Newtonian-Lewis-Doppler_Theory

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Abstract

Relativistics equations are derived using concepts of Newton, Lewis, Doppler and non-instantaneous forces. And the theory is in agreement with particle collision, mass variation, time dilation, transversal Doppler effect, kinetic energy, etc.

We propose a mass spectroscopy experiment to test the theory.

1. Introduction

In table 1 we have a comparative between the equations of Newtonian-Lewis-Doppler theory (NLD) and special relativity (SR).

For $V = 0$, equations of NLD and SR are the same.

Where V is the velocity of the inertial frame S' with respect to the preferred frame S (CMB).

All equations for NLD are derived and explained in the next sections. Equations (1-4) were derived by Lewis (who received 35 nominations for the Nobel prize in chemistry) [1] using concepts of Newton and Maxwell.

Equations	Newt.-Lewis-Doppler Th.	Special Relativity	Equ.	Sect.
Mass variation	$m = m_0\gamma$	same	(1)	5
Kinetic energy	$k = m_0c^2(\gamma - 1)$	same	(2)	5
Relation mass-energy	$E = m_0c^2$	same	(3)	5
Inertial force	$\mathbf{F} = m\dfrac{d\mathbf{v}}{dt} + \dfrac{\mathbf{v}(\mathbf{F}.\mathbf{v})}{c^2}$	same	(4)	6
Particle collisions	$E_i^2 = \dfrac{m_a^2c^4(1+\beta_a\beta_b)^2}{1+\beta_a^2\beta_b^2 - \beta_a^2 - \beta_b^2}$	same	(14)	8.2
Time dilation	$\Delta t = \Delta t_0\gamma$	same	(35)	13.1
Transv. Doppler eff.	$f = f_0/\gamma$	same	(38)	13.2
Longit. Doppler eff.	$f_l = f_0\dfrac{\sqrt{1\mp\beta}}{\sqrt{1\pm\beta}}$	same	(49)	13.4
Coulomb force	$m_0\gamma\gamma_x^2\dfrac{dv_x}{dt} = \dfrac{qQ}{4\pi\varepsilon_o}\dfrac{r_x}{r^3}$	same	(22)	10
Force propagation	non-instantaneous	non-instantaneous	xx	3, 9, 10
Transformations: position, veloc., time	Galilean	Lorentz	xx	3, 9

Table 1 – Equations - Comparison between SR and NLD for frame S.

2. NLD experimental test

Experiments with very high acuracy are analyzed by NLD (see Table 2) and are in agreement. Michelson-Morley experiment is an open question and needs more research as shown in Section 16.

Experiments	Special Relativity	Extend. Newton. Th.	Sect.
Particle collision	$\sqrt{s}$	same	8
Mass spectrometer sectors	Accuracy $\approx 1ppm$	same	12
Mössbauer effect	Accuracy 1×10^{-13}	same	14
Ions as clock and lasers	Accuracy $< 2\times10^{-10}$	same	15
Light velocity c constant	in all inertial frames	with respect to the CMB	3, 4
Michelson-Morley	$\delta = 0$	open question	16

Table 2 – Experiments - Comparison between SR and NLD.

To test NLD we can make a mass spectrometer with electric and magnetic sector with a special geometry. From the movement of the earth we measure the mass variation of $\approx 10\,ppm$ and compare with theoretical NLD value and the position of the spectrometer with respect to the CMB, see Section 12.

3. Postulates and work assumptions

a) The velocity of light is a constant c with respect to the preferred frame, independent of the direction of propagation, and of the velocity of the emitter.
b) An observer in motion with respect to the preferred frame will measure a different velocity of light, according to Galilean velocity addition.
c) The preferred frame is the cosmic microwave background (CMB). The velocity of the earth with respect to the CMB is approximately V=370km/s=0.00123c and the direction is approximately parallel to the earth's orbital plane.
d) According to Zeldovich, at every point in the Universe, there is an observer in relation to which microwave radiation appears to be isotropic.
e) A Coulomb force, magnetic force and gravitational force are generated respectively by an electric, magnetic and gravitational wave. The electric, magnetic and gravitational waves have constant velocities c with respect to the preferred frame, independent of the direction of propagation, and of the velocity of the emitter.

4. Experimental speed of the light

For measurement of the speed of the light when is used the two way method, that is, the light goes, return and the medium velocity for NLD is constant and exactly $c = 0.5[(c+V)+(c-V)]$.

Experiments with resonators like microwave cavity has also the medium value constant c.

Experiments using optical instruments with lenses like telescope, for NLD needs a special study in reflection and refraction in glass with velocity V with respect to the CMB, as shown in section 16.

5. Mass variation, kinetic energy and mass-energy relation

Using concepts of Newton and Maxwell, Lewis (who received 35 nominations for the Nobel prize in chemistry and coined the word 'photon') [1] derived the equations for mass variation, kinetic energy and mass-energy.

Equations (1), (2) and (3) are, respectively, equations (15), (16) and (18) in [1].

The following is from [1]: "Recent publications of Einstein and Comstock on the relation of mass to energy has emboldened me to publish certain views which I have entertained on the subject and which a fews years ago appeared purely speculative, but which have been so far corroborated by recent advances in experimental and theoretical physics… In the following pages I shall attempt to show that we may construct a simples system of mechanics which is consistent with all known experimental facts, and which rests upon the assumption of the truth of the three great conservation laws, namely, the law of conservation of energy, the law of conservation of mass, and the law of conservation of momentum. To these we may add, the law of conservation of electricity".

6. Inertial force

For the preferred frame S and from equations (1), (2) and (3), we derive the equation of inertial force:

$$\mathbf{F} = \frac{d(m\mathbf{v})}{dt} = m\frac{d\mathbf{v}}{dt} + \frac{\mathbf{v}(\mathbf{F}\cdot\mathbf{v})}{c^2}, \qquad (4)$$

$$F_x = m\frac{dv_x}{dt} + \frac{v_x^2 F_x}{c^2}, \qquad (5)$$

Equations for y and z are similar with (5) and we substituted x for y or z .

Substituting (1), we have:

$$F_x = m_o \gamma\gamma_x^2 \frac{dv_x}{dt} \qquad (6)$$

Equations for y and z are similar with (6) and we substituted x for y or z .

Where m, v are respectively the mass and velocity of the body (particle) with respect to the preferred frame (S), $\beta = v/c$, $\gamma = 1/\sqrt{1-\beta^2}$, $\gamma_x = 1/\sqrt{1-\beta_x^2}$, $\gamma_y = 1/\sqrt{1-\beta_y^2}$ and m_0 is the mass of the body (particle) at rest in the preferred frame (S).

7. Classical Doppler effect

For a source, the classical Doppler effect is:

$$f = \frac{f_0 c}{c \pm (\mathbf{n}\cdot\mathbf{v}_s)} \qquad (7)$$

Where f_0 is the frequency of the source at rest in S, f is the frequency in frame S, $\mathbf{n}$ is the unitary vector normal to $\mathbf{r}$, r is the distance travelled by the light from source to absorber, $\mathbf{v}_s$ is the velocity of

the source with respect to S . The sign (+) is source moving away from S and (-) is source moving towards S .
For a absorber the classical Doppler effect is:

$$f^{'} = \frac{f(c \pm \mathbf{n} \cdot \mathbf{v})}{c} \qquad (8)$$

Where $f^{'}$ is the frequency received by the absorber, $\mathbf{v}$ is the velocity of the absorber with respect to S. The sign (+) is absorber moving towards S and (-) is absorber moving away from S .

8. Particle collisions

This Section is an introduction to particle collision for NLD and the complete equations need to be developed.
For collisions with respect to the frame S (CMB) we have the total and the maximum transfer energy equations the same for NLD (Equ. 14) and SR (Appendix A, Equ. (A4)). SR explanation for particle collision, see Appendix A.

