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Quantum to Cosmological Phenomena in Gravity Induced Electromagnetism

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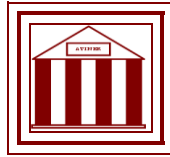
An Introduction to
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Dr. Gregory T. Papanikos
President
Athens Institute for Education and Research

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Shubhen Biswas

Abstract

An introduction to the manifestation of electromagnetism relates to the dynamic mass in terms of weak-field approximation using the General Relativistic approach. The possible outcome regarding this approach is the **Theory of Dynamic Gravitational Electromagnetism (TDGEM)** for the physical perceptions in Quantum to Cosmological phenomena.

Considering a moving particle of finite mass there corresponds a dynamic change in extra potential at the observation point or the space-time metric in the General Relativistic approach [1]. It is postulated that the changing potential will be transformed into an electromagnetic field. In a four dimensional space - time continuum the electromagnetic field tensors are constructed with the help of velocity dependent extra potential. Thus, TDGEM is consistent with dimensions as well as Maxwell's equations. With the help of these relations, excluding the ion core dynamo theory, the origin of terrestrial magnetic field has been further explained.

The elementary particles are considered as a self-bound lump of relativistic photonic masses [2]. A treatment of the dynamic variable of TDGEM as the quantum mechanical observable, allowed the measuring of the quantized charges and spinning magnetic moment of the elementary particles. The results are very much in agreement with recent experimental data of electrons and quarks (Leptons).

An extension of the TDGEM refers to the theory on gravity induced electromagnetic field for accelerated mass [3]. It is also shown that an accelerating particle of finite mass can radiate electromagnetic energy like the accelerated charge particle.

One of the biggest enigmas regarding energy flow $\sim 10^{47} Joules$ in a matter of seconds for Gamma Ray Bursts are explained on the basis of the theoretical consequence of electromagnetic radiation from decelerated mass [4]. This has been assigned to bounce at the end of gravitational collapse in 'on-self' for massive stellar objects or at their merger. In the present theoretical consideration neither deceleration at the collapse nor the rotation itself can produce jets.

Introduction

If a uniformly moving mass m with velocity 'v' is compelled to stop, then it will encounter an instant loss of mass $(\gamma - 1)m$, where $\gamma = 1/\sqrt{1 - v^2/c^2}$ [5] and thereby an amount of energy $(\gamma - 1)mc^2$ is radiated due to mass-energy equivalence regarding the Special Theory of Relativity with the condition that the withdrawn energy does not evolve to any mechanical or chemical energy.

Since electromagnetic radiation occurs due to change of four potentials there must be some induced four potentials associated with the moving mass. The general field equation is actually constructed for the static mass and hence the corresponding metric also depends on static potential. Now if the moving mass continues to move uniformly then there will be variation of metric which ultimately leads to a dynamic variation of gravitational potential at the observation point. From the conservation of energy the variation of gravitational potential needs to be identified with electromagnetic four potentials because at the stopping of mass the electromagnetic radiation is followed by the sudden unfolding of induced velocity dependent on extra potential. These facts are formulated and supported with some applications in quantum regime to a cosmological scale in the following sections.

Theory of Dynamic Gravitational Electromagnetism [TDGEM]

Explanation of Relativistic Extra Potential

The first and foremost aspect under consideration is the behavior of uniform movement of the source point mass with respect to field points i.e. point of observation. At present the interest is something different besides the gravitational radiation and quantization of field.

If the source moves with respect to the observation point it is obvious that the field point will experience a dynamic change of gravitational field. That is, for the uniformly moving source the observation point will encounter a variation of the metric tensor.

$$\delta g_{\alpha\beta} = \delta\eta_{\alpha\beta} + \delta h_{\alpha\beta}$$

$$or \ \delta g_{\alpha\beta} = \delta h_{\alpha\beta}, \ [as \ \delta\eta_{\alpha\beta} = 0]$$

The line element in the presence of gravitational field is given by K. Schwarzschild [6] as

$$ds^2 = \left(1 - \frac{2Gm}{c^2 r}\right)c^2 dt^2 - \left(1 - \frac{2Gm}{c^2 r}\right)^{-1}.dr^2$$
$$-r^2 d\theta^2 - r^2 \sin^2\theta d\phi^2 \qquad (1)$$

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When the field is very weak, such that $\dfrac{2Gm}{r} \ll c^2$

Then the line element of the above will be just like a Minkowskian line element except for the temporal part.

