To Date : 02.06.2000

Dr. M. C. Duffy (michael.duffy@sunderland.ac.uk),
University of Sunderland,
United Kingdom.

Dear Dr. Duffy,

We are sending herewith our paper "**A CRITICAL ANALYSIS OF SPECIAL RELATIVITY**" for its presentation in the PIRT VII conference to be held in the Imperial College, London. We are trying our best to attend the conference.

Please send us invitation letters by post, otherwise, we will not get visas to enter U.K. Please acknowledge receipt of this paper.

Yours sincerely,

(**SANKAR HAJRA**)
For SANKAR HAJRA & DEBABRATA GHOSH

RBI, DICGC,
15, N. S. Road,
Calcutta - 700 001,
India.

A CRITICAL ANALYSIS OF SPECIAL RELATIVITY

SANKAR HAJRA & DEBABRATA GHOSH
R.B.I., DICGC,
15, N. S. Road,
Calcutta- 700 001, India

A B S T R A C T

Oliver Heaviside (1850 - 1925), the greatest electromagnetician after Maxwell (1831-1879) calculated the electric field and the magnetic field of a moving point charge in free space.

Heaviside and his followers found that the d' Alembert's equations of scalar and vector potentials for a system of charges distributed in any way, and moving in free space with a constant velocity in any direction could be reduced to the form of Poisson's equation. Thus, they developed the way of solving dynamic potential problems in a static way, through some unreal Heavisidean auxiliary space equations and auxiliary field equations which correlate between the static and the dynamic states. Lorentz extended this tactics to Maxwell's wave equation to solve dynamic radiation problems and developed his famous auxiliary time equation.

It can be easily shown that Heaviside's electrodynamics could be used to understand many puzzling experiments in electrodynamics e.g.,

(i) The Fizeau Experiment (1851), (ii) The Michelson-Morley Experiment (1881, 1887), (iii) The Ives-Stilwell Experiment (1938), (iv) The Experiment of Farley et al (1966), if it is assumed that the earth's surface is a stationary free space. Moreover, it has been observed that optical phenomena like reflection, refraction, diffraction interference etc., either from terrestrial or astral sources are independent of the motion of this planet which indicate that no further induction (other than induction for the movements of electromagnetic bodies on the surface of the earth) takes place when the inductor or the inducted body moves along with the earth, whatever high movement the earth may have with respect to stars.

But, from the considerations of Maxwell, the surface of the earth should not be treated as a stationary free space because the earth is moving with a very high velocity in the free space as has been confirmed by the phenomenon of aberration observed by Bradley (1729), and further induction should take place for the motion of this planet.

To overcome the difficulty, Lorentz assumed that Heavisidean auxiliary space equations are real and Einstein assumed that Lorentz's auxiliary time equation is real, which are the bases of special relativity and which are improbable and unproven, and which contradict our experiences.

Alternatively, it may be proposed that the earth carries with its surroundings fixed minute dipoles (as electromagnetic medium) which communicate and transfer electromagnetic forces and vibrations on earth and induction takes place only when the inductor or the inducted body crosses these dipoles. The same is true for all large heavenly bodies as well as free space. This simple consideration will make the surfaces of all large heavenly bodies completely equivalent to free space for our description of electromagnetic phenomana which implies that all large heavenly bodies carry electromagnetic forces and vibrations mostly like all other physical vibrations on them.

In the paper it has been conclusively proved that special relativity is simply the point charge electrodynamics of Heaviside, a special case of his general treatment of the electrodynamics of the moving system of charges and it has been pointed out that if we assume that the earth carries with it

electromagnetic forces and vibrations mostly like all other physical vibrations on earth, an equivalent alternative approach to special relativity in the frame work of Heaviside's electrodynamics emerges.

ORIGINAL PAPER

1] INTRODUCTION

Oliver Heaviside (1850-1925), the greatest electromagnetician after Maxwell (1831-1879) based his electrodynamics in free space on the considerations of Maxwell.

Maxwell's equations and Heaviside's electrodynamics have important roles to understand many puzzling electromagnetic and electrodynamic phenomena on earth if it is assumed that the surface of the earth is equivalent to free space.

But the earth is not at rest in free space. It is moving in free space with a very high velocity which has been confirmed by the observations of Bradley (1729) on stellar aberration.

Therefore, Maxwell's equations and, consequently, Heaviside's electrodynamics should not be applicable on the surface of the moving earth without some modifications.

But, the fact is that Maxwell's equations and Heaviside's electrodynamics are fully applicable on the surface of the moving earth without any such modifications.

In the present communication, we have studied Heaviside's electrodynamics in free space and judged the applicability of Maxwell's equations and Heaviside's electrodynamics on the moving earth from some new considerations attaching much importance to the phenomenon of fixed aberration observed by Airy (1781).

2] Heaviside's Electrodynamics

Maxwell (1831-1879) has ingeniously explained the nature of propagation of electromagnetic wave in free space where light from fixed stars travels with constant speed 'c', and Heaviside (1850-1925) has developed the way of calculating the electric and magnetic fields of a system of charges moving in free space basing his line of thought on Maxwell.

Now we know that,

$$\frac{\partial^2\Phi}{\partial x^2}+\frac{\partial^2\Phi}{\partial y^2}+\frac{\partial^2\Phi}{\partial z^2}-\frac{1}{c^2}\frac{\partial^2\Phi}{\partial t^2}=-\frac{\rho}{e_0} \tag{1}$$

and $$\frac{\partial^2 A*}{\partial x^2}+\frac{\partial^2 A*}{\partial y^2}+\frac{\partial^2 A*}{\partial z^2}-\frac{1}{c^2}\frac{\partial^2 A*}{\partial t^2}=-\frac{J}{e_0c^2} \tag{2}$$

are the d' Alembert's equations of scalar and induced vector potentials for a system of charges moving with velocity u in free space (where Φ and A* are the scalar and induced vector potentials, ρ is the volume charge density of the system, J = current density, e_0 is the permittivity of the free space and the introduced co-ordinates are in the free space and OX is the direction of motion of the charges in the introduced co-ordinate).