8.1 Force in particle collision

In a collision, the distance between particles and/or subparticles is $r \approx 0$ and by hypothesis the force has a factor due the Doppler effect.
Suppose two charged particles q_a and q_b with velocity β_a and β_b in opposite direction and collision head-on. We consider the frame S between the particles and q_a and q_b are moving towards S . The Coulomb Doppler force is:

$$F = \frac{1}{4\pi\varepsilon_0} \frac{q_a(1+\beta_a)}{r(1-\beta_b)} \frac{q_b(1+\beta_b)}{r(1-\beta_a)} \qquad (9)$$

The Doppler effect is:
a) the source q_a emitts to S frame (from (7), source moving towards S), $f = f_0/(1-\beta_a)$. The absorber q_b receive the frequency (from (8), absorber moving towards S), $f^{'} = f(1+\beta_b) = f_0(1+\beta_b)/(1-\beta_a)$.
b) the source q_b emitts to S frame (from (7), source moving towards S), $f = f_0/(1-\beta_b)$. The absorber q_a receive the frequency (from (8), absorber moving towards S), $f^{'} = f(1+\beta_a) = f_0(1+\beta_a)/(1-\beta_b)$.
Suppose a charged particle q_b at rest in S and a incident charged particle q_a with velocity β_i .
The Coulomb Doppler force with respect to S , from (9) and for $\beta_b = 0$ is

$$F = \frac{1}{4\pi\varepsilon_0} \frac{q_a q_b}{r^2} \frac{(1+\beta_i)}{(1-\beta_i)} \qquad (10)$$

Equaling (9) and (10) and isolating β_i we have

$$\beta_i = \frac{\beta_a + \beta_b}{1 + \beta_a \beta_b} \qquad (11)$$

8.2 Energy in particle collision

In the collision of a incident particle (q_a) with velocity β_i and a target (particle q_b at rest) the total incident energy is:

$$E_i = \frac{m_a c^2}{\sqrt{1-\beta_i^2}} \qquad (12)$$

In the collision of two charged particles (q_a and q_b) with opposite momenta we have the total energy

$$E = E_a + E_b = \frac{m_a c^2}{\sqrt{1-\beta_a^2}} + \frac{m_b c^2}{\sqrt{1-\beta_b^2}} \qquad (13)$$

Where m_a and m_b are the rest mass of the charged particles.
Substituting (11) in (12) we have:

$$E_i^2 = \frac{m_a^2 c^4 (1+\beta_a \beta_b)^2}{1+\beta_a^2 \beta_b^2 - \beta_a^2 - \beta_b^2} \qquad (14)$$

This is the same equation than the used in SR (Appendix A, Equ. (A4)). So, the total and the maximum transfer energy calculated for SR and NLD in collisions are the same.
This conclusion is for the frame S (for example, the linear accelerator is at rest in CMB (frame S)). For the frame S' (for example the linear accelerator at rest in earth), needs to be developed.

8.3 Particle collision example

Particle collision can be illustrated by the example of the creation of Z bosons in electron positron annihilations. In an $e^- e^+$ collider we need two opposite beams of half the Z boson mass, i.e., of approximately 45.5 GeV each. For two beams with electron rest mass $m_a = 0.51$ MeV, $E_a = E_b = m_a c^2 / \sqrt{1-\beta_a^2} = 45.5$ GeV and we have $\beta_a = \beta_b$. From (14) we have $E_i = 8.3 \times 10^6$ GeV, where 8.3×10^6 GeV is the energy necessary for the incident particle in a fixed target to produce Z bosons.

9. Electric field of a point charge.

Let us suppose two inertial frames S and S' with parallel axis and S' with constant velocity $\mathbf{V}$ with respect to S. Charge Q is at rest in the coordinates center of frame S'. The electric field at point $P'(x', y', z')$ at rest in S' (see Fig. 1) is:

$$\mathbf{E}=\frac{Q}{4\pi\varepsilon_0}\frac{\mathbf{r}}{r^3} \tag{15}$$

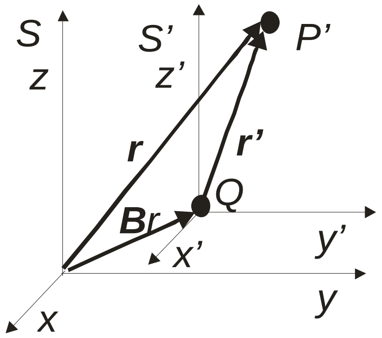

Fig. 1 – Inertial frames S and $S^{'}$ with parallel axis and $S^{'}$ with constant velocity $\mathbf{V}$ with respect to S.

The velocity of the electric field with respect to S is c, $r=ct$, $\mathbf{r}=\mathbf{r}^{'}+\mathbf{V}t$, $\mathbf{V}=\mathbf{B}c$, substituting we have

$$\mathbf{r}=\mathbf{r}^{'}+\mathbf{B}r=x^{'}\mathbf{i}+y^{'}\mathbf{j}+z^{'}\mathbf{k}+B_x r\mathbf{i}+B_y r\mathbf{j}+B_z r\mathbf{k} \tag{16}$$

$$r^2=r_x^2+r_y^2+r_z^2=\left(x^{'}+B_x r\right)^2+\left(y^{'}+B_y r\right)^2+\left(z^{'}+B_z r\right)^2 \tag{17}$$

$$r=\frac{x^{'}B_x+y^{'}B_y+z^{'}B_z\pm\sqrt{\left(x^{'}B_x+y^{'}B_y+z^{'}B_z\right)^2+r^{'2}\left(1-B^2\right)}}{1-B^2} \tag{18}$$

$$E_x=\frac{Q}{4\pi\varepsilon_0}\frac{r_x}{r^3},\quad E_y=\frac{Q}{4\pi\varepsilon_0}\frac{r_y}{r^3}\ \text{and}\ E_z=\frac{Q}{4\pi\varepsilon_0}\frac{r_z}{r^3}. \tag{19}$$

For $V=0$ we have $r=r^{'}$ and $E=E_0$.

10. Electric force with one particle at rest

Suppose a charge Q (mass M) at rest in in the center of coordinates of $S^{'}$ ($M>>m$) and $S^{'}$ with constant velocity $\mathbf{V}$ with respect to S. At point P' we have a charge q (mass m) with velocity $\mathbf{v}^{'}$with respect to $S^{'}$. From (19) we have the electric force.

$$F_x=\frac{qQ}{4\pi\varepsilon_0}\frac{r_x}{r^3},\quad F_y=\frac{qQ}{4\pi\varepsilon_0}\frac{r_y}{r^3}\ \text{and}\ F_z=\frac{qQ}{4\pi\varepsilon_0}\frac{r_z}{r^3} \tag{20}$$

Equating (6) and (20) yields the following differential equations:

$$m_0\gamma\gamma_x^2\frac{dv_x}{dt}=\frac{qQ}{4\pi\varepsilon_o}\frac{r_x}{r^3} \tag{21}$$

Equations for y and z are similar with (21) and we substituted x for y or z.
Multiplying and dividing the first term of (21) for dx' we have:

$$m_0\gamma\gamma_x^2 dv_x v_x^{'}=\frac{qQ}{4\pi\varepsilon_o}\frac{r_x}{r^3}dx^{'} \tag{22}$$

Where $dv_x = dv_x^{'}$ (inertial frames), $\beta = v/c$, $B = V/c$, $\beta^{'} = v^{'}/c$, $\mathbf{v} = \mathbf{v}^{'} + \mathbf{V}$, $\gamma = 1\big/\sqrt{1-\beta^2}$, $\gamma_x = 1\big/\sqrt{1-\beta_x^2}$ and m_0 is the mass of the particle q at rest in the preferred frame (S).

10.1 Gravitation

Suppose a particle (body) with masss M = constant at rest in the center of coordinates of $S^{'}$ and $S^{'}$ with constant velocity $\mathbf{V}$ with respect to S. At point P' we have a particle of mass m ($M >> m$) with velocity $\mathbf{v}^{'}$ with respect to $S^{'}$. The gravitational force in m is $F_x = GmM\, r_x/r^3$ (equations for y and z are similar and we substituted x for y or z) where $m = m_0\gamma$, $M = M_0\big/\sqrt{1-B^2}$ and G is the gravitational constant. Equaling the gravitational and inertial forces we have the acceleration of the mass m with respect to S and $S^{'}$ ($dv_x = dv_x^{'}$ for inertial frames):

$$\frac{dv_x}{dt}=G\frac{M}{\gamma_x^2}\frac{r_x}{r^3} \tag{22b}$$

11. Mass

11.1 Sun mass

The velocity of the sun with respect to CMB (S frame) is aproximately $V_{sun} \cong 370$ km/s towards the constellation Leo.
The mass of the sun with respect to the CMB (S frame) is

$$M_{sun}=\frac{M_{0sun}}{\sqrt{1-\left(V_{sun}/c\right)^2}} \tag{23}$$

where M_{0sun} is the mass of the sun at rest in CMB.

11.2 Earth mass

The velocity of the earth (frame S') with respect to CMB is $V_{earth} \cong 370 \pm 30$ km/s aproximately parallell to the earth's orbital plane (see [2], Fig. 3.2).
The mass of the earth with respect to the CMB is

$$M_{earth} = \frac{M_{0earth}}{\sqrt{1-(V_{earth}/c)^2}} \tag{24}$$

where M_{0earth} is the mass of the earth at rest in CMB.

11.3 Particle mass

The velocity of a particle at rest in the surface of the earth with respect to CMB depends of the location, for example, in equator is $V \cong 370 \pm 30 \pm 0.5$ km/s and in the poles is $V \cong 370 \pm 30$ km/s.

The mass of a particle at rest in the surface of the earth with respect to CMB is

$$m_* = \frac{m_0}{\sqrt{1-(V/c)^2}} \tag{25}$$

where m_0 is the mass of the particle at rest in CMB.

