Brief analysis of Einstein Fallacies - Special Relativity

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Abstract

This is a brief analysis of some errors as they appear in standard *Special Relativity* as taught in Universities. Specifically regarding the energy - momentum balance during *light emission* process and in the concept of *simultaneity*. We also analyse the problems with *light clock* thought experiments and discuss a consequence of Lorentz time transformation which causes material objects in relative motion to *dematerialise*. Further we show some misconceptions about electromagnetism created in Relativity and some inherited from Maxwell and others.

I. RELATIVISTIC LIGHT EMISSION

There is a mismatch between the frequency value worked out using Relativistic Energy-Momentum Balance Equations and the Relativistic Doppler Effect Equations.

According to relativity, no matter from which frame we look at, a photon has the same speed c. Assume it has a momentum of $\frac{h\nu}{c}$ and Energy $h\nu$ as seen from some frame. Thus if an atom of (rest)mass M was moving with an initial velocity v(towards us) emits a photon(towards us) and attains a final velocity u wrt our frame then,

Momentum Balance Equation,

$$\frac{Mu}{\sqrt{1-\frac{u^2}{c^2}}} + \frac{h\nu}{c} = \frac{Mv}{\sqrt{1-\frac{v^2}{c^2}}} \tag{1}$$

Energy Conservation Equation,

$$\frac{Mc^2}{\sqrt{1-\frac{u^2}{c^2}}} + h\nu = \frac{Mc^2}{\sqrt{1-\frac{v^2}{c^2}}} + E_0 \tag{2}$$

E_0 is the energy stored in atom for releasing photon.

$Eqn(2) - Eqn(1) \times c \implies$

$$\frac{Mc(c-u)}{\sqrt{1-\frac{u^2}{c^2}}} = \frac{Mc(c-v)}{\sqrt{1-\frac{v^2}{c^2}}} + E_0$$

$$\sqrt{\frac{c-u}{c+u}} = \frac{E_0}{Mc^2} + \sqrt{\frac{c-v}{c+v}} \tag{3}$$

Eqn(3) implies,

$$\frac{1}{\sqrt{1-\frac{u^2}{c^2}}} = \frac{1+\left(\frac{E_0}{Mc^2}+\sqrt{\frac{c-v}{c+v}}\right)^2}{2\left(\frac{E_0}{Mc^2}+\sqrt{\frac{c-v}{c+v}}\right)} \tag{4}$$

Using Eqn(4) in Eqn(2) we get,

$h\nu =$

$$\frac{Mc^2}{\sqrt{1-\frac{v^2}{c^2}}} + E_0 - Mc^2\left[\frac{1+\left(\frac{E_0}{Mc^2}+\sqrt{\frac{c-v}{c+v}}\right)^2}{2\left(\frac{E_0}{Mc^2}+\sqrt{\frac{c-v}{c+v}}\right)}\right] \tag{5}$$

When $v = 0$, i.e. viewing from a frame where the atom(source of light) was at rest initially,

$$h\nu_0 = E_0 - \left[\frac{E_0^2}{2\left(E_0+Mc^2\right)}\right] \tag{6}$$

Thus Eqn(5) does not match the relativistic Doppler effect equation which we expect when the source of light is moving towards us(our frame),

$$\nu = \nu_0\sqrt{\frac{c+v}{c-v}} \tag{7}$$

If the atom was moving with an initial velocity v(away from us) emits a photon(towards us) and attains a final velocity u wrt our frame then Eqn(1) becomes,

$$\frac{Mu}{\sqrt{1-\frac{u^2}{c^2}}} - \frac{h\nu}{c} = \frac{Mv}{\sqrt{1-\frac{v^2}{c^2}}} \tag{8}$$

Using Eqn(2) and Eqn(8) we get,

$h\nu =$

$$\frac{Mc^2}{\sqrt{1-\frac{v^2}{c^2}}} + E_0 - Mc^2\left[\frac{1+\left(\frac{E_0}{Mc^2}+\sqrt{\frac{c+v}{c-v}}\right)^2}{2\left(\frac{E_0}{Mc^2}+\sqrt{\frac{c+v}{c-v}}\right)}\right] \tag{9}$$

Again we confirm Eqn(9) does not match the relevant Doppler effect equation, $\nu = \nu_0\sqrt{\frac{c-v}{c+v}}$, indicating an inconsistency with Relativity. However if we use a classical particle emission theory for both Energy-Momentum balance and for working out the Doppler effect then we get a consistent match between the two calculations.

An inconsistency involving Energy and Momentum equations also appear in the concept of Simultaneity as proposed by Einstein.

II. NOTE ON EINSTEIN'S SIMULTANEITY

Consider a stationary frame S with a box AB(Fig.1) and a source of light located stationary at the center(x_0) of the box. At time $t = 0$ photons are emitted in either direction. Photon 1 travels a distance ct in time t and is described by $x_1 = x_0 - ct$ similarly Photon 2 is described by $x_2 = x_0 + ct$ in frame S at time t. Frame S' is moving with velocity v m/s along +ve X-axis wrt frame S.

Einstein used semi-Classical analysis on his way to derive Lorentz transformation from the thought experiment. However, we shall rely entirely on Lorentz transformations for our analysis of his thought experiment.