If we consider that fields are carried along with the system, we have,

$\frac{\partial^2\Phi}{\partial t^2}=u^2\frac{\partial^2\Phi}{\partial x^2}$ and so the equations (1) and (2) could be written as

$$\left(1-\frac{u^2}{c^2}\right)\frac{\partial^2\Phi}{\partial x^2}+\frac{\partial^2\Phi}{\partial y^2}+\frac{\partial^2\Phi}{\partial z^2}=-\frac{\rho}{e_0} \tag{3}$$

and $$\left(1-\frac{u^2}{c^2}\right)\frac{\partial^2 A*}{\partial x^2}+\frac{\partial^2 A*}{\partial y^2}+\frac{\partial^2 A*}{\partial z^2}=-\frac{\rho u}{e_0c^2} \tag{4}$$

where **J** = ρ**u** as suggested by Fitzgerald. Now $A_y* = 0$, $A_z* = 0$ (5)

and so by comparison of the equations (3) and (4) we have, $A^*{}_x = \frac{u}{c^2}\Phi$ (6)

This system is called the dynamic S system with charges and currents moving in free space.

Now if we substitute x by $x'k$, $y = y'$ and $z = z'$ (7)

(or $x' = \gamma\,(x - ut)$, $y' = y$ and $z' = z$ which are called Heavisidean auxiliary space equations, in the auxiliary S' system, if electromagnetic action is considered after the time t of the instant when the co-ordinate attached with the system coincide with the coordinate attached with the free space).

where $k = \sqrt{1-\frac{u^2}{c^2}}$, and $\gamma = 1/k$, (8)

the auxiliary volume density of charge in this transformation become $\rho' = \rho k$, (9)
and similarly Φ', the auxiliary scalar potential becomes equal to Φk, (10)
and the equations (3) and (4) take the form,

$$\frac{\partial^2\Phi'}{\partial x'^2}+\frac{\partial^2\Phi'}{\partial y'^2}+\frac{\partial^2\Phi'}{\partial z'^2}=-\frac{\rho'}{e_0} \tag{11}$$

and $$\frac{\partial^2 A*'}{\partial x'^2}+\frac{\partial^2 A*'}{\partial y'^2}+\frac{\partial^2 A*'}{\partial z'^2}=-\frac{\rho' u}{e_0c^2} \tag{12}$$

which are again Poisson's equations used generally to solve the scalar potentials for a system of charges stationary in free space. Thus, Heaviside and his followers proceeded to solve the potential problems of a system of moving charges by transforming d' Alembert's equation of potentials for this system of moving charges into Poisson's form, by the elongation of the OX axis which was the direction of motion of the system of charges. They, thus, developed the way of solving dynamic potential problem in a static way through an unreal static auxiliary equation in the form of Poisson's potential equation which correlates between the static and dynamic potential states. Now, the electric field components (E_x, E_y, E_z) and the magnetic field components (B_x, B_y, B_z) of a system of charges where E is the electric field of the moving system of charges at a point P (x, y, z) could be calculated in the following way :

$$E_x = \frac{\partial\Phi}{\partial x} - \frac{\partial A_x^*}{\partial t} = \frac{\partial\Phi}{\partial x} - \frac{u^2}{c^2}\frac{\partial\ \Phi}{\partial x} = \frac{\partial\Phi^/}{\partial x^/} = Ex^/, E_y = \gamma E^/ y \text{ and } E_z = \gamma E_z^/ \tag{13}$$

and so for a point charge (Q), we have

$$E^/ x = \frac{Qx^/}{4\pi e_0 r^{/3}}, E^/ y = \frac{Qy^/}{4\pi e_0 r^{/3}}, E^/ z = \frac{Qz^/}{4\pi e_0 r^{/3}} \tag{14}$$

where $E_x^/$, $E_y^/$ and $E_z^/$ are the components of auxiliary electric field in the Heavisidean imaginary elongated system at $P^/$ ($x^/$, $y^/$, $z^/$) and $r^/ = \sqrt{x^{/2} + y^{/2} + z^{/2}}$ where $P^/$ ($x^/$, $y^/$, $z^/$) of the $S^/$ system is the corresponding point P (r,θ) of the S system. Whence,

$$E = \frac{Qk^2}{4\pi e_0 r^2\left(1 - \frac{u^2}{c^2}\text{Sin}^2\theta\right)^{3/2}} \underline{r} \tag{15}$$

and from, $B^* = \nabla x A^*$ (16)

we have, $B^*_x = 0$, $B^*_y = -\frac{u}{c^2} E_z = -\gamma\frac{u}{c^2}E_z$, $B^*_z = \frac{u}{c^2}E_y = \gamma\frac{u}{c^2}E^/ y$ (17)

where B* is the induced magnetic field.

For similarly moving independent magnetic field B, we have, $A_x = \gamma A^/_x$, $A_y = A^/_y$, $A_z = A^/_z$ and whence,

$$B_x = \left[\frac{\partial A_z}{\partial y} - \frac{\partial A_y}{\partial Z}\right] = \left[\frac{\partial A_z^/}{\partial y^/} - \frac{\partial A_y^/}{\partial Z^/}\right] = B_x^/$$

$$B_y = \left[\frac{\partial A_x}{\partial Z} - \frac{\partial A_Z}{\partial x}\right] = \left[\frac{\gamma\partial A_x^/}{\partial Z^/} - \gamma\frac{\partial A_z^/}{\partial X^/}\right] = \gamma B_y^/ \tag{18}$$

$$B_z = \left[\frac{\partial A_Y}{\partial X} - \frac{\partial A_X}{\partial Y}\right] = \left[\gamma\frac{\partial A_y^/}{\partial X^/} - \gamma\frac{\partial A_x^/}{\partial y^/}\right] = \gamma B_z^/$$

where $A_x^/$, $A_y^/$ and $A_z^/$ are the components of the Auxiliary magnetic potential in the Heavisidean imaginary elongated system $S^/$. For the induced vector, we have the relation E* = -u x B, from which we have,

$E_x^* = 0$, $E_y^* = uB_z = \gamma uB^/_z$, $E^*_z = -uB_y = -\gamma uB^/_y$ (19)

Corollary 1. Now suppose that E and B are moving field of static fields E_0 and B_0 , and $E^/$ and $B^/$ are Heavisidean auxiliary fields, then it is evident that if $\frac{(E_0)p}{(B_0)q} = a$, then $\frac{E^/ p}{B^/ q} = a$, where p and q are the components of the fields and a is a constant.

