New equations for the motions of bodies

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Abstract

New equations for the motions of bodies are derived from non-instantaneous forces, some equations of special relativity (but derived from Newtonian Physics), Galilean transformations and a preferred frame (the cosmic microwave background).

1. Introduction

In the new Newtonian physics discussed herein, we use the following:

a) some special relativity equations (Table 1),
b) non-instantaneous forces (Sections 5 and 6),
c) Galilean transformations and a preferred frame (cosmic microwave background), (Section 4).

Below, we compare the basic equations from special relativity and our new Newtonian physics.

Experiment	Special Relat.	New Newton. Phys.
Mass variation	$m = m_0 \gamma$	$m = m_0 \gamma$ (1)
Kinetic energy	$k = m_0 c^2 (\gamma - 1)$	$k = m_0 c^2 (\gamma - 1)$ (2)
Relation mass-energy	$E = mc^2$	$E = mc^2$ (3)
Time dilation	$\Delta t = \Delta t_0 \gamma$	See section 6.2
Michelson-Morley	$\delta = 0$	See section 7

Table 1 - Equations of special relativity and new Newtonian physics

Using the concepts of Newtonian physics, Lewis (who received 35 nominations for the Nobel prize in chemistry) [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]. In these equations, m_0, v, c are respectively, particle rest mass, particle velocity, velocity of light, $\beta = v/c$ and $\gamma = 1/\sqrt{1-\beta^2}$.

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”.

2. Inertial and non-inertial frames

New equations for the motions of bodies in inertial and non-inertial frames are deduced in Sections 5 and 6.

The need for new equations is discussed by Novello [2], the original of which is in Portuguese, but our translation follows:

" Four of the principal criticisms of relativity are in the territory of astrophysics and cosmology, namely, singularity, dark matter, dark energy and quantization…Scientists then began to search for a new theory of gravitation that is the relativistic version of the Newtonian formulation and describes the gravitational field as a scalar, that is, via a single function (similar in this respect, to the Newtonian version)..."

3. Force

From equations (1), (2) and (3), we derive the equation of force:

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

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

$$F_y = m\frac{dv_y}{dt} + \frac{v_y^2 F_y}{c^2},$$

Substituting (1), we have:

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

$$F_y = m_o\gamma\gamma_y^2\frac{dv_y}{dt},$$

where $\gamma = 1\big/\sqrt{1-\beta^2}$, $\gamma_x = 1\big/\sqrt{1-\beta_x^2}$ and $\gamma_y = 1\big/\sqrt{1-\beta_y^2}$.

4. Basic equations

From (6), Galilean transformations, non-instantaneous force, preferred frame S (cosmic microwave- background) and frame S', we can obtain the equations for the motions of bodies.

From Newtonian physics:

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), and the velocity of the earth with respect to the CMB is approximately 390 km/s (0.0013c).
d) According to Zeldovich, at every point in the Universe, there is an observer in relation to which microwave radiation appears to be isotropic.

From new Newtonian physics:
e) A Coulomb force is generated by an electric wave. A gravitational force is generated by a gravitational wave. The electric 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.

5. Inertial frames and non-instantaneous force

Suppose two inertial frames (S and S'), one particle without acceleration (charge Q, mass M) and one particle with acceleration (charge q, mass m).

S is the preferred frame (CMB) and S' has constant velocity V in relation to S and parallel to the x axis. The velocity of q is **v** in relation to S.

Charge Q is at rest in S' (it is an approach for $M >> m$ and $Q \geq q$ or $Q >> q$ and $M \geq m$); the frames and particles are illustrated in Figure 1.

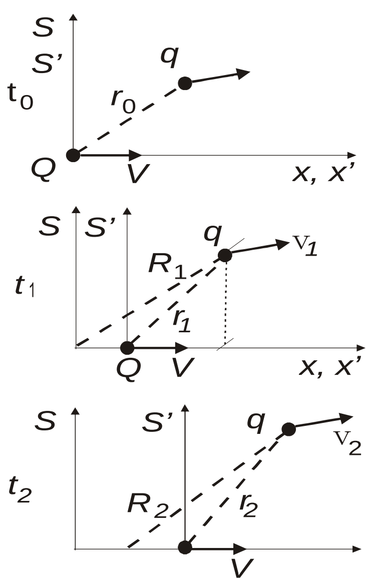

Figure 1 – Inertial frames S , S' and particles q, Q.