At time $t = 0$, origin of S' coincides with the origin of S and time is synchronized ($t' = 0$). Instead of c, for

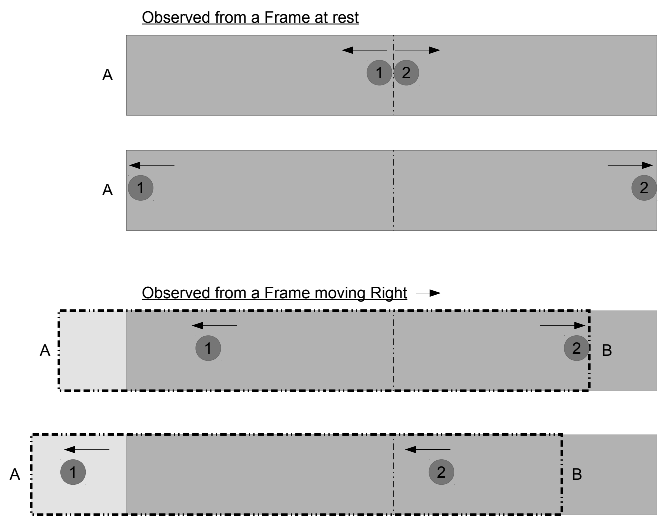

FIG. 1. Top 2 panels show the process as viewed from a rest frame. Here the two photons hit the ends simultaneously. The bottom 2 panels show the same process as viewed from a moving frame(According to Einstein). Note that Photon 1 travels a larger distance compared to Photon 2 according to Relativistic perception.

generality let us assume the two objects move at $\pm u$ that is, $x_1 = x_0 - ut$ and $x_2 = x_0 + ut$.

Using Lorentz Tranformation $S(x,y,z) \rightarrow S'(x',y',z')$,

$$x' = \frac{x - vt}{\sqrt{1-\frac{v^2}{c^2}}}, t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}, z' = z \tag{10}$$

the time and location of first object coming towards the origin of S as noted by S' frame are,

$$x'_1 = \frac{x_0 - (u+v)t}{\sqrt{1-\frac{v^2}{c^2}}}, t'_1 = \frac{t + \frac{vut}{c^2} - \frac{vx_0}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$x'_1 = \frac{x_0\sqrt{1-\frac{v^2}{c^2}}}{1+\frac{vu}{c^2}} - \frac{(u+v)t'_1}{1+\frac{vu}{c^2}} \tag{11}$$

the time and location of second object moving away from the origin of S as noted by S' frame are,

$$x'_2 = \frac{x_0 + (u-v)t}{\sqrt{1-\frac{v^2}{c^2}}}, t'_2 = \frac{t - \frac{vut}{c^2} - \frac{vx_0}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$x'_2 = \frac{x_0\sqrt{1-\frac{v^2}{c^2}}}{1-\frac{vu}{c^2}} + \frac{(u-v)t'_2}{1-\frac{vu}{c^2}} \tag{12}$$

At $t = 0$ Eqns(11,12) give,

$$x'_1 = x'_2 = \frac{x_0}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$t'_1 = t'_2 = -\frac{vx_0}{c^2\sqrt{1-\frac{v^2}{c^2}}} \tag{13}$$

At $t = \frac{L}{u}$ Eqns(11,12) give,

$$x'_1 = \frac{x_0 - (u+v)\frac{L}{u}}{\sqrt{1-\frac{v^2}{c^2}}}, t'_1 = \frac{\frac{L}{u} + \frac{vL}{c^2} - \frac{vx_0}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$x'_2 = \frac{x_0 + (u-v)\frac{L}{u}}{\sqrt{1-\frac{v^2}{c^2}}}, t'_2 = \frac{\frac{L}{u} - \frac{vL}{c^2} - \frac{vx_0}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{14}$$

Therefore from Eqn(14),

$$\Delta x' = x'_2 - x'_1 = \frac{2L}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$\Delta t' = t'_2 - t'_1 = -\frac{2vL}{c^2\sqrt{1-\frac{v^2}{c^2}}} \tag{15}$$

$\Delta x'$ shows the spatial separation and $\Delta t'$ shows time difference between the 2 collision events as seen from S'. It is not a coincidence that the two values are exactly the same values according to Lorentz length contraction interpretation of the Michelson-Morley experiment.

Thus regardless of photons or other material objects released from x_0 in frame S, according to Lorentz transformation all of them display the same non-simultaneous(time gap) behaviour wrt a particular moving frame. The time difference($\Delta t'$ in Eqn(15)) depends only on the spatial distance L and relative velocity v and is a consequence of using the Lorentz transformation, Eqn(10).

Since the two objects collide at different instances with the ends of the box according to S' frame, we expect that there will be some exchange of momentum between the box and objects 1 and 2 as viewed from S'. But if the two objects are identical and moving with the same speed hit the edges of the box simultaneously in S frame there will be no exchange of momentum between the box and the objects 1 and 2. Thus the dynamics of the system as seen from S' frame must be quiet different from what is found in S frame. The way the box reponds to the collision events depends on the order of collisions. Hence simultaneity can not be relative. It is absolute. Let us examine the Energy/Momentum balance closely.