Thus for the weak field approximation [6, 7] we can ignore all $h_{\alpha\beta}$ part in the metric except h_{00}.

Then equating the metric component with (1)

$$h_{00} = -\frac{2Gm}{c^2 r}$$

$$= -\frac{2\phi_g}{c^2}, \quad \phi_g = \frac{Gm}{r} \qquad (2)$$

The only term of interest is h_{00} . Using (2) the variation of the metric for proper time $\delta\tau$ in which information regarding the moving source will reach to the observation point leads to

$$\delta h_{oo} = \frac{\partial g_{oo}}{\partial \chi^\gamma} \frac{\partial \chi^\gamma}{\partial \tau} \delta\tau$$

$$= \frac{\partial h_{oo}}{\partial \chi^\gamma} \frac{\partial \chi^\gamma}{\partial \tau} \delta\tau$$

As $\quad \dfrac{\partial \chi^\gamma}{\partial \tau} = o$ for $r=1,2,3$

Here the observation point is supposed to be at rest with respect to the moving source in its own co-ordinate system.
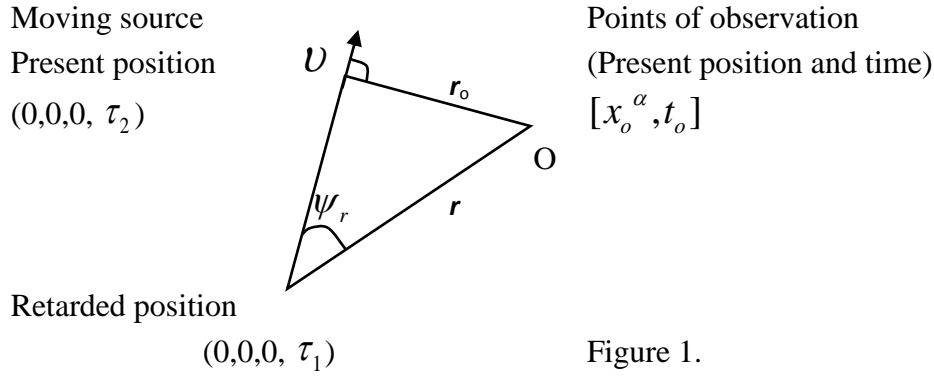
$$= -\frac{2\phi_g \gamma \upsilon}{c^2 r} \cos \psi_r \delta\tau$$

Putting $\delta\tau = \dfrac{r}{\gamma c}$

Here 'r 'is the distance between retarded position of moving source and the point of observation.

$$or \quad \delta h_{oo} = -\frac{2\phi_g}{c^2} \cdot \frac{\upsilon}{c} \cos\psi_r, \text{ in terms of present position and}$$

time

Moving source   Points of observation

Present position   (Present position and time)

$(0,0,0, \tau_2)$ $[x_o{}^\alpha, t_o]$

Retarded position

$(0,0,0, \tau_1)$ Figure 1.

$$\cos\psi_r = \frac{\upsilon}{c} \text{ at fixed } \psi_o = \frac{\pi}{2}$$

Or $$\delta\mathrm{h}_{oo} = -\frac{2\phi_g}{c^2}\cdot\frac{\upsilon^2}{c^2}$$

$$\delta\mathrm{h}_{oo} = -\frac{2\phi_g}{c^2}(1-\frac{1}{\gamma^2}) \tag{3}$$

where $\gamma = \dfrac{1}{\sqrt{1-v^2/c^2}}$.

Then (3) is the variation of metric due to the moving source. At the observation point the associated varying extra potential is

$$\delta\phi_g = \phi_g\left(1-\frac{1}{\gamma^2}\right) \tag{4}$$

Formation of Long Range Rank one Tensor Potential

Now when the source moves uniformly with respect to the point of observation it is obvious that at the observation point δh_{oo} term will be a function of proper time.