At time t_0, charge Q emits an electric wave front that reaches charge q at time t_1. At time t_1, charge Q emits an electric wave front that reaches charge q at time t_2, and so forth. The electric wave has velocity c in relation to S.

For constant $V > 0$, from Galilean transformations, we have:

$$x = Vt + x'$$
$$y = y' \qquad (7)$$
$$t = t' \quad \text{(see discussion of time dilation in Section 6.2, Equation (25)),}$$

$$R_x = V\Delta t + x', \qquad (8)$$

where Δt is the time interval in which the force travels distance R and $R = c\Delta t$,

$$R_y = y = y' \qquad (9)$$

$$R_x = V\frac{R}{c} + x' = BR + x',$$

and

$$R = \frac{Bx' \pm \sqrt{x'^2 + y'^2\,(1 - B^2)}}{1 - B^2}, \qquad (10)$$

where $B = V/c$.

The non-instantaneous Coulomb force in q is:

$$F_x = KqQ\frac{R_x}{R^3} \qquad (11)$$

$$F_y = KqQ\frac{R_y}{R^3}.$$

Equating (6) and (11) yields the folowing differential equations:

$$m_0\gamma\gamma_x^2\frac{dv_x}{dt} = KqQ\frac{R_x}{R^3} \qquad (12)$$

$$m_0\gamma\gamma_y^2\frac{dv_y}{dt} = KqQ\frac{R_y}{R^3}$$

Multiplying and dividing the first term of (12) for dx', and from $dv_x = dv_{x'}$, we have:

$$m_0\gamma\gamma_x^2\int v_{x'}dv_{x'} = \pm KqQ\int\frac{R_x}{R^3}dx' \qquad (13)$$

$$m_0\gamma\gamma_y^2\int v_{y'}dv_{y'} = \pm KqQ\int\frac{R_y}{R^3}dy',$$

where (+) is a repulsive force and (-) is an attractive force.

The differential equation is second-order and requires two integrations.

In the first integration, we have:

$$v_{x'} = f(x') \tag{14}$$

$$v_{y'} = f(y').$$

In the second integration, we have:

$$x' = f(t) \tag{15}$$

$$y' = y = f(t).$$

5.1 - Gravitation

The non-instantaneous gravitational force in q , is:

$$m_0 \gamma \gamma_x^2 \frac{dv_x}{dt} = G m_0 \gamma M_0 \gamma_M \frac{R_x}{R^3} \tag{16}$$

and

$$\gamma_x^2 \frac{dv_x}{dt} = G M_0 \gamma_M \frac{R_x}{R^3} \tag{17}$$

where $\gamma_M = 1 \big/ \sqrt{1 - V^2 / c^2}$.

For $V = 0$, we have an instantaneous force ($R = r$). From (9) and (10), we have:

$$\begin{aligned} &R_x = x = x' \\ &R = \sqrt{x'^2 + y'^2} \\ &\gamma_x^2 \frac{dv_x}{dt} = G M_0 \frac{R_x}{R^3}. \end{aligned} \tag{18}$$

6. Non-inertial frame and non-instantaneous forces

a) We have one preferred frame (S) and one non-inertial frame (S'). Particle Q is at rest in S' , and q is accelerating in relation to S' .

b) Let us suppose the particular case of repulsive forces between equal particles (mass $m = M$ and charge $q = Q$). We can make a mathematical construct with: two inertial frames (S, S') and two particles (q, Q) with acceleration between them that is, equal in modulus but with inverse y directions.

Thus, cases a) and b) are similar and mathematically equal; the calculated values of R, v, F, t and others are the same when calculated in relation to S .

The velocity of S' in relation to S is constant, and $V > 0$. We consider only the Coulomb force. (Fig. 2).