A. Momentum Balance of the Box

Eqns(11,12) shows how objects 1 and 2 appear to S'. Let us see how do the sides A and B appear to S'.

For S frame $x_A = x_0 - L$ and $x_B = x_0 + L$ are both at rest. Thus from S',

$$x'_A = \frac{x_0 - L - vt}{\sqrt{1-\frac{v^2}{c^2}}}, t'_A = \frac{t - \frac{v(x_0-L)}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}}$$

$$x'_B = \frac{x_0 + L - vt}{\sqrt{1-\frac{v^2}{c^2}}}, t'_B = \frac{t - \frac{v(x_0+L)}{c^2}}{\sqrt{1-\frac{v^2}{c^2}}} \tag{16}$$

The trajectories seen in S' are,

$$x'_A = (x_0 - L)\sqrt{1 - \frac{v^2}{c^2}} - vt'_A$$
$$x'_B = (x_0 + L)\sqrt{1 - \frac{v^2}{c^2}} - vt'_B \qquad (17)$$

At first, Object 2 and Side B collide. Let us assume they collide at x', t' as seen from S'. This implies the x'_2 trajectory from Eqn(12) and x'_B trajectory from Eqn(17) meet at x', t'.

$$x'_2 = \frac{x_0\sqrt{1 - \frac{v^2}{c^2}}}{1 - \frac{vu}{c^2}} + \frac{(u-v)t'_2}{1 - \frac{vu}{c^2}} = x'$$
$$x'_B = (x_0 + L)\sqrt{1 - \frac{v^2}{c^2}} - vt'_B = x'$$
$$And, t'_2 = t'_B = t'$$

Therefore we get the meeting point of Object 2 and Side B, (x', t') as,

$$t' = \frac{\frac{L}{u}\left(1 - \frac{vu}{c^2}\right) - \frac{vx_0}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}$$
$$x' = \frac{x_0 + L - \frac{vL}{u}}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad (18)$$

Which corresponds to $x = x_0 + L$ and $t = \frac{L}{u}$ in frame S. This is what is observed in Frame S as the impact between object 2 and side B in Eqn(14).

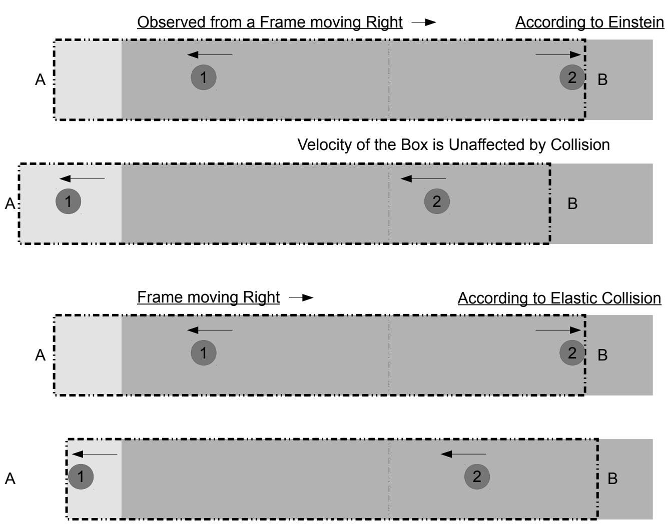

FIG. 2. Top 2 panels show the process as viewed from a moving frame(According to Einstein). Bottom 2 panels show how the process should appear if it is an elastic collision, which transfers some momentum to the box.

At this point, due to the requirements of elastic collision we expect the box(of rest mass m) moving with $-v$ m/s to exchange momentum with object 2(of mass m) moving with velocity $\frac{u-v}{1-\frac{vu}{c^2}}$ wrt S'. That is after collision, object 2 should start moving with $-v$ m/s and the box should start moving right with $\frac{u-v}{1-\frac{vu}{c^2}}$ m/s. But if we simply do the Lorentz transformations of the (x,t) values found in S to calculate the (x', t'), then Energy and Momentum balance goes haywire in S'. Thus loss of simultaneity leads to breakdown of laws of Physics in moving frames. There is one preferred frame where Energy and Momentum are conserved. The consequence of Lorentz transformation is even more dire it can obliterate objects just by relative velocity.

III. DEMATERIALISATION OF OBJECTS

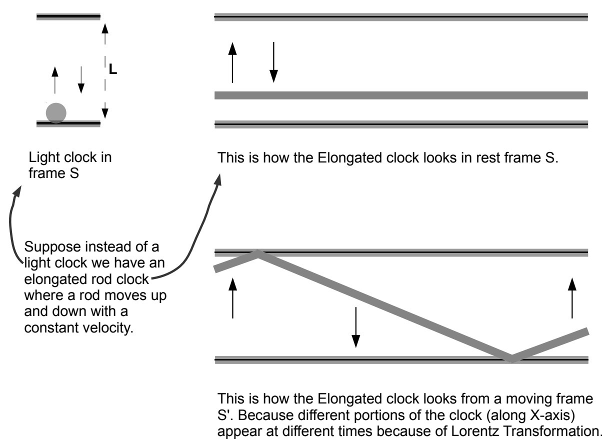

FIG. 3. An extended object executing an up and down motion at constant velocity appears to dematerialise as seen from a frame moving with some non-zero relative velocity. Because the moving frame looks at different parts of the objects from different time instances of their rest frame values, as one single instance of S' frame.

