being flat and identifiable with a four-dimensional ball. Although the Universe is to be considered as being globally flat, the space we are allowed to perceive, when we are at rest, is curved, since it is identified with a hyper-sphere whose radius depends on our state of motion (Cataldo, 2016a, 2017c). All the points are replaced by straight line segments: more precisely, what we perceive as being a point may actually be a straight-line segment crossing the centre of the 4-ball with which we identify our Universe (Cataldo, 2016b). Time is considered as being absolute: however, it is fundamental to underline how this strong assumption does not imply that instruments and devices of whatever kind, finalized to measure time, are not influenced by motion and gravity (Cataldo, 2017d).

2. Motion and the Absoluteness of Time

The Lorentz transformations can be considered, without any doubt whatsoever, as the backbone of the theory of Special Relativity. Nonetheless, both the conventional derivation of the transformations and the meaning commonly assigned to them have been often savagely criticized, to the extent that, despite an alleged empirical evidence, the whole Special Relativity, in several occasions, has been brought into question. Firstly, it is worth underlining that, as Lorentz himself was forced to admit at a later time (Lorentz, 1909), the transformations had been already conceived, several years before the publication of the famous paper (Lorentz, 1904), by someone else (Voigt, 1887). Secondly, the work of Lorentz was anything but concretely linked to relativistic issues, at least in the Einsteinian sense of the term. Very simply, Lorentz's aim fundamentally lay in finding some transformations able to formally make the Maxwell equations (Maxwell, 1873) invariant. On this subject, moreover, it has been proved how the Lorentz transformations are not the only ones able to preserve the formal validity of the Maxwell equations (Di Mauro et al., 1997).

We have elsewhere (Cataldo, 2016a) shown how the Lorentz transformations can be alternatively deduced, albeit with a different meaning, once some noteworthy hypotheses concerning our Universe have been assumed, among which the existence of at least a further spatial dimension and the absoluteness of time stand out. Our alternative deduction, what is more, allows us to overcome a well-known misleading problem related to the so-called time transformations. It is commonly said that, when the speed assumed by the mobile frame of reference is far less than that of light, the Lorentz transformations tend to the Galilean ones. In other terms, according to the previous assertion, Galilean Relativity should be interpreted as a particular case of the Einsteinian one. This is an erroneous conviction (Ghosal et al., 1961). In fact, it is easy to verify how no limitation turns out to be formally imposed, as far as the numerators of the time transformations are concerned, on the spatial coordinates. Therefore, since the above-mentioned coordinates can evidently assume arbitrarily large values, an unconditional identification of the Lorentz transformations with the Galilean ones, when the speed tends to zero, should be considered as being de facto impossible (Di Mauro et al., 1995).

The procedure we exploit to alternatively deduce the Lorentz transformations is fundamentally based upon the conservation of energy. Firstly, taking advantage of the hypotheses highlighted in the introduction, we can easily obtain the so-called mass-energy equivalence. Bearing in mind that, according to our models, each point may actually be a straight-line segment crossing the center of the four-dimensional ball with which we identify our Universe, we can state that what we perceive as being a translatory motion is nothing but a rotation around the center of the above-mentioned ball. We have elsewhere (Cataldo, 2017c) proven that, by virtue of the conservation of energy, the radial extension of any segment depends on its state of motion: the more the speed increases, the more the radial extension decreases. When a point (actually a segment) is at rest, the corresponding radial extension, obviously, equates the radius (of curvature) of the Universe: in other terms, the point is placed on the external hyper-surface. In no case can the local speed exceed that of light. Nonetheless, we can also define a virtual speed (the speed measured by an observer at rest) whose value is provided by the product between the local (real) speed and the relativistic factor. Very evidently, the virtual speed can exceed that of light, and it tends to infinity when the radial extension tends to zero (when the local speed tends to that of light). When a point, initially at rest, starts moving (when a segment, initially at rest, starts rotating), the radial extension undergoes a reduction: consequently, once considered a second point, placed at a certain angular distance from the first (the angular distance is meant as the one measured by an ideal observer placed at center of the 4-ball), the corresponding arc distance depends on the state of motion. Ultimately, time does not undergo any dilation whatsoever due to the motion: on the contrary, the arc distance between two generic points (the only one we can actually measure) is not symmetric, and it depends on the value of the speed.