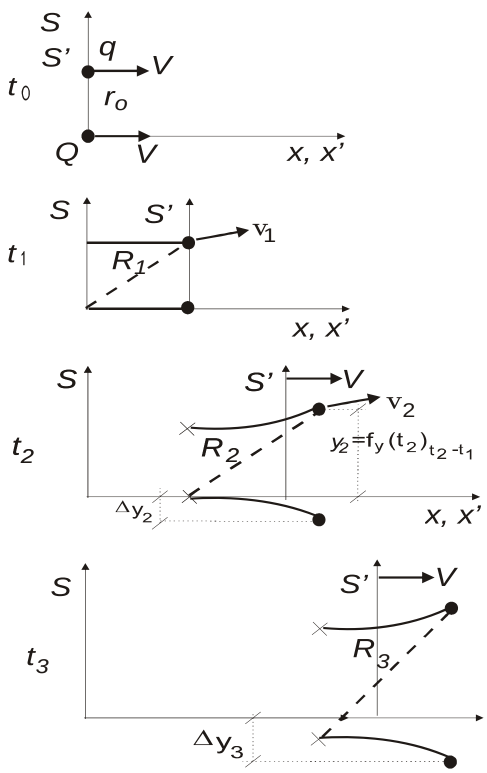

Figure 2 – Non inertial frame - Mathematical construct using two inertial frames (S, S') and particles q, Q with acceleration between them that is equal in modulus but with inverse y directions. For t_o to t_1, the particles haves no acceleration; for $t > t_1$, the particles accelerate in relation to S and S'.

6.1 From t_o to t_1 - First sequence

In this time interval, the particles have no acceleration, and the trajectories are parallel. This is an approach, see Fig. 3.

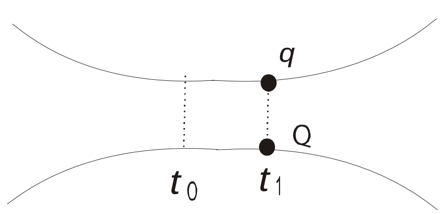

Figure 3 – Trajectories of particles q and Q. In the time interval time t_o to t_1, the trajectories are approximately parallel.

The initial velocity of q and Q is V, which is parallel to x, x'.
From Galilean transformations, we have:

$$x = Vt$$
$$y = y' \qquad (19)$$
$$t = t'$$ (see discussion of time dilation in Section 6.2, Equation (25)).

From Fig. 1, we have:

$$R = c\Delta t\,, \tag{20}$$

where $\Delta t = t_1 - t_o$ is the time interval in which the force travels distance R.

$$R_x = V\Delta t \tag{21}$$
$$R_y = y = y',$$

$$R = \frac{y'}{\sqrt{1-B^2}} \tag{22}$$

$$R_1 = \frac{y_1'}{\sqrt{1-B^2}}\,,$$

and

$$R_{x1} = BR_1 \tag{23}$$
$$R_{y1} = y_1\,.$$

6.2 Time dilation

From (22) and dividing both terms by c, we have:

$$\frac{R_1}{c} = \frac{y_1'}{c}\frac{1}{\sqrt{1-B^2}} \tag{24}$$

and

$$\frac{R_1}{c} = t_1 - t_o = \frac{t_a}{\sqrt{1-B^2}}\,. \tag{25}$$

Equation (25) expresses time dilation, where $t_a = y_1'/c$ (for $V = 0$). The equation is only applicable to the first sequence. For the others sequences, the time dilation differs from equation (25). This subject should be further explored. Thus, time dilation in new Newtonian physics is due to the variation of forces (inside the atom) in relation to the velocity of the atom (v). For the example above, we have $t_1 - t_o = t_a\Big/\sqrt{1-\beta^2}$ and $\beta = v/c$.