As an example for a specific place and day, from [3] the components of the terrestrial motion with respect to CMB in Cleveland (Ohio) on 8 July 1887, the first day of the Michelson-Morley experiment (see Fig. 2) is

$$\mathbf{V} = \mathbf{V}_{east} + \mathbf{V}_{north} + \mathbf{V}_{zenith} \tag{26}$$

We consider the terrestrial coordinates $x = east$, $y = north$ and $z = zenith$. The modulus is

$$V = \sqrt{V_{east}^2 + V_{north}^2 + V_{zenith}^2} = \sqrt{V_x^2 + V_y^2 + V_z^2} \tag{27}$$

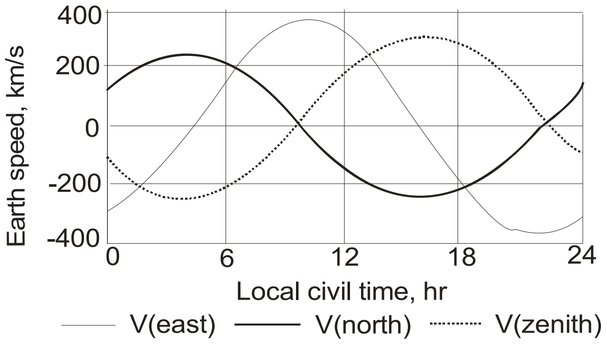

Fig. 2 - Components of the terrestrial motion with respect to CMB in Cleveland (Ohio) on 8 July 1887, the first day of the Michelson-Morley experiment (from [3], Fig. 3)

For a particle with velocity v' with respect to the surface of the earth we have $\mathbf{v} = \mathbf{v}' + \mathbf{V}$, where v is the velocity of the particle with respect to CMB.

The mass of the particle with respect to CMB is

$$m = \frac{m_0}{\sqrt{1-(v/c)^2}} \qquad (28)$$

Where m_0 is the mass of the particle at rest in CMB.

11.4 Experimental mass

The most basic mass experiment is the particle deflections with electric and magnetic fields. The complete equations of electric (E) and magnetic (H) fields are in Appendix B and C.

Let us suppose a condenser of parallel plates with area $l' \times l'$ (l' very large) at rest in the surface of the earth (S') and the plates are parallel to plane x', y' (east, north).

For $V = V_x = 390$ km/s (10hs, see Fig 2), from (B10) we have $E = E_0 =$ constant where E_0 is the electric field between the plates of the condenser and condenser at rest in CMB.

The particle has initial velocity $v' = v_y'$ with respect to the earth, v_y' is constant and v_z' varies from zero to v_z', see Fig. 3.

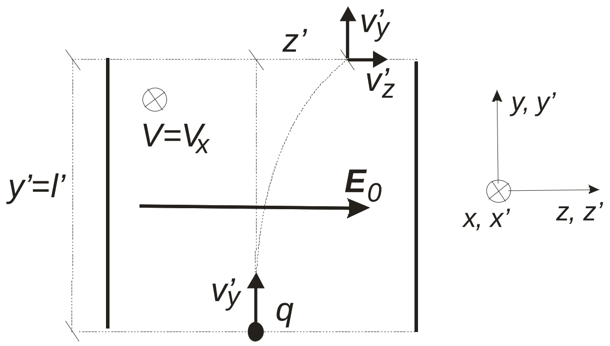

Fig. 3 – Condenser plates at rest in the surface of the earth. The place where is located the condenser, at time 10hs has velocity $V = V_x = 390$ km/s with respect to the CMB (see Fig. 2)

The instantaneous mass of the particle with respect to S is

$$m = \frac{m_0}{\sqrt{1-\left(\frac{v_y'^2 + v_z'^2 + V^2}{c^2}\right)}} \qquad (29)$$

Where $v_y' =$ constant, $V \cong$ constant (in the time interval Δt of the experiment we have $\Delta V \cong 0$ for Δt with few seconds or miliseconds, see Fig. 2) and v_z' is not constant. For $v_z' \cong 0$ and $v_z' << 390$ km/s we have

$$m_{const} = \frac{m_0}{\sqrt{1-\left(\left(v_y'^2 + V^2\right)/c^2\right)}} \qquad (30)$$

where $m_{const} =$ constant (in the interval Δt). The force is

$$F_z = qE_0 = \frac{m_0}{\sqrt{1-\left(\left(v_y'^2 + V^2\right)/c^2\right)}} a_z \tag{31}$$

where $E_0 =$ constant and $a_z = a_z' =$ constant (S' is a inertial frame because in the Δt of the experiment we have $\Delta V \cong 0$).

The equations of the movement are $y' = l' = v_y' \Delta t$, $z' = 0.5 a_z' \Delta t^2$, substituting we have

$$m_0 = \frac{1}{2} qE_0 \sqrt{1-\left(\left(v_y'^2 + V^2\right)/c^2\right)} \frac{l'^2}{z' v_y'^2} \tag{32}$$

From initial conditions we have q, E_0, v_y', V, l' and measuring z', from (32) we have m_0.

Therefore, in this experiment we measure m_0 the mass of the particle at rest in CMB.

11.5 Experimental mass with numeric calculation

If v_z' is not small and it cannot be despised we have

$$F_z = qE_0 = \frac{m_0}{\sqrt{1-\left(\left(v_y'^2 + v_z'^2 + V^2\right)/c^2\right)}} a_z = m a_z \tag{33}$$

where v_z' and a_z are variables. Therefore it is necessary to use numeric calculation with small Δt considering in this time interval a_z constant ($a_z = a_z'$, because S' is a inertial frame).

And we make the sequence of calculations: give a value for m_0, $m_1 = m_0 \Big/ \sqrt{1-\left(\left(v_y'^2 + v_{z1}'^2 + V^2\right)/c^2\right)}$, $a_{z1} = qE_0 / m_1$, $z_2' = z_1' + v_{z1}' \Delta t + 0.5 a_{z1} \Delta t^2$, $v_{z2}' = v_{z1}' + a_{z1} \Delta t$, $y_2' = y_1' + v_y' \Delta t$, $m_2 = m_0 \Big/ \sqrt{1-\left(\left(v_y'^2 + v_{z2}'^2 + V^2\right)/c^2\right)}$ and we repeat the equations until $y' = l'$. Compare z' of numeric calculation with z' experimental, if different we give new value for m_0 and repeat the numeric calculation until z' (experimental) = z' (numeric calculation).

11.6 Experimental mass with E variable

In the Fig. 3, if we rotate the condenser of 90 degrees (condenser plate parallel to y', z' plane) the electric field E between the plates of the condenser is variable. Therefore we use equation (B10) from Appendix B2 to calculate E and numeric calculations similar as the section 11.5.

12. Experimental test for NLD theory

Mass spectroscopy experiments can prove (or to disapprove) NLD theory. This subject is described below.

12.1 Mass spectroscopy description

Mass spectroscopy [4-6] is the most basic mass experiment. It uses an electric field deflection (electrostatic analyser) and later a magnetic field deflection (magnetic analyser). The receiver sensor can be a photographic plate (spectrograph) or an electron multiplier (spectrometer).

12.1 Nier-Johnson spectrometer

Nier-Johnson spectrometer [6-9] uses an accelerator, a 90 degree electrostatic analyser and a 60 degree magnetic analyser.

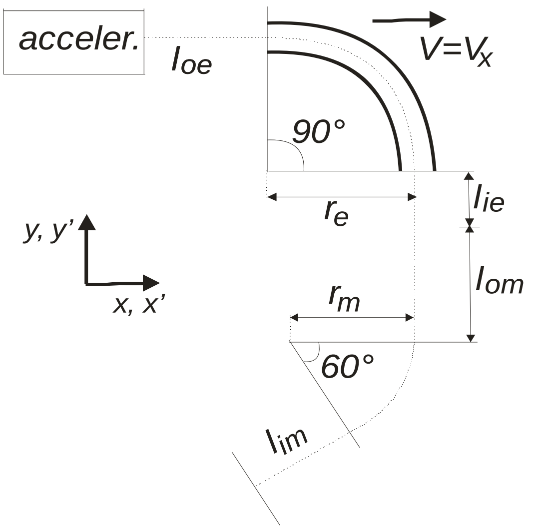

Fig4 – Nier-Johnson geometry in 'C' configuration, from [9], Fig. 5.

The mass accuracy of the Nier-Johnson spectrometer is aproximately 1 ppm in a typical doublet $O^{16} - C^{12}H_4^1$ experiment.

From NLD equations (B10), (B14) and (C8) respectively for the accelerator, electrostatic analyser, magnetic analyser and using numeric calculation with the software Maxima Algebra System, for two different times, for example 10hs and 22 hs (see Fig. 2) we have a mass difference of aproximately 2 ppm. But this difference can be confused with the systematic error.

12.2 Systematic error

From [6]: "The history of doublet determinations is studded with instances which values for a given mass difference, obtained in different laboratories, were incompatible... Such a systematic effect has been reported for instruments at the Argonne National Laboratory (40 ppm), Harvard University (20 ppm), Osaka University (36 ppm), University of Minnesota (20 ppm)...".

