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Atom in a New Light: orbiting electrons do not radiate and Rutherford atom is stable

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***Abstract*—Long held belief that the Rutherford atom where electrons orbiting the nucleus was unstable and the electrons would spiral down due to radiation is incorrect. Charge particles moving at constant speed on circular orbits do not radiate. Rutherford atom is stable. Object and its inverse square law fields are a single entity; they have no independent existence. Inverse square law fields exist relative to the object, and they are independent of the motion of the object. Inverse square law fields are not waves, they do not propagate, and they do not satisfy Maxwell's equations. Gravitational and Coulomb electric fields are time invariant. Magnetic field of a charge moving at constant speed on a linear path or on a circular orbit is time invariant. Not all accelerating charge particles radiate; charge particles at stand still under gravity are at acceleration, yet they do not radiate. Only the charge particles with non-zero speed along the accelerating force radiate. A Moving charge particle with time varying velocity relative to the current position of the particle generates a magnetic field of independent existence, which in turn generates its electric field counterpart resulting in an electromagnetic wave burst that satisfies the Maxwell's equations. Radiation is real, not relative. Reality is not relative. If the radiation is relative, existence of matter is not possible. It is not possible to make charge particles radiate just by running away from them, as it is not possible to move a mountain just by running away from it. Charge particles cannot lose energy by riding on a passenger seat of a vehicle. The net force on a charge is observer independent. Time and Radiation is observer independent or absolute. Any phenomenon that is observer dependent is an observer perception that is not real. Only a motion of a charged object relative to its current position leads to radiation, and observer independent real physical contraction. Physical reality is independent of observers. Moving charged object with non-zero speed along accelerating force radiates, and moving object contracts in all directions; they are observer independent physical realities.**

***Keywords*—Atom; Radiation; Electromagnetic; Orbit; Fields; relativity; Rutherford-atom; Waves**

I. INTRODUCTION

The planetary model of the atom, where electrons are orbiting the nucleus, was first proposed by Ernest Rutherford in 1911. The Rutherford atom was immediately abandoned under the misconceived presumption that "every accelerating charge particles radiate". This, never proven presumption, is taken for granted as a fact, which is indeed incorrect. The real folly of that presumption is very clear if we pay attention to some important facts:

1) Every accelerating body is not in motion. A good example is a stationary object under gravity. An object at stand still under gravity does not radiate.
2) Velocity of an orbiting object under constant speed is time invariant relative to the present position of the object.
3) Every moving object under acceleration is not under time varying velocity relative to the present position of the object. A good example is an orbiting object under uniform speed. It is only an object at time varying velocity relative to the present position of the object that radiates.

Property 1.1: A Fact of Radiation

Only a moving charge particle with non-zero speed along the acceleration force generates radiation. An object at stand still under acceleration does not radiate.

Although orbiting electrons are moving at constant speed, they are under a force toward the nucleus that hold them in the orbits and hence under acceleration. A charged object under acceleration is believed to be subjected to radiation resulting in a radiation energy loss. The energy loss due to radiation is expected to slow down the orbiting particle. It was also a widespread belief that the decrease in speed of an orbiting particle would cause the orbiting particle to spiral down to the orbiting center resulting in the collapse of the orbiting system [1]. These erroneous conclusions on orbiting systems led to the abandonment of the Rutherford atom with circular orbits, in favor of prevailing quantum spookiness, which is indeed unreal. Quantum spookiness somehow supposes to move the electron in an atom radiation free. Surprisingly, how the quantum spookiness move electron within an atom without generating any radiation was never explained. However, the fact is, nothing, not even quantum spookiness, can cover up the undeniable fact that a charge particle with time varying velocity relative to the object generates radiation.

The act of disappearing of electrons from one place and reappearing in another place as proposed in quantum mechanics is not going to make the process of moving electrons radiation free. In fact, to the contrary, the disappearing act of electrons is expected to create even more radiation. Whenever there is a change of velocity of an electron, there will be radiation; there is no avoiding of that. If you say there is this much probability of finding an electron at certain place at certain time, it indicates electrons are moving in an unpredictable manner. Unpredictability of a charge particle is the recipe for radiation. Any electron that is moving in an unpredictable manner leads to radiation and hence the loss of energy making the atom unstable. Although, the probabilistic description of atom using a wave function is used to address the perceived instability as an alternative to the Rutherford atom, probabilistic description of the electrons is a catalyst for radiation and hence the instability of the atom.

Neil Bohr tried to evade the problem of radiation loss due to the motion of electron by suggesting that there is a minimum stable energy level for electrons below which electrons cannot fall toward the nucleus due to the radiation loss and the electrons in the minimum energy level are stable. The fact is, whether radiation takes place or not doesn't depend on what the energy level an electron is. If there is a change of velocity of the charge particle, there will be energy loss due to radiation even when the charge particle or electron is in that so called minimum stable energy level; the minimum stable energy level is not so minimum and not so stable energy level after all. There is nothing in that so called minimum energy level that prevents an electron from radiating; if the velocity of the electron is time varying with respect to the current position of the electron, it will radiate.

Whether the motion of electrons in an atom is described by probabilities using a wave function or using a deterministic path, whenever there is an electron motion with time varying velocity with respect to the position of an electron or whenever there is an uncertain or unpredictable position of the electron, there will be a radiation loss; there will not be a way around that. For atoms to be stable, electrons must be taking a path that does not lead to any radiation. So, our task is to find a path that electrons in atoms take without resulting in radiation loss. Although, electrons moving at constant speed on linear path do not radiate, we know that the path can't be linear since the electrons are moving about the nucleus under the influence of electromagnetic attraction towards the nucleus. What other path could the electrons in an atom take without losing energy to radiation?

If a speed perturbation in an orbiting system leads to a catastrophic spiraling down of the orbiting object, none of the orbiting systems would be stable, including our solar system. All it takes for an orbiting planet to collapse is a hit by a meteorite. We don't see planets spiraling down every time they are hit by meteorites.

In addition, it was also widely believed that the radiation is relative and depends on the observer's frame of reference. This led to the erroneous conclusion that the time is relative [1,2]. If the radiation is relative, observers in different frame of references experience a different amount of radiation from the same charged object. Could this really happen? The answer is a clear unequivocal 'no'. We certainly can't make an inactive obese person lose weight simply by running away from that person; this is indeed true for charge particles too. We certainly can't make charge particles radiate just by running away from them.

Here, we show that a charged object on a circular orbit at constant speed is not subjected to radiation. It is because, with respect to the present position of an object, the velocity of the object that orbit at constant speed is time invariant. The Rutherford atom with circular orbits is stable. In general, the decrease in the speed of an orbiting object does not lead to spiraling down of the object and the ultimate collapse of the orbiting system. Instead, if an orbiting system is subjected to any speed perturbation, it causes the orbit to dilate or contract resulting in a new stable orbit. Orbiting systems are auto-tuned stable systems. We also show that the radiation is not relative and hence the time is absolute. Passive observer has no influence on the radiation. Whether a moving charged object radiates or not is determined by the motion of the object with respect to its immediate position. Observer cannot make a moving charged object radiate by altering the observer's frame of reference. Similarly, observer cannot stop a radiating charge particle from radiating by altering the observer's frame of reference.

II. A CHARGED OBJECT AND ITS FIELDS

Axiom-1:

For a field to be a wave that propagates independently, the field must have an independent existence from the source; the field should not be tethered to the source.

Axiom-2:

Gravitational fields, Coulomb electrical fields, and Biot-Savart magnetic fields exist always relative to an object and have no independent existence; they are always tethered to the source. They are not waves. They do not propagate.

Axiam-3:

The direction of gravitational field, Coulomb electrical field, and Biot-Savart magnetic field are always radial and independent of the medium and the motion of the charge particle.

Axiom-4:

The change of velocity of a charge particle generates a magnetic field of independent existence, which, in turn, generates an electric field of independent existence that is not tethered to the source. These wave bursts satisfy the Maxwell's equations and they propagate; the radiation.

Axiom-5:

The presence of an accelerating force itself without change of velocity of the charge particle does not generate radiation. A charge particle sitting still under gravity does not radiate.

Axiom-6:

The inverse square law fields do not satisfy the Maxwell's equations. These fields are not waves. They have no independent existence from the source, and they do not propagate. The directions of these fields are not governed by the medium. The directions of these fields are radial and governed by the source alone.

A. Gravitation

It is not possible for an object to exist without its ever present infinite span gravitational field and vice versa. The object and its gravitational field are a single entity. Neither an object no a gravitational field has an independent existence. The radial gravitational field exists relative to the object and it is always static irrespective of the state of the object. The direction of the gravitational field depends only on the source. The direction of the gravitational field is independent of the medium.

The gravitational field $\boldsymbol{\mathcal{E}}_G$ at point P in space at distance R due to an object O is given by,

$$\boldsymbol{\mathcal{E}}_G=k_G(m/R^2)\mathbf{r}, \quad (2.1)$$

where $\mathbf{r}$ is the unit vector from object O to point P, $\mathbf{R}=R\mathbf{r}$, m is the mass of the object and k_G is the gravitational constant.

The gravitational flux density $\mathbf{D}_G$ is given by,

$$\mathbf{D}_G=\delta_G\boldsymbol{\mathcal{E}}_G \quad (2.2)$$

where, $\delta_G=(1/4\pi k_G)$.

The gravitational field $\boldsymbol{\mathcal{E}}_G$ exists relative to the object and is unaffected by the motion of the object. When the object moves to a new location, the field of infinite span exists relative to the new location concurrently since the object and its fields have no independent existence. Any change of mass of the object is present in the field of infinite span immediately since the mass of the object and the gravitational field is a single entity. The widely held belief that the gravitational field is a wave that travels at the speed of light has no basis to it, and simply preposterous. There are no gravitational waves. There is no space-time [4], and the speed of light has nothing to do with gravity.

Property 2.1: Nature of Gravitational Field

An object and its gravitational field are a single entity. The gravitational field is static and independent of the motion of the object. It exists always relative to the object and has no independent existence. The gravitational field is not a wave, and it does not propagate. Any change of an object is concurrent in the gravitational field. Gravitational field exerts an influence only on other masses. Gravitational field has no effect either on time or light. The direction of the Gravitational field is independent of the medium.

B. Coulomb Electric Field

If an object has a charge, then, in addition to its associated gravitational field, it is also associated with Coulomb electric field of infinite span. A charged object has no existence without its associated Coulomb electric field and vice versa. Neither a charged object nor its Coulomb electric field has an independent existence. The Coulomb electric field of a charged object is always static irrespective of the state of the object. The Coulomb electric field does not vary with time irrespective of what the motion of the charged object is. The motion of a charged object has no effect on the Coulomb electric field or the gravitational field. The motion of a charged particle does not alter the field pattern of the Coulomb electric field or gravitational field since the Coulomb electric field and gravitational field exist always relative to the charged object. The radial Coulomb electric field, straight out of the charged object with infinite span, exists relative to the object. Coulomb electric field is not a wave, it does not satisfy the Maxwell's equations, and it does not propagate since it has no independent existence. The direction of the Coulomb electric field is independent of the medium.

The Coulomb electric field $\boldsymbol{\mathcal{E}}$ at point P in space due to a charged particle O with charge q is given by,

$$\boldsymbol{\mathcal{E}}= k_e\,(q/R^2)\mathbf{r} \quad (2.3)$$

where, $\mathbf{R}=R\mathbf{r}$

$\mathbf{r}$ is the unit vector along OP, q=charge of the object, k_e is a parameter.

The electric flux density, $\mathbf{D}_\varepsilon$ is given by,

$$\mathbf{D}_\varepsilon = \delta_e\boldsymbol{\mathcal{E}}. \quad (2.4)$$

where, $\delta_e =(1/4\pi k_e)$

The Coulomb electric field $\boldsymbol{\mathcal{E}}$ exist relative to the charged object, and electric field $\boldsymbol{\mathcal{E}}$ is unaffected by the motion of the object of any kind. When the charged object is in motion, the electric field $\boldsymbol{\mathcal{E}}$ always exists relative to the object since electric field $\boldsymbol{\mathcal{E}}$ has no independent existence. Any change in the charged object is concurrently present in the electric field $\boldsymbol{\mathcal{E}}$ since they are a single entity.