6.3 From t_1 to t_2 - Second sequence

$$x = Vt + x'$$
$$y = y' \qquad (26)$$
$$t = t'$$

From Fig. 1, we have:

$$R = c\Delta t\,, \qquad (27)$$

$$R_x = V\Delta t + x' \qquad (28)$$
$$R_y = y = y'\,,$$

where $\Delta t = t_2 - t_1$, and

$$R = \frac{Bx' \pm \sqrt{x'^2 + y'^2\,(1 - B^2)}}{1 - B^2}\,. \qquad (29)$$

From (29) and differential equation (13), in the first integration, we have:

$$v_{x'} = f(x')_{t_2 - t_1} \qquad (30)$$

$$v_{y'} = f(y')_{t_2 - t_1}$$

In the second integration, we have:

$$x' = f_x(t)_{t_2 - t_1} \qquad (31)$$

$$y' = f_y(t)_{t_2 - t_1}\,,$$

and, at time t_2, we have:

$$x'_2 = f_x(t_2)_{t_2 - t_1}$$

$$y'_2 = f_y(t_2)_{t_2 - t_1}$$

$$x_2 = Vt_2 + x'_2 \qquad (32)$$

$$y_2 = y'_2$$

$$R_{x2} = BR_2 + x'_2$$

$$R_{y2} = y_2\,.$$

6.4 From t_2 to t_3 - Third sequence

$$x = Vt + x'$$
$$y = y' \qquad (33)$$
$$t = t'$$

From Fig. 1, we have:

$$R = c\Delta t\,, \qquad (34)$$

where $\Delta t = t_3 - t_2$,

$$R_x = V\Delta t + x' - x'_2 \qquad (35)$$
$$R_y = y + f_y(t - \frac{R}{c})_{t_2 - t_1} - y_1\,.$$

For example, for $R_{2.1}$ (Figure 4), we have:

$$R_{y2.1} = y_{2.1} + \Delta y_{1.1} = y_{2.1} + y_{1.1} - y_1, \qquad (36)$$

where $y_{1.1} = f_y\left(t_{2.1} - \frac{R_{2.1}}{c}\right)_{t_2 - t_1}$.

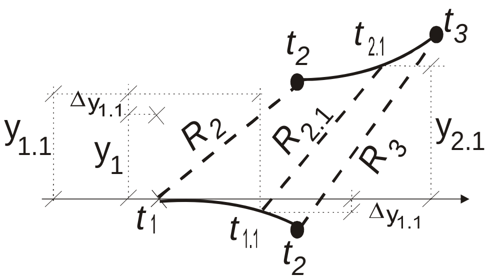

Figure 4 - Function $f_y\left(t_{2.1} - R_{2.1}/c\right)_{t_2 - t_1}$

$$R = \frac{Bx' - Bx'_2 \pm \sqrt{\left(-2Bx' + 2Bx'_2\right)^2 - (1 - B^2)\left(-x'^2 - 2x'x'_2 + x'^2_2 - y'^2 - 2y'\left(f_y(t - R/c)_{t_2 - t_1} - y_1\right) + \left(f_y(t - R/c)_{t_2 - t_1} - y_1\right)^2\right)}}{1 - B^2}$$

(37)

From (37) and differential equation (13), in the first integration, we have:

$$v_{x'} = f(x')_{t_3 - t_2} \tag{38}$$

$$v_{y'} = f(y')_{t_3 - t_2} ,$$

In the second integration, we have:

$$x' = f_x(t)_{t_3 - t_2} \tag{39}$$

$$y' = f_y(t)_{t_3 - t_2} ,$$

and, at time t_3, we have:

$$x'_3 = f_x(t_3)_{t_3 - t_2}$$

$$y'_3 = f_y(t_3)_{t_3 - t_2}$$

$$x_3 = Vt_3 + x'_3 \tag{40}$$

$$y_3 = y'_3$$

$$R_{x3} = BR_3 + x'_3 - x'_2$$

$$R_{y3} = y_3 + y_2 - y_1 .$$

6.5 From t_3 to t_4 - Fourth sequence

$$R_x = V\Delta t + x' - x'_3 \tag{41}$$
$$R_y = y + f_y(t - R/c)_{t_3 - t_2} - y_1 ,$$

and, at time t_4, we have:

$$x'_4 = f_x(t_4)_{t_4 - t_3}$$

$$y'_4 = f_y(t_4)_{t_4 - t_3}$$

$$x_4 = Vt_4 + x'_4 \tag{42}$$

$$y_4 = y'_4$$

$$R_{x4} = BR_4 + x'_4 - x'_3$$

$$R_{y4} = y_4 + y_3 - y_1 .$$

The same calculations can be repeated for the following sequences.