Corollary 2. It can easily be shown that Heaviside's fields obey Maxwell's equations just like Coulomb's fields. Therefore, if a stationary dipole radiates in free space, it will also radiate while moving in free space at constant velocity.

Now, if the source of an independent electric field and an independent magnetic field move with a constant velocity u in free space, then from the consideration of equations (13), (17), (18), and (19). We have the following Heavisidean auxiliary field equations :

$$Ex = Ex' \qquad Bx = Bx'$$

$$E_y = \gamma\left[E'_y + uB'_z\right] \qquad B_y = \gamma\left[B'_y - \frac{u}{c^2}E'_z\right]$$

$$E_z = \gamma\left[E'_z - uB'_y\right] \qquad B_z = \gamma\left[B'_z + \frac{u}{c^2}E'_y\right] \tag{20a}$$

Or

$$E'_x = Ex \qquad B'_x = Bx$$

$$E'_y = \gamma\left[E_y - uB_z\right] \qquad B'_y = \gamma\left[By + \frac{u}{c^2}E_z\right]$$

$$E'_z = \gamma\left[E_z + uB_y\right] \qquad B'_z = \gamma\left[By - \frac{u}{c^2}E_y\right] \tag{20b}$$

(solely derived from Heaviside, Faraday and Ampere-Maxwell), where E and B are the moving electric and the magnetic fields, E' and B' are auxiliary quantities which relate moving E and moving B to static electric and magnetic fields.

Those equations are also valid for induced electromagnetic fields when the inductor or the inducted body moves with respect to the free space.

3] APPLICATION OF HEAVISIDE'S ELECTRODYNAMICS IN THE FREE SPACE

Oliver Heaviside (1850 - 1925), the greatest electromagnetician after Maxwell (1831-1879) has shown that a charged ellipsoid having its axes with the ratios k:1:1 which while moving with a velocity u in free space produces the same external effect as that of a moving point charge [1,2], k being in the direction of motion of the charge.

3.1. The electromagnetic momentum of a Heaviside's ellipsoid (with the axes $\delta Rk : \delta R : \delta R$) while moving with a velocity u in the OX direction in the free space

$$G_X = \int \left(D_y B*_z - D_z B*_y\right) dv$$

$$= \frac{u}{c^2} e_0 \int \left(\gamma^2 E'^2_y + \gamma^2 E'^2_z\right) k dv'$$

$$= \gamma \frac{u}{c^2} e_0 \int \left(E'^2_y + E'^2_z\right) dv' \ \left[\text{cf. equations (13)and (17)}\right]$$

(and as E'_y, E'_z and dv' are related to a sphere and so each integral is equal to $\frac{q^2}{12\pi e_0^2 \delta R}$)

$$= \frac{q^2 u}{6\pi e_0 c^2 \delta R k} = \mu u \tag{21}$$

which is the electromagnetic momentum of a point charge moving in the free space with a velocity u, where μ_0 and μ are the electromagnetic masses of the point charge moving with the velocities 0 and u respectively in free space such that

$$\frac{q^2}{6\pi e_0 c^2 \delta R} = \mu_0 \text{and } \frac{\mu_0}{k} = \mu$$

(21a)

3.2. Electromagnetic force acting on a point charge moving in the free space

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

$$F_{II} = \frac{|dG|}{d|u|} a_{II} = \frac{\mu_0}{k^3} a_{II} \quad (22)$$

where a_{II} is the acceleration of the point charge in the direction parallel to the field.

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

$$F_{\perp} = \frac{|G|}{|u|} a_{\perp} = \frac{\mu_0}{k} a_{\perp} \quad (23)$$

where $a_{\perp}$ is the acceleration of the point charge in the direction perpendicular to the field.

3.3. Similarly, energy of a point charge moving in the free space

$$\mathcal{E} = \int \left(\frac{\partial G}{\partial t} \right) dx = \frac{\mu_0 c^2}{k} = \mu c^2 \quad (24)$$

3.4. Frequencies of light emitted from a source moving in the free space -

Let an electric force drive a point charge back and forth from one end to the other end of a radiating dipole stationary in the free space.

Then, $F_0 = - \mu_0 \omega_0^2 S$, (25)

the velocity of oscillation being small, where μ_o is the electromagnetic mass of the charge in the stationary dipole, ω_o is the radian frequency of oscillation of the charge, S is the separating distance of the dipole.

Now, if the dipole moves with a velocity u in the free space in any direction perpendicular to its direction of oscillations, the electric force and the magnetic force acting on the charge will be respectively from equations (15) and (16),

$$\gamma F_0 \text{ and } -\frac{u^2}{c^2}\gamma F_0$$

Therefore, total electromagnetic force acting on the moving charge = $F_o k$ (26)

Now, under the circumstances, if the moving dipole radiates we have ,

$F = -\mu\omega^2 S$ (27)

where μ is the electromagnetic mass of the charge in the moving dipole, ω is the frequency of oscillation of the charge which is moving with a velocity u in the free space with the dipole and F is the electromagnetic force acting on the moving charge.

From equations (21a), (25), (26) and (27) for the dipole moving in any direction perpendicular to its direction of motion we have,

$$\omega = \omega_0 k \qquad (28)$$

Now, if that radiating dipole while moving with a velocity u towards a direction parallel to OX, is seen from the origin at any point P which makes an angle θ with OX axis at the origin, we have,

$$\omega_{observed} = \frac{\omega_0 k}{1+\frac{u}{c}\cos\theta} \text{ from Doppler} \qquad (29)$$

$$\text{whence } \omega_{trans.} = \omega_0 k \qquad (30)$$

i.e., the well known transverse Doppler effect, if the dipole moving in a direction parallel to OX and oscillating in a direction parallel to OZ is seen at a point (0,y,0) from the origin.