For the result of 2 ppm, we make the calculation for Cleveland (Ohio) on 8 July 1887, the first day of the Michelson-Morley experiment, see Fig. 2. The velocity of the spectrometer with respect to the CMB at 10hs is: $B_x = B_{east} = 390000/c = 0.0013$, $B_y = B_{north} = 0$, $B_z = B_{zenith} = 0$ and for 22hs is: $B_x = B_{east} = -0.0013$, $B_y = B_{north} = 0$, $B_z = B_{zenith} = 0$.

12.3 Test for NLD theory

a) The Nier-Johnson spectrometer (Fig. 4) has in cm $r_e = 50.31$, $r_m = 40.64$, $l_{oe} = l_{ie} = 17.6$, $l_{om} = 92.72$ and $l_{im} = 55.28$. If we modify $l_{im} = 5$cm, for 10hs and 22hs we have the mass diference of 10 ppm. Therefore, with a Nier-Johnson spectrometer with a different geometry we can make experiments to prove (or to disapprove) NLD theory. Below we have Table 3 for 'S' and 'C' spectrometer configurations. For Table 3 we used equations (B10), (B14), (C8) and the software Maxima Algebra System to calculate the integral Ψ and to do the numeric calculation as in the Section 11.5 . The original Nier-Jonhson experiment is with 'C' configuration and $l_{im} = 55$ cm (bold in Table 3).

	Geometry Configuration 'C'	Geometry Configuration 'S'
l_{im} (cm)	Mass diffe-rence (ppm)	Mass diffe-rence (ppm)
5	7	10
55	**0.05**	2
100	1.5	1

Table 3 – Nier-Johnson spectrometer with 'S' and 'C' configurations. Original experiment configuration in bold.

b) Another problem in the experiments is the line shift in time: "in the case of asymmetric lines, to an aparent shift in the line position with the increasing exposure..." [6] and "However, the lines are frequently asymmetrical, in which case, as a line approaches saturation density, its centre of gravity shifts, ..."[5]. We can measure this shift on the time and to compare to the NLD forecast.
c) For a correct stabilization of the electric and magnetic fields, see Appendix D.

13. Time dilation and transverse Doppler effect

We make a initial study about time dilation and transverse Doppler effect. This subject needs more research for complete explanation.

13.1 Time dilation

Let us suppose two equal particles (same mass m and same charge q with repulsive forces. The particles have velocity v equal in modulus but with inverse y directions, see Fig. 5.

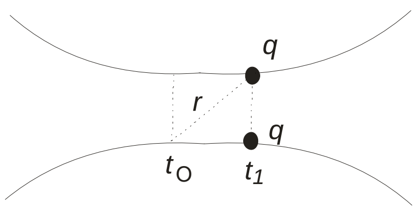

Figure 5 – Trajectories of the two particles q. In the time interval time t_o to t_1, the trajectories are approximately parallel.

For the time interval time t_o to t_1, the trajectories are approximately parallel and we have $x = vt$ and $y = r_0 = constant$. From Fig. 5, $r = c\Delta t = \sqrt{r_x^2 + r_y^2}$ where $\Delta t = t_1 - t_o$ is the time interval in which the wave force travels the distance r. $r_x = v\Delta t$ and $r_y = y = r_0$, substituting we have

$$r = \frac{r_0}{\sqrt{1-\beta^2}} \qquad (34)$$

dividing both terms by c, we have $r/c = r_0 \Big/ \left(c\sqrt{1-\beta^2}\right)$ and

$$\frac{r}{c} = \Delta t = \frac{\Delta t_0}{\sqrt{1-\beta^2}}\,. \qquad (35)$$

Equation (35) expresses time dilation, where $\Delta t_0 = r_0/c$ (for $v = 0$).
Thus, time dilation in NLD theory is due to the variation of forces (inside the atom) with respect to the velocity of the atom.

13.2 Transverse Doppler effect

From section 13.1 we have: " time dilation in NLD theory is due the variation of forces (inside the atom) with respect to the velocity of the atom".
If the atom (source) and observer are at rest in frame S (CMB), the internal Coulomb potential energy is:

$$U_o = \frac{qQ}{4\pi\varepsilon_o}\frac{1}{r_o} \qquad (36)$$

where r_o is the distance between the nucleus and the electron (for example the hydrogen) and the emitted frequency is f_o.
If the atom (source) is with velocity v with respect to S from (34) and (36) we have:

$$U = \frac{qQ}{4\pi\varepsilon_o}\frac{1}{r} = U_o\sqrt{1-\beta^2} \qquad (37)$$

And we have the frequency proportional to the Coulomb potential energy. Substituting U by f in (37) we have:

$$f_\perp = f_o\sqrt{1-\beta^2} \qquad (38)$$

where $f_\perp$ is the transverse Doppler effect measured by the observer at rest in S and perpendicular to the atom velocity and f_o is the observed frequency with the atom and observer at rest in S. The longitudinal Doppler effect in S is:

$$f_\ell = \frac{f_\perp}{1 \pm \beta} = \frac{f_o\sqrt{1-\beta^2}}{1 \pm \beta} \tag{39}$$

The sign is positive (negative) when the source is moving away from (towards) S.

13.3 Frequency measured with source and observer at rest in earth

With the atom (source) and observer at rest in earth (S') we measure always the following frequency:

$$f_0' = f_0\sqrt{1-B^2} \tag{40}$$

Where f_0' is the frequency measured with atom (source) and observer at rest in S' (earth), f_0 is the frequency measured with atom and observer at rest in S (CMB) and $V = Bc$ is the velocity of S'(earth) with respect to S (CMB). The frequency f_0' is constant for any position of the experimental equipment in S' (earth), for example, for longitudinal position of the measurer (observer) we have the same relation $f_0' = f_0\sqrt{1-B^2}$, see below.

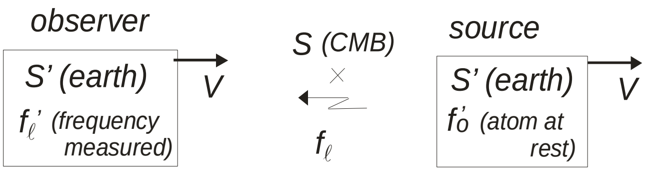

Fig. 6 – Atom (source) and measurer (observer) at rest in earth (S').

From Fig. 6 and (38) we have:

$$f_{\perp.(ATOM)} = f_o\sqrt{1-B^2} \tag{41}$$

The longitudinal atom frequency at CMB (from (7)(+)) is:

$$f_\ell = \frac{f_{\perp.(ATOM)}}{1+B} \tag{42}$$

The longitudinal atom frequency measured in earth (from(8)(+)) is:

$$f_\ell' = f_\ell(1+B) \tag{43}$$

Substituting we have:

$$f_\ell^{'} = f_{\perp(ATOM)} = f_o^{'} = f_o\sqrt{1-B^2} \tag{44}$$

13.4 Longitudinal Doppler effect in earth

Let us suppose a distant star source ($S^{"}$) with velocity v with respect to the CMB (S) and emitts from hydrogen atom (source). The observer is at rest in earth ($S^{'}$), $S^{'}$ is with velocity V with respect to S in direction of the star and V is parallel to v, see Fig. 7.

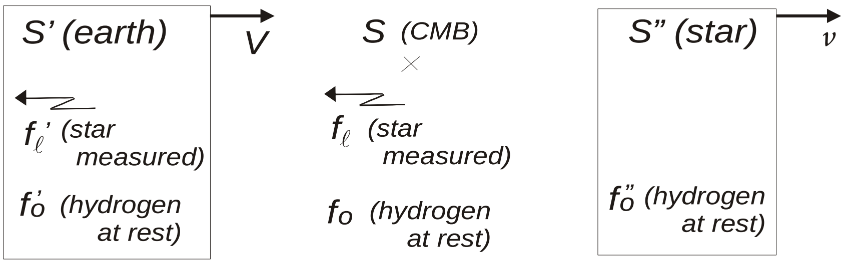

Fig. 7 – Longitudinal Doppler effect in earth. Star frequency measured by an observer at rest in earth.

From (44) we have:

$$f_o^{'} = f_o\sqrt{1-B^2} \tag{45}$$

From (38) we have:

$$f_{\perp.(STAR)} = f_o^{"} = f_o\sqrt{1-\beta^2} \tag{46}$$

Where f_o, $f_o^{'}$ and $f_o^{"}$ are the hydrogen frequency measured with the atom and observer at rest respectively in S (CMB), S' (earth) and S'' (star).

The longitudinal star frequency at CMB (from (7)(+)) is:

$$f_\ell = \frac{f_o^{"}}{1+\beta} \tag{47}$$

The longitudinal star frequency measured in earth (from (8)(+)) is:

$$f_\ell^{'} = f_\ell(1+B) \tag{48}$$

Substituting (45), (46) and (47) in (48) we have:

$$f_\ell^{'} = f_o^{'}\frac{\sqrt{1-\beta}}{\sqrt{1+\beta}}\frac{\sqrt{1+B}}{\sqrt{1-B}} \tag{49}$$

Where $f_\ell^{'}$ is the longitudinal star frequency measured with observer at rest in earth.