From Lorentz Transformation(Eqn(10)) we know,

$$x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}}, t' = \frac{t - \frac{vx}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}}, z' = z$$

Suppose for simplicity we consider $z = ut$. In rest frame each part of the rod, located at any x, is moving with the same rate vertically, defined by $z = ut$. So at an instant t, they would all be located at the same height z as seen from the rest frame S.

$x = x_0 =$ some stationary point on the rod at distance x_0. Vertical motion $z = ut$. So, from Eqn(10) we get,

$$x' = \frac{x_0 - vt}{\sqrt{1 - \frac{v^2}{c^2}}}, z' = z = ut$$
$$t' = \frac{t - \frac{vx_0}{c^2}}{\sqrt{1 - \frac{v^2}{c^2}}} \qquad (19)$$

Inverting the time eqn from Eqn(19) we get the time at location x_0 in S frame,

$$t_{x_0} = t'\sqrt{1-\frac{v^2}{c^2}} + \frac{vx_0}{c^2} \tag{20}$$

Let us assume that S and S' had synchronized their clocks at $x = x' = 0$ and $t = t' = 0$ therefore whenever it is time t on clock S it will be time $t' = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}}$ in S' clocks. Using this in Eqn(20) we get,

$$t_{x_0} = t'\sqrt{1-\frac{v^2}{c^2}} + \frac{vx_0}{c^2} = t + \frac{vx_0}{c^2} \tag{21}$$

Thus at time instance t' in S' frame a point at x_0 in S(rest) frame appears to be from a time instant $t + \frac{vx_0}{c^2}$(Eqn(21)). That is if $x_0 > 0$ then S' will be looking at a future time instant of that place and if $x_0 < 0$ then S' will be looking at a past time instant. In fact by placing mirrors and cameras in S frame and controlling them, S' can gaze at its own indefinite past and infinite future and perhaps even manipulate it too.

A consequence of seeing multiple time instances at once is that the material object will dematerialise, its different parts seem to execute their own independent motion, lose all its rigidity, appear as a much elongated(Fig.3) saw tooth like wave. All this due to a few m/s of relative velocity of the observer. Not just material objects even light rays have been used absurdly in relativity.

IV. LIGHT CLOCK FALLACY

The example of light clock in a moving train may not be due to Einstein but it is pedagogically used to build an intuition for the time dilation concept in special relativity. One of the major fallacies in that is that the assumption that we can **simply see** a ray of light, or a photon in flight and measure its speed from a distance!. In that example they do not specify any realistic mechanism as to how the two frames measure the speed of the same ray as seen from different frames. Nevertheless we will carry on with the same thought experiment example, just change the angles of the mirror a bit and show that the ray diagrams or photon trajectories do not work that way as imagined in that thought experiment.

Suppose there is a light source at the origin which lights up at time $t = 0$ when S and S' frames coincide and synchronize their clocks S'. It sends a ray up along Z-axis(Fig.4 - Panel A). There is a slanted mirror(at 45^o) which meets the Z-axis at an height z_0. In the rest frame, S sees that the ray goes straight up along Z-axis, get reflected and emerge parallel to X-axis.

If the mirror had an original slant of $\frac{\pi}{4}$ radians then due to length contraction along X-axis it attains a new angle θ such that,

$$Tan(\theta) = \frac{z_0}{z_0\sqrt{1-\frac{v^2}{c^2}}} = \frac{c}{\sqrt{c^2-v^2}} \tag{22}$$

This change in angle is not that crucial to the argument.

And the ray going straight up in S frame appears as slanted at some angle α and speeding at c m/s as seen from S'.

$$Tan(\alpha) = \frac{\sqrt{c^2-v^2}}{v} = \sqrt{\frac{c^2}{v^2}-1} \tag{23}$$

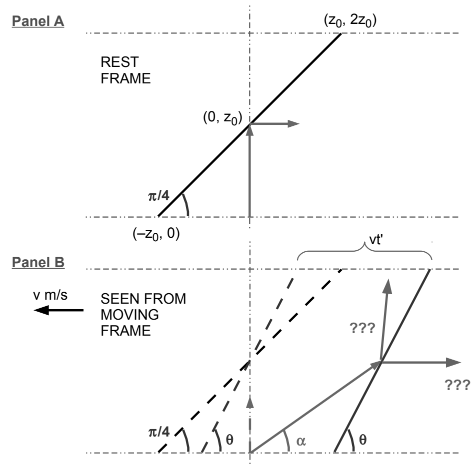

FIG. 4. Panel(A) Reflection from a slanted mirror as seen in rest frame. Solid black line shows an inclined Mirror. Solid orange line shows a ray of light. Solid blue line shows a moving inclined Mirror after length contraction along X-direction. Panel(B) Reflection from a slanted mirror as seen from a relativistic inertial frame.

In much of the cases where the mirror is placed between 0 and 90 degrees wrt X-axis(Fig.4), the light ray has to tunnel through from behind the mirror if it has to satisfy the Lorentz transformations between S and S' variables.