3.5. The period of oscillation (t)for a radiating dipole moving in the free space

we have,

$$t_0 = \frac{2\pi}{\omega_0} \qquad (31)$$

where ω_0 is the radian frequency of the radiating dipole stationary in the free space, and t_0 is its period of oscillation. Now, if the same dipole moves with a velocity u and radiates in free space, we have,

$$t = \frac{2\pi}{\omega} \qquad (32)$$

where t is the period of oscillation and ω is the radian frequency of the moving dipole.

Comparing equations (31) and (32) with the equation (28) we have $t = \gamma t_0$ (33)

or the period of oscillation of a moving dipole increases with its velocity in the free space.

3.6. Life spans of radioactive particles moving in the free space

a) Proton-proton Decay or Electron-electron Decay

Consider two similar point charges tied by some unknown forces. The repelling electromagnetic force is here tending to destroy the equilibrium whereas the unknown forces are keeping the charges tied together.

Therefore, spontaneous transformation of those particles will depend also on the repulsive electromagnetic force just like on time. Therefore, we may write for disintegration

$$N=N_0 \; e^{-\lambda F t} \qquad (34)$$

where N are the untransformed particles present at the time t from initial untransformed particle N_0 at t = 0

Now, if N_o radioactive particles of similarly charged bodies are at rest in the free space, and if we have N untransformed particles after the time t_0, then we have,

$$N=N_0 \; e^{-\lambda F_0 t_0} \qquad (35)$$

where F_0 is the repelling force acting on the charged particles at rest in the free space.

Now if the charged particles move with a velocity u in the free space in any direction perpendicular to their direction of oscillation, we will find N untransformed particles after a time t such that

$$N=N_0 \quad e^{-\lambda Ft} \tag{36}$$

comparing the equations (35) and (36) with the equation (26), we have $t = \gamma t_o$ (37)

b) Similarly for negative or positive muon-type decay.

we may consider that a muon is a point negative or positive charge tied with a point mass by the attractive electric force which is giving stability but some other unknown repelling forces responsible for decay are acting here to destabilise the equilibrium. So here,

$$N = N_0 e^{-\frac{\lambda t}{F}} \tag{38}$$

as N decreases with t but increases with F

Now, the decay equations of muons for stationary and moving states respectively could be written as follows :

$$N = N_0 e^{-\frac{\lambda t_o}{F_o}} \tag{39}$$

$$N = N_0 e^{-\frac{\lambda t}{F}} \tag{40}$$

The magnetic force is here 0, because the magnetic field is non-operative on moving mass, only the moving electric force is here $F = \gamma F_0$ (41)

Comparing the equations (39), (40) and (41), we may write for muon decay

$$t = \gamma t_o \tag{42}$$

Thus, we may conclude that the life-span of a charged electromagnetic radioactive particle increases with its velocity in the free space.

Now, if the source be stationary in the free space and the observer moves, there should be no transverse Doppler effect, no time increment, as such if transverse Doppler effect and time increment are confirmed experimentally in such cases, only then some special theories could be held superior in this regard.

3.7. Velocity of light in a medium moving in the free space

We know from Maxwell that the relation between the electric field (E_0) and the magnetic field (B_0) in a ray moving in OX direction inside a dielectric at rest in the free space is

$$\frac{(E_0)_y}{(B_0)_z} = \frac{c}{n} \tag{43}$$

where n is the refractive index of the medium.

Now, if the dielectric moves with a velocity u in the OX direction in the free space, V_x is the velocity of the ray in OX direction with respect to the free space and E_y and B_z are the electric field and the magnetic field of the ray in the moving dielectric, we have,

$$V_x = \frac{E_y}{B_z} = \frac{\gamma\left[E'_y + uB'_z\right]}{\gamma\left[B'_z + \frac{u}{c^2}E'_y\right]} \qquad \text{[cf. Equation (20a)]}$$

$$= \frac{\frac{c}{n} + u}{1 + \frac{u}{nc}} \approx \frac{c}{n} + u\left(1 - \frac{1}{n^2}\right) \qquad (44)$$

[using the Corollary 1 of the section 2, i.e., if $\frac{(E_0)_y}{(B_0)_z} = \frac{c}{n}$, then $\frac{E'_y}{B'_z} = \frac{c}{n}$]

3.8. Velocity of charges in a conductor moving in free space

Suppose that some charges are moving with a velocity υ_x in the OX direction over the surface of a conductor at rest in the free space where an electric field E_0 and a magnetic field B_0 are operating on the charges. Then from Lorentz,

$$(F_0)_y = q\left[(E_0)_y - \upsilon_x (B_0)_z\right] \qquad (45)$$

where $(F_o)_y$ is the force acting on the charges in OY direction, which is equal to O. In such a situation,

$$\upsilon_x = \frac{(E_0)_y}{(B_0)_z} \qquad (46)$$

Now, if the conductor moves with a velocity u in the OX direction in the free space, we have for the velocity (V_x) of charges with respect to the free space in the moving conductor.

$$V_x = \frac{E_y}{B_z} = \frac{\gamma\left[E'_y + uB'_z\right]}{\gamma\left[B'_z + \frac{u}{c^2}E'_y\right]} \qquad \text{[cf. Equations (20a)]} \qquad (47)$$

where E_y and B_z are moving electric and magnetic fields.

Now if $\frac{(E_0)_y}{(B_0)_z} = \upsilon_x$ then from Corollary 1 of the Section 2 we have, $\frac{Ey'}{Bz'} = \upsilon_x$

Therefore, $V_x = \frac{u + \upsilon_x}{1 + \frac{u\upsilon_x}{c^2}}$ (48)

In similar analyses, we can show with little manipulations

$$V_y = \frac{\upsilon_y k}{1 + \frac{u\upsilon_x}{c^2}} \qquad (49)$$

$$V_z = \frac{\upsilon_z k}{1 + \frac{u\upsilon_x}{c^2}} \qquad (50)$$

4] DERIVATION OF THE SECOND SET OF LORENTZ'S AUXILIARY TRANSFORMATION EQUATIONS FROM HEAVISIDE'S AUXILIARY EQUATIONS

Following Heaviside, Lorentz engaged himself in developing some transformation equations through which and their corollaries, he could solve optical problems of moving bodies as well as electrodynamic problems of charges moving with high velocities in symmetric and easy form, reducing the equations of moving system to the form of ordinary formula that hold for a system at rest.