Property 2.2: Nature of Coulomb Electric Field

A charge particle and its Coulomb electric field is a single entity. Coulomb electric field has no existence without the charge object and vice versa. Coulomb electric field is static irrespective of the motion of the charged object and has no independent existence. The Coulomb electric field exists always relative the charged object. It is not a wave, it does not satisfy the Maxwell's equations, and it does not propagate. Coulomb electric field exerts an influence only on other charge particles. The direction of the Coulomb electric field is independent of the medium.

C. Biot-Savart Magnetic Field

The Biot-Savart magnetic field comes into existence with the movement of a charged object. A moving charged object does not have an independent existence from its associated Biot-Savart magnetic field and vice versa. The Biot-Savart magnetic field has an infinite span and it exists relative to a moving charged object. The Biot-Savart magnetic field disappears when the charged object is at stand still even when it is under the influence of an accelerating force such as gravitation. A charged particle at stand still on the surface of a gravitational object has no Biot-Savart magnetic field since the presence of Biot-Savart magnetic field depends on the velocity of the charge particle and not on the presence of an accelerating force. What creates a Biot-Savart magnetic field is not the presence of a force that is acting on the charge particle; it is the changing position of the charge particle that is responsible for the Biot-Savart magnetic field. Since the Biot-Savart magnetic field has no independent existence it is not a wave; it does not propagate. The Biot-Savart magnetic field of a charged object can either be static or time varying depending on the nature of the movement. The direction of the Biot-Savart magnetic field is independent of the medium.

Property 2.3: Nature of Biot-Savart Magnetic Field

The moving charge particle and its Biot-Savart magnetic field is a single entity. Biot-Savart magnetic field can either be stationary or time varying and has no independent existence from the moving charge particle. Biot-Savart magnetic field exists always relative the moving charged object. The direction of the Biot-Savart magnetic field is independent of the medium. Biot-Savart magnetic field is not a wave; it does not satisfy the Maxwell's equations; it does not propagate. Biot-Savart magnetic field exerts an influence only on other moving charge particles.

Let us consider a charge particle O traveling at velocity **V**(t) on an arbitrary path, where t is the time. Consider a point P relative to the moving charged object in 3D-space at distance R away from the charged object O. The Biot-Savart magnetic flux density **ß** at point P relative to the moving charged object O is given by,

$$\mathbf{ß} = k_m[qV(t)/R^2](\mathbf{v}(t)\times\mathbf{r}) \qquad (2.5)$$

where, $\mathbf{R}=R\mathbf{r}$, and k_m is a parameter,

r is the unit vector along OP, $\mathbf{v}(t)\times\mathbf{r}$ is the direction of the Biot-Savart magnetic flux density **ß** at P, R is the distance to point P relative to the charged object at time t,

$$\mathbf{V}(t)=V(t)\mathbf{v(t)}, \qquad (2.6)$$

V(t) is the speed at time t, and **v**(t) is the unit velocity vector tangent to the path at the object O at time t, **V**(t) is the velocity of the object at time t,

$\mathbf{v}(t)\times\mathbf{r}$ is the cross product of vectors **v**(t) and **r**,

q=charge of the object.

The Biot-Savart magnetic field, $\mathbf{H}_ß$ is given by,

$$\mathbf{ß}= \delta_m \mathbf{H}_ß, \qquad (2.7)$$

From eqns. (2.5) and (2.7), we get,

$$\mathbf{H}_ß =(1/4\pi)[qV(t)/R^2](\mathbf{v}(t)\times\mathbf{r}) \qquad (2.8)$$

where, $\delta_m=4\pi\, k_m$.

The Biot-Savart magnetic field $\mathbf{H}_ß$ has infinite span and it is ever present relative to the moving charged object. Neither a moving charged object nor its Biot-Savart magnetic field has an independent existence. The Biot-Savart magnetic field $\mathbf{H}_ß$ is not a wave and it always exists relative to the moving charged object; the Biot-Savart magnetic field $\mathbf{H}_ß$ has no independent existence. As it is with the gravitational field $\mathbf{Ɛ}_G$ and the Coulomb electric field **Ɛ**, the Biot-Savart magnetic field $\mathbf{H}_ß$ is closely tied to the moving charged object and hence has no freedom to propagate as an independent wave. The moving charged object and its Biot-Savart magnetic field are not two separate entities; they are a single entity. Any change in the moving charged object is concurrently present in the Biot-Savart magnetic field since the moving charged object and its Biot-Savart magnetic field are a single entity.

D. Non-Propagating Fields

The gravitational field, Coulomb electric field, and Biot-Savart magnetic field are proportional to the inverse square distance, $1/R^2$. Any field that is proportional to $1/R^2$ does not satisfy the Maxwell's equations. Therefore these fields are not waves and they do not propagate. They exist relative to the object and have no independent existence. Only the fields of independent existence can propagate in a direction determined by the characteristic of the medium or lack of it.

Property 2.4: Non-Propagating Fields

Any field that is proportional to $1/R^2$, i.e. a field govern by inverse square law, does not satisfy the Maxwell's equations; such fields are not waves and have no independent existence from the object. These fields are tethered to the object. An object and its inverse square law fields of infinite span are a single entity; one cannot exist without the other. The directions of the inverse square fields are radial from the source, and independent of the medium.

III. RADIATING SOURCE

Let us consider a charge particle O traveling at velocity **V**(t) on an arbitrary path, where t is the time. At time t, let the plane passing the moving charged particle O at an angle θ to **V**(t), be S, where $0< \theta<\pi$. It doesn't matter where the charged object O is, the plane S is there with it. In other words, we can consider the plane as if it is hypothetically attached to O. The plane S exists with reference to the charged object O irrespective of the position of the charged object O.

The plane S exists relative to the moving charged object at any time t. Plane S is at an angle θ to the direction of the motion of the object, **v**(t).

Consider a closed loop L of radius R centered at the moving charged object O on plane S. Since the charge particle is moving relative to the present position of the charge particle, there is an electrical current. Electrical current is independent of any observer. Although, the charge particle is stationary relative to the plane S, charge particle is moving relative to the present position of the charge particle. It is the movement of a charge particle relative to the present position of the charge particle that determines the electrical current. Therefore, at time t, the electrical current, **I**(t) passing through the loop L on plane S is given by,

$$\mathbf{I}(t)=q\mathbf{V}(t)\sin(\theta), \text{ inside the loop } L\in S \qquad (3.1)$$

on plane S, and

$$\mathbf{I}(t)=0, \text{ loop } L\notin S, \qquad (3.2)$$

outside the plane S.

In other words, **I**(t) is a point current that exist at O only. The radiating magnetic flux density **B** is given by the Ampere's rule.

Let **B** be the radiating magnetic flux density at any point P on the loop L on plane S. Since the loop L is a circular path of radius R on plane S, the magnitude of the magnetic flux density **B** will be the same on the loop. If a small section of the path at P on S is $\delta\boldsymbol{\ell}$, then the closed loop integral is given by,

$$\oint \boldsymbol{B} \bullet \delta\boldsymbol{\ell} \tag{3.3}$$

where, ● is the dot-product.

Since the charged object O is inside the loop on plane S at time t, the instantaneous point current **I**(t) that passes through the plane is given by,

$$\mathbf{I}(t)=q\mathbf{V}(t)\sin(\theta). \tag{3.4}$$

I(t) exists only on the plane S at the moving charged object O. Anywhere outside the plane S,

$$\mathbf{I}(t)=0,\ L\notin S,\ 0<\theta<\pi. \tag{3.5}$$

Using Ampere's rule, we get,

$$\oint \boldsymbol{B} \bullet \delta\boldsymbol{\ell} = \mu_o\, \mathbf{I}(t), \tag{3.6}$$

where, μ_o is the permeability of free space.

Substituting for **I**(t) from eqn. (3.4), we get,

$$\oint \boldsymbol{B} \bullet \delta\boldsymbol{\ell} = \mu_o\, qV(t)\sin(\theta),\ 0<\theta<\pi. \tag{3.7}$$

Since the magnetic flux density **B** is in the same direction as of the $\delta\boldsymbol{\ell}$ and the magnitude of the magnetic flux density **B** is the same around the loop,

$$B\oint \delta\ell = \mu_o\, qV(t)\sin(\theta) \tag{3.8}$$

where, B=|**B**|, |.| denotes the magnitude.

$$\text{Since } \oint \delta\ell = 2\pi R, \tag{3.9}$$

we have,

$$B = (\mu_o/4\pi)\,(2q/R)V(t)\sin(\theta) \tag{3.10}$$

We know the direction of **B** at any point P is **v**(t)×**r**. Here, **v**(t) is the unit vector tangent to the path at the moving charged object O, or in other words, the unit vector representing the direction of motion. The velocity of the charged object, **V**(t) at time t is given by,

$$\mathbf{V}(t)=V(t)\mathbf{v}(t) \tag{3.11}$$

V(t) is the speed of the charged object O,

r is the unit vector at any point P in the 3-dimensional space in the direction OP. Further, the angle between unit vector **v**(t) and unit vector **r** is θ. So, we have,

$$\mathbf{B} = (\mu_o/4\pi)[2qV(t)/R](\mathbf{v}(t)\times\mathbf{r}) \tag{3.12}$$

At any time t, the radiating magnetic field is proportional to 1/R. The radiating magnetic flux density at any point P on space relative to the moving charged object O is give by,

$$\mathbf{B} = (\mu_o/4\pi)[2qV(t)/R](\mathbf{v}(t)\times\mathbf{r}). \tag{3.13}$$

The radiating magnetic flux density **B** at any point P in the direction **R** relative to the moving charged object can be written as,

$$\mathbf{B} = \Psi_{rad}(R)\, V(t)(\mathbf{v}(t)\times\mathbf{r}) \tag{3.14}$$

where $\Psi_{rad}(R)$ is time invariant and given by,

$$\Psi_{rad}(R) = (\mu_o/4\pi)\,(2q/R). \tag{3.15}$$

Differentiating **B** with respect to time t, we get,

$$\frac{\partial}{\partial t}[\mathbf{B}] = \Psi_{rad}(R)\,\frac{\partial}{\partial t}[V(t)\,(\mathbf{v}(t)\times\mathbf{r})] \tag{3.16}$$

$$=\Psi_{rad}(R)\,\{V(t)\frac{\partial}{\partial t}[\mathbf{v}(t)\times\mathbf{r}]+(\mathbf{v}(t)\times\mathbf{r})\frac{\partial}{\partial t}[V(t)]\,\} \tag{3.17}$$

Since **r** is time invariant, we have,

$$\frac{\partial}{\partial t}[\mathbf{B}] = \Psi_{rad}(R)\{V(t)[\mathbf{r}\times\frac{\partial}{\partial t}\mathbf{v}(t)] +(\mathbf{v}(t)\times\mathbf{r})\frac{\partial}{\partial t}[V(t)]\,\}$$

When **V**(t)=**0**, **B**=**0** and $\frac{\partial}{\partial t}[\mathbf{B}]=\mathbf{0}$.

Electromagnetic burst of independent existence that satisfies the Maxwell's equation or radiation exists only when $\frac{\partial}{\partial t}[\mathbf{B}] \neq \mathbf{0}$.

So, we get,

$$\frac{\partial}{\partial t}[\mathbf{B}] \neq \mathbf{0},\ \text{if, } \frac{\partial}{\partial t}[V(t)] \neq 0, \tag{3.18}$$

$$\text{or } \frac{\partial}{\partial t}[\mathbf{v}(t)\times\mathbf{r}] \neq \mathbf{0}, \tag{3.19}$$

or both.