The alleged increase of the lifetime of muons, although coherent with Special Relativity, may be easily explained avoiding time dilations. Muons evidently succeed in covering a distance clearly not compatible with their mean lifetime: this is irrefutable. On the one hand, we may admit that time, for muons, starts slowing down due to the high value of their speed, but on the other hand, and for the same reason, we may also imagine that, for muons, both the radial extension and the distances undergo a reduction (the phenomenon, according to our theory, is no longer restricted to the direction of the motion). In the latter case, the speed perceived by an observer at rest is greater than what it really is, and time does not undergo any dilation whatsoever. Two different explanations, one of which based upon the absoluteness of time, both fully compatible with the Lorentz transformations, that consequently, though, acquire a completely different meaning in the two cases.

3. Gravity and the Absoluteness of Time

We have elsewhere (Cataldo, 2017d) proposed a simple qualitative model, finalized to discuss the compatibility between gravity and the absoluteness of time. At the beginning, taking into account a global symmetry, matter is imagined as being evenly spread on the hyper-sphere with which we identify the Universe we are allowed to perceive (actually, according to our hypotheses, matter fills homogeneously the corresponding 4-ball in its entirety). Let's consider a circumference, belonging to the surface of the ball, and the corresponding center: in a curved space, obviously, the predicted radius (the ratio between the perimeter of the circumference and 2π) does not coincide with the measured one (related, as far as the scenario initially hypothesized is concerned, to the component g_{11} of the Robertson – Walker metric tensor). We postulate that, if the center acquires a greater mass, the circumference undergoes a contraction, but the value of the measured radius (the measured distance between the center and whatever point of the circumference) remains exactly the same, as well as the corresponding angular distance (as perceived by an ideal observer placed at the center of the 4-ball) (Cataldo, 2017d). If all the available mass is ideally concentrated in a single point, we may discuss the so-called vacuum field solution. Let's consider now a test particle orbiting around a point with a constant angular distance (the path is circular). We can state that the more the above-mentioned point acquires mass, the more the orbit followed by the particle turns out to be reduced. In spite of this, the measured distance, according to our model (Cataldo, 2017d), remains the same (the proper radius, consequently, is no longer related, as far as the so-called vacuum field solution is concerned, to the component g_{11} of the Schwarzschild metric tensor) (Schwarzschild, 1919).

As we know, there are two kinds of so-called relativistic corrections for GPS (Global Positioning System). Special Relativity predicts that time, on satellites, should slow down by virtue of their (relative) motion: this phenomenon, that we consider as being merely apparent, has been discussed in the previous paragraph. On the contrary, General Relativity requires that time, on satellites, should flow faster than it does on the surface of the Earth (in other terms, clocks closer to a massive object should tick more slowly, so to say, than those located at a greater distance). According to our model, the more a gravitational singularity acquires mass, the more the time needed to cover a whole orbit, at a fixed angular distance, turns out to be reduced, in spite of the fact that, by virtue of our hypotheses, the proper radius remains exactly the same: consequently, the more a particle approaches a gravitational source, the more time turns out to be apparently dilated. Ultimately, once again, we may state that time dilation is nothing but a merely apparent phenomenon, exclusively related, as far as gravity is concerned, to the contraction of the orbits.

Now, let's suppose that we are not disposed to accepting such a situation. More precisely, let's imagine that, instead of admitting that the orbit drawn by a test particle undergoes a contraction, we prefer to hypothesize that, due to a gravitational source placed at the origin, time starts slowing down. By virtue of this interpretation, taking into account the fact that, coherently with our model, a light impulse takes the same time, with or without gravitational singularity, to cover the distance (once fixed the angular one) between the origin and any other point, we are forced to modify the value of the proper radius. The reason is very simple. On the one hand, the speed of light cannot be influenced by the singularity; on the other hand, we forcefully postulate that, due to the gravitational source, time starts to slow down (we refuse to admit that the orbit undergoes a contraction). As a consequence, in order to keep the speed of light constant, we have to imagine that the proper radius undergoes a dilation. In the light of this interpretation, we have elsewhere (Cataldo, 2017d) deduced a Schwarzschild-like metric (more precisely a Droste/Brillouin/Hilbert-like metric) without using General Relativity.