Taking the derivative of δh_{oo} with respect to the proper time τ

$$\frac{d}{d\tau}(\delta h_{oo}) = \frac{\partial(\delta h_{oo})}{\partial\chi^\gamma}\frac{d\chi^\gamma}{d\tau}$$

$$= \frac{\partial}{\partial\chi^\gamma}\left[h_{oo}(1-\frac{1}{\gamma^2})\right]U^\gamma \tag{5}$$

U^γ refers to the four velocity as source moving uniformly with respect to the observation point, then U^γ can be inserted in the bracket.

$$= \frac{\partial}{\partial \chi^{\gamma}} \left[h_{oo}(1 - \frac{1}{\gamma^2})U^{\gamma} \right] \qquad (6)$$

If the observation point has same velocity as at the source, i.e. both of them are co-moving, then there will be no variation of $h_{..}$ as well as of field. In this case

$\delta h_{oo} = 0$ and hence $\frac{d}{d\tau}(\delta h_{oo}) = 0$, and the principle of general equivalence

leads $\frac{d}{d\tau}(\delta h_{00}) = 0$ for any general co-ordinate system.

Then (6) can be written as $\frac{\partial}{\partial \chi^{\mu}} \left[h_{00}(1 - \frac{1}{\gamma^2})U^{\mu} \right] = 0$

Or $\qquad \frac{\partial}{\partial \chi^{\mu}} \left[-\frac{2\phi_g}{c^2}(1 - \frac{1}{\gamma^2})U^{\mu} \right] = 0$

From the energy conservation point of view, the four divergence of flow of extra potential gives

Or $\qquad \frac{\partial}{\partial \chi^{\mu}} \left[\phi_g(1 - \frac{1}{\gamma^2})U^{\mu} \right] = 0 \qquad (7)$

Here $(1 - \frac{1}{\gamma^2})$ is not a pure constant, but is a function of relative velocity so it

cannot be dropped and the term in the square bracket shows the flow of extra potential at the observation point at present time.

Substituting

$$\phi_g(1 - \frac{1}{\gamma^2})U^{\mu} = A^{\mu}$$

$$\frac{\partial}{\partial \chi^{\mu}}\left[A^{\mu} \right] = 0 \qquad (8)$$

Equation (8) shows that the divergence of four vectors (A^{μ}) is zero.
Thus first order approximation leads to

$$(A^{\mu}) = \frac{1}{4\gamma}\frac{v^2\phi}{c^2}gU^{\mu}, \quad (1 - \frac{1}{\gamma^2}) = \frac{1}{4\gamma}\frac{v^2}{c^2} + higher\ order \quad (9)$$

The authenticity of equation (8) can be checked by four divergences taking

$$(A^{\mu}) = \frac{1}{4\gamma}\frac{v^2\phi}{c^2}gU^{\mu}, \text{ as the following.}$$

$$\frac{\partial}{\partial \chi^{\mu}}\left[\frac{1}{4\gamma}\phi\, g\, \frac{\upsilon^2}{c^2} U^{\mu}\right] \text{, as } \frac{\partial}{\partial t} = -\upsilon.\nabla$$

$$= \frac{1\upsilon^2}{4\gamma c^2}\left[-\gamma g.\upsilon + \gamma g.\upsilon\right]$$

$$= o$$

Properties and Identification of Velocity Dependent Four Potential with Electromagnetic Four Vector Potential

a) From equation (4), a moving mass point induces an extra potential over static mass at the point of observation so from equation (8) A^{μ}, the velocity dependent four potential is just a four dimensional flow of gravitational extra potential.

b) If the moving mass point comes to rest instantly then there must be a disappearance of extra potential into certain types of energy according to mass energy conservation. In this situation the disappearance of velocity dependent extra potential might be transformed as electromagnetic energy. So, the velocity dependent four potential is likely to be the electromagnetic four potential.

c) The electromagnetic four potential associated with a charged particle is $A^{\lambda} \propto \frac{1}{r} U^{\lambda}$, [8]. Moreover, the induced velocity dependent four potential due to moving mass point from (8) is $A^{\mu} \propto \frac{1}{r} U^{\mu}$.