A. Electromagnetic Waves

Since we already have the magnetic field **B** of independent existence from the Ampere's law, we have the induced electric field **E** of independent existence,

$$\nabla\times\mathbf{E} = -\frac{\partial}{\partial t}[\mathbf{B}], \tag{3.20}$$

where,

$$\mathbf{B} = \Psi_{rad}(R)\, V(t)\,(\mathbf{v}(t)\times\mathbf{r}) \text{ and} \tag{3.21}$$

$$\Psi_{rad}(R) = (\mu_o/4\pi)\,(2q/R). \tag{3.22}$$

Even though the Biot-Savart magnetic flux density **ß** has no independent existence from the moving charged object, the time varying magnetic flux density **B** has an independent existence. It is this time varying magnetic flux density **B** of independent existence that is responsible for generating its electric field counterpart **E** of independent existence. Once generated, **B** and **E** have no attachment to the moving charged object; they mutually feed each other. Unlike the gravitational field, Coulomb electric field, and Biot-Savart magnetic field, this induced electromagnetic field (**B**, **E**) is not harnessed to the moving charged object in any form; it is free to propagate and satisfies the Maxwell's equations.

The magnitude of the electromagnetic field **E** is proportional to 1/R, or it satisfies the inverse distance law. The electromagnetic field **E** satisfies the Maxwell's equations since the closed loop integral is independent of R. Both the magnetic flux density **B** and the induced electric field **E** have an independent existence from the source resulting in propagating wave burst or radiation that is sustainable by feeding one by the other. The time variation of magnetic field **B** generates its electrical field counterpart **E** and the time variation of electric field **E** generates its magnetic field counterpart **B**. As we see later, the major player in this is the existence of $\frac{\partial}{\partial t}[\mathbf{B}]\neq\mathbf{0}$. The direction of the radiation is radial, outward from the moving charged particle. Once the radiation field is generated, the propagation path of the radiating field is independent of the source and depends only of the density gradient of the medium.

Corollary 3.1: Maxwell Fields

Only the inverse distance fields or fields that are proportional to 1/R satisfies the Maxwell's equations.

Now, we want to see what the equivalent source of radiating field at the object O is.

We have the radiating magnetic flux density **B**, where

$$\frac{\partial}{\partial t}[\mathbf{B}] = (\mu_o/4\pi)\,(2q/R)\,\frac{\partial}{\partial t}[V(t)\,(\mathbf{v}(t)\times\mathbf{r})]. \tag{3.23}$$

Since,

$$\nabla \times \mathbf{E} = - \frac{\partial}{\partial t} [\mathbf{B}], \quad (3.24)$$

we have,

$$\nabla \times \mathbf{E} = (1/4\pi\varepsilon_o)(\varepsilon_o\mu_o)(2q/R) \frac{\partial}{\partial t} [V(t) \, (-\mathbf{v}(t)\times\mathbf{r})].$$

We can write this as,

$$\nabla \times \mathbf{E} = (1/4\pi\varepsilon_o) \, (2\mathbf{I}_{rad}/R), \quad (3.25)$$

where,

$$\mathbf{I}_{rad}=(q/c^2) \frac{\partial}{\partial t} [V(t) \, (-\mathbf{v}(t)\times\mathbf{r})], \quad (3.26)$$

ε_o is the permittivity of the free space,

$c^2=1/\mu_o\varepsilon_o$, and c is the speed of light in free space.

$\mathbf{I}_{rad}$ is the equivalent radiating point source that exists only at the moving charged object. The radiating point source $\mathbf{I}_{rad}$ is responsible for the generation of radiation burst of independent existence, where,

$$\nabla \times \mathbf{E} = - \frac{\partial}{\partial t} [\mathbf{B}], \quad (3.27)$$

$$\nabla \times \mathbf{B} = \mu_o\varepsilon_o \frac{\partial}{\partial t} [\mathbf{E}]. \quad (3.28)$$

The induced **E** is in such a direction that reduces the increase of **B** with time. The **B** is perpendicular to **E** clockwise, and the direction of propagation is outward.

Existence Theorem:

The radiating magnetic field **B** can exist if and only if $\frac{\partial}{\partial t}[\mathbf{B}] \neq \mathbf{0}$. There will be no radiation If $\frac{\partial}{\partial t}[\mathbf{B}] = \mathbf{0}$.

Proof: For the radiating magnetic field **B** to exist, it's radiating electric field counterpart **E** must exist; neither **B** nor **E** has an independent existence.

Since, $\nabla \times \mathbf{E} = - \frac{\partial}{\partial t}[\mathbf{B}]$, for **E** to exist, the time variation of **B** must be non-zero, i.e. $\frac{\partial}{\partial t}[\mathbf{B}] \neq \mathbf{0}$.

In other words, if $\frac{\partial}{\partial t}[\mathbf{B}]=\mathbf{0}$, then $\mathbf{E}=\mathbf{0}$.

Since, $\nabla \times \mathbf{B}=\mu_o\varepsilon_o\frac{\partial}{\partial t}[\mathbf{E}]$, if $\mathbf{E}=\mathbf{0}$, then $\mathbf{B}=\mathbf{0}$. So, for radiation to exists, both **B** and **E** must exist. For both **B** and **E** to exist, $\frac{\partial}{\partial t}[\mathbf{B}]$ must be non-zero, $\frac{\partial}{\partial t}[\mathbf{B}]\neq\mathbf{0}$. This indicates that there will be no radiation if $\frac{\partial}{\partial t}[\mathbf{B}]=\mathbf{0}$.

B. Determining if a Path is Radiation Free

We can use the Existence Theorem to obtain if a charge moving on a certain path is radiation free or not. All we have to do is use the Ampere's law to obtain the radiating magnetic field of independent existence **B** for the charge particle moving on a given path, and then check to see if $\frac{\partial}{\partial t}[\mathbf{B}] = \mathbf{0}$ **or not**.

If $\frac{\partial}{\partial t}[\mathbf{B}] = \mathbf{0}$, then the motion of the charge particle on that path is radiation free. Later, we use this approach to show that a charge particle moving on a linear path or on a circular orbit is radiation free.

Property 3.1: Propagating Fields

Only the fields proportional to inverse distance, 1/R, satisfy the Maxwell's equations; these fields have an independent existence from the source, and they propagate; radiation. These fields are not tethered to a source. Once radiation fields are generated, the paths of these fields are independent of the source, and the path of propagation is determined solely by the density gradient of the medium.

Property 3.2: Cause of Radiation

The presence of an accelerating force does not determine the presence of radiation. It is the time variation of the vector cross product **V**(t)×**r** of a moving charge particle that determines the presence of radiation, where **V**(t) is the velocity of the charge and **r** is the unit distance vector to any point in 3-dimensional space relative to the moving object.

Corollary 3.1: Radiation

All the accelerating charge particles do not radiate. Only the accelerating charge particles with time varying velocities generate radiation.

Property 3.3: Radiation Free Motion

There will be no radiation If the vector cross product **V**(t)×**r** is a vector constant or time invariant over the path of the charge particle.

It is this property of a moving charge particle that makes the charge particles moving on a linear path or on a circular orbit radiation free.

IV. MOVING CHARGE ON LINEAR PATH AT CONSTANT SPEED

Theorem: Linear Path Theorem

A charge particle moving at constant speed on a linear path does not generate radiation.

Proof: We already have the time varying magnetic flux density of a moving source,

$$\frac{\partial}{\partial t}[\mathbf{B}] = \Psi_{rad}(R) \frac{\partial}{\partial t} [V(t)(\mathbf{v}(t)\times\mathbf{r})], \quad (4.1)$$

$$=\Psi_{rad}(R)\{V(t) \frac{\partial}{\partial t}[\mathbf{v}(t)\times\mathbf{r}] + [\frac{\partial}{\partial t}V(t)][\mathbf{v}(t)\times\mathbf{r}]\} \quad (4.2)$$

Since the charged object is moving at constant speed,

$$V(t)=V, \quad (4.3)$$

and V is time invariant, i.e.

$$\frac{\partial}{\partial t} V(t) = 0. \quad (4.4)$$

So, we have,

$$\frac{\partial}{\partial t}[\mathbf{B}] = \Psi_{rad}(R)V \frac{\partial}{\partial t} [\, \mathbf{v}(t)\times\mathbf{r} \,]. \quad (4.5)$$

The time variation of **B** depends on the time variation of **v**(t)×**r**. The vector **r** is the unit direction vector in 3-dimensional space relative to the moving charged object O and it is time invariant. The vector **v**(t) is tangent to the path at O. Since the path is linear, it doesn't matter where the charged object O is on the path, **v**(t)×**r** is time invariant.

There is an alternative way to view this. Assume that instead of moving the charged object O on the path, we freeze the charged object O and its direction of motion at O, which is the same as the tangent to the moving path at O at time t in place, and move the path backward. Then, we find that the every section of the path that passes through the charged object O coincides with the frozen direction of the movement of charged object O, indicating that the cross product **v**(t)×**r** is time invariant, i.e.

$\frac{\partial}{\partial t}$[**v**(t)×**r**]=0, (4.6)

for a linear path.

Therefore, for a charged particle moving at constant speed on a linear path, we have,

$\frac{\partial}{\partial t}$[**B**] = 0. (4.7)

From eqn. (2.5), we already have the Biot-Savart magnetic flux density at any point P of distance **R** in 3D-space,

ß = $\Psi_ß(R^2)$ V(t)(**v**(t)×**r**) (4.8)

where

$\Psi_ß(R^2) = k_m(q/R^2)$. (4.9)

Differentiating with respect to time,

$\frac{\partial}{\partial t}$[**ß**] = $\Psi_ß(R^2)$ $\frac{\partial}{\partial t}$[V(t) (**v**(t)×**r**)] (4.10)

=$\Psi_ß(R^2)${V(t) $\frac{\partial}{\partial t}$[**v**(t)×**r**]+[$\frac{\partial}{\partial t}$V(t)][**v**(t)×**r**]} (4.11)

Since radiating magnetic flux density **B** and the Biot-Savart magnetic flux density **ß** differ only by the functions $\Psi_{rad}(R)$ and $\Psi_ß(R^2)$ that are time independent, when,

$\frac{\partial}{\partial t}$[**B**] = **0**, (4.12)

we also have,

$\frac{\partial}{\partial t}$[**ß**] = **0**. (4.13)

The radiating magnetic flux density **B** and the Biot-Savart magnetic flux density **ß** of a moving charged object are time invariant when the charged object is moving on a linear path.

When **B** is time invariant, the induced propagating electric field,

E=**0**. (4.14)

We know that the magnetic flux density counterpart **B** of the propagating electric field of independent existence **E** is given by,

$\nabla \times$ **B** = $\mu_o\varepsilon_o$ $\frac{\partial}{\partial t}$[**E**]

Since propagating electric field of independence, **E**=**0**, its magnetic counterpart is given by,

B=**0**.

In other words, there is no electromagnetic radiation when a charged object is moving on a linear path.

Property 4.1: Linear Path Motion

For a charge moving at constant speed on a linear path, the vector cross product V**v**(t×**r**=constant vector, and $\frac{\partial}{\partial t}$[**v**(t)×**r**]=**0**.

Property 4.2: Linear Path and Radiation

A charged object moving at constant speed on a linear path does not radiate; in other words, the induced radiating fields, **B**=**0**, and **E**=**0**.

We are going to use the same procedure to analyze charged particles moving on a circular orbit.

V. MOVING CHARGED OBJECT ON CIRCULAR ORBIT AT CONSTANT SPEED

Theorem: Circular Orbit Theorem

A charge particle moving at constant speed on a circular orbit does not generate radiation.

Proof: The Biot-Savart magnetic flux density **ß** exists relative to the moving charged object O. The time varying Biot-Savart magnetic flux density **ß** at any point in the 3-dimensional space relative to the moving charged object is given by,

$\frac{\partial}{\partial t}$[**ß**] = $\Psi_ß(R^2)$ $\frac{\partial}{\partial t}$[V(t) (**v**(t)×**r**)] (5.1)

=$\Psi_ß(R^2)${V(t) $\frac{\partial}{\partial t}$[**v**(t)×**r**] + [$\frac{\partial}{\partial t}$V(t)][**v**(t)×**r**]} (5.2)

The direction of motion **v**(t) is also tangent to the path at the charged object O. Since speed of the object is time invariant, we have,

V(t)=V and $\frac{\partial}{\partial t}$V(t) = 0. (5.3)

So, we have,

$\frac{\partial}{\partial t}$[**ß**] = $\Psi_ß(R^2)$ V $\frac{\partial}{\partial t}$[**v**(t)×**r**]. (5.4)

As in the case of the motion on a linear path, time varying Biot-Savart magnetic flux density of a moving charge particle on a circular orbit depends on the time variation of the vector cross product **v**(t) × **r**. The direction vector **r** is relative to the moving charged object and hence **r** is time invariant. Unlike the linear path, **v**(t) for circular orbit with respect to the orbiting center varies with time since the tangent to the circular orbit differs from point to point as the charge particle moves on the path. However, as we will see later, with respect to the moving charged object, the **v**(t) is time invariant. Since Biot-Savart magnetic field exists with respect to the moving object O, what matters is the velocity of the object with respect to the present position of the object.