And in most cases where the mirror is placed between 90 and 180 degrees wrt X-axis(Fig.4), the light ray must break the law of reflection(i.e. angle of incidence = angle of reflection) inorder to satisfy Lorentz transformation. Coincidentally the law of reflection seems to work well only in one particular configuration; when the mirror placed at angle 0 wrt X-axis, or parallel to X-axis. In all other cases it eiter breaks the law of common sense or atleast the law of reflection. The ray must necessarily be carried along with the source-mirror system. Preferred frame exists. And there is a mismatch even in length measurements as done by frames at two ends of that length.

V. LENGTH MEASUREMENT MISMATCH

Suppose we are tracking the point $(x, y, z) = (0, 0, 0)$ from frame S at all times. Since it is stationary it will be $(x, y, z, t) = (0, 0, 0, t)$. If we track the same point from frame S' we get,

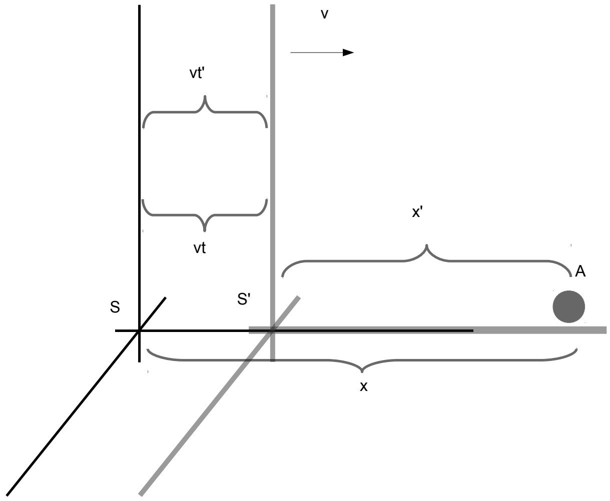

FIG. 5. Frames of Reference

$$x' = \frac{-vt}{\sqrt{1-\frac{v^2}{c^2}}}, t' = \frac{t}{\sqrt{1-\frac{v^2}{c^2}}} \tag{24}$$

Now suppose we are tracking the point $(x', y', z') = (0, 0, 0)$ from frame S' at all times. Since it is stationary it will be $(x', y', z', t') = (0, 0, 0, t')$. If we track the same point from frame S we get,

$$x = \frac{vt'}{\sqrt{1-\frac{v^2}{c^2}}} = vt, t = \frac{t'}{\sqrt{1-\frac{v^2}{c^2}}} \tag{25}$$

Thus the distance between frames S and S' appears to be $x = vt$ as seen from frame S but $x' = \frac{-vt}{\sqrt{1-\frac{v^2}{c^2}}}$ at the same instant. Since both the frames are inertial and are moving with velocity v m/s wrt each other we should get the same distance between S and S' whether we measure it from S or S'.

But as measured from frame S we get,

$$SS' = x = vt \tag{26}$$

and as measured from frame S' we get,

$$S'S = x' = \frac{-vt}{\sqrt{1-\frac{v^2}{c^2}}} \tag{27}$$

Eqns(26,27) indicate an inherent inconsistency in the Lorentz Transformation.

VI. ABUSE OF FARADAY & LORENTZ LAWS

A. Faraday Law

The electric field($\vec{E}$) at a point on a conducting wire loop due to external magnetic field $\vec{B}$ is given by,

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \tag{28}$$

Suppose a charge(q) is responding to $\vec{E}$ in the wire loop,

$$\begin{aligned} \nabla \times q\vec{E} &= -q\frac{\partial \vec{B}}{\partial t} \\ \nabla \times \vec{F} &= -q\frac{\partial \vec{B}}{\partial t} \end{aligned} \tag{29}$$

Where $\vec{F}$ is like the Coulomb force effect on charge q. Suppose the mass associated with charge q is m. Then we can write $\vec{F} = m\frac{d\vec{V}}{dt}$. Therefore,

$$\begin{aligned} \nabla \times m\frac{d\vec{V}}{dt} &= -q\frac{\partial \vec{B}}{\partial t} \\ \nabla \times \frac{m}{q}\frac{d\vec{V}}{dt} &= -\frac{\partial \vec{B}}{\partial t} \end{aligned} \tag{30}$$

The RHS should have been a total derivative $\frac{d\vec{B}}{dt}$ because change of magnetic flux on the current loop not only happens when a magnet moves. But also when the magnetic strength of a static magnet varies with time. Nevertheless, if we consider a magnet with constant magnetic strength we capture the electromagetic experiment done by Faraday.

In Eqn(30) $\vec{V} = V_x\hat{i} + V_y\hat{j} + V_z\hat{k}$ is defined wrt the wire loop. If in some frame of reference the wire loop appears to move with uniform velocity of $\vec{U}$ m/s, then the observed velocity of the charge will be $\vec{V'} = \vec{V} + \vec{U}$. Even in that frame $\frac{d\vec{V'}}{dt} = \frac{d\vec{V}}{dt}$ as $\frac{d\vec{U}}{dt} = 0$.

