ORIGIN, DEVELOPMENT AND DECLINE OF THE THEORY OF RELATIVITY

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ABSTRACT

Special relativity is an Einstein's theory which is developed to justify the reality of auxiliary Lorentz transformation equations by two principles consisting of two pairs of equations inversely deduced from Lorentz transformation equations themselves with the assumption that those two pairs of auxiliary equations are real. In short, special relativity of Einstein is the assumption that the auxiliary Lorentz transformation equations are real. This theory implies 4 –dimensional flat space to describe steady motion and 4-dimentional curved space for accelerated motion of test particles. General relativity is another Einstein's theory which constructs an artificial equation to describe assumed curvature in the Riemannian manifold originating from the presence of mass in the free space and having the structure as that required to describe acceleration in the framework of special relativity, such that the advance of the perihelion of Mercury and the Newton's Law of motion near the surface of the earth could be deduced from the chosen structure of the manifold as natural geodesic motion of a test particle in the manifold. In short, general relativity is the belief that presence of mass and energy in the supposed Minkowski space makes that space curved in such a way that all gravitational equations could be deduced from that curvature as the natural geodesic equation of motion of test particles in that space instead of as the results of the gravitating force acting between the objects. Electromagneticians have amply demonstrated that electric field, magnetic field, electric charges and electromagnetic energy are all real physical entities. All physical objects are subject to gravitation. Therefore, it is likely that electromagnetic entities too are subject to gravitation. It could be easily shown that if we assume that electromagnetic entities are subject to gravitation and they have the same acceleration as that of all physical bodies in the same gravitating field, all electromagnetic and gravitational phenomena could readily be explained from classical electrodynamics.

1.1 Origin and Development of Special Relativity:

The scalar and vector potentials of a system of charges and currents stationary in free space are governed by Poisson's equation whereas the similar potentials of a system of charges and currents steadily moving in free space are governed by D'Alembert's equation. Heaviside (1888, 1889) and Thomson (1889) first correctly calculated the scalar and vector potentials of a steadily moving point charge by transforming the D'Alembert's equation of the potentials for the steadily moving charge into Poisson's form for a static charge by elongating a coordinate axis lying along the direction of the translation of the charge. They thus developed a way to solve dynamic problems like static problems using an auxiliary equation in the form of Poisson's potential equation.[1,2,3, 4, 5, 9].

Heaviside and Thomson deduced their auxiliary equations i.e., $x' = \gamma\, x$, $y' = y$, $z' = z$ [where $\gamma = 1/k$ and $k = \sqrt{1-u^2/c^2}$, (x,y,z) are the co-ordinates attached with the free space and 'u' is the velocity of the system in the free space] to solve the potential problem of the system of charges and currents moving steadily in free space. If electromagnetic action is considered after the time t of the instant when the coordinate attached to the system coincided with the coordinate attached to free space, the above equation should be changed to the following equation:

$$x' = \gamma(x - ut), \;\; y' = y, \;\; z' = z \qquad \text{(1a-c)}$$

The device of this auxiliary system imaginarily elongated as per the above equations and comprising of x', y', z' was successfully initiated and used by Heaviside (1888,1889) and Thomson (1889) to study the potentials of moving system of charges classically. From this analysis, we see that the E-field and B-field in our moving system (S) are not connected with the same quantities of the same system at rest (S_0). These quantities of the moving system (S) are connected with the corresponding quantities of the system (S') in which the co-ordinates parallel to the OX axis lying along the direction of movement of the system have been elongated by the Eqs. (1a-c) [1, 2,3,4,5,9].

The problem Heaviside and Thomson addressed was to model the potentials for charges having a constant translational velocity in free space. They solved this problem by transforming the D' Alembert's equation in an invariant form with Poisson's in the auxiliary system. Lorentz's problem was to model radiation from moving bodies. He solved this problem by transforming Maxwell's equations for the moving radiating body to the same form for the auxiliary system, which correlates between the static and dynamic radiation states.