When the charged object is at point Q on the orbit, we have the velocity of the object, $\mathbf{V}_Q$,

$\mathbf{V}_Q$=V$\mathbf{v}_Q$, (5.5)

where, $\mathbf{v}_Q$ is the unit velocity vector at Q. If $\delta\ell_Q$ is a small section of the path at Q, the $\mathbf{v}_Q$ is the unit vector tangent to $\delta\ell_Q$ or the path at Q. When the charge particle is at point Q, we have the vector cross product,

V$\mathbf{v}_Q$×**r** = kV $\delta\ell_Q$× **r** (5.6)

where, k is a scalar constant.

Similarly, when the object is at point O on the orbit, we have,

$\mathbf{V}_O$=V$\mathbf{v}_O$, (5.7)

where, $\mathbf{v}_O$ is the unit velocity vector at O. If $\delta\ell_O$ is a small section of the path at O, the $\mathbf{v}_O$ is the unit vector tangent to $\delta\ell_O$ or the path at O.

When the charge particle is at point O, we have the vector cross product,

V$\mathbf{v}_O$× **r** = kV $\delta\ell_O$× **r** (5.8)

Now, assume that the $\delta\ell_O$ is hypothetically attached to the object. Since the charge particle is on a circular orbit, when object moves to the point Q from point O, the hypothetically attached small section $\delta\ell_O$ will overlap the small section $\delta\ell_Q$ at point Q on the path. In other words, the movement of the object from point O on the orbit to point Q on the orbit does not change the vector cross product **v**(t)×**r**, since

$\delta\ell_O$×**r**=$\delta\ell_Q$×**r**. (5.9)

The choice of point Q is arbitrary and it can be any point on the orbit, yet, the vector cross product **v**(t)×**r** remains the same as the charged object moves on a circular orbit. In the case of circular orbits at constant speed V, the unit vector **v**(t) with respect to the object is time invariant. Hence, the vector cross product **v**(t)×**r** is time invariant; it remains a constant independent of where the object is at any time t. When the object moves at constant speed on a circular orbit, the whole 3-dimensional field pattern of infinite span remains unaltered with reference to the charged object. There is no change to the field relative to the moving charged object. The Biot-Savart magnetic flux density **ß** remains time invariant.

There is an alternative way to look at this is. Let us freeze the object O at time t with its vector cross product **v**(t)×**r** and move the orbit backward. Now, it doesn't matter which point of the path passes the frozen charged object O in reverse, the gradient at any point of the path that passes the frozen charged object O coincides with frozen v(t) indicating that the cross product **v**(t)×**r** is time invariant, i.e.

$$\frac{\partial}{\partial t}[\mathbf{v}(t)\times\mathbf{r}]=\mathbf{0}, \quad (5.10)$$

for a circular path.

Therefore, for a charged particle moving at constant speed on a circular orbit, the Biot-Savart magnetic flux density **ß** is time invariant, i.e.,

$$\frac{\partial}{\partial t}[\mathbf{ß}] = \mathbf{0}. \quad (5.11)$$

In Eqn. (3.14), we have already seen that the radiating magnetic flux density is given by,

$$\mathbf{B} = \Psi_{rad}(R)\ V(t)\ (\mathbf{v}(t)\times\mathbf{r}) \quad (5.12)$$

where,

$$\Psi_{rad}(R) = (\mu_o/4\pi)\ (2q/R). \quad (5.13)$$

Differentiating **B** in Eqn. (5.12) with respect to time t, we get,

$$\frac{\partial}{\partial t}[\mathbf{B}] = \Psi_{rad}(R)\ \frac{\partial}{\partial t}[V(t)\ (\mathbf{v}(t)\times\mathbf{r})] \quad (5.14)$$

$$=\Psi_{rad}(R)\{V(t)\ \frac{\partial}{\partial t}[\mathbf{v}(t)\times\mathbf{r}]+(\mathbf{v}(t)\times\mathbf{r})\ \frac{\partial}{\partial t}[V(t)]\} \quad (5.15)$$

Since,

$$V(t)=V, \quad (5.16)$$

we have,

$$\frac{\partial}{\partial t}[V(t)]=0, \quad (5.17)$$

and hence,

$$\frac{\partial}{\partial t}[\mathbf{B}] = \Psi_{rad}(R)\ V\ \frac{\partial}{\partial t}[\ \mathbf{v}(t)\times\mathbf{r}\ ] \quad (5.18)$$

Since the radiating magnetic flux density **B** and the Biot-Savart magnetic flux density **ß** only differs by the function $\Psi_{rad}(R)$ and $\Psi_{ß}(R^2)$ that are time invariant, when,

$$\frac{\partial}{\partial t}[\mathbf{ß}] = \mathbf{0}, \quad (5.19)$$

we vave,

$$\frac{\partial}{\partial t}[\mathbf{B}] = \mathbf{0}. \quad (5.20)$$

Both the radiating magnetic flux density **B** and the Biot-Savart magnetic flux density **ß** are time invariant when a charged object is orbiting at constant speed on a circular path.

Since the radiating electric field of independent existence **E** is given by,

$$\nabla\times\mathbf{E} = -\frac{\partial}{\partial t}[\mathbf{B}]$$

when **B** is time invariant, the induced electric field of independent existence,

$$\mathbf{E}=\mathbf{0} \quad (5.21)$$

We know that the magnetic flux density counterpart **B** of the propagating electric field of independent existence **E** is given by,

$$\nabla\times\mathbf{B} = \mu_o\varepsilon_o\ \frac{\partial}{\partial t}[\mathbf{E}]$$

Since propagating electric field of independence, **E**=**0**, its magnetic counterpart is given by,

B=**0**.

In other words, there is no electromagnetic radiation when a charged object is moving on a circular orbit.

Property 5.1: Orbiting Charge

For a charge moving at constant speed on a circular orbit, the vector cross product V**v**(t)×**r** is time invariant, V**v**(t)×**r**=vector constant.

From the vector cross product V**v**(t)×**r** at any time t, it is not possible to say if the charge is moving at constant speed on a uniform path or on a circular orbit.

Corollary 5.1: Linear Paths and Circular Orbits

From the vector cross product V**v**(t)×**r**, if it is not possible to distinguish if a charge particle is moving on a linear path or on a circular orbit, then, the charge particle is not undergoing any radiation.

Property 5.2: Circular Orbit and Radiation

A charged object moving at constant speed on a circular orbit does not radiate, i.e. the induced radiating fields of independence, **B**=0, and **E**=0.

Lemma 5.1: Stability of Atom

Atoms with electrons orbiting the nucleus on circular orbits are stable.

Proof: We know electrons on circular orbits do not radiate. Therefore, electrons on circular orbits are not subjected to radiation energy loss, and hence the atoms with electrons on circular orbits are stable. The Rutherford's model of atom with circular orbits is stable.

A charged object orbiting the nucleus at constant speed has a force toward the nucleus. However, as we have seen, the radiation is proportional to the rate of change of velocity of the object with respect to the object. Therefore, for a moving charged object to radiate, the presence of a force itself is not sufficient. There must be a non-zero change of speed of the moving charged object along the force in order for radiation to take place. As an example, a charged object at rest on the ground is under the gravitational force, yet it does not undergo radiation since there is no non-zero change of speed associated with the charged object in the direction of the gravitational force. It is not the presence of a force that generates the radiation; it is the accelerated motion, non-zero speed along the direction of the force, which generates the radiation.

Property 5.3: Force and Radiation

A charged object under a force is not subjected to radiation if the speed of the charged object in the direction of the force is zero. The determining factor of radiation is the time variation of the vector cross product V**v**(t)×**r** of a charged object, not the mere presence of an accelerating force.

Property 5.4: Circular Orbit and Radiation

For a charge particle orbiting at constant speed on a circular orbit, $\frac{\partial}{\partial t}$ V[**v**(t)×**r**]=**0**, and hence there is no radiation.

In the case of electrons orbiting the nucleus at constant speed on circular orbits, the speed along the accelerating force toward the nucleus is zero all the time, and the change of the speed is zero, and hence there will be no radiation. An accelerating force without non-zero change in velocity does not generate radiation.

Radiation Free Paths for a Moving Charge:

1) if a charged object is moving at constant speed on a linear path, then,

V**v**(t)=V**v**, ∀t, a constant (time invariant), and

V**v**(t)×**r**=V**v**×**r**, ∀t, a vector constant (time invariant), where, V is the speed and **v**(t) is the unit vector tangent to the path at the object at time t.

2) if a charged object is moving at constant speed on a circular orbit, then,

V**v**(t)≠V**v**, ∀t, not a vector constant (time varying) relative to the orbiting center or an observer.

V**v**(t)=V**v**, ∀t a constant vector (time invariant) with respect to the present position of the moving object.

V**v**(t)×**r**=V**v**×**r**, ∀t, a constant vector (time invariant) with respect to the present position of the moving object.

3) Since V**v**(t)×**r**=V**v**×**r**, ∀t, a constant or time invariant with respect to the present position of the object for a charge moving at constant speed on a linear path or on a circular orbit, there will be no radiation.

4) Although, the Charge particles moving at constant speed on a linear path, and the charge particles moving at constant speed on a circular orbits are free from radiation, charge particles moving on any other path are subjected to radiation.

VI. STABILITY OF ORBITING SYSTEMS

There are two types of orbiting systems of interest that differs by the forces acting on them. One is the smallest scale atomic orbiting systems dominated by electrostatic forces over gravitational forces, and the other is the much larger scale planetary and galactic orbiting systems dominated by gravitational forces over electrostatic forces.

A. Stability of Atom

Now, we know that the atomic model, where electrons orbiting the nucleus, is stable. However, it is interesting to see what happens if an electron loses its speed; are they going to spiral down? Let consider the case where electron of mass m and charge –q is orbiting the nucleus of charge q and mass M at radius r. So, at stable point, we have,

$$k_e q^2/r^2 + k_G Mm/r^2 = mv^2/r \quad (6.1)$$

where, k_G is the gravitational parameter.

We can write Eqn. (6.1) as,

$$k_e q^2/r^2 = m(v^2/r) - k_G(Mm/r^2) \quad (6.2)$$

$$=(m/r)[v^2 - k_G M/r] \quad (6.3)$$

Since M and m are negligibly small, and v is large, $k_G M/r << v^2$, we get,

$$k_e q^2/r^2 = mv^2/r \quad (6.4)$$

Since q, m and k_e are constants, From Eqn. (6.4), we have,

$$rv^2=\text{constant}. \quad (6.5)$$

Eqn. (6.5) represents the stable condition for an atom where electrons are orbiting the nucleus on circular orbits. Now, we want to know what happens to this stable condition of the system if it is perturbed by a small amount. Differentiating, with respect to time, we get,

$$v^2 \frac{\partial}{\partial t}[r] + 2rv \frac{\partial}{\partial t}[v] = 0, \text{ i.e.,} \quad (6.6)$$

$$\frac{\partial}{\partial t}[r] = -2(r/v) \frac{\partial}{\partial t}[v]. \quad (6.7)$$

If the speed of electron decreases, the orbit dilates, in effect, reaching a new stable orbit. The decrease in speed of the orbiting electrons does not lead to a spiraling down of the electrons in to the nucleus.

Property 6.1: Orbiting Under Perturbation

Any perturbation of a stable orbiting system does not lead to a catastrophic collapse of the orbiting system; the system under perturbation shifts itself into a new stable state through the self adjustment of the orbits.