In that frame we need to negate the observed velocity of the wire loop to get back the correct Eqn(30). Since it is an accelerated motion we would find the same acceleration(of charges) from any frame of reference.

For simplicity let the magnetic field be defined only along X-axis, $\vec{B} = \vec{B}_x\hat{i}$. Therefore,

$$\frac{\partial \vec{B}}{\partial t} = \frac{\partial B_x}{\partial t}\hat{i} = \frac{\partial B_x}{\partial x}\frac{dx}{dt}\hat{i} = U_x\frac{\partial B_x}{\partial x}\hat{i} \tag{31}$$

Eqn(31) is also stated in the rest frame of the current loop. The relative velocity between the loop and the magnet is $\vec{U} = U_x\hat{i} + U_y\hat{j} + U_z\hat{k}$. Assume $U_y = U_z = 0$.

$$\nabla \times \frac{m}{q}\frac{d\vec{V}}{dt} = -U_x\frac{\partial B_x}{\partial x}\hat{i} \tag{32}$$

$\vec{U}$ is also defined wrt the wire loop. If this is seen from a different frame wrt which the loop is moving with $\vec{W}$ then the apparent motion of the charge will be $\vec{V'} = \vec{V} + \vec{W}$. And the magnet will appear to move at $\vec{U'} = \vec{U} + \vec{W}$ m/s. Thus we can get the relative velocity of the charge(and magnet) wrt the loop by simply subtracting the velocity of loop from the observed velocity of the charge(and magnet) to get the correct Eqn(32). That is if we blindly apply the law in the frame moving wrt the loop Eqn(32) becomes,

$$\nabla \times \frac{m}{q}\frac{d\vec{V}'}{dt} = -(U_x + W_x)\frac{\partial B_x}{\partial x}\hat{\imath} \tag{33}$$

But $\frac{d\vec{V}'}{dt} = \frac{d\vec{V}}{dt}$. And $\nabla \times \frac{m}{q}\frac{d\vec{V}}{dt} \neq -(U_x + W_x)\frac{\partial B_x}{\partial x}\hat{\imath}$. Even if we assume $\vec{B}$ becomes $\vec{B}'$ such that,

$$-(U_x + W_x)\frac{\partial B'_x}{\partial x}\hat{\imath} = -U_x\frac{\partial B_x}{\partial x}\hat{\imath}$$
$$B'_x = \frac{B_x U_x}{U_x + W_x}$$

When $W_x = -U_x$ then $B'_x = \infty$ and when $W_x = -2U_x$ then $B'_x = -B_x$. Thus in some frames the polarity of the magnet appears in reverse and in some frames the magnetic field appears as infinite, both of which are unrealistic. Thus Eqn(33) is wrong and Eqn(32) is the correct way of describing the phenomena. In Faraday law it is like there is a preferred frame. The rate of change of magnetic flux is defined wrt the wire loop and not wrt any observer moving wrt the loop.

B. Lorentz Force

$$\vec{F} = q\vec{E} + q(\vec{V} \times \vec{B})$$
$$m\frac{d\vec{V}}{dt} = q\vec{E} + q(\vec{V} \times \vec{B}) \tag{34}$$

In the LHS $q\vec{E}$ is the Coulombic Force which produces linear motion. And $q(\vec{V} \times \vec{B})$ is the Lorentz contribution and it produces circular motion. We can never convert one kind of motion into another.

The motion produced by the force term $q\vec{E}$ is defined wrt the charge distribution producing $\vec{E}$ field. And $\vec{V}$ is defined wrt the magnet producing the $\vec{B}$ field. Suppose the sources producing $\vec{E}$ and $\vec{B}$ fields be at rest wrt each other. If this is seen from a frame wrt which the sources(of $\vec{E}$ and $\vec{B}$) are moving with $\vec{W}$ m/s then the apparent motion of the charge will be $\vec{V'} = \vec{V} + \vec{W}$. The sources producing $\vec{E}$ and $\vec{B}$ will appear to move at $\vec{W}$ m/s. Thus we can get the relative velocity of the charge(and magnet) wrt the loop by simply subtracting the velocity of loop from the observed velocity of the charge(and magnet) to get the correct Eqn(34). But if we blindly apply the law in the frame moving wrt the loop Eqn(34) then,

$$m\frac{d\vec{V}'}{dt} = q\vec{E} + q(\vec{V}' \times \vec{B}) \tag{35}$$

Again we find $\frac{d\vec{V}'}{dt} = \frac{d\vec{V}}{dt}$.
And $\nabla \times \frac{m}{q}\frac{d\vec{V}'}{dt} \neq q\vec{E} + q(\vec{V}' \times \vec{B})$. Even if we assume $\vec{B}$ becomes $\vec{B}'$ such that,

$$(\vec{V} + \vec{W}) \times \vec{B}' = \vec{V} \times \vec{B}$$
$$Then, \left(\frac{d\vec{V}}{dt} + \frac{d\vec{W}}{dt}\right) \times \vec{B}' = \frac{d\vec{V}}{dt} \times \vec{B}$$
$$\frac{d\vec{V}}{dt} \times \vec{B}' = \frac{d\vec{V}}{dt} \times \vec{B}$$
$$So, \vec{B}' = \vec{B}$$

Thus Eqn(35) is wrong and Eqn(34) is the correct way of describing the phenomena. Like in Faraday law, even in Lorentz force case it is like there is a preferred frame. The velocity term($\vec{V}$) appearing in $q(\vec{V} \times \vec{B})$ must be defined wrt the source of $\vec{B}$ field.