From the considerations of Heaviside's electrodynamics, it could be shown that when a radiating dipole moves, its fields change. Therefore, a stationary radiating dipole may not radiate while it moves. But when a radiating dipole moves steadily, its fields must be Heaviside's fields which obey Maxwell's equations just like Coulomb's fields do. Therefore, if a stationary dipole radiates, it will also radiate while steadily moving i.e.,
If $\Box^2 \mathbf{E_0} = 0$, then $\Box^2 \mathbf{E} = 0$, (where E_0 is the electric field of the stationary dipole and E is the similar field of the moving dipole). From this, we get,

$$x^2 + y^2 + z^2 = c^2 t^2 \qquad \text{(2a)}$$

To solve radiation problems in a way analogous to that as developed by Heaviside[1,2,3,4,5], we are to keep the Maxwell's equation in the same form in the S' system; i.e., it is now required that $\Box'^2 \mathbf{E}' = 0$ where $\mathbf{E}'$ is the auxiliary electric field of Heaviside and Thomson in the S' system. That is, we are to make,

$$x'^2 + y'^2 + z'^2 = c^2 t'^2 \qquad \text{(2 b)}$$

where x', y', z' are defined in eqs. (1a-c) and t' is to be chosen appropriately.

Subtracting Eq. (2a) from Eq. (2b) and using the Heaviside-Thomson auxiliary equations (1a-c)

$$x' = \gamma(x - ut), \;\; y' = y, \;\; z' = z$$

to replace the primed variables, we get

$$c^2 t'^2 = (x-ut)^2 / \left(1-u^2/c^2\right) + x^2 - c^2 t^2$$

Or, $t' = \gamma(t - ux/c^2)$ (1d)

the famous auxiliary time equation of Lorentz. From the analysis presented in this section, we see that the wave properties (i.e., wave –length and time period of the wave) of our moving system (S) are not connected with the same quantities of the same system at rest (S_0). These quantities of the moving system (S) are connected with the corresponding quantities of the system (S') in which the co-ordinates and time have been elongated as per the equations (1a-c) and (1d) conjointly.

An interesting fact about the equations is that the inverse Lorentz Transformation equations (which could be deduced from Lorentz Transformation equations) have the same form as the Lorentz Transformation equations themselves; *i.e.*, if

$x' = \gamma(x - ut),\ y' = y,\ z' = z,\ t' = \gamma(t - ux/c^2)$ (1 a-d)

then

$x = \gamma(x' + ut'),\ y = y',\ z = z',\ t = \gamma(t' + ux'/c^2)$ (3a-d).

Therefore, Lorentz transformation equations can be deduced in reverse from the dyads of Eqs. (2a) & (2b) and (1a-c) & (3a). These transformation equations were later observed and used by A. Einstein in his theory.

It should be mentioned here that all the quantities x', y', z', t' are auxiliary. Thus, from the standpoint of electrodynamics, Lorentz Transformation Equations are tactical, just like the tactical equations of Heaviside and Thomson. To consider all four Lorentz's transformation equations *i.e.*, Eqs.(1a-d) as 'real' is an unwise over simplification of electrodynamics and of nature. Lorentz's auxiliary equations are actually extended Heaviside-Thomson auxiliary equations which are solely based on Newton-Maxwell interpretation of the physical world.

Those auxiliary equations are very useful to solve correctly many electrodynamic as well as radiational problems of moving systems of charges and currents classically. Therefore, all electrodynamic and radiation equations used by relativists are the same as the classical equations. Anybody who uses these equations to explain any electrodynamic phenomena employ classical physics at the outset.

Up to this point of development, Lorentz proceeded classically. But thereafter he left the classical path for the following reasons:

Light propagates with the speed 'c' in free space where Earth moves with a very high velocity. Therefore, the speed of light should change if measured on the surface of Earth depending on the direction of movement of the earth. Michelson in 1881 and Michelson & Morley in 1887 measured the difference of speeds of light in two different directions on Earth and got the null result [i.e., there is no direction dependence of the speed of light on the surface of the moving Earth]. Moreover it was known at that time that all electrodynamic phenomena on the surface of the moving earth are independent of the movement of Earth. All those perplexing phenomena bewildered Lorentz.

To overcome the difficulty, especially to explain the null result of the Michelson-Morley Experiment, FitzGerald in 1889 suggested the real contraction of moving bodies.

As discussed previously, by proceeding from the Heaviside-Thomson auxiliary space equations [*i.e.*, $x' = \gamma(x - ut)$, $y' = y$, $z' = z$] Lorentz developed his auxiliary time equation $t' = \gamma(t - ux / c^2)$ to solve radiation problems of moving bodies classically. But, Lorentz could not explain the null result of the Michelson-Morley experiment from any electro-dynamic principle. So he accepted the doctrine of FitGerald that moving bodies really contract *i.e*., the equations $x' = \gamma(x - ut)$, $y' = y$, $z' = z$, are real for moving electromagnetic bodies as well as moving mechanical bodies. This view was endorsed by Larmor.