Corollary 6.1: Loss of Speed

If the speed of an orbiting electron decreases, the decrease in the speed of an orbiting electron in an atom does not lead to spiraling down of the electron and collapse of the orbiting system.

Property 6.2: Orbit Dilation

If the speed of an orbiting electron decreases, the decrease in speed of an orbiting electron in an atom leads to orbit dilation toward a new stable orbit.

B. The Stability of Planetary Systems

Consider a planet of mass m orbiting a center mass M at radius r and speed v. At stability, we have,

$$k_G Mm/r^2 = mv^2/r, \quad (6.8)$$

where, k_G is the gravitational constant,

In other words, at stability,

$$k_G M = rv^2 \quad (6.9)$$

We want to find out what happens to the stability when the parameters are perturbed. Differentiating with respect to time, we get,

$$v^2 \frac{d}{dt}[r] + 2rv\frac{d}{dt}[v] = k_G \frac{d}{dt}[M] \quad (6.10)$$

$$\frac{d}{dt}[r] = -2(r/v) \frac{d}{dt}[v] + (k_G/v^2) \frac{d}{dt}[M] \quad (6.11)$$

From eqn. (6.9), we have,

k_G/v^2=r/M, therefore, eqn. (6.11) becomes,

$$\frac{d}{dt}[r] = -2(r/v)\frac{d}{dt}[v] + (r/M)\frac{d}{dt}[M] \quad (6.12)$$

If $\frac{d}{dt}[v]<0$, or $\frac{d}{dt}[M]>0$, or both, then, $\frac{d}{dt}[r]>0$ resulting orbit dilation. So, the decrease of orbiting speed or the increase of orbiting center mass or both result in orbit dilation.

If a planet is orbiting at constant speed, $\frac{d}{dt}[v]=0$ and hence, eqn. (6.11) becomes,

$$\frac{d}{dt}[r] = (r/M)\frac{d}{dt}[M] \quad (6.13)$$

$$\frac{d}{dt}[r] = Hr$$

where $H=[\frac{d}{dt}(\ln M)]$.

If the mass of the orbiting center M decreases, $\frac{d}{dt}[M]<0$ and hence $\frac{d}{dt}[r]<0$ resulting in an orbit contraction. If H>0, then orbit dilates. If H<0, then the orbit contracts. When a planet is orbiting at constant speed, in other words, if the mass of the planet remains constant or time invariant, then the change of orbit is determined by the rate of change of mass of the orbiting center.

The orbit contraction has a catastrophic effect on planets, especially on the habitable planets such as earth, resulting global warming. The contraction caused by the decrease of the mass of the sun is unavoidable; we do not have any control over it. However, it is not just the decrease of the mass of the sun that is responsible for the orbit contraction. The changing mass of orbiting planets also contributes to the orbit contraction.

In order to see the effect of the changing mass of the planets on the orbiting distance we consider the stability of the planetary system under constrain of the conservation of the angular momentum.

Using the conservation of angular momentum of an orbiting system, we have,

$$mv=\text{constant}. \quad (6.14)$$

Differentiating with respect to time, we get,

$$m\frac{d}{dt}[v] + v\frac{d}{dt}[m] = 0, \text{ i.e.} \quad (6.15)$$

$$\frac{d}{dt}[v] = -(v/m)\frac{d}{dt}[m] \quad (6.16)$$

Substituting for $\frac{d}{dt}[v]$ in the orbit dilation relationship in Eqn. (6.12), for stability under perturbation, we get,

$$\frac{d}{dt}[r] = 2(r/m)\frac{d}{dt}[m] + (r/M)\frac{d}{dt}[M] \quad (6.17)$$

$$\frac{d}{dt}[r] = [2\frac{d}{dt}(\ln m) + \frac{d}{dt}(\ln M)]r \quad (6.18)$$

$$\frac{d}{dt}[r] = Hr \quad (6.19)$$

where $H=[2\frac{d}{dt}(\ln m) + \frac{d}{dt}(\ln M)]$,

with ln being the natural logarithm.

H is the orbit adjustment parameter that depends on the rate of change of masses of the orbiting system. It is hard to avoid noticing the similarity of H to the Hubble's parameter. The difference is that while H here is time varying, the Hubble's parameter derived by observation is considered to be a constant approximately. It is because the H may appear to be a constant since the change of masses with time is relatively small.

If H is positive, the result is orbit dilation, whereas if H is negative, the result is an orbit contraction.

If $\frac{d}{dt}[m]>0$, or $\frac{d}{dt}[M]>0$, or both, then, $\frac{d}{dt}[r]>0$, resulting orbit dilation.

If $\frac{d}{dt}[m]<0$, and $\frac{d}{dt}[M]<0$, then, $\frac{d}{dt}[r]<0$, resulting orbit contraction.

C. No Spiraling Down in Orbiting Systems

The change of the mass of an orbiting system leads to a shift in the orbiting distance. Any perturbation in the orbiting system does not lead to a collapse of the orbiting system from spiraling in or out. Instead, the orbiting system that is under perturbation moves toward a new stable state through the automatic fine-tuning of the orbits through orbit dilation or contraction as necessary.

The orbit dilation or contraction takes place when there is a perturbation to the orbiting system:

1) The increase in mass of the orbiting center mass, the sun in our planetary system, or the decreasing speed of the orbiting planet leads to an orbit dilation resulting in a new stable orbit for the increased mass of the orbiting center or the decrease in speed of the planet or both. The decrease in the speed of an orbiting planet is a result of the increase in mass of the orbiting planet.

2) The decrease in mass of the orbiting center mass, the sun in our planetary system, or the increase in the speed of the orbiting planet leads to an orbit contraction resulting a new stable orbit for the decrease mass of the sun or the increase speed of the orbiting planet or both. The increase in the speed of an orbiting planet is a result of the decrease in mass of the orbiting planet.

In principle, electrons orbiting the nucleus of an atom have the same characteristics as of the planets orbiting the sun. A perturbation in speed of an orbiting object does not result in the collapse of the orbiting system from spiraling out or in. A slight change in one parameter gets adjusted by appropriate changes of other parameters automatically. An external divine intervention, as envisioned by Newton, is not required to keep a planetary system stable.

Property 6.3: Orbiting System Stability

An orbiting system does not collapse under perturbation, and remains stable due to autonomous orbit dilation or contraction.

Lemma 6.1: Global Warming and Mass of Sun

The decrease in the mass of the sun leads to global warming.

Proof: If the mass of the sun M in our solar system decreases, then we have $\frac{d}{dt}[M]<0$, So, from eqn. (6.13), we have, $\frac{d}{dt}[r]<0$ indicating the decrease of the orbiting radius. In other words, as the mass of the sun decreases due to the burning of material, the orbiting planets move toward the sun. The closer a planet get toward the sun, higher the temperature of the planet resulting in global warming.

Lemma 6.2: Global Warming and Mass of Earth

The decrease in the mass of the earth leads to global warming.

Proof: If the mass of the earth m decreases, then we have $\frac{d}{dt}$[m]<0. Since the mass of the sun decreases with time due to the burning of hydrogen, $\frac{d}{dt}$[M]<0. Therefore, when the mass of the earth decreases, from eqn. (6.19), we have, $\frac{d}{dt}$[r]<0 indicating the decrease of the orbiting radius. In other words, as the mass of the earth decreases due to the burning of material and the destruction of the biomass, the orbit contracts bringing the earth toward the sun. The closer a planet get toward the sun, higher the temperature of the planet resulting in global warming.

Corollary: Damper on Global Warming

Although we are not able to control the decrease of the mass of the sun, we are able to control the reduction of the mass of the earth. It is possible to apply damper on global warming by taking conscientious effort to reduce the loss of mass of the earth.

Proof: Excessive Burning of fossil fuels leads to a mass loss due to electromagnetic radiation loss. Destruction of the biomass also leads to the reduction of the conversion of the electromagnetic energy into mass. In addition, any hydrogen leaked out during the use of hydrogen as a fuel source will be completely lost since the gravitation of the earth is not strong enough to retain hydrogen resulting in mass loss [4]; hydrogen fuel cells are not environmentally friendly as they are proclaimed to be. By reducing the consumption of fossil fuel as well as the restoration of the biomass reduces the loss of mass of the earth in effect reducing the global warming and bringing back the natural balance. It is the biomass that plays a crucial role in maintaining the earth in the goldilocks zone by converting the electromagnetic energy into mass.

VII. RADIATION AND RELATIVITY

Consider the case where there are two observers Jack and Jill. Jack is sitting in a moving train travelling at speed V(t) while Jill is sitting inside a stationary (V(t)=0) car. Even though the car is stationary, relative to Jack, the car is travelling at velocity **V**(t) given by,

$$\mathbf{V}(t)=V(t)\mathbf{v}(t) \quad (7.1)$$

where, V(t) is the relative speed of the car at time t, and the vector **v**(t) is the relative direction of the car at time t.

Assume, we have a charge particle O sitting still in the passenger seat of the car next to Jill. With respect to the observer (Jill) sitting inside the car charge particle is still. However, with respect to Jack in the train, the charge particle is moving at the relative velocity of the car. Assume that the plane that passes the charge particle O at an angle θ to the direction of motion or the velocity **V**(t)=V(t)**v**(t) is S. With respect to Jill inside the car, the charge particle is at standstill and hence, the net force on unit charge at point P at distance R relative to the charge particle O on plane S is solely due to the Coulomb electric field and it is given by,

$$\mathbf{F}_{net}(Jill)=\boldsymbol{\mathcal{E}}(Jill) \quad (7.2)$$

where, **Ɛ**(Jill) is the Coulomb electric field relative to Jill in the stationary car with the charge.

From Eqn. (2.2),

$$\boldsymbol{\mathcal{E}}(Jill)=k_e(q/R^2)\mathbf{r}$$

where, **r** is the unit vector along OP, **R**=R**r**.

Now, we have,

$$\mathbf{F}_{net}(Jill)= k_e(q/R^2)\mathbf{r} \quad (7.3)$$

The distance R with respect to Jill, sitting inside the car next to the charge particle, is not the same for the observer Jack [3, 4], since the car is moving relative to Jack at velocity **V**(t). Although in reality, the car with Jill and the charge particle is still, with respect to Jack it is moving at speed V(t). Let the distance OP with respect to Jack when the car is relatively moving at relative speed V(t) at time t be R', where,

$$\mathbf{R}'=R'\mathbf{r}, \text{ and} \quad (7.4)$$

$$\mathbf{V}(t)=V(t)\mathbf{v}(t). \quad (7.5)$$

When the car is moving relative to Jack, the net force at point P on a unit charge at distance R' relative to the charge particle O on plane S with respect to Jack, or the so called Lorentz's field $\mathbf{F}_{net}$(Jack) is given by,

$$\mathbf{F}_{net}(Jack)=\boldsymbol{\mathcal{E}}(Jack)+\mathbf{V}\times\boldsymbol{\beta}(Jack) \quad (7.6)$$

where, **ß**(Jack) is the magnetic flux density relative to Jack.

Since $\boldsymbol{\mathcal{E}}(Jack) =k_e[q/(R')^2]\mathbf{r}$,

we have,

$$\mathbf{F}_{net}(Jack) =k_e[q/(R')^2]\mathbf{r} + \mathbf{V}\times\boldsymbol{\beta}(Jack) \quad (7.7)$$

where **R**∈**S**.

We know from Eqn. (2.3),

$\boldsymbol{\beta}=k_m(qV(t)/R^2)(\mathbf{v}(t)\times\mathbf{r})$.

Since distance R relative to Jack is R',

$\boldsymbol{\beta}(Jack)=k_m[qV(t)/(R')^2](\mathbf{v}(t)\times\mathbf{r})$.

Substituting for **ß**(Jack) in Eqn. (7.7), we get,

$$\mathbf{F}_{net}(Jack) =k_e[q/(R')^2]\mathbf{r} + k_m[q(V(t)\sin(\theta))^2/(R')^2](-\mathbf{r}) \quad (7.8)$$

$$=k_e[q/(R')^2]\,[1-(V(t)\sin(\theta))^2/c^2]\mathbf{r} \quad (7.9)$$

where $k_m/k_e=1/c^2$.