Both of them are long ranged rank one tensor.

d) From the Lorenz gauge, the four divergence of electromagnetic four potential vanishes. Further, equation (7) shows the same property for the induced velocity dependent four potential.

e) Here (A^{μ}) is a purely rank one tensor so it doesn't contribute to the gravitational field or wave which is actually characterized over the second rank metric.

All these above physically mean that when mass is moving uniformly there will be a flow of extra potential from the observation point with the same velocity as the moving mass point, and the induced gravitational extra potential will be transformed into some kind of four potential similar to electromagnetic four potential. **Here it is postulated that the gravity induced four potential is nothing but the electromagnetic four potential.** Also, it is obvious that as the relative velocity between source and observer vanishes, the induced electromagnetic potential vanishes instantly.

Representation of Gravitational Electromagnetic Field
The choice of electromagnetic tensor in a vacuum regarding the velocity dependent extra potential follows the same configuration as the conventional electromagnetic field tensor in flat space or Minkowskian space.

The Maxwell's electromagnetic field tensor [$F^{\mu\nu}$] in Relativistic electrodynamics [9] is expressed as

$$F^{\mu\nu} = \left[\frac{\partial A^{\nu}}{\partial \chi^{\mu}} - \frac{\partial A^{\mu}}{\partial \chi^{\nu}} \right] \tag{10}$$

The tensor associated with velocity dependent gravitational extra potential using equation (8) given as
For uniform velocity the four velocities U^{ν}'s are independent on χ^{u}. Thus

$$F^{\mu\nu} = \left[\frac{\partial}{\partial \chi^{\mu}} (\delta\phi_g) U^{\nu} - \frac{\partial}{\partial \chi^{\nu}} (\delta\phi_g) U^{\mu} \right] \tag{11}$$

Using the above equation, the component

$$F^{jo} = \left[\frac{\partial}{\partial \chi^{j}} (\delta\phi_g) U^{o} - \frac{\partial}{\partial \chi^{o}} (\delta\phi_g) U^{j} \right] \tag{12}$$

Here χ^{j} represents space coordinates and χ^{o} (=ct) represents time coordinate.

The first partial differentiation in the square bracket is carried over constant present time (t_0) and the second partial differentiation with respect to time is over constant present position (χ_o^{α}).

The present time separation between moving point source and observation point is 'SPACE-LIKE' [10], because, $\sum \left| d(\chi_o^{\alpha} - \chi_o^{\alpha}) \right|^2 \neq 0$

And $c^2 \left| d(t_2 - t_o) \right|^2 = 0,$ \hfill (13)

As, $t_2 = t_o$, at present time.

Now $U^{o} = \dfrac{cdt}{d\tau}, \tau$ is proper time

Using equation (6), at constant present time,

$$U^{o} = \frac{cd(t_2 - t_o)}{d\tau} = 0 \tag{14}$$

In Figure 1., the retarded and present position of source in terms of proper coordinates are given by (0,0,0, τ_1) and (0,0,0, τ_2.)

Now the proper time interval for the moving point source

$$\tau = \tau_2 - \tau_1$$

$$d\tau = d(\tau_2 - \tau_1)$$

$$= \frac{1}{\gamma} d(t_2 - t_1)$$

Then, $\gamma d\tau = d(t_2 - t_1)$

But present time related with retarded time [8], $t_o = t_1 + \frac{r}{c}$

$$d(t_o - t_1) = \frac{dr}{c}$$

Or, $d(t_2 - t_1) = \frac{dr}{c}$ [here present time $t_o = t_2$]

Hence $d\tau = \frac{dr}{\gamma c}$ (15)

Now $\quad U^j = \frac{d(\chi^j - \chi_o^j)}{d\tau}$

Then at constant present position, $d\chi_o^j = 0$

Or $\quad U^j = \frac{d\chi^j}{d\tau} = \gamma c \frac{d\chi^j}{d\tau}$ (16)

At present position implying (14), (15) and equation (16) in equation (12), and using $[\frac{\upsilon \partial \chi^j}{\partial r} = \upsilon^j]$ we have

$$F^{j0} = \tfrac{1}{4} g \frac{\upsilon^2 \upsilon^j}{c^2}$$ (17)