From this consideration, Earth is also really dilated to its direction of motion when measured on Earth.

Now, if $x' = \gamma(x - ut)$ is a real equation for the moving Earth, then x', y', z' are not some arbitrary auxiliary elongated unreal Cartesian co-ordinates, and $\mathbf{E}'$ and $\mathbf{B}'$ will not be auxiliary fields of similar nature, invented to solve some problems, as classical electro-magneticians did. Instead, x', y', z' will be the real co-ordinates of the moving Earth, and $\mathbf{E}'$ and $\mathbf{B}'$ are the real fields measured on the moving Earth. Thus, when a stick on the moving Earth is kept parallel to the direction of motion of the Earth, and is measured from free space, its length, according to Lorentz, will be shorter by the factor k than its length if measured on Earth. Fitzgerald, Lorentz and Larmor have interpreted this as meaning that moving objects contract towards their directions of motions.

Lorentz, however, considered that his time equation is auxiliary and unreal. Thus, to Lorentz, the Cartesian co-ordinate derivative part of the auxiliary Maxwell equation $\Box'^2\mathbf{E}' = 0$ is real, while the time derivative part of the same equation is auxiliary and unreal and the above auxiliary Maxwell equation is quasi-real to him.

Max Abraham contradicted correctly the real contraction of moving objects. Thus the Lorentz transformation equations though derived from classical electro-dynamics, when infused with the idea of real contraction while moving violated classical mechanics. These masterpieces of Lorentz, although immensely effective in calculating the radiation problems of moving point charges, were illegitimate from the standpoint of mechanics. Lorentz was fully aware of this.

Einstein assumed with a further novelty that the time equation of Lorentz was also real, in addition to the reality of the transformation equations of Heaviside-Thomson. So to him the auxiliary Maxwell equation $\Box'^2\mathbf{E}' = 0$ was not quasi-real as it was to Lorentz; it was fully real to Einstein just like radiation equation of the Heaviside's fields i.e. , $\Box^2\mathbf{E} = 0$.

Lorentz did not proceed to prove the real contraction of his transformation equation from any electro-dynamic or general principle. It was accepted by him as an *ad-hoc* basis to explain the null result of the Michelson-Morley Experiment.

Einstein's step was however to justify by some arbitrary principles the reality of the useful Lorentz transformation equations, and to qualify that these principles are absolutely real as such, and that Lorentz transformation equations derived reversely from those principles are also absolutely real. Thus, Einstein justified the equation

$\Box^2\mathbf{E} = 0$ [,i.e., $x^2 + y^2 + z^2 = c^2t^2$ (2a)]as well as $\Box^2\mathbf{E} = 0$,[i.e., $x'^2 + y'^2 + z'^2 = c^2t'^2$(2b)]

by the principle that *the velocity of light is the same for all inertial frames by which he means (with some philosophy) the dyad of equations i.e.,* $x^2 + y^2 + z^2 = c^2t^2$ and $x'^2 + y'^2 + z'^2 = c^2t'^2$, and, thereafter to justify the sets of the standard and the inverse Lorentz Transformation equations excepting the time equations he principled *that all physical laws are covariant to all inertial frames, by which he means (obviously with some philosophy)* $x' = \gamma(x - ut)$, $y = y'$, $z = z'$ *(1a-c)and* $x = \gamma(x' + ut')$, $y' = y, z' = z$*(3a-c) where* γ *is an arbitrary constant.* Thus, these two sets of two equations when solved will give Lorentz transformation equations, and if those principles are real, then all the four Lorentz Transformation Equations will also be real.

In his interpretation Einstein has removed the question of real contraction of moving electron as advocated both by Lorentz and Poincare. According to Einstein's interpretation, the shape and size of the electron remain the same whereas different observers at different velocities would observe it differently.

Thereafter Einstein has further proceeded to extend his beloved covariant principle to the cases of accelerated motions which is according to him equivalent to gravitation.

Therefore, from historical point of view, we may say that both of the Poincare-Lorentz and Einstein-Minkowski Programs originate from the assumptions that the auxiliary transformation equations of Lorentz are real.

However, to explain the null result of the Michelson-Morley Experiment, the assumption of the reality of auxiliary transformation equations of Lorentz are not essential.