7. Michelson-Morley experiment and new Newtonian physics

The Michelson-Morley experiment [3] involves 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. 5.

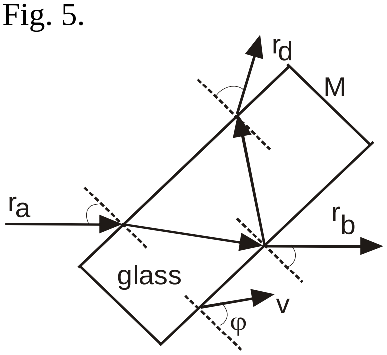

Figure 5 - Semitransparent mirror M with velocity V as well as, incident ray (r_a), the refracted-reflected-refracted ray (r_d) and refracted-refracted ray (r_b).

For complete calculations of the trajectory and displacement of the interference fringes, we must study the equations of refraction and reflection in vacuum and in glass.

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

7.1 Reflection in vacuum

In the Supplement of the MM paper [3], the equations of ray reflections in a moving mirror are shown in relation to a preferred frame. The equations in relation to the CMB are the same.

From [3]:

"Let ab (Fig. 6) 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."

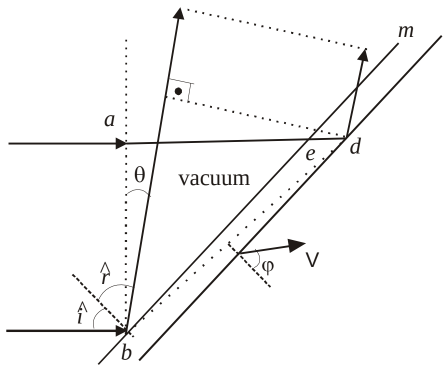

Fig. 6 – Reflection in vacuum. Incident and reflection plane waves

Michelson and Morley also demonstrated the following equation:

$$\tan\left(45^\circ - \frac{\theta}{2}\right) = \frac{ae}{ad} = 1 - \frac{V\sqrt{2}\cos\varphi}{c} \quad . \tag{43}$$

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 [4], we have:

$$\tan\hat{r} = \frac{1 - B^2\cos^2\varphi}{1 + B^2\cos^2\varphi \pm 2B\cos\varphi\sec\hat{i}}\tan\hat{i} \, , \tag{44}$$

where $\hat{i}$ and $\hat{r}$ are respectively, the angles of incidence and reflection in relation to the normal of the mirror. Additionally, $B = V/c$, where V is the velocity of the mirror in relation to the CMB, 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.

7.2 Reflection in glass

For $V = 0$:

$$u = \frac{c}{1.52} = 0.658c \, , \tag{45}$$

where u is the velocity of light inside the glass in relation to the CMB and glass with $V = 0$.

For $V > 0$:

$$\mathbf{u}_{CMB} = \mathbf{u} + \mathbf{V}\left(1 - \frac{u^2}{c^2}\right)$$

and (46)

$$u_{CMB}^2 = \left[u_x + V_x\left(1 - \frac{u^2}{c^2}\right)\right]^2 + \left[u_y + V_y\left(1 - \frac{u^2}{c^2}\right)\right]^2, \quad (47)$$

where u_{CMB} is the velocity of light inside the glass in relation to the CMB, V is the velocity of glass in relation to the CMB and $V\left(1 - u^2/c^2\right)$ is the Fresnel drag.

In addition,

$$\mathbf{u}_{glass} = \mathbf{u}_{CMB} - \mathbf{V}, \quad (48)$$

where u_{glass} is the velocity of light inside the glass in relation to glass.

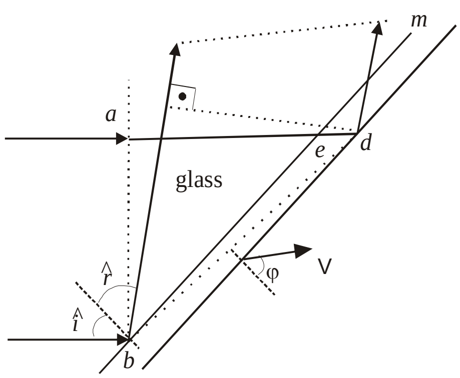

Figure 7 – Reflection in glass. Incident plane wave and reflected non-plane wave.