From Eqn. (7.3),

$\mathbf{F}_{net}(Jill)=k_e(q/R^2)\mathbf{r}$, and hence, substituting in Eqn. (7.9), we get,

$$\mathbf{F}_{net}(Jack)=\mathbf{F}_{net}(Jill)[R/R']^2[1-(V(t)\sin(\theta))^2/c^2]. \quad (7.10)$$

Let,

t_{PQ}(Jill)=the time it takes for a unit charge to move for point P to Q in the direction OP relative to the observer (Jill) inside the car, and

t_{PQ}(Jack)=the time it takes for a unit charge to move for point P to Q in the direction OP relative to the observer (Jack) outside the car

Since the time is absolute, the time it takes, t_{PQ}(Jill), for a unit charge to move for point P to Q in the direction OP relative to the observer (Jill) inside the car should be the same as the time t_{PQ}(Jack) it takes for a unit charge to move from point P to Q on OP with respect to the observer, Jack outside the car when the car is relatively moving relative to Jack. Jack and Jill should experience the same event at the same time, i.e.

$$t_{PQ}(Jack)=t_{PQ}(Jill). \quad (7.11)$$

For this to happen, in other words, for time to be absolute, or time to be independent of the observer's frame of reference, the net force at point P on a unit charge relative to the observer (Jill) inside the car must be equal to the net force on a unit charge at point P relative to the moving observer (Jack) outside the still car.

In other words,

$$\mathbf{F}_{net}(Jack)= \mathbf{F}_{net}(Jill) \quad (7.12)$$

Substituting for $\mathbf{F}_{net}$(Jack) from Eqn. (7.12) in Eqn. (7.10), we get,

$$\mathbf{F}_{net}(Jill)=\mathbf{F}_{net}(Jill)\ [R/R']^2\ [1-(V(t)\sin(\theta))^2/c^2] \quad (7.13)$$

This satisfies, when

$$[R/R']^2\ [1-(V(t)\sin(\theta))^2/c^2]=1 \quad (7.14)$$

$$R'=[1-(V(t)\sin(\theta))^2/c^2]^{1/2}R, \quad (7.15)$$

$$R'=\alpha R, \quad (7.16)$$

where,

$$\alpha=[1-(V(t)\sin(\theta))^2/c^2]^{1/2},\ \ 0<\theta<\pi. \quad (7.17)$$

A moving body contracts by a factor α relative to an observer [3, 4]. In our example, the car is the object and it was still; the car and the charge particle were not moving. Yet, relative to the observer in the moving train outside the car, the object was moving, and hence a relative contraction has taken place. This relative contraction of an object is not a real physical contraction, and it is an observer perception. It is similar to a rainbow. Even though a rainbow does not exist physically, each observer experiences it differently depending on the observed angle. Similarly, observers perceive a different amount of contraction of the object depending on the relative speed of the object relative to each observer, even though there is no physical contraction of the object is taking place. It is an observer perception, not a physical reality. Physical change of an object is not observer dependent. Physical change of an object is absolute. Only an observer perception can be observer dependent. The observer dependent relativity is not real.

A real physical change of an object is observer independent. An observer cannot make an object contract physically just by running towards or away from it. You cannot make an object smaller by running towards or away from it. You can't make a charge particle radiate by carrying it in the passenger seat of a car, as much as you can't lose weight by riding the passenger seat of a car. Also, you can't change your age, or how you age, by riding in a spaceship. Time is observer independent. The time is same everywhere in the universe. Mass is observer independent [3, 4]. Radiation is observer independent.

In our example, the object with charge particle and Jill inside is physically not moving. Since Jack is moving, the object appears to Jack as if it is moving. Charge particle stands still relative to Jill, while charge particle is moving relative to Jack. When R'=αR, the net force $\mathbf{F}_{net}$(Jack) on a unit charge at any point in space due to a charge inside a relatively moving object with respect to Jack, who is outside the moving object, would be the same as the net force $\mathbf{F}_{net}$(Jill) on a unit charge at the same point in space with respect to Jill, who is sitting still next to the charge particle inside the stationary object. Therefore, the time remains the same for both observers Jack and Jill in different frames of reference.

The net electromagnetic force at point P relative to a charged object is independent of the observer's frame of reference. There is no observer dependent Lorentz force. Electromagnetic force is independent of the observer.

Property 7.1: Absolute Force

Electromagnetic force is independent of the observer's frame of reference; electromagnetic force is real, not relative. Electromagnetic force is absolute.

Property 7.2: Absolute Time

The time is independent of the observer's frame of reference; time is absolute.

Property 7.3: Absolute Mass

The mass of an object is independent of the observer's frame of reference; mass is absolute [4].

Corollary 7.1: No Lorentz Force

There is no observer dependent Lorentz force. Any physical force is independent of the observer's frame of reference.

Corollary 7.2: Apparent Contraction

Any observer dependent relative contraction of an object is not a real physical contraction; it is an observer perception. Observer perceptions are not real.

Corollary 7.3: Real Moving Body Contraction

A moving object, an object that is moving with respect to its current position, contracts in all directions whether there is an observer to witness it or not. This contraction is real.

VIII. RELATIVITY IS NOT REAL

As we have seen, a charged object under accelerated MOTION, or in other words, a charged object with non-zero speed in the direction of the accelerating force, has an inherent time varying magnetic field of independent existence that generates a time varying electric field of independent existence; a radiating electromagnetic field. Now, the question is, if an accelerating motion of a charged object generates a radiating electromagnetic wave burst, acceleration related to what? Motion related to what? Speed related to what? It is the accelerated motion, or speed related to the current position of the moving charged object that generates the radiation. It is the change of the state of the object relative to the current state of the object that generates the radiation. A charged object does not radiate relative to observers. The electromagnetic radiation is observer independent; radiation is not relative. Reality is not relative.

The observer dependent relative speed is an apparent speed that depends on an observer. Anything that is observer dependent is not real. It is not possible to make a real change to a physical quantity by making changes to observer's frame of reference. You can't move a mountain by running towards to or running away from the mountain. Just because an observer running away from a mountain sees that the mountain is moving away relative to the observer does not mean mountain is moving away; mountain remains where it always has been. An apparent movement is not a real movement. If you want to move a mountain you have to physically shovel it away to a new location. Similarly, you can't make a stationary charged object radiate simply by running towards to or running away from the charged object. The radiation is a result of a charged object physically moving from its current location to another location relative to the present position of the object. If you attach a charged object inside the box and throw the box away, there will not be any radiation since the position of the charged object relative to the current position has not changed; in this case, the position of the object is fixed inside the box. In order for radiation to take place the charged object has to move from its present position.

The radiation has nothing to do with an observer; it is observer independent. If you want a charged object to radiate, you physically have to throw it away; running by it or keeping it in a passenger seat of a vehicle is not going to achieve that. It doesn't matter what accelerated speed you run, a charged object in your pocket is not going to radiate since there is no change of the position with respect to the current position of the charge. If the charge is on the move inside the pocket while you run or if the charge is moving in the passenger seat of the car while car is in the motion, then the charge undergoes radiation.

The observer dependent relativity is something that varies from observer to observer; the reality is not. Any phenomenon that is observer dependent is an apparent phenomenon; not real. Electromagnetic radiation is associated with real energy loss. Electromagnetic radiation is real; it is not something that varies from observer to observer. The presence of an observer is not necessary for electromagnetic radiation to take place. Electromagnetic radiation is observer independent. You can't make a charged object radiate by running toward it or away from it. You can't also make radiating charged object stop radiating by running towards it or away from it. The state of Schrödinger's cat does not depend on an observer; the state of the cat is determined by the physical reality not by relativity.

In addition, you cannot annihilate the Biot-Savart magnetic field of a moving charge just by running synchronously with it. When you are running synchronously with the object, with respect to you the moving object may appear as if it is still. Just because the charged object is still relative to you does not mean the Biot-Savart magnetic field of the object is zero; it is not zero. The charged object is moving relative to the current position of the charged object and hence the Biot-Savart magnetic field is non-zero. Your running has no effect on the Biot-Savart magnetic field of a moving charged object. Your running has no effect on the radiation of a moving charged object.

Property 8.1: Radiation and Relativity

Radiation is not relative. It is not possible to make a still charged object radiate just by running towards it or running away from it.

Property 8.2: Magnetic Field and Observer

The Biot-Savart magnetic field of a moving charge particle is observer independent; it is absolute.

Corollary 8.3: Radiation

The presence of an observer is not required for a charge at accelerated motion to radiate; **t**he radiation is absolute or independent of any observer.

A. Relative Contraction of a Moving Object

Relative to an observer, moving objects contract in the direction of motion by a factor $[1-V^2/c^2]$, and in the lateral plane perpendicular to the direction of motion by a factor $[1-V^2/c^2]^{1/2}$, where V is the speed of the object and c is the speed of light [3,4]. The mass of the object and the time is independent of the observer. This contraction is relative to an observer. Observers in different frames of reference will experience different contractions. These are not real contractions; they are apparent contractions relative to observers. In actual fact, object does not undergo any physical contraction when the movement of the object is relative to the observer. For any observer inside the object (moving vehicle or cabin), everything is normal, nothing has changed. If the object is approaching the speed of light relative to an observer, then the relative volume of that object approaches zero relative to that particular observer; relative to this observer object appears as a transient black hole. However, relative to any other observer, object is normal. An object that appears as an apparent transient black hole to one observer will be perfectly normal object to an observer inside the object; it may very well be normal yet for any another outside observer at stand still too.

The observer dependent relativity does not determine actual shape, volume or the mass of an object or the time. Observer dependent relativity does not change the reality; observer dependent relativity gives an impression of change of an object relative to the state of an observer. We know that there is no such thing called rainbow physically, yet each observer get to see a distinct rainbow. A rainbow is an observer dependent phenomenon that only exists relative to an observer; it has no existence without an observer. Similarly, the contraction of an object relative to an observer is an observer dependent apparent phenomenon. A motion of an object relative to an observer does not undergo a real physical contraction. Physical state of an object or the physical state of the universe is not determined by the observer dependent relativity. A real physical contraction takes place when the motion of an object is relative to the current position or the state of the object itself.

Corollary 8.1: Observer Perception

If a stationary object is different for different observers on different frames of reference, it is not the object that is being changed, it is the observer's perception of it; no physical change has ever taken place.

Corollary 8.2: Real Contraction

The real physical contraction of a moving body takes place when an object is moving relative to the current position or the state of the object itself.

B. What Would Happen if Radiation is Relative

Consider our solar system. Each planet contains an innumerable number of charged particles, an equal number of protons and electrons. All these charge particles in a planet are orbiting the sun at the speed of the planet. That mean, each proton and electron moving at constant speed in an orbit relative to the sun. Since planetary orbits are non-circular elliptical paths, if the radiation is relative, each moving proton and electron is going to lose energy due to radiation. When all the protons and electrons that planets consist of lose energy due to radiation, the eventual outcome would be the collective gradual loss of the orbiting speed of the planets leading to ever unstable planetary system where planets will be slowly drifting away from the sun to oblivion. If the radiation due to moving charged objects is relative, it is not just our planetary system that is going to be unstable, but all the planets themselves as well due to their spin, and other planetary systems, galaxies, local galactic clusters and other orbiting systems in the universe. Not only that, the protons and electrons planets consist of would radiate relative to the movement of the observers, and observers themselves are subject to radiation loss since they themselves are a collection of protons and electrons; living species and matter as we know them wouldn't exist.

The presence of stable objects and planetary systems is also a good indication that the radiation due to the moving charged objects is not relative. When planets are orbiting, the protons and electrons the planets consist of are in the passenger seat, and hence there is no radiation; there are no changes to the positions of the charge particles with respect to the current positions of the charge particles due to the movement of the planets; radiation is not relative. On the other hand, if a moving charged object is radiating, it is not possible to stop its radiation just by running with it as much as it is not possible to stop a runner losing weight just by running in phase with the runner.

Property 8.3: Relativity and Reality

Observer dependent relativity is not real. It is an observer dependent apparent phenomenon. Observer dependent relativity does not create any real physical change. Anything that is observer dependent is not physically real. Observer dependent relativity is not reality.