1.2 Alternative to Special Relativity:

Instead, if we assume that electric and magnetic fields are real physical entities [5,6,7] and the earth carries electric and magnetic fields along with its surroundings just like it carries all other physical objects with it [8], the null result could simply be explained. Moreover, this simple assumption could at once settle why all electrodynamic phenomena as observed on the surface of the moving earth are independent of the movement of the earth [vide appendix-I attached with the last part of this paper].

2.1 Origin and Development of General Relativity:

Isaac Newton formulated the laws of mechanics as well as the law of gravitation. Similarly, Einstein reformulated the laws of mechanics in his construction of special relativity and set his plan to reformulate the law of gravitation consistent with the propositions of special relativity.

To do so, he first assumed that infinitesimally, the physical effects of gravitation are indistinguishable from those of acceleration which implies that inertial mass and gravitational mass are one and the same [which is, however, not at all tenable from physical point of view at the outset. As for an example, when a charge accelerates in free space, it will radiate but if the charge is at rest in the free space and the observer accelerates towards it, no one should believe from only Einstein's suggestion that the observer will measure radiation from the charge]

From Galileo, it was known that acceleration of bodies in gravitating field is independent of its inertial mass which as per Newton's mechanics and his gravitational theory implies that inertial mass is proportional to gravitational mass. This is simply a co-incident.

But, as per Einstein's gravitational theory, both the masses are by definition the same.

It is not possible to describe acceleration as per Einstein's special relativistic mechanics in flat Minkowski space. In this case, special relativity must use general curvilinear co-ordinate for the specification of points in the physical space. Therefore, as per Einstein's assumption [i.e., the structure of gravitational space is similar to that of the space required to describe acceleration in Minkowski space], gravitational space must be Riemannian manifold having the structure of that type of space required to describe acceleration in terms of special relativistic mechanics.

Maxwell described the force acting between two charges separated by a distance by the stress of the points in the free space caused by the presence of charges in free space (ether). William Clifford (1845-1879), a British mathematician developed the idea that the physical properties of matter and properties of curved space are related. Following the same line of thought, Einstein assumed that presence of gravitating body in free space will alter the structure of the flat Minkowski space to that required for description of accelerated motion as per special relativity. This altered structure of space should create curvature in the manifold which could explain the motion of a test particle near a large body as the natural geodesic motion of the particle in the manifold, instead of the gravitating force acting between the large body and the test particle. Just like Maxwell imagined space (ether) as a material body, so did Einstein.

Therefore, according to Einstein, the natural geodesic motion of a test particle in that curved space is equivalent to its motion in a gravitational field. Einstein's special relativistic space to describe acceleration is a curved 4-dimensional space, space being a function of time. Therefore, space near a gravitating body will similarly be a curved 4-dimentional space.

Thus, at the outset, Einstein started with the assumed similarity of the gravitational space with the space required to describe acceleration in Minkowski space. Thereafter, he proceeded to formulate the exact specification of space time curvature of that space which will fit with the known results of motion of bodies in a gravitating field.

Now, a 4 - dimensional curvilinear general space can only be studied with the help of Riemannian geometry. Therefore, Einstein formulated his theory of gravitation in the framework of Riemannian geometry with 16 matrices $g_{\mu\nu}$, every element of which should be determined from the behavior of a test particle near a gravitating body. Out of those 16 matrices, by dint of the tacit assumption of Einstein stated previously (i.e., the structure of gravitational is similar to that required to describe acceleration in special relativity), 14 are the same as 14 matrices of Minkowski geometry. The remaining two elements g_{11} and g_{44} are to be chosen in such a way that could explain the Newton's laws of motion near the surface of the earth as well as the exact equation of motion of Mercury round the sun.

Now, according to Einstein, Earth's gravitational field is a weak gravitational field where Newton's equation of gravitational potential holds. In such situation, g_{44} should be approximately equal to $(1+2\Phi/c^2)$ i.e., $(1-\frac{2GM}{c^2 r})$, r being the distance of the test-particle from the center of the gravitating body, Φ is the potential function, G, the gravitational constant, M, the mass of the gravitating body and c is the speed of light in free space.