As shown in Fig. 7, after reflection, we have a non-plane wave.
The equations of reflection in glass must be further developed.

7.3 Refraction in vacuum-glass for V = 0

From Snell's law of refraction we have:

$$\sin\hat{i} = \frac{c}{u}\sin\hat{f}_0 = 1.52\sin\hat{f}_0 . \quad (49)$$

7.4 Refraction in vacuum-glass for V > 0

Additionally,

$$\sin\hat{i} = \frac{c}{u_{CMB}}\sin\hat{f}, \quad (50)$$

where $\hat{i}$, $\hat{f}_0$ and $\hat{f}$ are the angles, respectively, of incidence, refraction for $V = 0$ and refraction for $V > 0$. The angles are in relation to the normal of the glass (Fig. 4).

7.5 The Michelson-Morley experiment

The Michelson-Morley experiment requires one semi-transparent mirror, 16 mirrors, a lens and a telescope. In Fig. 8, we substitute 2 mirrors for 16 mirrors.

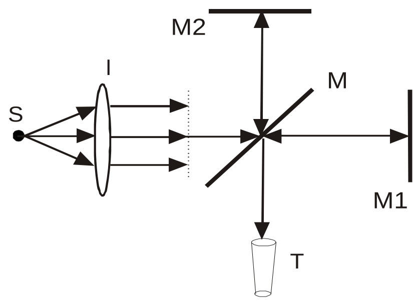

Figure 8 – Michelson-Morley experiment with one semi-transparent mirror, 2 mirrors, a lens and a telescope.

In Fig. 8, S, l, M, M1, M2 and T are, the light source, lens, semi-transparent mirror, mirror 1, mirror 2 and telescope, respectively.
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 [5-7].
For the telescope, we substitute screen B, as shown in Fig. 9.

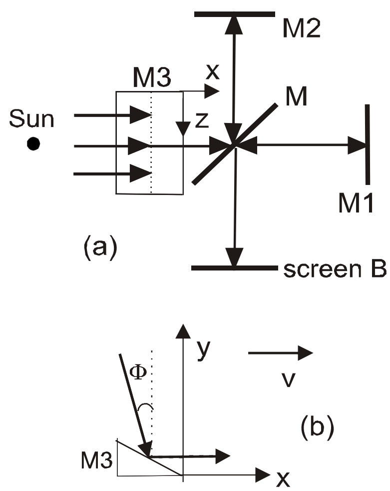

Figure 9 – Michelson-Morley experiment with sun light and secreen B. Panel (a) shows the x-z plane, while (b) shows the x-y plane.

M3 is a mirror to capture sun or star light.
The displacement of interference fringes must be calculated using the equations above.

Conclusion

New equations for the motions of bodies are derived for inertial and non-inertial frames using:
a) some special relativity equations (but derived from Newtonian physics)

b) non-instantaneous forces
c) Galilean transformations and a preferred frame (the cosmic microwave background).

The same special relativity equations of mass variation, kinetic energy and mass-energy relations are derived by Newtonian physics using the laws of conservation of mass, energy and momentum.

Time dilation by our new Newtonian physics is shown in the initial equations, although further development is required to derive the complete equations.

For the Michelson-Morley experiment, equations for refraction and reflection in glass are derived (the MM experiment uses a semi-transparent mirror, lens and telescope), although, again, further development of the complete equations is needed.

References

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[2] M. Novello, *Scientific American Brasil, Edição Especial, Artigos: Observatório*, **125** (outubro 2012) 22 – original in Portuguese: "Quatro das principais criticas à relatividade estão no território da astrofísica e da astronomia, a saber: singularidade, matéria escura, energia escura e quantização....Os cientistas começaram então a procurar por uma nova teoria da gravitação que fosse a versão relativista da formulação newtoniana sendo então levados a descrever o campo gravitacional como um campo escalar, isto é, por via de uma só função (semelhante neste aspecto, à versão newtoniana)...."
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