For $B = 0$ we have the same equation of SR longitudinal Doppler effect.

For $\beta = B$ we have $f_\ell^{'} = f_o^{'}$. Therefore, the frequency measured in earth is $f_0^{'}$ constant independent of the position of the emitter and observer with respect to the velocity **V**.

14. Mössbauer effect

From [11]: "A possible experimental arrangement, consists of an Fe^{57} absorber, an Fe^{57} source which can be moved at a constant velocity, and a detector for the 14.4-KeV gamma rays; we measure the rate of transmitted gamma rays. At zero velocity the transmission is low because of resonant absorption; as the velocity of the source is increased, however, the resonance is destroyed and the transmission increases.......In this way we "trace out" the natural line width for this nuclear gamma ray, and measure energy deviations is of 1 part in 10^{13} ($v \approx 0.06 mm/\sec$)."

14.1 SR explanation

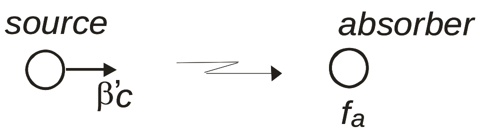

Fig. 9 – Mössbauer effect – SR explanation. Source with velocity $\beta^{'}c$ with respect to the laboratory frame and absorber at rest.

The frequency in the absorber (f_a) at rest in laboratory frame is

$$f_a = f_0 \frac{\sqrt{1-\beta^{'2}}}{1-\beta^{'}} \tag{50}$$

Where $\beta^{'}c$ and f_0 are respectively the velocity of the source with respect to the laboratory frame and the frequency of the source at rest in laboratory frame.

14.2 NLD explanation

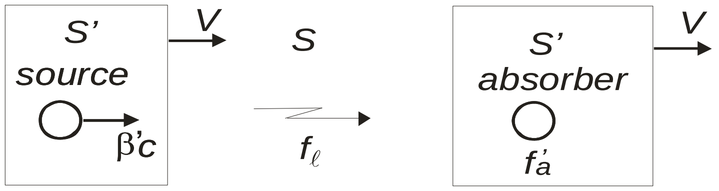

Fig.10 – Mössbauer effect – NLD explanation. Source with velocity $\beta^{'}c$ with respect to the laboratory frame and absorber at rest.

The absorber is at rest in $S^{'}$ (earth) and the velocity of $S^{'}$ with respect to S (CMB) is $V = Bc$.

The velocity of the source with respect to $S^{'}$ is $\beta^{'}c$.

The source and absorber at rest in S has a transition with a frequency f_o.

The source and absorber at rest in $S^{'}$ has a transition with a frequency from (44) $f_0^{'} = f_0\sqrt{1-B^2}$.

The transverse Doppler effect measured by the observer at rest in S and perpendicular to the source velocity from (38) is $f_{\perp(SOURCE)} = f_0\sqrt{1-\beta^2} = f_0\sqrt{1-\left(\beta^{'}+B\right)^2}$. The longitudinal frequency with respect to S from (7) is $f_l = f_{\perp(SOURCE)}/\left(1-\left(\beta^{'}+B\right)\right)$ and the frequency in the absorber with respect to $S^{'}$ from (8) is $f_a^{'} = f_l(1-B)$. Substituting we have:

$$f_a^{'} = f_0^{'}\frac{\sqrt{1-\left(\beta^{'}+B\right)^2}}{1-(\beta^{'}+B)}\frac{1-B}{\sqrt{1-B^2}} \qquad (51)$$

For $B=0$ we have the same equation of SR Mossbäuer effect.

14.3 Example - Mossbäuer effect

For $B = V/c = 0.00123$ and $\beta^{'} = \left(0.06mm/s\right)/c = 2\times10^{-13}$ from (50) and (51) we have for SR and NLD:

$$f_a\left(SR\right) = f_0\times1.000000000000200$$

$$f_a^{'}(NLD) = f_0^{'}\times1.000000000000200$$

And the results are the same for SR and NLD with respect to the earth**.**

15. Test of time dilation using stored ions as clocks with accuracy $< 2\times10^{-10}$.

15.1 SR explanation

From [10]: " We have performed experiments of the Ives-Stiwell (IS) type that test time dilation of Special Relativity via the relativistic Doppler shift. A beam of ions, which exhibit an optical transition with a frequency f_0 in their rest frame, is stored at velocity $\beta = v/c$ in a storage ring. The resonantly excite these ions by a laser at rest in the laboratory frame, the frequency f of the laser needs to be Doppler shifted according to $f = f_o/\gamma\left(1-\beta\cos\theta\right)$, where θ is the angle between the laser and the ion beam, measured in laboratory frame, and γ governs time dilation. For a parallel $\left(\theta_p = 0\right)$ or na antiparallel $\left(\theta_a = \pi\right)$ laser beam the frequencies required are $f_{p,a} = f_o/\gamma\left(1\mp\beta\right)$ respectively. Multiplying these two frequencies and using $\gamma = \left(1-\beta^2\right)^{-1/2}$ as predicted by SR results in

$$\frac{f_p f_a}{f_o^2} = 1, \qquad (52)$$

i.e. the geometric mean of the Doppler shifted frequencies equals the rest frame frequency for all velocities β.

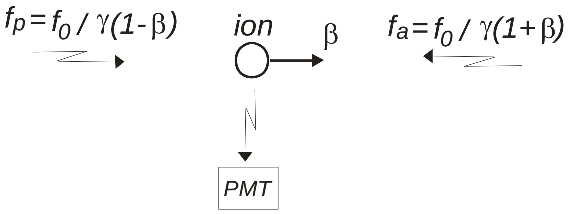

Fig. 11 – SR explanation – Beam ion with velocity $\beta = v/c$ and two laser beam parallel (f_p) and antiparallel (f_a).

In one of our implementations of the IS experiment saturation spectroscopy is used by overlapping simultaneously a parallel and antiparallel laser beam with the ion beam to select a narrow velocity class β within the ions' velocity distribution. The parallel laser is held fixed at the laser frequency $f_p = f/\gamma(1-\beta)$ and is resonant with ions at β, while the other laser is scanned over velocity distribution. The fluorescence yield, measured with a photomultiplier (PMT) located around 90 degree with respect to the ion beam, will exhibit a minimum (a Lamb dip) when the antiparallel laser talks to the same velocity class β , i. e. when the frequency is at $f_a = f_0/\gamma(1+\beta)$. SR thus predicts the Lamb dip to occur when Eq. (52) is fulfilled, which is shown to be confirmed by our experiments to an accuracy of $< 2\times10^{-10}$ on Li^+ ions at $\beta = 0.03$ and $\beta = 0.06$ .....Neither do we measure the frequency of the emitted light nor do we intend to observe at exactly right angle. We only record the number of re-emitted photons as a function of the scanning laser frequency to monitor the Lamb dip caused by simultaneous resonance of both lasers with the same ions.........The frequency f_0 occuring in Eq. (52) has nothing to do with the frequency of the emitted light in our experiment, but is the rest frame frequency f_0 deducted from experiments at smaller ion velocities."

15.2 NLD explanation

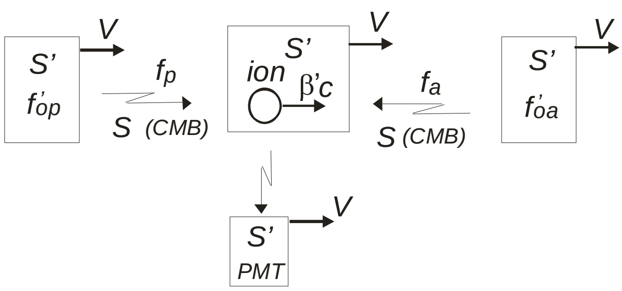

Fig. 12 - NLD explanation – Beam ion with velocity $\beta' c$ and two laser beam parallel (f'_{0p}) and antiparallel (f'_{0a}).

The lasers and PMT are at rest in S' (earth) and $V = Bc$ is the velocity of S' with respect to S (CMB).

The velocity of the ion with respect to S' is β'.

The ion at rest in S has a optical transition with a frequency f_o.

The ion at rest in $S^{'}$ has a optical transition with a frequency from (44) $f_o^{'} = f_0\sqrt{1-B^2}$ with respect to $S^{'}$.