IX. SINGLE-ENTITY EXISTENCE

An object and its inverse square law fields have a single-entity existence. These single-entity existence fields includes, gravitational field of a mass, Coulomb electric field of a charged object, and Biot-Savart magnetic fields of a moving charged object. An object cannot exist without its inverse square law fields and inverse square law field cannot exist without the presence of an object. If an object disappears, the associated inverse square fields disappear with it.

A. Gravitational Field

An object and its gravitational field is a single entity. The gravitational field exists always relative to an object. An object and it gravitational field do not have an independent existence from each other. At any time, there will be no object without its gravitational field of infinite span, and no gravitational field of infinite span without its object. Any change in the mass of an object is concurrent in the field of infinite span anywhere in the space; a change of mass cannot take place without concurrent change of its field of infinite span. Since the gravitational field is governed by inverse square law, it does not satisfy the Maxwell's equations and it is not an electromagnetic wave. The idea that there are gravitational waves that travel at the speed of light is simply absurd. The gravitational field has no independence existence and hence it does not propagate. Only the fields with independent existence are able to propagate. The fields that are tethered to an object do not have the necessary freedom to propagate. The widely held belief that the gravitational field is a wave that propagate at the speed of light has no basis and simply preposterous. There are no gravitational waves as such.

The direction of gravitational field is always radial from the source. The direction of the gravitational field is independent of the medium.

If the sun in our solar system disappears, the effect of it will be immediately felt anywhere in the space of infinite span since the object and its gravitational field of infinite span are a single entity. The gravitational field of an object is static, and independent of the motion of the object; it only exerts an influence on other masses. It has no effect on electromagnetic waves. Gravity does not bend light. The gravity exerts an indirect influence on light in the presence of a medium. The gravity creates a density gradient of the medium around the gravitational object and it is this density variation of the medium that diffract the light, not the gravity itself [4]. The widely held belief that "nothing can travel faster than light" has no basis to it, and has never been proven. It is only an object, anything with mass or gravitational object that cannot travel beyond the speed of light due to volume contraction. The maximum speed limit of a mass or a gravitational object is the speed of light.

*Property 9.1: Object and its Gravitational Fiel*d

Gravitational fields do not satisfy Maxwell's equations and they are not waves; they do not propagate. An object and its gravitational field of infinite span are a single entity; neither object nor the field has an independent existence. Any change of mass of an object is concurrent in its associated gravitational field of infinite span.

Property 9.2: Speed Limit

It is only a mass or a gravitational object that is subjected to the maximum speed limit, the speed of light, nothing else.

B. Coulomb Electric Field

A charged object and its Coulomb electric field is a single entity. Neither a charged object nor its Coulomb electric field has an independent existence. Since Coulomb electric field is proportional to inverse of the square distance, $1/R^2$, it does not satisfy the Maxwell's equations and it is not a wave. Coulomb electric field does not propagate and has no independent existence. The Coulomb electric field is static and independent of the motion of the charged object. Coulomb electric field of infinite span exists always relative to the charged object. Any change in the charge of the object is immediately felt anywhere in the space since the charged object and its Coulomb field of infinite space span is a single entity. A motion of the charged object does not distort the field since the field exists always relative to the charged object; there will not be any kinks in the field lines when the object is in motion, as it was suggested in [1]. The field is always radial, straight out of the object independent of the medium and the movement of the charged object. It does not matter what kind of motion the charged object is subjected to, the Coulomb electric field does not generate radiation. Coulomb electric field only exists relative to the charged object and exerts an influence on the other charged objects anywhere in the space concurrently; its influence is immediate.

Property 9.2: Object and its Electric Field

Coulomb electric field does not satisfy Maxwell's equations and it is not a wave; it does not contribute to the generation of radiation. A charged object and its Coulomb electric field of infinite span are a single entity. Neither the charge particle nor its Coulomb electric field has an independent existence. Any change of charge in an object is concurrent in its Coulomb electric field since they are a single entity.

C. Biot-Savart Magnetic Field

A moving charged object and its associated Biot-Savart magnetic field of infinite span are a single entity. The Biot-Savart magnetic field of infinite span in space has no independent existence; it exists relative to a moving charged object. A moving charged object has no independent existence without its Biot-Savart magnetic field of infinite span, in addition to its gravitational field and Coulomb electric field. Even though the gravitational field and the Coulomb electric field are always static, the Biot-Savart magnetic field of a moving charged object can either be static or time varying. The Biot-Savart magnetic field of a moving charge at constant speed on a linear path or on a circular orbit is always static, time invariant. It is the changing speed of a charged object or the changing path of a moving charged object or both, in other words the time varying velocity of the object that makes the Biot-Savart magnetic field time varying.

If the path is linear, then, the path is not time varying. If the path is a circular orbit, then, the direction of the object varies in time relative to the center of the orbit. However, relative to the object, the direction of the object is time invariant. Therefore, the vector cross product $\mathbf{v}(t)\times\mathbf{r}$ relative to the moving charged object is time invariant, where $\mathbf{v}(t)$ is the unit vector in the direction of movement of the object at any point on the path and $\mathbf{r}$ is the unit vector to any point in 3-dimensional space relative to the moving charged object. In both cases, when the path is linear and when the path is a circular orbit, the vector cross product $\mathbf{v}(t)\times\mathbf{r}$ is time invariant.

The Biot-Savart magnetic field depend on both the path and the speed $\mathbf{V}(t)=V(t)\mathbf{v}(t)$; the Biot-Savart magnetic field depends directly on the vector cross product $\mathbf{v}(t)\times\mathbf{r}$. The vector cross product $\mathbf{v}(t)\times\mathbf{r}$ is time invariant for circular orbits relative to the object even though the $\mathbf{v}(t)$ is time varying relative to the center of the orbit. Therefore, the Biot-Savart magnetic field is time invariant for moving charge particles at constant speed on linear path as well as on circular orbits. The Biot-Savart magnetic field at any point in space will be the same whether the charge particle at constant speed takes a linear path or a circular path.

The Biot-Savart magnetic field is based on the inverse square law that is proportional to $1/R^2$, and hence it does not satisfy the Maxwell's equations. The Biot-Savart magnetic field is not a wave and it does not propagate. The Biot-Savart magnetic field does not have an independent existence from the moving charged object. The Biot-Savart magnetic field is tethered to the moving charged object and exists always relative to the moving charged object. The Biot-Savart magnetic field is radial and always exists relative to the moving charged object directed straight out into the infinite span of space as it is the case with the gravitational field and the Coulomb electric field. The Biot-Savart magnetic field is observer independent; it only depends on the change in the position of the object relative to the current position. You cannot create a Biot-Savart magnetic field by running towards to or running away from a still charged object. The Biot-Savart magnetic is not relative or observer dependent.

The direction of Biot-Savart magnetic field is always radial from the source. The direction of the Biot-Savart magnetic field is independent of the medium.

Property 9.3: Object and its Magnetic Field

The Biot-Savart magnetic field does not satisfy Maxwell's equations, it is not a wave and it does not propagate; it has no independent existence from the moving charged object. Biot-Savart magnetic field is time invariant for charge particles travelling at constant speed on linear paths and also on circular orbits. Biot-Savart magnetic field is not relative; it is observer independent.

D. Electromagnetic Radiation

An accelerating charge with a non-zero speed in the direction of acceleration generates a time varying magnetic field proportional to the inverse distance that satisfies the Maxwell's equations. It is this time varying magnetic field that creates an electric field that satisfies the Maxwell's equations. These time varying electric and magnetic fields, or wave bursts have an independent existence and propagates out of the moving charge. These electromagnetic wave bursts do not require Coulomb electric field or Biot-Savart magnetic field of the original moving charge as a carrier.

Radiating electromagnetic field has nothing to do with the Coulomb electric field or Biot-Savart magnetic field, neither in the generation of the radiation nor on the propagation of the radiating electromagnetic burst. Once an electromagnetic wave burst has been created, its existence has nothing to do with the source, the moving charged object or its Coulomb electric field or the Biot-Savart magnetic field. Weather a wave burst takes a straight path or curved path is determined by the medium density gradient or the lack of it.

The polarity of the electromagnetic field is opposite to the direction of motion of the source, the moving charged object. The Maxwell's equations describe the propagation of this radiating electromagnetic wave burst of independent existence.

Radiating Electromagnetic wave bursts undergo slow and gradual frequency shift due to path energy loss, as well as the loss of strength due to path attenuation. Path energy loss leads to a frequency shift while path attenuation results in the loss of strength; both these losses are observable in the light from the distance galaxies. The frequency shift limits our visible universe. Our visible universe is limited not because universe had an origin, it is because there is a maximum distance light can travel without being subjected to frequency shift away from the visible region [4]. When the light from the distance sources is frequency shifted out of the visible region of the frequency spectrum, the outcome is the cosmic microwave background. The cosmic microwave background has nothing to do with a hypothetical big bang [4].

Radiating electromagnetic wave burst is independent of the observer's frame of reference. Radiation is absolute, not relative. You cannot make charge particle radiate just by running by it. You cannot make a charge particle radiate by carrying it in the passenger seat of a vehicle.

After the generation of the radiating electromagnetic field, the direction of radiating electromagnetic wave burst is always independent of the source. The direction of the radiating electromagnetic field is determined by the density gradient of the medium or lack of it.

Corollary 9.1: Autonomous Radiation

Radiating electromagnetic field has nothing to do with the Coulomb electric field or Biot-Savart magnetic field, neither in the generation of the radiation nor on the propagation of the electromagnetic burst.

Property 9.4: Radiating Electromagnetic Burst

An accelerating charge particle with non-zero speed along the direction of the accelerating force generates a time varying magnetic field of independent existence that satisfies the Maxwell's equations. It is this magnetic field that is responsible for generating its electric field counterpart that satisfies the Maxwell's equations. This radiating field is observer independent; not relative. The direction of the radiating field is determined by the density gradient of the medium.

E. How to Determine If you are Moving at Steady Speed or Not from inside a Sealed Cabin on a Train

The absolute, observer independent, nature of the electromagnetic field has an interesting application. Assume you are in a sealed cabin on a train. You don't know if the cabin is moving at steady speed or at stand still. How can you find out your state? It has been widely believed that it is not possible to find this out? Both Newton and Einstein and many others believed that there is no experiment available to an observer, a person inside the sealed cabin, to determine if the cabin is moving at steady speed or not. This is not true. This erroneous conclusion came out of a misconception that the electromagnetic radiation is relative. The electromagnetic propagation is not relative; it is absolute [3]. This absolute nature of the electromagnetic radiation can be used to determine if the cabin is moving at steady speed or not from inside the sealed cabin.

When you are inside the sealed cabin on a train, you can fire an electromagnetic burst vertically. Since the electromagnetic burst is not relative, if the cabin is moving, the electromagnetic burst will take an angular path relative to the observer inside the cabin. On the other hand if the cabin is at stand still, the electromagnetic burst will take a straight vertical path relative to the observer inside the cabin. So, you can indeed determine if you are moving at a steady speed or not; this is all the result of the fact that the electromagnetic radiation is absolute, not relative [3].

F. Some Universal Facts [3, 4]

- Electrons orbiting on circular orbits at constant speed do not radiate.
- Rutherford atom with circular orbits is stable.
- Radiation is independent of observers.
- Inverse square distance fields are not waves.
- Inverse square distance fields do not satisfy Maxwell equations.
- Inverse distance fields satisfy the Maxwell equations.
- Moving charged object with time varying velocity with respect to the object generates inverse distance electromagnetic fields that propagate; radiation.