Heaviside's problem was to solve potential problem for moving charges which he did by transforming the d' Alembert's equation in an invariant form with Poisson's in the auxiliary system.

Lorentz's problem was to solve the radiation problems of moving radiating bodies which he did by transforming the Maxwell's equation for the moving radiating body to the same form for the auxiliary system, which correlates between the static and dynamic radiation states.

As has been stated earlier that from classical stand-point. Maxwell's equations remain in the same form for the static system as well as for the system moving with a constant velocity and so the equation of propagation of a wave remains in the same form in the stationary as well as in the moving state from the consideration of Heaviside and Maxwell.

Under these circumstances, we may write,

$$\frac{\partial^2 E}{\partial x^2}+\frac{\partial^2 E}{\partial y^2}+\frac{\partial^2 E}{\partial z^2}-\frac{1}{c^2}\frac{\partial^2 E}{\partial t^2}=0 \qquad (51)$$

where E is the moving electric field, when we consider a radiating moving body.

As the radiating system is moving with the velocity u in the free space, consequently, here also, the scalar potential of the moving system of the form as in equation (1) will be reduced to the form as in the equation (11) through equation (8), (9), and (10).

Then the first three of the second [3] set of transformation equations of Lorentz were instant from Heaviside which were same as in equation (7) i.e., $x' = \gamma$ (x-ut), $y' = y$, $z' = z$.(52)

electromagnetic action is being considered here after the time 't' of the instant when the co-ordinate attached with the system coincide with the coordinate fixed with the free space.

These transformation equations must retain, as after elongation of the OX axis, Lorentz must get the same potential as envisaged by Heaviside. So far Lorentz proceeded in the Heaviside's way.

Then Lorentz found from his previous experiences of his first set [4] of transformation equations that if he defines a new auxiliary equation $t'=\gamma\left(t-\frac{ux}{c^2}\right)$ (53)

and uses Heavisidean auxiliary equations, he will get

$$\frac{\partial^2 E'}{\partial x'^2}+\frac{\partial^2 E'}{\partial y'^2}+\frac{\partial^2 E'}{\partial z'^2}-\frac{1}{c^2}\frac{\partial^2 E'}{\partial t'^2}=0 \qquad (54)$$

(where E' is the auxiliary electic field in elongated Heavisidean S' frame as explained earlier) through the equations (20) i.e., the Maxwell's wave equation for the static and moving system will retain its form also for the auxiliary system which correlates between the static and dynamic radiation state.

Lorentz deduced $t'=\gamma\left(t-\frac{ux}{c^2}\right)$ possibly from trial and error method. But it can easily be derived from (i) equation (51) which indicates $x^2 + y^2 + z^2 = c^2t^2$ (ii) equation (54) which indicates $x'^2 + y'^2 + z'^2 = c^2t'^2$ and (iii) Heavisidean auxiliary space equations $x' = \gamma$ (x-ut), $y' = y$ and $z' = z$, all these 5 equations when solved together will give the auxiliary time equation (53).

An interesting fact about the equations is that the reverse of Lorentz Transformation equations have the same form as that of the Lorentz Transformation equations themselves i.e.,

$$
\begin{aligned}
&\text{If } x' = \gamma (x-ut) && \text{then } x = \gamma (x' + ut') \\
&y' = y && y = y' \\
&z' = z && z = z' \\
&t' = \gamma\left(t - \frac{ux}{c^2}\right) && t = \gamma\left(t' + \frac{ux'}{c^2}\right)
\end{aligned}
\qquad (55)
$$

(which were later observed and used by A. Einstein in his theory).

It should be mentioned here that all the quantities x', y', z', t', E', B' etc. are auxiliary and unreal, so the auxiliary equation

$$\frac{\partial^2 E'}{\partial x'^2} + \frac{\partial^2 E'}{\partial y'^2} + \frac{\partial^2 E'}{\partial z'^2} - \frac{1}{c^2}\frac{\partial^2 E'}{\partial t'^2} = 0 \text{ is unreal.}$$

Thus, from the stand point of classical electrodynamics, the second set of Lorentz Transformation Equations is tactical just like the Heaviside's tactical equations and these equations can be used to solve the electrodynamic problems of moving bodies correctly.

5] GENERAL PROBLEMS OF MAXWELL'S EQUATIONS AND HEAVISIDE'S ELECTRODYNAMICS

All those equations originating from Maxwell's equations are only applicable in free space where the earth is moving with a vigorous velocity which is confirmed by the phenomenon of aberration as observed by Bradley (1729).

Therefore, the laws enumerated above [Equations (1)-(55)] may be expected not to be applicable on the surface of the earth without any further modification.

So, a magnetic field is likely to be observed for a charge or a system of charges stationary on the moving earth. The magnitude of magnetic field should change depending on the direction of orientation of a current carrying wire on earth. The velocity of light in water moving on the surface of the earth should vary with the direction of orientation of the Fizeau Apparatus or more precisely, the Michelson-Morley Experiment on earth should register a definite fringe shift. But, surprisingly, it is well confirmed that all optical phenomena which are produced by terrestrial sources are independent of the motion of the planet, which clearly indicate that the earth is moving with a part of electromagnetic medium fixed with its surface.

Further, it has been found that an astronomer after having determined the apparent direction of a star's rays and their apparent frequency can predict from these, by the ordinary laws of optics and without attending any more to the motion of the earth, the result of all experiments on reflection, refraction, diffraction and interference that can be made with these rays [5] which indicates that no further induction (other than induction for the movements of electromagnetic bodies on the surface of the earth) takes place when the inductor or the inducted body moves along with the earth whatever high movement the earth may have with respect to stars.

6] RELATIVISTIC APPROACH

Both Lorentz and Einstein overlooked the easy solution of the problems indicated in the Section 5].

To reach a solution, they developed a new theory : special Relativity which is summarily described below.