The frequency of the laser at rest in $S^{'}$ are adjusted for $f_{op}^{'} = f_0^{'}\sqrt{1-\beta^{'2}}\Big/\left(1-\beta^{'}\right)$ and $f_{oa}^{'} = f_0^{'}\sqrt{1-\beta^{'2}}\Big/\left(1+\beta^{'}\right)$ with respect to $S^{'}$ and parallel and antiparallel respectively.

$$\frac{f_{op}^{'} \times f_{oa}^{'}}{f_0^{'2}} = 1 \qquad (51)$$

i.e. the geometric mean of the Doppler shifted frequencies equals the rest frame ($S^{'}$) of the lasers frequency for all velocities $\beta^{'}$ and too for any position of the experimental equipment with respect to the CMB or more precisely with respect to the velocity $\mathbf{V}$. The accuracy of the experiment is the same than SR: $< 2\times10^{-10}$ on Li^{+} ions at $\beta^{'} = 0.03$ and $\beta^{'} = 0.06$.

16. Michelson-Morley experiment and NLD theory.

The Michelson Morley experiment [12] is an open question for NLD.

For complete calculations of the trajectory and displacement of the interference fringes, we must study and to develop the equations of refraction and reflection in vacuum and in glass with velocity V with respect to the CMB, which are used in: a) in the lenses of the telescope and b) in one semi-transparent mirror (half-silvered) in which the incident ray r_a is refracted, reflected and divided into two rays (r_b and r_d), as shown in Fig. 13.

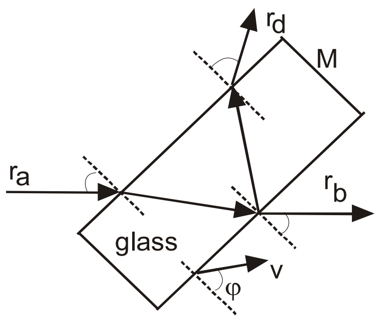

Figure 13 - Semitransparent mirror M with velocity V with respect to CMB (S), incident ray (r_a), the refracted-reflected-refracted ray (r_d) and refracted-refracted ray (r_b).

The Michelson-Morley experiment requires one semi-transparent mirror, 16 mirrors, a lens and a telescope.

16.1 Reflection in vacuum

In the Supplement of the MM paper [12], the equations of ray reflections in a moving mirror are shown with respect to the preferred frame. Let us suppose a mirror at rest in $S^{'}$ and with velocity V with respect to S (CMB). The equations with respect to S are the same of MM paper.

From [12]: “Let ab (Fig. 14) be a plane wave falling on the mirror m at an incidence of $45°$. If the mirror is at rest, the wave front after reflection will be ae. Now suppose the mirror to move in a direction which makes an angle φ with its normal, with velocity V. Let c be the velocity of light in the ether supposed stationary, and let ed be the increase in the distance the light has to travel to reach d.”

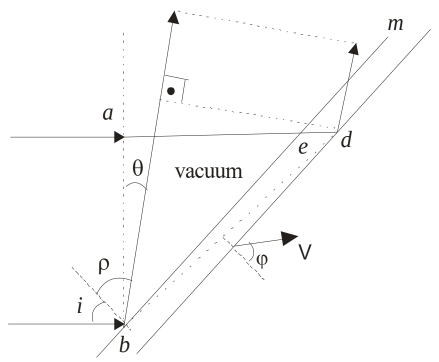

Fig. 14 – Reflection in vacuum. Incident and reflection plane waves

Michelson and Morley also demonstrated the following equation:

$$\tan\left(45° - \frac{\theta}{2}\right) = \frac{ae}{ad} = 1 - \frac{V\sqrt{2}\cos\varphi}{c} \quad . \tag{54}$$

Below, we have an equivalent and more general equation for any angle of incident rays. From Equations (5) and (6) in the work of Kohl [13], we have:

$$\tan\rho = \frac{1 - B^2\cos^2\varphi}{1 + B^2\cos^2\varphi \pm 2B\cos\varphi\sec i}\tan i\,, \tag{55}$$

where i and ρ are respectively, the angles of incidence and reflection with respect to the normal of the mirror, $B = V/c$ and φ is the angle of V with respect to the normal of the mirror.

The sign is negative (positive) when the mirror is moving away from (towards) the incident ray.

16.2 Reflection in glass

Let us suppose a glass at rest in S. The velocity of light inside the glass is

$$u_0 = \frac{c}{n} \tag{56}$$

For the glass with velocity $\mathbf{V}$ to respect to S we have

$$\mathbf{u} = \mathbf{u}_0 + \mathbf{V}\left(1 - \frac{u_0^2}{c^2}\right) \tag{57}$$

where u is the velocity of light inside the glass with respect to S and $V\left(1 - u_0^2/c^2\right)$ is the Fresnel drag.
The equations of reflection (similar at (55)) in glass must be further developed.

16.3 Refraction in vacuum-glass

From Snell's law of refraction we have:

$$\sin i = \frac{c}{u} \sin \xi \tag{58}$$

Where i and ξ are the angles, respectively, of incidence and refraction. The angles are with respect to the normal of the glass (Fig. 13).

16.4 The Michelson-Morley experiment

The Michelson-Morley experiment requires one semi-transparent mirror, 16 mirrors, a lens and a telescope. In Fig. 15, we substitute 16 mirrors for 2 mirrors.

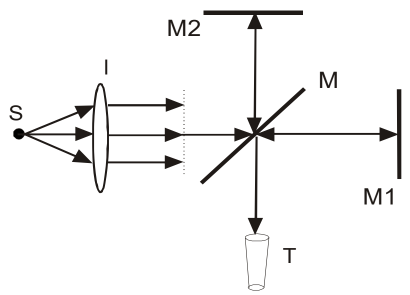

Figure 15 – Michelson-Morley experiment with one semi-transparent mirror, 2 mirrors, a lens and a telescope.

In Fig. 15, S, l, M, M1, M2 and T are respectively, the light source, lens, semi-transparent mirror, mirror 1, mirror 2 and telescope.
For calculus simplification, we substitute for lens l the sun or star light, which has wave front that is practically planare when reaching the earth. The interchange between sun or star lights and laboratory sources in no way alters the results [14-16].
For the telescope, we substitute screen B, as shown in Fig. 16.

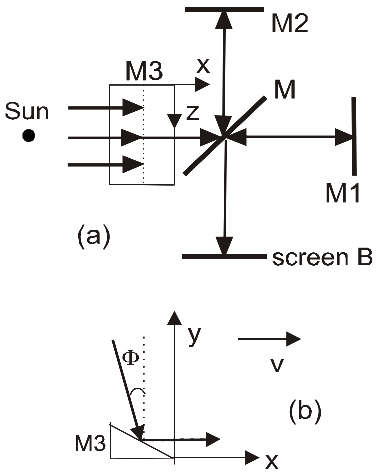

Figure 16 – Michelson-Morley experiment with sun light and secreen B. Panel (a) shows the x-z plane, while (b) shows the x-y plane.

M3 is a mirror to capture sun or star light.

The displacement of interference fringes must be calculated using the equations above and further development of the complete equations is needed. At the end of the calculations we need calculate for the telescope and use equations for lens which need to be developed.

Therefore, MM experiment is an open question for NLD.

Conclusion

NLD and SR has the same basic equations for $V = 0$ and the difference between the theories is for $V > 0$.

SR use in the calculations the relative velocity between two bodies. In NLD uses a intermediate frame (the preferred frame, in prattice the CMB) where the calculations are in relation to the preferred frame and the results are transformed for the two bodies.

And NLD is in agreement with experiments with high accuracy, like: mass spectrometer using magnetic and electric sector (Niels-Jonhson, Matsuda, etc) with accuracy $< 1 ppm$, Mössbauer effect with energy deviations with accuracy 10^{-13} and time dilation using stored ions as clocks with accuracy $< 2\times10^{-10}$. We propose a test for NLD using a mass spectrometer with a special geometry.

Appendix

Appendix A. Particle collisions – SR explanation

For SR, the equation for the collision of two particles (with rest mass m_a and m_b) with opposite momenta is:

$$E^2 = \left(m_a^2 + m_b^2\right)c^4 + 2\left(E_a E_b + |p_a||p_b|c^2\right) \quad \text{(A1)}$$

where E is the total energy and E_a and E_b, respectively is is the total energy of particles m_a and m_b.

For two particles with equal and opposite momenta ($\mathbf{p_a} + \mathbf{p_b} = 0$,i.e., the total momentum vanishes in the center of mass frame) we have the maximum transfer of energy for production of others particles or photons.

For a incident particle (m_a) and a fixed target (m_b) we have:

$$E^2 = s = \left(m_a^2 + m_b^2\right)c^4 + 2E_i m_b c^2 \tag{A2}$$

Where E_i is the total energy of the incident particle.

Equaling (A1) and (A2) we have:

$$E_i m_b c^2 = E_a E_b + |p_a||p_b|c^2 \tag{A3}$$

Substituting $E_a = m_a c^2 \Big/ \sqrt{1-\beta_a^2}$, $E_b = m_b c^2 \Big/ \sqrt{1-\beta_b^2}$, $p_a = m_a v_a \Big/ \sqrt{1-\beta_a^2}$ and $p_b = m_b v_b \Big/ \sqrt{1-\beta_b^2}$ in (A3) we have:

$$E_i^2 = \frac{m_a^2 c^4 \left(1 + \beta_a \beta_b\right)^2}{1 + \beta_a^2 \beta_b^2 - \beta_a^2 - \beta_b^2} \tag{A4}$$

Equation (A4) is the same derived for NLD, see Sect. 8.2, Equ. (14). Therefore, the total and the maximum energy transfer calculated for SR and NLD in collisions are the same.