- Electromagnetic force is not relative.
- Time is independent of observers.
- Propagation of light is independent of observers.
- Electromagnetic spectrum is not continuous.
- Energy has no mass.
- Mass and energy are not one and the same.
- Particles are not waves.
- Waves are not particles.
- Probability is not a tool of nature; it is a human data analysis tool.
- There is no space-time.
- Universe is not expanding.
- Planetary mass is not time invariant.
- Planetary orbits are not time invariant.
- Increasing in mass of a planet result in orbit dilation while decrease in mass of planet leads to orbit contraction.
- Orbit contraction leads to Global Warming.
- There was no big bang.
- Universe is infinite.
- There was no beginning to the universe and there is no end to the universe.
- Galactic red shift or frequency shift of light from distance galaxies is due to propagation energy loss.
- Light is subjected to frequency shift due to the propagation loss; this limits the range of visible light.
- Our visible universe is limited due to the limited range of the visible light.
- Cosmic background is the frequency shifted light out of the visible region due to the propagation loss; cosmic background does not represent a baby universe or an origin of the universe.
- Quantum spookiness can't prevent radiation loss of the moving electrons and hence the instability of the atom due to radiation loss.
- Moving body contracts in all directions.
- Reality is observer independent; the fate of the Schrödinger's cat is observer independent.
- Observer perception or the relativity is not real.
- Orbiting system does not collapse under perturbation.

X. CONCLUSIONS

A moving charged object and its associated gravitational field, Coulomb electric field, and Biot-Savart magnetic field are a single entity; they do not have an independent existence. These fields governed by inverse square law do not satisfy the Maxwell's equations. None of these fields are waves and they do not propagate. These fields are essential part of the moving charged object without which the moving charged object itself cannot exist. A mass cannot exist without its associated gravitational field of infinite expands and vice versa. A charged object cannot exist without its associated Coulomb field and gravitational field of infinite span and vice versa. A moving charged object cannot exist without its associated Biot-Savart magnetic field, Coulomb electric field and gravitational field and vice versa.

There are no gravitational waves. There are no Coulomb electric field waves. There are no Biot-Savart magnetic field waves. There are no gravitational waves that travel at the speed of light and the idea itself is simply preposterous. If sun disappears in our solar system, its effect will be concurrent and immediate in the field of infinite span in the universe since the mass and its gravitational field is a single entity. If the gravitational field is a wave that travels at a limited speed, the existence universe as we know it is not possible.

The idea that the gravity is the result of space-time geometry does not hold true since there is no such thing called space-time. The light is not relative [3]. Light does not travel relative to observers. When the light is not relative, space-time is not possible; time is not a function of space. Time is not relative; time is absolute. The claim that "nothing can travel faster than light" is an unsubstantiated claim; it is never been proven. What is proven is that "a mass cannot travel faster than light". A moving mass contracts in all direction that results in a volume contraction; it is this volume contraction that limits the maximum speed of a mass to the speed of light.

The gravitational field and the Coulomb electric field of a moving charged object is always time invariant, static. The movement of an object does not have any effect on the gravitational as well as the Coulomb electric fields since they exist relative to the object and these fields are independent of the motion of the object. The Coulomb electric field has nothing to do with the generation of radiation or the electromagnetic wave propagation. The gravitational field exerts and influence on anything that has a mass; it has no influence on anything that has no mass. Gravity has no direct effect on light. The Coulomb electric field exerts influence on any object that has a charge; it has no influence on anything that has no charge.

The Biot-Savart magnetic field of a moving charged object can either be static or time varying. The Biot-Savart magnetic field has no independent existence from the source and hence it is not a wave. If a charged object is moving at constant speed on a linear path or on a circular orbit, the Biot-Savart magnetic field remains time invariant or static. When an object is on a circular orbit, as the charged object orbits on the circular path at constant speed, the whole 3-dimensional field pattern rotates with the object and hence the fields remain time invariant or static relative to the object.

Since the magnetic field of a charged object at constant speed on a linear path or on a circular orbit is time invariant, there will not be any radiation; no electromagnetic wave is generated. The Biot-Savart magnetic field can only exert an influence on other moving charged objects; it has no effect on the charged objects that are stationary. Biot-Savart magnetic field is not relative; a relative, observer dependent speed does not generate a Biot-Savart magnetic field. Only a movement of a charge relative to the current position of the charge results in a Biot-Savart magnetic field.

When a charged object is moving at time varying speed on a time varying path or at constant speed on a non-linear or non-circular path or both, in other words when a charged object is moving at a time varying velocity or at an acceleration with non-zero speed, the accelerating moving charge generates a radiating magnetic field that is time-varying. The presence of an accelerating force itself does not generate radiation as it is the case with a charge sitting still under gravity or a charge on a circular orbit; in both these cases there is no speed along the direction of the accelerating force. For a charge to radiate there must be a non-zero speed in the direction of the accelerating force. It is the nonzero speed along the direction of accelerating force that generates the radiation. This generated radiating magnetic field at any point in 3-dimensional space is proportional to the inverse distance and hence satisfies the Maxwell's equations.

The time varying magnetic field results in a time varying electric field. This radiating electromagnetic wave burst is generated at the moving charged object, and has an independent existence from the source. Unlike the non-propagating inverse square law fields such as gravitation field $\mathcal{E}_G$, Coulomb electric field **Ɛ** and the Biot-Savart magnetic field **ß**, this radiating electromagnetic field (**B**, **E**) is not tethered to the source in any form. It propagates outward from the source; the radiation.

Once the radiating electromagnetic field is generated, the direction of propagation of the electromagnetic wave has nothing to do with the source. The direction of propagation of the radiating electromagnetic field is determined solely by the density gradient of the medium.

Only the inverse distance fields satisfy the Maxwell's equations; these fields are independent from the source and hence able to propagate. Neither the radiating magnetic field **B** nor the radiating electric field **E** can exist if $\frac{\partial}{\partial t}[\mathbf{B}] = \mathbf{0}$. The determining factor for the radiation of a moving charge is $\frac{\partial}{\partial t}[\mathbf{B}] \neq \mathbf{0}$. The radiating magnetic field of independent existence **B** is not the same as the Biot-Savart magnetic field **ß** of a moving charge particle that is tethered to the particle, **B≠ß**. The radiating electric field of independent existence **E** is not the same as the Coulomb electric field **Ɛ** of a charge particle that is tethered to the particle, **E≠Ɛ**. The radiating electric field **E** exists if and only if $\frac{\partial}{\partial t}[\mathbf{B}] \neq \mathbf{0}$. On the other hand, **B** exists only if **E≠0**.

The radiation of a moving charged object is not relative. The radiation depends on the rate of change of velocity or the acceleration of a charged object and the rate of change of velocity or acceleration is determined by the relative change of position of the object with respect to its current position of the object. The radiation is independent of the frame of reference of the observer. You cannot make a charged object at stand still radiate simply by running away from it or towards it, as you cannot move a mountain by running away from it or towards it. If you want to move a mountain you have to shovel it off physically. If you want to make a charged object radiate, you physically have to throw it away. A charge sitting on a passenger seat of a moving vehicle does not have any radiation loss, as much as it is not possible for a person to lose weight by riding the passenger seat of a vehicle. If you want to lose weight, you have to physically get moving, and it is not any different for a charge particle.

If the radiation is relative, no planetary system in the universe would be stable, including our solar system since every object in the universe is a collection of discrete positive and negative charge particles with relative movements. If the radiation is relative every charge particle would be losing energy due to radiation since they are always under relative motion, and hence the universe would not be the same. Our existence, as well as the existence universe depends on the stability of the atoms and molecules. If the radiation is relative, the stable atoms and molecules are not possible. The stability of the atoms and molecules is an indication that the radiation is not relative. Charged particles on passenger seat do not radiate; it is a good thing, otherwise we wouldn't have been here.

The net electromagnetic force at any point in 3-dimensional space due to a moving charge particle is observer independent. There is no observer dependent Lorentz force. The net electromagnetic force is not determined by the motion of a charge particle relative to an observer. The net electromagnetic force of a moving charged object is determined by the change of the velocity of the object with reference to the current position of the object. Net electromagnetic force due to moving charge particle at any point is 3-dimensional space is absolute or observer independent.

For an observer at an angle θ ($0<\theta<\pi$) to the direction of motion of a charged object, the object appears as if it has been contracted by a factor α where, $\alpha=[1-(V\sin\theta)^2/c^2]^{1/2}$. This observer perceived contraction of a moving object makes the time independent of the frame of reference. Jack on a moving frame, and Jill with a charge particle in a stand still cabin experience the events of the charge particle at the same time; time is absolute.

There is no actual physical contraction of the moving charged object relative to an observer. If an object is moving relative to an observer, the observer perceives the object as if it has been contracted. Relative to an observer on a different frame of reference, object may remains perfectly unchanged or as if it has turned itself into a black hole depending on the speed of the observer's frame of reference. These perceived contractions are not physically real. No real change of an object occurs with relativity. A real physical change of an object is independent of the observer. Real physical contraction is associated with the movement of an object with relative to the current position of the object, not with the motion relative to an observer.

The planetary model of the atom with electrons orbiting the nucleus on circular orbits is stable. A charged object on a circular orbit at constant speed does not generate radiation. However, the Rutherford's planetary model of the atom with electrons orbiting the nucleus on elliptic orbits will still be unstable. Although a charge on circular orbit does not generate radiation, a charge on elliptic orbit generates radiation and hence elliptic orbits of charge particles are unstable. The atom where electrons orbit the nucleus on circular orbits is a stable and most appropriate model for the atom.

The long held belief that the atomic model where electrons orbiting the nucleus on circular orbits generate radiation is incorrect. The orbiting electrons are not subjected to radiation energy loss and as a result these orbiting electrons do not lose speed.

There is never any spiraling in or spiraling out of the orbiting electrons when they are orbiting the nucleus on circular orbits. The previously abandoned atomic model where electrons orbiting the nucleus on circular orbits is in fact a realistic and stable model for the atom. This model also fits the magnetic properties of the material as well since orbiting electrons generate bipolar magnetic fields. The fundamental origin of magnetic field is due to the orbiting electrons in an atom. This is also the reason why there can't be magnetic monopoles at any circumstance.

The movement of electrons in an atom is very orderly on circular orbits and hence there is no quantum spookiness to the motion of electrons in an atom. The atomic model with the probabilistic description of electrons based on wave function approach will be unstable since the uncertainty of electrons lead to radiation loss and to atomic instability. Further, the wave function description of electrons have no physical reality since there is no wave particle duality; a mass is not a wave and wave has no mass; mass and energy are not one and the same [3]. The kinetic energy, mc^2 is not quantized and hence cannot be represented as the Plank constant time the frequency ($mc^2 \neq hf$). It is only the electromagnetic energy, e that is quantized since electromagnetic energy comes in wave bursts of constant duration. Only the electromagnetic energy can be represented as the Plank constant time the frequency ($e=hf$), the energy of an electromagnetic burst. The duration of an electromagnetic burst is a universal constant [3].

In an orbiting system, the decrease in the speed of planets does not lead to a catastrophic spiraling down and the collapse of the orbiting system. This is equally true for smallest scale orbiting systems like atoms as well as large scale orbiting systems like our solar system. Any loss of speed of an orbiting object leads to orbit dilation and as a result a new stable orbit. No external intervention is required to keep a planetary system stable under any perturbation as it was erroneously deemed necessary by Newton. Planetary systems maintain their stability through the process of orbit dilation and contraction automatically; universal orbiting systems are self-adjusting autonomous systems.

Observer dependent phenomena or relative phenomena are observer perceptions where there is no real physical change takes place. However, the contraction of a moving object is real when the movement of the object is with respect to the current position or the state of the object, not the state relative to an observer. Observer cannot change the physical reality. Observer does not determine the state of Schrödinger's cat. Only a physical intervention an observer can change the physical reality.

Electrons in circular orbits are stable. Atom with electrons orbiting the nucleus is stable. There is no quantum spookiness to electron motion; electrons do not disappear from one place and reappear at another place without tracing a physical path. It is the good old and faithful circular orbit that electrons take when they move around the nucleus. Probability, which is a human creation, takes no part in the movement of the electrons in an atom. Electromagnetic wave equations are not a probabilistic description of finding a charge particle at a given location. Electromagnetic waves are not carrying charge particles. Electromagnetic waves are not relative and they come in independent bursts; these bursts are detached from the source as well as from any observer. Gravity has no direct influence on electromagnetic waves. Since the presence of gravity can change the density gradient of a medium and the path light takes is affected by the density gradient of the medium, the gravity exerts an indirect influence through the medium. In the absence of a medium, the gravity has no effect on electromagnetic waves. Spookiness of an atom is a human fabrication, not a physical reality.

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