Equating the tensor component with the electromagnetic tensor components [9] derived from the Maxwell's electromagnetic relations.

$$F^{j0} = -\frac{E^j}{c}[\text{in S.I units}]$$

$$F^{j0} = -E^j[in \text{ C.G.S units}]$$ (18)

Where

$$[F^{uv}] = \begin{bmatrix} 0 & \dfrac{E_1}{c} & \dfrac{E_2}{c} & \dfrac{E_3}{c} \\[2mm] -\dfrac{E_1}{c} & 0 & B_3 & -B_2 \\[2mm] -\dfrac{E_2}{c} & -B_3 & 0 & B_1 \\[2mm] -\dfrac{E_3}{c} & B_2 & -B_1 & 0 \end{bmatrix} \quad \text{In S.I system} \quad (19)$$

Equations (17) and (18) give

$$E = -\tfrac{1}{4} g \frac{v^2}{c} \upsilon = -\frac{1}{4\gamma} \frac{Gmv^3 \hat{\upsilon}}{r_0^2 c} \quad \text{[In S.I units]}$$

$$E = -\frac{1}{4} g \frac{v^2}{c^2} \upsilon = -\frac{1}{4\gamma} G \frac{m}{r_\circ^2} \frac{v^3}{c^2} \hat{\upsilon} \quad \text{[In C.G.S units]} \qquad (20)$$

Equation (20) is the required representation of the electric field at the observation point due to a moving point mass.

The field tensor

$$F^{ij} = \left[\frac{\partial}{\partial \chi^i} \left(\frac{1}{4\gamma} \phi_g \frac{v^2}{c^2} \right) \frac{d\chi^j}{d\tau} - \frac{\partial}{\partial \chi^j} \left(\frac{1}{4\gamma} \phi_g \frac{v^2}{c^2} \right) \frac{d\chi^i}{d\tau} \right] \qquad (21)$$

Here also substituting $d\tau = \frac{dr}{\gamma c}$, and contra-variantly $\frac{\partial \phi_g}{\partial \chi^i} = -g^i$, the gravitational field component.

$$= -\frac{1}{4} \frac{v}{c} \left[\mathbf{g}^i \frac{v dx^j}{dr} - \mathbf{g}^j \frac{v dx^i}{dr} \right], where\ v \frac{dx^j}{dr} = v^j$$

$$= -\frac{1}{4} \frac{v}{c} [\mathbf{g} \times v]_k$$

But $F^{ij} = B_\kappa$ [in C.G.S and S.I units]

Then the required relation for the magnetic field due to a moving point mass is

$$B = -\frac{1}{4} \frac{v(\mathbf{g} \times v)}{c} = -\frac{1}{4\gamma} \frac{Gmv^2}{r_0^2} \frac{(\hat{r_0} \times \hat{v})}{c} \qquad (22)$$

$$E \Rightarrow [1 \text{S.I} = \tfrac{1}{3} \times 10^{-4} C.G.S]$$

$$B \Rightarrow [1 \text{ S.I} = 10^4 C.G.S]$$

The above relations give the first essence about the similarity with the practically observed relations between two unit systems (C .G.S and S.I) in the case of an electric and magnetic field.

However, the consistency of the Maxwell's equation regarding equation (20) and (22) can be proved as follows.

$$\nabla \times \mathrm{E} = -\frac{\partial \mathbf{B}}{\partial t}.$$

Also $[F^{\mu\nu}]$ is anti symmetric and it is obvious that $\nabla \cdot B = O$

Explanation of the Earth-Magnetism

The next point to consider is about highly massive bodies which move with very high speed possessing significant magnetic field. The mathematical consequences, using the equations, have been developed.

Then we have the scope to treat the Earth as an experimental object for calculating its magnetic field as follows.

For simplicity, let the Earth be considered as two hemispherical lobes. The centre of mass of each lobe is at distance $'r'$ from the Earth's center (Figure 3.).