If we postulate the absoluteness of time, the so-called Gravitational Redshift, obviously, can no longer be legitimized by means of time dilation. To explain the above-mentioned phenomenon, experimentally verified more than half a century ago, we hypothesize a local variability of the Planck constant (Kentosh et al., 2012a, 2012b; Flambaum et al., 2012) and impose, very intuitively, the conservation of energy (Cataldo, 2017a). Up until now, we have tacitly accepted the fact that mass is capable to warp space. Actually, if mass were to really warp space, we would be forced into admitting that, in a certain sense, the shape of the Universe can be modified with respect to something else, taken as reference. In the light of the foregoing remark, we may rather imagine that the value of space could be somehow modified by the presence of a gravitational source. Once accepted that a test particle, that we perceive as being punctual, is actually characterized by a radial extension, we could simply state that the more we approach the gravitational source, the more the value of the radial extension decreases. It has been previously claimed that the Universe we are allowed to perceive, when we are at rest, may be assimilated to a hypersphere. This assumption is not entirely correct: in fact, the space we perceive should be rather identified with a hyper-spherical shell, obviously characterized by a thickness (Cataldo, 2017c). In order to understand the previous assertion, suffice it to consider that we are undeniably used to identifying a paper sheet with a bi-dimensional surface. Nonetheless, we are well aware of the fact that a bi-dimensional surface represents nothing but a pure abstraction, and the above-mentioned sheet is evidently characterized by a thickness, whose value in no case should be considered as being null. We have to imagine the Planck constant as being linearly dependent on the dimensional thickness that, in turn, is linearly dependent on the radial coordinate (Cataldo, 2017a). In this way, by assigning a new meaning to the parameter usually identified with a Schwarzschild coordinate (our parameter does not represent a distance nor a radius of curvature) (Cataldo, 2017d), imposing the conservation of energy, we can obtain, without using General Relativity, the well-known expression for the Gravitational Redshift.

Acknowledgements

I would like to dedicate this paper to the memory of my father, Antonio Cataldo, who unexpectedly passed away on the 11th of June 2016.

References

Cataldo, C. (2016a). Faster than Light: again on the Lorentz Transformations. *Applied Physics Research*, *8*(6), 17-24. http://dx.doi.org/10.5539/apr.v8n6p17

Cataldo, C. (2016b). Effects of a Global Symmetry on the Observation of Astronomical Objects. *Applied Physics Research, 8*(5), 75-80. http://dx.doi.org/10.5539/apr.v8n5p75

Cataldo, C. (2017a). A short discussion on the Gravitational Redshift in the light of an alleged local variability of the Planck Constant. *Journal of Applied Mathematics and Physics, 5*, 1001-1008. https://doi.org/10.4236/jamp.2017.55087

Cataldo, C. (2017b). From General Relativity to A Simple-Harmonically Oscillating Universe, and Vice-Versa: a Review. *Applied Physics. Research, 9*(1), 86-92. http://dx.doi.org/10.5539/apr.v9n1p86

Cataldo, C. (2017c). From the Oscillating Universe to Relativistic Energy: a Review. *Journal of High Energy Physics, Gravitation and Cosmology, 3*, 68-77. http://dx.doi.org/10.4236/jhepgc.2017.31010

Cataldo, C. (2017d). Gravity and the Absoluteness of Time: a simple qualitative model. *Applied Physics Research, 9*(2), 42-52. http://dx.doi.org/10.5539/apr.v9n2pxx

Di Mauro, P., & Notarrigo, S. (1995). Critica delle usuali derivazioni delle trasformazioni di Lorentz. *Comunicazione al LXXXI Congresso Nazionale SIF, Perugia*. Retrieved from http://www.lascuolaitalica.it/pubbl12.htm