Now, from Einstein's consideration, presence of gravitating mass in free space will modify the Minkowski space as has been used by him in special relativity. Structure of the space, as per his assumption will be similar to that used to represent points for acceleration as per special relativity. However, mass point is static and isolated, line element in that space will be spatially spherically symmetrical. The most general form of such a line element compatible with the Minkowski line element is:

$$ds^2 = -e^{\lambda} dr^2 - r^2 d\theta^2 - r^2 \sin^2\theta d\phi^2 + e^{\nu} dr^2,$$

where e^{λ} and e^{ν} are to be chosen in such a way which could explain the known laws of motion in a gravitating field as natural geodesic motion of test particles in the assumed curvature instead of the results of the gravitating force acting between objects.

It was known for a long time that Newton's equation of planetary motion

$\frac{d^2U}{d\theta^2} + U = \frac{GM}{H^2}$ could not explain the advance of perihelion of Mercury.

Einstein found that the chosen equation $\frac{d^2U}{d\theta^2} + U \approx \frac{GM}{H^2} + \frac{3GM}{c^2 r^2}$ could be used to explain the advance of the perihelion of Mercury.

Previously, it is shown that to explain the equation of gravitational potential near the surface of the earth, Einstein has chosen $e^{\nu} \approx (1-\frac{2GM}{c^2 r})$. Now he finds that if he chooses $e^{\lambda} \approx (1-\frac{2GM}{c^2 r})^{-1}$, somehow he could explain the advance of the perihelion Mercury.

Thus the question of the exact specification of the space compatible with Einstein's theory of gravitation, which could explain the advance of the perihelion of Mercury as well as Newton's laws of motion near the surface of the earth, was settled. Now, it is likely that the motion of light waves near a gravitating body should be constrained by the structure of this space.

Now, as per Riemannian geometry, such a space is possible when the Ricci tensor, $R_{\mu\nu} = 0$.
Therefore, Einstein inversely assumed that in empty space $R_{\mu\nu} = 0$. This will inversely lead to the result of g_{11} via the result of g_{44}, which in turn will explain the advance of the perihelion of Mercury as well as Newton's Laws of motion near the surface of the earth.

Finally, it is clear that Einstein's equation of gravitation should be organized in such a way that (i) the equation of gravitation in the empty space will be $R_{\mu o} = 0$ (ii) and for so called weak field, as in the case of the earth, the equation could be transformed to $\nabla^2\Phi = 4\pi G\rho$.

For these, Einstein chose the artificial equation

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = 4\pi G\rho \ ,$$

where R stands for scalar curvature and ρ is the density of matter.
However, for his personal tensorial belief not relevant to physics, he liked to remodel the equation as

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = -8\pi T_{\mu\nu}$$, (where $T_{\mu\nu}$ is the material energy tensor)

which is the famous Einstein's law of gravitation measuring curvature of space on account of the presence of mass and energy at a point . The equation as shown in the analysis is made quite artificially.

Therefore, the belief that the advance of perihelion of Mercury provides one of the experimental tests of general relativity is not at all correct.

Einstein incorporated the metric $g_{11} \approx -(1 - \frac{2GM}{c^2 r})^{-1}$ via $g_{44} \approx (1 - \frac{2GM}{c^2 r})$ (in his theory through $R_{\mu o} = 0$) to explain the known observed effect.

2.2 Alternative to General Relativity:
However, to explain the motion of Mercury round the sun, the assumption of the reality of the specific space- time curvature of the so-called 4-dimensional Minkowski space near the surface of the gravitating body is not essential. Instead, if we assume that planets contain charges which act as mass points in the gravitating fields, the motion of Mercury round the sun could easily be explained. More over, this simple assumption, if extended to the case of electromagnetic energy, could readily explain the gravitational red shift of astral rays and the observed bending of light rays grazing the surface of the sun [10,11, vide the appendix-II attached with the last part of this paper].

References

[1] O. Heaviside, Electrician, Dec.7, 145, (1888).
[2] O.Heaviside, *Electrical Papers,* Vol. ii, 514 (1892).
[3] E.T.A.Whittaker, *History of the Theories of Ether and Electricity*, Vol.1 (Thomas Nelson and Sons Ltd., 1951), 307-309.
[4] S.Hajra, and D.Ghosh, A critical analysis of special relativity, in *Physical Interpretations of Relativity Theory 2000*, edited by Dr M. C. Duffy, 137-155.
[5] Sankar Hajra, Nature of electric and magnetic fields at the vicinity of the Earth's surface, PIRT-Moscow, 2003, Edited by Dr. M.C. Duffy, V.O. Gladyshev & A.N. Morozov, pp.224-238.
[6] S. Kompaneyets, *Theoretical physics* (Foreign Language Publishing House, Moscow, 1961), 105.