6.1 Fitzgerald - Lorentz assumption that the Heavisidean auxiliary space equations(52) are real

To overcome the difficulty, especially to explain the null result of the Michelson-Morley Experiment, Fitzgerald [6] in 1889 suggested the real contraction of moving bodies.

Perplexed with the null result of the Michelson-Morley Experiment and fascinated with Fitzgerald's contraction hypothesis (1889), Lorentz accepted the doctrine of Fitzgerald that moving bodies really contract which was correctly contradicted by Max Abraham [7].

Larmor [8] pointed out (1895) that the real contraction of moving bodies (as suggested by Fitzgerald and Lorentz to explain the null result of the Michelson-Morley Experiment) was compatible with classical electrodynamics and he, following the footsteps of Lorentz, put forward the equation $x^{/} = \gamma(x-ut)$ as a real equation for all kinds of moving objects and $t^{/} = \gamma\left(t - \frac{ux}{c^2}\right)$ as the tactical equation to explain the null result of Michelson-Morley Experiment as well as other effects of moving electric bodies.

To explain the so-called anomaly of the null result of the Michelson-Morley Experiment, Lorentz following Larmor assumed with novelty that the Heavisidean transformation equations are real and these are not only real for moving charges but also real for any moving objects other than the charges.

Consequently, the earth is also really dilated to its direction of motion when measured on earth.

Now, if x' = γ(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 E' and B' will not be auxiliary fields of similar nature, invented to solve some problems, as classical electromagneticians did. Instead, x', y', z' will be the real co-ordinates of the moving earth, and E' and 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 on earth, its length, according to Larmor and Lorentz, will be greater on earth than its measurement from the free space, which is called by Fitzgerald and Lorentz 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 equation (54) is real, while the time derivative part of the equation (54) is auxiliary and unreal and the equation (54) is quasi-real to him.

Thus according to the Heavisidean, the system S is real and the system S' is imaginary. Consequently, dilation is the imaginary process by which S is transformed to S' and the equations (52) is solely tactical to him. But according to Lorentz, both the systems S and S' are real (excepting the time equation) and S' is considered by him the standard system. Consequently, contraction is the relevant phenomenon in his interpretation and the equation (52) is real to him.

The calculation of potential of moving charges as done by Lorentz is the same as that of Heaviside, but the interpretation is a bit different.

The calculation and interpretation on the effects of a moving point charge are the same to both Heaviside and Lorentz, as the geometry of a point charge remains the same in both interpretations. But, from the stand point of Heaviside, the equation of the electric potential of a moving spherical conducting charge which keeps its shape the same both in the stationary and in the moving state, should be, according to Lorentz, the scalar potential of a moving charge in the shape of an oblate ellipsoid of revolution in the stationary state, and which is spherical in the moving state, because of the fact that the equations (52) are tactical to Heaviside but real to Lorentz.

Similarly, according to Heaviside, the equation of the scalar potential of a moving conducting contracted ellipsoid of revolution which keeps its shape the same both in the stationary and in the moving state, should be, according to Lorentz, the scalar potential of a moving charge in the shape of a conducting sphere in the stationary state, and which is a contracted ellipsoid of revolution in the moving state, because of the different interpretation of the equations (52) by both the interpreters.

Lorentz always advocated for his contracted ellipsoidal moving electron against spherical electron of Abraham. He always tried to establish that his electron had advantage over Abraham's which was simply his bias.

Thus, Lorentz transformation equations though derived from classical electrodynamics when infused with the idea of real contraction while moving violated classical mechanics and these master-pieces of Lorentz though immensely effective in calculating the radiation problem of moving bodies was illegitimate from the stand point of mechanics, and Lorentz was fully aware of it.

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

He only found that if he would put

$x' = \gamma\,(x - ut)$ (as real) and $t' = \gamma\left(t - \frac{ux}{c^2}\right)$ (as tactical) as linear functions of t and x, he would explain Lienard - Wiechert potential for a moving point charge, the null result of Michelson-Morley experiment as well as he would keep Maxwell's equations in two systems in an invariant form which being symmetric, the calculations of optical phenomena and electrodynamics of moving point charges could be done in a symmetrical easy form. To him, the fourth transformation equation was not real but only tactical and these transformation equations could never be used beyond electromagnetism except the interpretation of the Michelson-Morley Experiment.

Now a simple watch of the Lorentz Transformation Equations could reveal some interesting facts.

Firstly, the reverse equations of the Lorentz Transformation Equations were symmetric with the original Lorentz Transformation Equations, i.e., if

$$x' = \gamma(x - ut) \text{ and } t' = \gamma\left(t - \frac{ux}{c^2}\right), \quad \text{then } x = \gamma(x' + ut') \text{ and } t = \gamma\left(t' + \frac{ux'}{c^2}\right),$$

Secondly, Maxwell's Equation

$$\frac{\partial^2 E}{\partial x^2} + \frac{\partial^2 E}{\partial y^2} + \frac{\partial^2 E}{\partial z^2} - \frac{1}{c^2}\frac{\partial^2 E}{\partial t^2} = 0 \text{ [which indicates } x^2 + y^2 + z^2 = c^2t^2 \text{]} \qquad (56)$$

through Heavisidean transformation equations (52), (20) and Lorentz's auxiliary time equation (53) takes the invariant form :

$$\frac{\partial^2 E'}{\partial x'^2} + \frac{\partial^2 E'}{\partial y'^2} + \frac{\partial^2 E'}{\partial z'^2} - \frac{1}{c^2}\frac{\partial^2 E'}{\partial t'^2} = 0 \text{ [which indicates } x'^2 + y'^2 + z'^2 = c^2t'^2 \text{]} \qquad (57)$$

So from the algebraic point of view, from those two equations (56) and (57), the Lorentz transformation equations could be recovered with some prior knowledge of the equation (55), and the reality of those equations might also be justified.