Appendix B – Electric field

Appendix B1. Electric field of a charged ring

Let us suppose a charged ring of radius $R^{'}$ parallel to plane $x^{'}, y^{'}$ and at rest in $S^{'}$. $S^{'}$ is with constant velocity $\mathbf{V}$ with respect to S. Fom fig. Fig B1 we have $dq = \lambda ds^{'} = \lambda R^{'} d\phi^{'}$ and the electric field at point $P^{'}\left(x^{'}, y^{'}, z^{'}\right)$ at rest in S' is

$$d\mathbf{E} = \frac{dq}{4\pi\varepsilon_0} \frac{\mathbf{r}}{r^3} = \frac{\lambda R^{'}}{4\pi\varepsilon_0} \frac{\mathbf{r}}{r^3} d\phi^{'} \tag{B1}$$

$$\mathbf{r} = \mathbf{u}_P^{'} + \mathbf{B}r - \mathbf{u}^{'} = \left(x^{'}\mathbf{i} + y^{'}\mathbf{j} + z^{'}\mathbf{k}\right) + r\left(B_x\mathbf{i} + B_y\mathbf{j} + B_z\mathbf{k}\right) - R^{'}\left(\cos\phi^{'}\mathbf{i} + \sin\phi^{'}\mathbf{j}\right) \tag{B2}$$

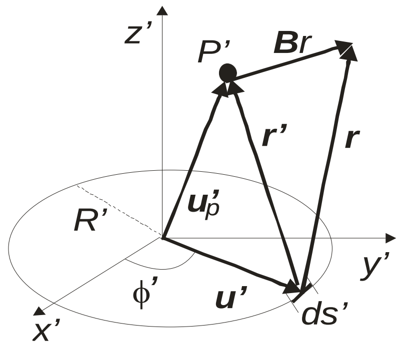

Fig. B1 – Charged ring at rest in frame $S^{'}$.

For the ring we have $q = 2\pi\lambda R^{'}$, substituting and integrating

$$\mathbf{E} = \frac{q}{8\pi^2\varepsilon_0}\int_0^{2\pi}\frac{\left(x^{'} + rB_x - R^{'}\cos\phi^{'}\right)\mathbf{i} + \left(y^{'} + rB_y - R^{'}\sin\phi^{'}\right)\mathbf{j} + \left(z^{'} + rB_z\right)\mathbf{k}}{r^3}d\phi^{'} \tag{B3}$$

$$\mathbf{E} = \frac{q}{8\pi^2\varepsilon_0}\Psi \tag{B4}$$

$$r^2 = \left(x^{'} + rB_x - R^{'}\cos\phi^{'}\right)^2 + \left(y^{'} + rB_y - R^{'}\sin\phi^{'}\right)^2 + \left(z^{'} + rB_z\right)^2 \tag{B5}$$

$$r = \left\{-B_x\left(x^{'} - R^{'}\cos\phi^{'}\right) - B_y\left(y^{'} - R^{'}\sin\phi^{'}\right) - z^{'}B_z \mp \sqrt{\left[B_x\left(x^{'} - R^{'}\cos\phi^{'}\right) + \ldots\right.}\right.$$

$$\left.\sqrt{\ldots + B_y\left(y^{'} - R^{'}\sin\phi^{'}\right) + z^{'}B_z\right]^2 - \left(B^2 - 1\right)\left[\left(x^{'} - R^{'}\cos\phi^{'}\right)^2 + \left(y^{'} - R^{'}\sin\phi^{'}\right)^2 + z^{'2}\right]}\right\} \Big/ \left(B^2 - 1\right) \tag{B6}$$

Appendix B2. Electric field of a charged disk

Let us suppose a disk at rest in $S^{'}$ and parallel to plane $x^{'}, y^{'}$ and we have $dq = \sigma dA = \sigma 2\pi w^{'}dw^{'}$ where $2\pi w^{'}dw^{'}$ is the area of a ring of radius $w^{'}$ and thickness $dw^{'}$, from (B4) we differentiated and in expressions of Ψ and r we substituted $R^{'}$ by $w^{'}$.

$$d\mathbf{E} = \frac{dq}{8\pi^2\varepsilon_0}\Psi_w = \frac{\sigma w^{'}dw^{'}}{4\pi\varepsilon_0}\Psi_w \tag{B7}$$

$$\Psi_w = \int_0^{2\pi}\frac{\left(x^{'} + rB_x - w^{'}\cos\phi^{'}\right)\mathbf{i} + \left(y^{'} + rB_y - w^{'}\sin\phi^{'}\right)\mathbf{j} + \left(z^{'} + rB_z\right)\mathbf{k}}{r^3}d\phi^{'} \tag{B8}$$

$$r^2 = \left(x^{'} + rB_x - w^{'}\cos\phi^{'}\right)^2 + \left(y^{'} + rB_y - w^{'}\sin\phi^{'}\right)^2 + \left(z^{'} + rB_z\right)^2 \tag{B9}$$

By numeric calculation we gives $\Delta w^{'}$ until $w^{'} = l^{'}$ where $l^{'}$ is the maximum outer radius of the disk.

$$E = \frac{\sigma}{4\pi\varepsilon_0}\Delta w'\left(\sum_0^n w'\Psi_w\right) \qquad \text{(B10)}$$

Where $w' = 0.5\Delta w' + n\Delta w'$ and $n = 0, 1, 2,...$ until $n = \left(l'/\Delta w'\right) - 1$.

For a condenser with two parallel plane plates and distance d' between the plates we added the electric field E_1 in the point P' of the positive plate with E_2 of the negative plate.

Appendix B3. Electric field of a condenser with circular 90° plate

Let us suppose a circular 90° plate perpendicular to plane x', y' and at rest in S', see Fig. B2. S' is with constant velocity $\mathbf{V}$ with respect to S.

We make a mathematical artifice substituting z' by z'_f in equations (B3) and (B5).

$$\mathbf{E} = \frac{q}{8\pi^2\varepsilon_0}\int_0^{\frac{\pi}{2}} \frac{\left(x' + rB_x - R'\cos\phi'\right)\mathbf{i} + \left(y' + rB_y - R'\sin\phi'\right)\mathbf{j} + \left(z'_f + rB_z\right)\mathbf{k}}{r^3} d\phi'$$

$$\mathbf{E} = \frac{q}{8\pi^2\varepsilon_0}\Psi_f \qquad \text{(B11)}$$

$$r^2 = \left(x' + rB_x - R'\cos\phi'\right)^2 + \left(y' + rB_y - R'\sin\phi'\right)^2 + \left(z'_f + rB_z\right)^2 \qquad \text{(B12)}$$

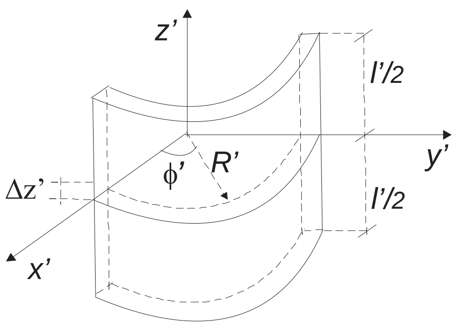

Fig. B2 – Circular 90 degree condenser plate at rest in S'.

For $dq = \sigma dA = \sigma 2\pi R' dz'$ where $2\pi R' dz'$ is the area of a ring of radius R' and thickness dz', substituing in (B11) we have

$$d\mathbf{E} = \frac{dq}{8\pi^2\varepsilon_0}\Psi_f = \frac{\sigma R' dz'}{4\pi\varepsilon_0}\Psi_f \qquad \text{(B13)}$$

$$E = \frac{\sigma R'}{4\pi\varepsilon_0}\Delta z'\left(\sum_0^n {}'\Psi_f\right) \qquad \text{(B14)}$$

Where $R^{'} = \text{constant}$, $z_{f}^{'} = z^{'} - \frac{l^{'}}{2} + \frac{\Delta z^{'}}{2} + n\Delta z^{'}$ and $n = 0,\ 1,\ 2,...$ until $n = \left(l^{'}/\Delta z^{'}\right) - 1$.

Therefore we used the mathematical artifice where $z_{f}^{'}$ is floating and the charged ring with thickness $\Delta z^{'}$ is fixed in the plane $x^{'}, y^{'}$. The point $P_{f}^{'}\left(x^{'} y^{'}, z_{f}^{'}\right)$ is floating and the electric field E is the same of $P^{'}\left(x^{'}, y^{'}, z^{'}\right)$.