[7] David J. Griffiths**,** *Introduction to Electrodynamics* (Prentice Hall International, Inc., Englewood Cliffs, 1989), 64.

[8] A. Zapfee, Ind.J. of Theo. Phy., **40,** 145-148. (1992).

[9] Sankar Hajra & Antina Ghosh, " Collapse of SRT-1:Derivation of Electrodynamic Equations from the Maxwell Field Equations", Galilean Electrodynamics, **16**, 4, 63-70 (2005),

[10] Sankar Hajra, Derivation of Lorentz transformation equations & the exact equation of planetary motion from Maxwell & Newton, PIRT-London, 2004, 439-444.

[11] C.Kar, *New Approach to the Theory of Relativity* (Institute of Theoretical Physics, "Bignan Kutir", 4/1,Mohan Bagan Lane, Calcutta-4,1970), 52-57.

Appendix-1

Equations of electro-dynamics describe interactions of charges with electric and magnetic fields, as well as propagation of electromagnetic disturbances in free space. Electromagnetic fields possess momentum and energy that could be experienced by our sense organs. It follows from these facts that electric and magnetic fields are real physical entities [6, 7].

The earth carries all physical objects which surround it. Therefore, it is natural that the earth should carry electric and magnetic fields just as it carries all physical objects with it.

All the results of electromagnetic experiments performed on the surface of the moving earth are seen to be unaffected by the motion of this planet. Therefore, one must conclude that in the vicinity of its surface, the earth carries electric and magnetic fields along with it just as it carries all other physical objects with it. The following examples are provided to demonstrate the point.

In a laboratory environment, when a charged condenser moves, the electric field around it changes and thereby a magnetic field is created. If the electric field originating from the condenser would move along with the condenser, there would be no change of electric field around the condenser and thereby, there would be no magnetic field around it.

Now, a condenser at rest on the earth's surface moves with the earth at the same velocity which is extremely high. But, the Trouton-Noble Experiment (1904) fails to detect any magnetic field around the condenser. This implies that the earth carries the condenser along with its electric field.

Light propagates with a velocity 'c' in free space where the earth also moves at a speed which is comparatively a lot less than 'c' but still very high. Therefore, the velocity of light should change if measured on the surface of the earth depending on the directions of movements of the earth and the light beam. But it is well confirmed by Michelson and Morley that the velocity of light is the same 'c' in all directions if measured on the surface of the moving earth. This can happen only if the earth carries the electromagnetic fields along with it.

The Michelson–Morley experiment is sensitive to the translation of the earth but not to its spinning around its axis. Kennedy and Thorndike (1932), using an interferometer with unequal arms, carried out the appropriate experiment and found that the result is independent of the spinning of the earth around its axis, or the rotation of this planet about the sun in its orbit. This is only possible if the earth, while it translates, spins around its axis and rotates in its orbit,the electric and magnetic fields translate, spin and rotate along with it.

The Michelson-Morley experiment performed on the surface of the earth with starlight (Tomaschek, 1924) and with sunlight (Miller, 1925) has also registered null results.

All the results of all those experiments confirm that the electric and magnetic fields originating from the earth or from the stars and detectable at the vicinity of the earth's surface translate, spin and rotate with the translation, spinning and rotation of the earth, exactly in the same way as all other physical objects on the earth's surface do.

If a man moves through rains falling straight, he has to incline his umbrella for a better cover due to the motion of rains relative to the motion of the man. Similarly, when light beam (photon rains) comes from the stars, one to see these stars has to tilt the telescope due to the motion of the light beams relative to the motion of the earth. This is commonly called the raindrop effect for starlight (or stellar aberration). Similar raindrop effect should have been observed for light rays coming from a high mountain. No raindrop effect is observed at the earth's surface for light rays coming from a high mountain top [8]. These observations clearly indicate that the earth carries electric and magnetic fields along with its surroundings just as it carries all other objects with it.

Thus, it may be clear from the above analysis that to explain the null result of the Michelson-Morley experiment and the relevant electrodynamic phenomena, FitzGerald –Lorentz contraction hypothesis and the consequent Einstein's two principles were unnecessary.