Figure 2. *Polar Magnetic Field of Earth for Two Hemispherical Lobes*

Figure 2.

$$B' = -\frac{1}{4}\frac{v}{c}g' \times v \qquad (24)$$
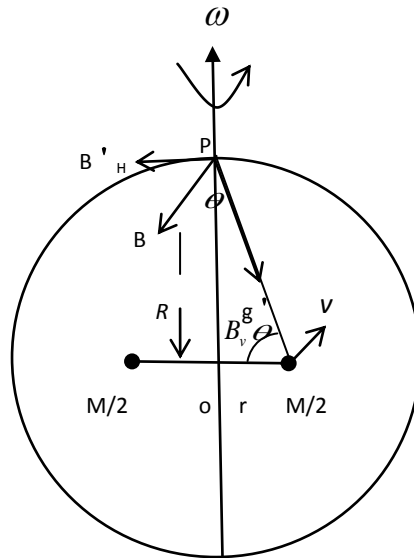
$$B'_v = -\frac{1}{4}\frac{v}{c}(g' \times v)\cos\theta \qquad (25)$$

For horizontal component B'_H the total magnetic field along the horizontal direction for two lobes is zero. Only the vertical component exists and is added up.

The total vertically downward field from figure 3.

$$\text{Hence } B = \frac{1}{4} \frac{g(\omega R)^2}{c} \cdot \frac{\alpha^3}{[1+\alpha^2]^{3/2}} \qquad (26)$$

In S.I units for earth

$$g = 9.8 m/s^2 , c = 3 \times 10^8 m/s , R = 6370 \times 10^3 m$$

$$\omega = \frac{2\pi}{86400} rad/s \text{ and } \alpha = .34 \text{ [1]}$$

the calculated value of magnetic field at the pole, $B = .58 \times 10^{-4}$. Tesla shows good agreement with the order of observed value [11].

In Table 1, *T stands for magnetic field in Tesla for some terrestrial objects keeping fixed α as of earth*

Table 1

Terrestrial bodies	$g(m/s^2)$	$R(m)$	$\omega(rad/s)$	Calculated(T)	Observed(T)
Mercury	.38g	.3829R	.069 ω	$.90 \times 10^{-9}$	$\sim 10^{-7}$
Venus	.904g	.9499R	.0041 ω	7.81×10^{-10}	almost zero
Earth	1g	1R	1 ω	5.8×10^{-5}	6×10^{-5}
Mars	.37g	.53R	.97 ω	5.68×10^{-6}	$\sim 10^{-6}$
Neutron star	10^{11} g	.0031396R	8640 ω	4.26×10^9	$\sim 10^9$

* The other planet and sun are excluded from the table as they are gaseous in nature and contribute in various ways to their magnetic field.

Quantization of Electronic Charge and Magnetic Moment from TDGEM

Concept of Charge

The TDGEM equation of induced four potentials (A^μ) for a moving mass particle, without any approximation, in terms of its gravitational potential (φ_g) at the observation point along the direction $(\cos\psi_r = 1)$ of motion of the mass particle is given by

$$A^\mu = (1 - \frac{1}{\gamma^2})\frac{c}{v}\varphi_g U^\mu \qquad (27)$$

Thus the induced electric field **E** at a distance **r** (present position) from the moving mass particle with velocity **v**, in a highly relativistic case will be

$$E = -\frac{G}{r^2}\frac{(mv)^2}{m}\hat{v} \qquad (28)$$

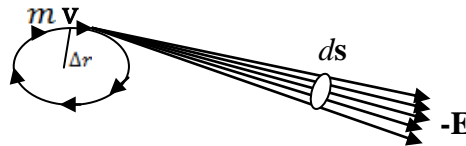Application of Gauss's divergence theorem to equation (28) for a uniformly moving particle, $(\nabla.V) = 0$.

$$\frac{q}{\epsilon_0} = \oint E.ds = \oint(\nabla.E)dv = 0 \qquad (29)$$

Thus equation (29) shows that a uniformly moving particle cannot have any induced charges (q) associated with it.

Using equation (28) allows

$$E = -\frac{G\,p^2}{r^2 m}\,\hat{r} \qquad (30)$$

Here the momentum, $p = (mv)$ and mass of the moving particle is, m

Figure 3.