Thus, if Lorentz would put the first dyad of equations i.e., (56) and (57) i.e.,

$$x^2 + y^2 + z^2 = c^2t^2 \quad (56a)$$

and $$x'^2 + y'^2 + z'^2 = c^2t'^2 \quad (57a)$$

and then a second dyad of equations [knowing from equation (55) that the transformation equations are linear and the reverse of the Lorentz transformation equation has the same form as that of the Lorentz transform equations themselves] i.e.,

$$x' = \gamma (x - ut) \quad (58)$$

and $$x = \gamma(x' + ut') \quad (59)$$

where γ is an arbitrary constant, and would justify those two sets of dyads from some philosophical view point, he could recover $\gamma = \frac{1}{\sqrt{1 - \frac{u}{c^2}}}$

which when substituted in (58) and (59) he would get Lorentz transformation equations where $y' = y$ and $z' = z$.

6.2. A. EINSTEIN'S ASSUMPTION THAT LORENTZ'S AUXILIARY TIME EQUATION (53) IS ALSO REAL

A Einstein assumed with a further novelty that the time equation of Lorentz was also real in addition to the reality of Heavisidean transformation equations, and so the equation (54) was not quasi-real to him like Lorentz, it was fully real to him.

6.3. ORIGIN OF EINSTEIN'S TWO PRINCIPLES

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

He, thus, justified the equations (56) and (57) i.e., equations (56a) and (57a) by the principle that *the velocity of light is the same for all intertial frames by which he means (with some philosophy) the dyad of equations (56a) and (57a) 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 dyad of equations (58) and (59) and also y'=y and z'=z, he principled *that all physical laws are the same to all intertial frames by which he means (obviously with some philosophy).*

$$x' = \gamma (x-ut)$$

$$x = \gamma (x' + ut')$$

and $y' = y$ *and* $z' = z$ *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.

Einstein thinks (which is later endorsed by Lorentz) that both shape and time of all bodies (even non-electromagnetic) really change in motion or rather (to avoid the equation of real contraction of moving electron as advocated by Lorentz) the shape of the object remain the same whereas different observers at different velocities should observe the object differently. In this interpretation, only S' and S should be correlated as S' and S are the real static and the real dynamic states here, along with their real time equations. According to this interpretation the shape of the moving radiating bodies really change when measured from the free space, which is the same as Lorentz's own interpretation but not acceptable from classical stand point. Moreover, this interpretation advocates that a man from the moving system must see that the time interval of the same oscillation for radiation is also really different from that measured from the free space system which is neither acceptable from Lorentz's own interpretation, nor from classical viewpoint.

In his explanations, A. Einstein has tried to remove the question on the real contraction of moving electron as advocated by Lorentz. According to this interpretation, the shape of electron remains the same whereas different observers at different velocities would observe the electron differently.

To Einstein, the second set of Lorentz Transformation Equations including the fourth equation (53) is real, absolutely exact and applicable not only to electrodynamics but also to every field of physics.

Thus, when Lorentz Transformation Equations are Transcendented as reality to all realm of physics, length contracts, gravitational mass varies or converts into energy, and more interestingly, time dilates with velocity!

6.3. CRITICISM OF SPECIAL RELATIVITY.

We may conclude that in the domain of electrodynamics, the second set of Lorentz transformation equations are actually the relation of co-ordinate and time between the imaginary auxiliary state of classical electrodynamics and real dynamic state. Special relativity makes an effort to justify the reality of those relations by the assumption that the auxiliary state itself is real or by some principles originating from this assumption.

But to the classicist, the reality of such relation is artificial and meaningless unless it is proved directly that matter in motion really contract by the factor k towards its direction of motion. Incidentally, for point charge electrodynamics, both the calculations concur owing to the same geometry of point charge in the static and auxiliary states, and for big charge electrodynamics they differ.

So, the effort of special relativity can be partly successful if it cites results of big-charge-experiments conforming only to their calculations, which they avoid.

To justify the reality of auxiliary state beyond electrodymamics, the relativist takes the advantage of the situation that for such bodies (as for planets and satellites) $\sqrt{1-u^2/c^2} \longrightarrow 1$, and so they conclude that both the results will be the same, for which they are not eager to verify it by experiment.

Such a creation of real auxiliary state in the mechanics seems to be fictitious and unnecessary unless it is confirmed by proper experiment.

It can be shown that the interactions of charges with electromagnetic fields, the transverse Doppler's effect of Ives-Stilwell experiment, the increment of time of oscillation of a charge in a moving dipole, the relation between electromagnetic mass and total energy of a moving point charge, the null result of the Michelson-Morley Experiment and the Fizeau Experiment can easily be explained from classical electrodynamics if it is assumed that the surface of the earth is equivalent to free space.

From the nature of development of the second set of Lorentz Transformation Equations and its algebraic deduction by A. Einstein, it stands that special relativity has neither any advantage whatsoever over classical electrodynamics supplemented with the above assumption, nor the reality of contraction can be proved from propositions derived from the assumption of the reality of contraction, nor it can be accepted without verification that the shape of an electron or a body remains the same whereas different observers at different velocities would realise it at different shapes.

To justify the reality of Lorentz Transformation Equations, A. Einstein has imposed reality on two sets of Equations [(56a) & (57a), (58) & (59)] derived from Lorentz Transformation Equations themselves.

The first set of equations [equations (56a) and (57a)] is philosophised as the principle of the constancy of the speed of light which is interpreted as "the speed of light in free space has the same value to all intertial observers" which is improbable and unproven. To justify the reality of the equations (58) and (59) which is philosophised by A. Einstein as the principle of equivalence (which is interpreted as "the laws of physics are the same in all inertial systems") beyond electrodynamics, relativists should design experiments outside the domain of electrodymamics which they never did. Similarly to justify the reality of 'the principle of equivalence' in electrodymamics, relativists should set the observer in motion when the charge is at rest and will show the same effect while the charge is in same opposite motion and the observer at rest, which escaped their notice.

7] APPLICABILITY OF MAXWELL'S EQUATIONS AND HEAVISIDE'S ELECTRODYNAMICS ON THE SURFACES OF ALL LARGE HEAVENLY BODIES

Under the circumstances, let us consider that the earth has with its surroundings fixed minute dipoles (as electromagnetic medium) which communicate and transfer electromagnetic forces and vibrations on earth and induction takes place only when the inductor or the inducted body crosses these dipoles. The same is true for the surfaces of all large heavenly bodies as well as free space. Thus, as a first part of the above new consideration, we may say that the surface of all large heavenly bodies and the free space itself are completely equivalent in respect of our description of electrodynamic phenomena which implies that all large heavenly bodies carry electromagnetic forces and vibrations mostly like all other physical vibrations on them.