On top of these, the pedagogic tool often used to introduce the need for relativity in electromagnetism is misconceived. In this it is claimed that a moving charge is either repelled or attracted towards a wire carrying current. And it is claimed that it happens due to Lorentz force in the frame that is at rest with the wire carrying current. But we know from Lorentz force formula that it produces a circling motion around the magnetic field vector rather than linear attraction/repulsion.

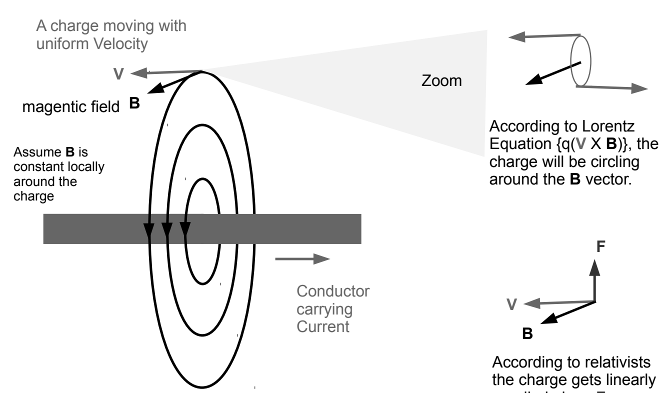

FIG. 6. Illustrating the misconception used in establishing relativistic equivalence between Coulombic force and Lorentz force.

Even the idea that flow of charges(Current) in a conductor is associated with some constant velocity is flawed. Currents, be it atmospheric, oceanic or electric are all associated with gradient driven flow. Pressure gradient, temperature gradient or charge gradient in case of current.

An electric current($\vec{I}$) is driven by Coulombic force,

$$\vec{F} = q\vec{E} = \frac{qQ}{4\pi\varepsilon_0\varepsilon_r x^2}\hat{\eta} \tag{36}$$

Where q is some test charge and Q is the charge driving the movement of q directed along some direction $\hat{\eta}$.

In fact in Ohm's law it is the potential gradient($\vec{\nabla}P$, Note: $\vec{E} = -\vec{\nabla}P$) that is driving the current, not the potential itself. That is Ohm's Law can be written as,

$$\vec{F} = -q\vec{\nabla}P = \vec{I}\mathcal{R} \tag{37}$$

Here $\mathcal{R}$ = Resistance. So, $\mathcal{R} = \frac{\mathcal{R}_0 L}{A}$ where L is the length of the conductor and A is the area of cross section. Thus,

$$\begin{aligned} \vec{I}\mathcal{R} &= \frac{qQ}{4\pi\varepsilon_0\varepsilon_r x^2}\hat{\eta} \\ \vec{I} &= \frac{qQ}{\mathcal{R}4\pi\varepsilon_0\varepsilon_r x^2}\hat{\eta} \\ \vec{I} &= \frac{qQA}{\mathcal{R}_0 L 4\pi\varepsilon_0\varepsilon_r x^2}\hat{\eta} \end{aligned} \tag{38}$$

This is sometimes treated as, $\vec{I} = \frac{q\vec{V}}{L} = \frac{qQA}{\mathcal{R}_0 L 4\pi\varepsilon_0\varepsilon_r x^2}\hat{\eta}$ which implies $\vec{V} = \frac{QA}{\mathcal{R}_0 4\pi\varepsilon_0\varepsilon_r x^2}\hat{\eta}$.

This aside,

C. Maxwells' Error

A major confusion about light starts with Maxwell's electromagnetic wave equation. He wrongly applied Ampere's law with Faraday's law in an unphysical situation.

Ampere's law in vector form due to Maxwell states,

$$\nabla \times \vec{B} = \mu_0 \left(\vec{J} + \varepsilon_0 \frac{\partial \vec{E}}{\partial t} \right)$$

In this equation both $\vec{J}$ and $\varepsilon_0 \frac{\partial \vec{E}}{\partial t}$ terms are driven by an external voltage source. That is when there is a discontinuity in the circuit due to capacitor. Then the charge build up in the capacitor(due to external voltage) creates the electric field. In the vicinity of the capacitor this varying electric field during charging and discharging of the capacitor creates a magnetic field even when $\vec{J} = 0$.

Let us consider the Faraday's law in vector form,

$$\nabla \times \vec{E}_1 = -\frac{\partial \vec{B}_1}{\partial t} \tag{39}$$

That is there is an external magnetic field $\vec{B}_1$, say produced by a permanent magnet. Movement of this magnet produces an electric field $\vec{E}_1$ in a current carrying loop.