For a condenser of parallel circular plates we added the electric field in $P^{'}\left(x^{'}, y^{'}, z^{'}\right)$ of the positive plate (radius $R_{1}^{'}$) with the negative plate (radius $R_{2}^{'}$).

Appendix C. Magnetic field

Appendix C1. Magnetic field of a spire

Let us suppose a spire of radius $R^{'}$ carrying electric current I. The spire is parallel to plane $x^{'}, y^{'}$, and at rest in $S^{'}$, see Fig. B1. $S^{'}$ is with constant velocity $\mathbf{V}$ with respect to S. The magnetic field at point $P^{'}\left(x^{'}, y^{'}, z^{'}\right)$ at rest in S' is

$$d\mathbf{H} = \frac{\mu_0 I}{4\pi}\frac{d\mathbf{s}^{'} \times \mathbf{r}}{r^3} \tag{C1}$$

$$\mathbf{r} = \mathbf{u}_{P}^{'} + \mathbf{B}r - \mathbf{u}^{'} = \left(x^{'}\mathbf{i} + y^{'}\mathbf{j} + z^{'}\mathbf{k}\right) + r\left(B_x\mathbf{i} + B_y\mathbf{j} + B_z\mathbf{k}\right) - R^{'}\left(\cos\phi^{'}\mathbf{i} + \sin\phi^{'}\mathbf{j}\right) \tag{C2}$$

$$d\mathbf{s}^{'} = d\mathbf{u}^{'} d\phi^{'}/d\phi^{'} = R^{'}\left(-\sin\phi^{'}\mathbf{i} + \cos\phi^{'}\mathbf{j}\right)d\phi^{'} \tag{C3}$$

$$\mathbf{H} = \frac{\mu_0 I R^{'}}{4\pi\varepsilon_0}\int_0^{2\pi}\frac{\cos\phi\left(z^{'} + rB_z\right)\mathbf{i} + \sin\phi\left(z^{'} + rB_z\right)\mathbf{j} + \left(-\sin\phi^{'}\left(y^{'} + rB_y\right) - \cos\phi^{'}\left(x^{'} + rB_x\right) + R^{'}\right)\mathbf{k}}{r^3}d\phi^{'} \tag{C4}$$

Where r is the same that (B6) of the electric ring.

Appendix C2. Solenoid

Let us suppose a solenoid of radius $R^{'}$ carrying electric current I. The circular plane of the solenoid is parallel to plane $x^{'}, y^{'}$ and at rest in $S^{'}$, the lenght $l^{'}$ is in the negative axis of $z^{'}$ from zero to $-z^{'}$. The magnetic field of the solenoid at point $P^{'}$ at rest in S' from (C4) is

$$d\mathbf{H}_m = \frac{\mu_0 R^{'}}{4\pi}\Psi_m dI = \frac{\mu_0 R^{'}}{4\pi}\Psi_m N I dz^{'} \tag{C5}$$

where N is the number of spires.

$$\Psi_m = \int_0^{2\pi}\frac{\cos\phi\left(z_{m}^{'} + rB_z\right)\mathbf{i} + \sin\phi\left(z_{m}^{'} + rB_z\right)\mathbf{j} + \left(-\sin\phi^{'}\left(y^{'} + rB_y\right) - \cos\phi^{'}\left(x^{'} + rB_x\right) + R^{'}\right)\mathbf{k}}{r^3}d\phi^{'} \tag{C6}$$

$$r = \left\{ -B_x\left(x' - R'\cos\phi'\right) - B_y\left(y' - R'\sin\phi'\right) - z'_m B_z \mp \sqrt{\left[B_x\left(x' - R'\cos\phi'\right) + \ldots\right.}\right.$$

$$\left.\sqrt{\ldots + B_y\left(y' - R'\sin\phi'\right) + z'_m B_z\Big]^2 - \left(B^2 - 1\right)\left[\left(x' - R'\cos\phi'\right)^2 + \left(y' - R'\sin\phi'\right)^2 + z'^2_m\right]}\right\} \Big/ \left(B^2 - 1\right) \quad \text{(C7)}$$

$$\mathbf{H}_m = \frac{\mu_0 R' NI}{4\pi} \Delta z' \sum_0^n \Psi'_m \quad \text{(C8)}$$

where $z'_m = z' + 0.5\Delta z' + n\Delta z'$ and $n = 0, 1, 2, \ldots$ until $n = \left(l'/\Delta z'\right) - 1$.

We used the mathematical artifice where z'_m is floating and the solenoid with thickness $\Delta z'$ is fixed in the plane x', y'. The point $P'_m\left(x'y', z'_m\right)$ is floating and the magnetic field H_m is the same of $P'\left(x', y', z'\right)$.

For a magnetic analyzer we calculate the magnetic field for two solenoids with a gap between them. The moving particle has the path in this gap.

Appendix D – Stabilization of electric and magnetic fields for NLD

For spectrometers and spectrographs, the difference in mass measured at two different times (see Sect. 12.1) is due the variation of the electric field betwwen the plates of the condenser (due the CMB velocity) and the variation of the magnetic field between the solenoids.

For NLD the spectrometer stability needs: a) magnetic field: to maintain constant the current of the solenoid and not to maintain the magnetic field constant. b) electric field: to maintain constant the charges in the condenser plates and not to maintain the electric field constant. See below.

a) From [4]: ¨As before, the poles-piece of the magnet were sickle-shaped, and a further refinement was the application of a very delicate fluxmeter control capable of detecting changes of the order of 10^{-5} in the magnetic field. This field was stabilized by a spiral mercury resistance controlled by hand during the exposure."

For NLD the best is to control the constant current in the solenoid and not the magnetic field. b) Electric and magnetic fields variations are automatically adjusted to restore the ion trajectories to their original state, from [8]: "In the initial instrument described here, a different approach to stability was employed. An auxiliary small single-focusing mass spectrometer was mounted so that it would experience the same magnetic field as the larger double-focusing instrument. It derived its ion-accelerating potential from the same power supply as the double-focusing instrument and had a split ion collector with a differential amplifier for detecting its ion beam. A variation in either the magnetic field or the power supply providing the ion accelerating and deflection fields for the two instruments would cause an imbalance of the current at the collectors of the single-focusing instrument. The imbalance sent a signal to the power supply providing the ion accelerating and deflection fields, which in turn restored the ion trajectories to their original state... It, with improvements, was employed for a number of years until improved 'peak-matching' methods of measurement were adopted."

c) From [17]: "The second order focusing characteristics have been improved by the use of 'Balestrini shims'...".

References

[1] G. N. Lewis, A revision of the fundamental laws of matter and energy. Philos. Mag., **16,** 705-717

(1908).
[2] D. J. Raine, The isotropic universe: An introduction to cosmology (Adam Hilger Ltd, Bristol, 1981)
[3] H. A. Munera et al., Observation during 2004 of periodic fringe-shifts in na adialeiptometric stationary Michelson-Morley experiment. Electromagnetic Phenomena, V.6, No.1, 16, 70-92 (2006).
[4] F. W. Aston, Mass spectra and isotopes (Edwald Arnold & CO., London, 1942).
[5] H. E. Duckworth, Mass spectroscopy (Cambridge University Press, 1958).
[6] H. E. Duckworth et al., Mass spectroscopy (Cambridge University Press, second edition, 1986).
[7] K. S. Quisenberry et al., Atomic masses of H, D, C and S. Phys. Rev., **102,** 1071-1075 (1956).
[8] H. Hintenberger, Nuclear Masses and their Determination (London, Pergamon Press, 1957)
[9] E. G. Johnson and A. O. Nier, Angular aberrations in sector shaped electromagnetic lenses for focusing beams of charged particles. Phys. Rev., **91** 10-17 (1953).
[10] G. Staathoff *et al*., Comment on"Missing Transverse-Doppler effect in time-dilation experiments with high-speed ions". Eur. Phys. J. C **71**, 1596 (2011). arXiv:1102.5657v1.
[11] A. C. Melissinos, Experiments in Modern Physics (London, Academic Press Inc., 1966)
[12] A. A. Michelson, E. W. Morley, On the relative motion of the earth and the luminiferous ether. Am. J. Sci. **34,** 333-345 (1887).
[13] E. Kohl, Über den Michelsonschen Versuch. Ann. Phys. (Leipzig) **28**, 259-307 (1909).
[14] D. C. Miller, Ether-drift experiments at Mount Wilson. Proc. Natl. Acad. Sci., **11,** 306-314 (1925).
[15] R. Tomaschek, Über das verhalten des lichtes ausserirdischer lichtquellen. Ann. Phys. (Leipzig), **73,** 105-125 (1924).
[16] D. C. Miller, The ether-drift experiment and the determination of the absolute motion of the earth. Rev. Mod. Phys., **5,** 203-242 (1933).
[17] C. M. Stevens and P. E. Moreland, Mass measurements with the Argonne 100 in. spectrometer, Proceedings of the International Conference on Atomic Masses, ed. R. C. Barber, Winnipeg, University of Manitoba Press (1967).