This simple consideration will explain at a stroke why all electromagnetic phenomena produced from terrestrial sources are independent of the motion of the earth and justify the applicability of Maxwell's and Heaviside's electrodynamics not only in free space but also on the surfaces of the earth and all other large heavenly bodies.

As a consequence, the equations from (1) to (50) become valid not only in free space but also on the surfaces of the moving earth and all other moving large heavenly bodies, and there should be no magnetic field for a charge or for a system of charges stationary on the surface of the earth, the magnitude of the magnetic field should not vary depending on the direction of orientation or a current carrying wire, stationary on earth. The velocity of light in water moving on the surface of the earth should not change with the direction of orientation of Fizeau apparatus, or more precisely, the Michelson Morley experiment performed on earth or on any large heavenly body should give a null result, the last of which seem to be confirmed on earth by well done experiments. When a large heavenly body with its fixed dipoles in its atmosphere moves in the free space, vibrations of dipoles of free space due to a fixed star is transmitted to the dipoles fixed with the large heavenly bodies. Consequently, the relative direction of vibration outside the atmosphere of the heavenly bodies become the real direction of vibrations inside their atmosphere and, therefore, there will be the phenomenon of aberration as observed by Bradley (1729), and there will be no further aberration when the beam is passed through a strongly refractive substance as observed by Airy (1871). This phenomenon of fixed aberration clearly proves that the earth is moving with a part of electromagnetic medium fixed with its atmosphere.

Now, as a second part of our new consideration, we may say that no induction takes place when the inductor or the inducted body moves along with the electromagnetic medium, whatever high movement that may be, (induction is only possible when either the inductors or the inducted cross the electromagnetic medium) This will explain easily why electromagnetic phenomena like reflection, refraction, diffraction, interference etc., originating from astral sources are also independent of the motion of this planet.

Thus, when a radiating dipole is stationary on earth, there will be no change of frequency of radiation due to the change of motion of the earth as in such a case there will not be any further change of induction by the radiating dipole other than necessary for its radiation.

Similarly, when the source of light and the medium through which it propagates are stationary on earth i.e., both move with the earth, there is no relative motion between the two on earth, and so there is no further induction other than necessary for radiation. Therefore, the velocity of light from terrestrial stationary sources in any medium stationary on moving earth is c/n (n=refractive index of the medium) in all directions when measured from the earth which has been confirmed by Michelson (1881), and Michelson and Morley (1887). But if the source of light is fixed on earth and the medium through which light propagates moves on it, there will be further induction for crossing the dipoles fixed with the earth causing changes of the modes of vibrations of dipoles fixed with the earth in the moving water and thereby changing the velocity of light in it with respect to the earth as in Fizeau Experiment (1851). The same phenomenon is likely to be observed when the medium is stationary on earth and the source moves on it. Similarly, radiating dipoles moving on earth should change their frequency or radioactive particles moving on large heavenly bodies should change their life-spans just like in free space as has been observed on earth in Ives Stilwell Experiment (1938) and Farley et al experiment (1966) as given in equations (30), (37) and (42).

But, when such radiating dipoles or radioactive particles move with the large moving heavenly bodies, such changes are not likely to be observed what ever high movements of those heavenly bodies may have, and from wherever those are observed by an observer. And when a starlight or sunshine is passed through a transparent body at rest on any heavenly body and the transmitted ray is used for the Michelson-Morley Experiment on that heavenly body, there will be a real change (not apparent as thought by Bradley) of direction of the ray seen from the heavenly body as the phenomenon of fixed aberration, but there will be no further induction due to this motion of the heavenly body, and consequently, the Michelson-Morley Experiment on that heavenly body will register the same null result as has been observed by Tomaschek (1924) and Miller (1925) on earth.

But, if light coming from the radiating bodies moving vigorously inside a star is passed through a transparent body (n>>1) at rest on a large heavenly body and is used for the Michelson-Morley experiment on that heavenly body, a definite fringe shift should be observed!

8] CONCLUSION

It may be concluded, therefore, that if Maxwell’s equations and consequently Heaviside’s electrodynamics are supplemented with the considerations of force-communicating dipoles (or electromagnetic medium) fixed with the large heavenly bodies, or in other words if we assume that all large heavenly bodies carry electromagnetic forces and vibrations mostly like all other physical vibrations on them, explanations of electromagnetic phenomena become physical, easy and simple, and an equivalent alternative approach to special relativity in the frame work of Heaviside’s electrodynamics emerges.

REFERENCES :

[1] O. Heaviside, Electrician, Dec. 7, 1888, 148.

[2] O. Heaviside, ‘On the electromagnetic effects due to the motion of electrification through a dielectric’, The Philosophical Magazine, 1889, 324 - 339.

[3] For the first set consult, H. A. Lorentz, Versuch einer theorie der electrischen and optischen Erscheinungen in bewegter Kerperm (Leiden 1895, E. J. Brill), Reprinted in collected papers, 5,1 - 138 ;restated in the ‘Theory of Electrons’, 57 - 61.

[4] Sankar Hajra, Debabrata Ghosh, ‘On deduction and interpretation of Lorentz Transformation equations by Lorentz and Einstein’, PIRT London : 6-9, September 1996, Supplementary papers, 127-129 (Stage II).

[5] H.A. Lorentz, ‘The Theory of Electrons’ (Dover Publications, Inc. New York, 1909, 1915), 176.

[6] G. P. Fitzgerald, ‘The ether and the earth’s atmosphere’, Science, vol. 13, 1889, 390.

[7] H. A. Lorentz, ‘The Theory of Electrons’ (Dover Publications, Inc. New York, 1909, 1915), 214.

[8] J. Larmor, ‘A dynamical theory of the electric and luminiferous medium, Part II, the theory of electron’, Philosophical Transactions of the Royal Society, Vol. CL XXXVI, 1895, 695 - 743.