There is another system consisting of a capacitor and an external source(AC or Alternating Current) charging and discharging it. We will not find the effect of $\vec{J}$ here because we assume the length of the conducting wire connecting between voltage source and capacitor is zero,

$$\nabla \times \vec{B}_2 = \mu_0\varepsilon_0 \frac{\partial \vec{E}_2}{\partial t} \tag{40}$$

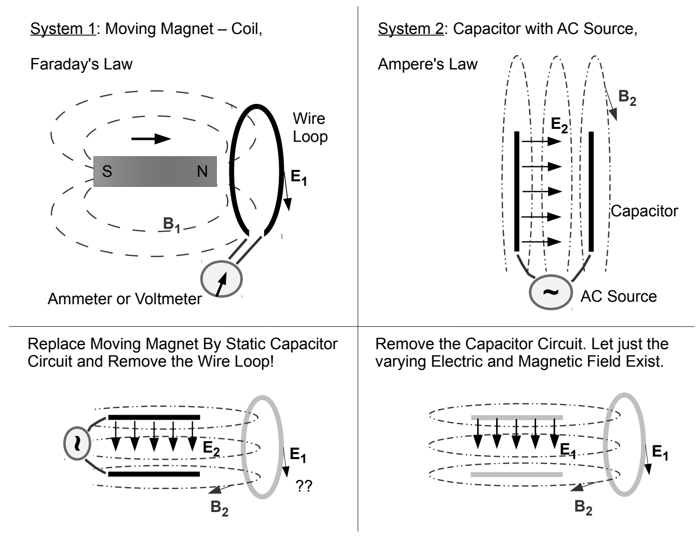

FIG. 7. Illustrating the blunder committed in Maxwell's Electromagnetic Wave Equation. System-1 illustrates Faraday's Law. System-2 illustrates Ampere's Law as applied in the context of displacement current. Then we short-circuit Sytem 1 and 2 by replacing the permanent magnet. Eventually we remove the coil present in System-1. Then we remove the capacitor circuit as well, claiming that the changing electric field $\vec{E}_2$ produces a changing magnetic field $\vec{B}_2$ which in turn produces back the original field $\vec{E}_1 = \vec{E}_2$ which caused it($\vec{B}_2$) in the first place. This is a vicious circular argument. Like an ouroboros eating itself and sustaining.

There is an external electric field $\vec{E}_2$, say produced by a capacitor, and $\vec{E}_2$ produces a magnetic field $\vec{B}_2$.

Consider partial time derivative of Eqn(40),

$$\frac{\partial[\nabla \times \vec{B}_2]}{\partial t} = \nabla \times \frac{\partial \vec{B}_2}{\partial t} = \mu_0\varepsilon_0 \frac{\partial^2 \vec{E}_2}{\partial t^2} \tag{41}$$

Assume $\vec{B}_1 = \vec{B}_2$, that is we replace the varying magnetic field $\vec{B}_1$ due to a moving permanent magnet by a static capacitor which produces variable magnetic field in its vicinity. So the magnetic field produced by the varying electric field of the capacitor is producing some secondary electric field $\vec{E}_1$ in the space around it.

$$\begin{aligned} \nabla \times \frac{\partial \vec{B}_2}{\partial t} &= \nabla \times (-\nabla \times \vec{E}_1) = \mu_0\varepsilon_0 \frac{\partial^2 \vec{E}_2}{\partial t^2} \\ \nabla^2 \vec{E}_1 - \nabla(\nabla \bullet \vec{E}_1) &= \mu_0\varepsilon_0 \frac{\partial^2 \vec{E}_2}{\partial t^2} \end{aligned}$$

Assume there is no wire loop as we discussed in Eqn(39). No material objects present, just free space hence there will be no charge build-up, so $\nabla \bullet \vec{E}_1 = 0$. Thus from the above equation we ALMOST get the D'Alembert wave equation(will be discussed in detail in a later article).

$$\nabla^2 \vec{E_1} = \mu_0 \varepsilon_0 \frac{\partial^2 \vec{E}_2}{\partial t^2} \tag{42}$$

Eqn(42) indicates that the varying electric field of the capacitor $\vec{E}_2$ produces another electric field $\vec{E}_1$ via electromagnetic induction. Now assume, $\vec{E}_2 = \vec{E}_1$ that is even the capacitor is removed, all that is left there is free space and an infinite expanse of varying electric field $\vec{E}_1$ which is not produced by anything else and is sustained in free space by properties of space(time) itself. It then reproduces itself via electromagnetic induction in a self-sustaining manner. And travels through free space as described by $\nabla^2 \vec{E_1} = \mu_0 \varepsilon_0 \frac{\partial^2 \vec{E}_1}{\partial t^2}$. This represents an unphysical situation. Like the smile of a Cheshire cat where just the smile exists but the cat doesnt. It also corrensponds to the Indian concept of Svayambhu(self-created).

VII. CONCLUSION

From the above considerations, i) Inconsistency in the light emission process, ii)Breakdown of Energy - Momentum balance equations in Einstein's concept of Simultaneity, iii)Impossibility of realistic reflection in most of the light clock configurations and iv)Dematerialisation of objects in relative motion and v)Several errors related with electromagnetism, we should declare special relativity as unfit to be a realistic theory of physics. And we should forget all the fantastical predictions of being able to gaze at and manipulate past and future alike, they are just fiction. Perhaps this also points at the need for an emission theory of light governed by classical particle physics rules. Only we need to have a particle based interpretation for Young's double slit experiment which will be attempted in a future article.