Appendix-II [10,11]

From the consideration of classical electrodynamics it could be shown that [9, p.67]

Electromagnetic force acting on a point charge moving steadily in free space

a) in a direction parallel to the direction of the uniform electric field operating in free space,

$$F_{||} = (d\,|P|/du)\ f_{||} = (m_0/k^3)\ f_{||} = \gamma^3 m_0 f_{||} \qquad (1)$$

where $f_{||}$ is the acceleration of the point charge in the direction parallel to u and

b) at a direction perpendicular to the direction of the uniform electric field operating in free space.

$$F_{\perp} = (|P|/|u|)\, f_{\perp} = (m_0/k)\, f_{\perp} = \gamma m_0 f_{\perp} \qquad (2)$$

Where $f_{\perp}$ is the acceleration of the point charge in the direction perpendicular to u.

If we assume that charges are subject to gravitation and they have same acceleration as that of material bodies in the same gravitating field, it could be shown with a little analysis that in a gravitating field, a point charge acts a mass point; mass of the mass point is proportional to the longitudinal electromagnetic mass of the point charge.

Exact Equation of Planetary Motion

Suppose that a planet of mass m_p contains 'Q' amount of positive and negative charges in total (ignoring the sign of the charges) and for simple calculation let us assume that the total charges are concentrated at the center of the planet. In this situation, if we assume that the longitudinal electromagnetic mass of a point charge is proportional to its mass, the equation of planetary motion will be as under:

Radial Force

$$-GM_s(m_p+\gamma^3 m_0)/r^2=(m_p+\gamma^3 m_0)\left(\ddot{r}-r\dot{\theta}^2\right)$$

$$-GM_s/r^2=\left(\ddot{r}-r\dot{\theta}^2\right) \qquad (3)$$

where $\gamma^3 m_0$ is the **longitudinal electromagnetic mass** as well as the mass of the charge associated with the planet, proportionality constant being taken as unity. M_s is the total mass (non-electromagnetic mass & mass originating from charges in the sun) of the sun concentrated at the origin, and the planet passes through a point $(r.\theta)$, r is the distance between the sun and the planet and θ is the angle down from the x-axis.

Cross-radial Force

$$=\left(F_G\right)_\theta=\frac{1}{r}\frac{d}{dt}\left[\left(m_p+\gamma^3 m_0\right)\times r^2\dot{\theta}\right]=0 \qquad (4)$$

Or. $\gamma^3 r^2\dot{\theta}\approx H=$ Constant (5)

Let $U=1/r$

From equations (3) & (5) we may deduce

$$d^2U/d^2\theta+U=GM_s\gamma^6/H^2=GM_s(1+3u^2/c^2)/H^2$$

$$=GM_s/H^2+3GM_s/c^2r^2 \qquad (6)$$

(When 'u' is very small in comparison to 'c' and replacing one H by equation (9) and noting that for circular motion $u=r\dot{\theta}$], which could explain the advance of the perihelion of Mercury satisfactorily.

Bending of Light Rays Grazing the Surface of the Sun

Now, assume that electromagnetic energy is similarly subject to gravitation.

This empowers us to apply equations (3) & (4) to the case of propagation of electromagnetic radiation grazing the surface of the sun having gravitational mass M_s and radius R_s .Therefore, equation of motion of a light beam passing through a medium (such that the velocity $'u'$ of the light beam in the medium is much smaller than $'c'$), medium being fixed with the sun's surface will take the form:

$$d^2U / d^2\theta + U = 3GM_s / c^2 R_s^2 \qquad (7)$$

By usual way, we may now deduce from eq.(13) the angle of the total deflection of light ray passing near the surface of the sun as $4GM_s / c^2 R_s$

which is widely believed to have been confirmed by many experiments.

Gravitational Red Shift

Suppose that a ray with the radian frequency ω is coming from the surface of a star of radius R_t and of mass M_t to the surface of the earth, r distance away from the star. As per our previous discussion, we assume that electromagnetic energy has the same acceleration as that of material bodies as well as point charges in the same gravitational field. Therefore, the velocity of the ray at the surface of the earth $V = c - \int_{R_t}^{r} (GM_t / r_1^2) dr_1 / c$, [where r_1 is the distance of an arbitrary point on the line of joining the star and the earth] $= c\left(1 - GM_t / R_t c^2\right)$,

from which we have,

$$\omega^{/} / \omega = \left(1 - GM_t / R_t c^2\right) \qquad (8)$$

($\omega^{/}$ is the radian frequency of the same light ray at the surface of the earth), as the number of complete waves passing through a point (i.e., frequency) must be proportional to the velocity of the waves.