Di Mauro, P., & Notarrigo, S. (1997). Sull'Invarianza delle Equazioni di Maxwell. *Atti del XVI Congresso Nazionale di Storia della Fisica e dell'Astronomia*, *CNR Gruppo di lavoro per le Celebrazioni Voltiane, Como*, 355-360. Retrieved from http://www.lascuolaitalica.it/pubbl5.htm

Flambaum, V. V., & Berengut, J. C. (2012).Comment on "Global Positioning System Test of the Local Position Invariance of Planck's Constant". *Physical Review Letters, 109*, 068901. https://doi.org/10.1103/PhysRevLett.109.068901

Ghosal, S. K., Nandi, K. K., & Chakraborty, P. (1961). Passage from Einsteinian to Galilean Relativity and Clock Synchrony. *Zeitschrift für Naturforschung, 46*(a), 256-258. https://doi.org/10.1515/zna-1991-0307

Harrison, E. R. (1967). Classification of Uniform Cosmological Models. *Monthly Notices of the Royal Astronomical Society, 137*, 69-79. https://doi.org/10.1093/mnras/137.1.69

Kentosh, J., M., & Mohageg, M. (2012a). Global Positioning System Test of the Local Position Invariance of Planck's Constant. *Physical Review Letters*, *108*, 110801. https://doi.org/10.1103/PhysRevLett.108.110801

Kentosh, J., & Mohageg, M. (2012b). Reply to Comment on "Global positioning system test of the local position invariance of Planck's constant". *Physical Review Letters, 109*, 068902. https://doi.org/10.1103/PhysRevLett.109.068902

Lorentz, H. A. (1904). Electromagnetic Phenomena in a System Moving with Any Velocity Smaller than That of Light. *Proceedings of the Royal Netherlands Academy of Arts and Sciences*, *6*, 809-831. Retrieved from http://www.dwc.knaw.nl/DL/publications/PU00014148.pdf

Lorentz, H. A. (1909). The Theory of Electrons and Its Applications to the Phenomena of Light and Radiant Heat. Teubner. Retrieved from https://archive.org/details/electronstheory00lorerich

Maxwell, J. C. (1873). A Treatise on Electricity and Magnetism. Clarendon Press, Oxford. Retrieved from https://archive.org/details/electricandmagne01maxwrich

Schwarzschild, K. (1919). Über das Gravitationsfeld eines Massenpunktes nach der Einsteinschen Theorie. *Sitzungsberichte der Deutschen Akademie der Wissenschaften zu Berlin*, 189-196 (On the Gravitational Field of a Mass Point according to Einstein's Theory, translated by S. Antoci and A. Loinger, 1999). Retrieved from http://zelmanov.ptep-online.com/papers/zj-2008-03.pdf

Seshavatharam, U. V. S., & Lakshminarayana, S. (2013a). Is Planck's Constant – A Cosmological Variable? *Intern. J. of Astronomy*, *2*(1), 11-15. Retrieved from http://article.sapub.org/10.5923.j.astronomy.20130201.02.html

Seshavatharam, U. V. S., Lakshminarayana, S., & Sai, B. V. S. T. (2013b). Inadequacy of Modern Cosmology and Basics of Atomic Cosmology. *viXra.org open e-Print archive.* http://vixra.org/pdf/1303.0214v1.pdf

Voigt, W. (1887). Ueber das Doppler'sche Princip. *Nachrichten von der Königlichen Gesellschaft der Wissenschaften und der Georg – Augusts – Universität zu Göttingen*, *Zeitschriftenband, 2*(10), 41-51. Retrieved from http://www.digizeitschriften.de/dms/img/?PPN=PPN252457072_1887&DMDID=dmdlog12

ISSN 1916-9639 E-ISSN 1916-9647
Published by Canadian Center of Science and Education

Reviewer Acknowledgements

Applied Physics Research wishes to acknowledge the following individuals for their assistance with peer review of manuscripts for this issue. Their help and contributions in maintaining the quality of the journal is greatly appreciated.

Applied Physics Research is recruiting reviewers for the journal. If you are interested in becoming a reviewer, we welcome you to join us. Please find the application form and details at http://recruitment.ccsenet.org and e-mail the completed application form to apr@ccsenet.org.

Reviewers for Volume 9, Number 3

Ahmad Hosseinizadeh, University of Wisconsin, United States

Lin Chen, Institute of Fluid Science, Tohoku University, Japan

Puramanathan Naidoo, Mangosuthu University of Technology, South Africa

Rachid MASROUR, Cady Ayyed University, Morocco

Rami Ahmad El-Nabulsi, Key Laboratory of Numerical Simulation of Sichuan Province, China

Sérgio Costa Ulhoa, Universidade de Brasília, Brazil

Thenappan Chidambaram, College of Nanoscale Science and Engineering, United States

Zhou Xing, Syracuse University, United States

Call for Manuscripts

Applied Physics Research is an international, double-blind peer-reviewed, open-access journal published by the Canadian Center of Science and Education. The journal focuses on the following topics: acoustics, astrophysics and geophysics, biophysics, computational physics, condensed matter physics, engineering physics, free electron physics, laser and quantum electronics, medical physics, optics, semiconductor physics and devices, solid state physics, space physics. The journal is available in electronic form in conjunction with its print edition. All articles and issues are available for free download online.

We are seeking submissions for forthcoming issues. All manuscripts should be written in English. Manuscripts from 3000–8000 words in length are preferred. All manuscripts should be prepared in MS-Word or LaTex format, and submitted online, or sent to: apr@ccsenet.org

Paper Selection and Publishing Process

a) Upon receipt of a submission, the editor sends an e-mail of confirmation to the submission's author within one to three working days. If you fail to receive this confirmation, your submission e-mail may have been missed.

b) Peer review. We use a double-blind system for peer review; both reviewers' and authors' identities remain anonymous. The paper will be reviewed by at least two experts: one editorial staff member and at least one external reviewer. The review process may take two to three weeks.

c) Notification of the result of review by e-mail.

d) If the submission is accepted, the authors revise paper and pay the publication fee.

e) After publication, the corresponding author will receive two hard copies of the journal, free of charge. If you want to keep more copies, please contact the editor before making an order.

f) A PDF version of the journal is available for download on the journal's website, free of charge.

Requirements and Copyrights

Submission of an article implies that the work described has not been published previously (except in the form of an abstract or as part of a published lecture or academic thesis), that it is not under consideration for publication elsewhere, that its publication is approved by all authors and tacitly or explicitly by the authorities responsible where the work was carried out, and that, if accepted, the article will not be published elsewhere in the same form, in English or in any other language, without the written consent of the publisher. The editors reserve the right to edit or otherwise alter all contributions, but authors will receive proofs for approval before publication.

Copyrights for articles are retained by the authors, with first publication rights granted to the journal. The journal/publisher is not responsible for subsequent uses of the work. It is the author's responsibility to bring an infringement action if so desired by the author.

More Information

E-mail: apr@ccsenet.org

Website: http://apr.ccsenet.org

Paper Submission Guide: http://submission.ccsenet.org

Recruitment for Reviewers: http://recruitment.ccsenet.org

The journal is peer-reviewed
The journal is open-access to the full text
The journal is included in:

- Bibliography and Index of Geology
- EBSCOhost
- Google Scholar
- JournalTOCs
- LOCKSS
- NewJour (Georgetown University Library)
- Open J-Gate
- PKP Open Archives Harvester
- SHERPA/RoMEO
- Standard Periodical Directory
- Ulrich's
- Universe Digital Library
- WorldCat

Applied Physics Research

Bimonthly

Publisher	Canadian Center of Science and Education
Address	1120 Finch Avenue West, Suite 701-309, Toronto, ON., M3J 3H7, Canada
Telephone	1-416-642-2606
Fax	1-416-642-2608
E-mail	apr@ccsenet.org
Website	apr.ccsenet.org

ISSN 1916-9639

9 771916 963178 03 >