Application of equation (30) to have the meaningful charges associated with a particle is possible if the particle has the AM orientation in every direction in three dimensional spaces such that it will be constrained in a tiny volume. Here in Figure 1. the contribution of the electric field through a small surface at a large distance from a unique loop has been depicted.

$$\oint E.ds = -4\pi G\frac{p^2}{m} \qquad (31)$$

In this case the nonzero divergence of the electric field of equation (31) associated with the particle is responsible for charge creation and the Gauss's theorem for electrostatics allows.

$$q = -4\pi\epsilon_0 G\frac{p^2}{m} \qquad (32)$$

TDGEM in Quantum Scale
Elementary particles like electron, quark up and down, annihilate with their antiparticles. This results in radiation energy and the creation of them is also possible from very high energetic photons as a consequence of mass energy equivalence. So there is enough scope to think of the elementary particles as the lump of relativistic photonic masses (m).

The rest mass of photon is zero but it must have relativistic mass corresponding to its momentum (p=h/λ) from the theory of Broglie. L.D.[12] regarding its wave length (λ). In the following, the momentum or AM of the bounded relativistic photonic masses will be considered for an elementary particle in place of quantization of rotational kinetic energy $I\omega^2$.

$$= -4\pi\epsilon_\circ G \frac{L.L}{m\Delta r^2} \tag{33}$$

Where angular momentum of the particle is

$$\mathbf{L} = \Delta\mathbf{r} \times \mathbf{p}$$

Where Δr is the allowed radial dimension for constituent bound photonic masses of the elementary particle, then presenting momentum $p = \hbar/\Delta r$ the charges associated with the elementary particle using (33) will be:

Thus the associated charge is defined as

$$q = -4\pi\epsilon_\circ G \left(\frac{\hbar}{\Delta r}\right)^2 . \frac{1}{m} \tag{34}$$

and Plank const $h \sim 6.626 \times 10^{-34} J.S$

The above equation (34) can be achieved more precisely and elegantly with the help of equation (33), just replacing the AM vector **L** with total AM **J=L+S**, where the quantum mechanical total AM operator is $\hat{J}$.

Using quantum mechanical AM operator for a localized electron states having non-zero angular momentum such as realization of the Lie algebra of the Poincaré group $[\hat{J}_i, \hat{J}_j] = i\hbar \in_{ijk} \hat{J}_k$ and $[\hat{J}_i, \hat{H}] = 0$.

Given $\hat{J}$ for the state ket $|\psi>$

$$\hat{J}^2|\psi> = J(J+1)\hbar^2|\psi>$$

Localized electron states orbital AM, L=0 and spin AM S=1/2 then keeping $J = 1/2$ for minimum intrinsic or spin angular momentum.

$$q = -4\pi\epsilon_0 G \frac{<\psi|\hat{J}^2|\psi>}{m\Delta r^2} \tag{35}$$

$$q = \mp 3\pi\epsilon_\circ G \left(\frac{\hbar}{\Delta r}\right)^2 \cdot \frac{1}{m}\frac{c^2}{c^2} \qquad (36)$$

Equation (35) leads the charge (q) associated with the elementary particles and antiparticles [ ] of mass (m), where for stationary state of particle energy $\mathcal{E} = \pm mc^2 \sqrt{(1 + \frac{p^2}{m^2c^2})}$ positive energy state for electron and for negative positron.

$$\Delta r = \left(\frac{3\epsilon_\circ G}{4\pi qm}\right)^{\frac{1}{2}} \cdot h \qquad (37)$$

The validity of equation (37) can be judged with the help of the following elementary particles like electron and quarks (Leptons).

The charges are $|q_d| = \frac{1}{3}\ e,\ \ |q_u| = \frac{2}{3}\ e,\ \ |q_e| =$ respectively for down quark, up quark and electron.

Taking $\ \ m_d \sim 10m_e\ $ and $\ \ m_u \sim 5m_e\ $ where,

$$m_e = 9.1 \times 10^{-31}\ K.g.$$
$$e = 1.6 \times 10^{-19}\ S.I.$$

Equation (37) gives

$$r_d = r_u \sim 0.11 \times 10^{-19} m. \ ,$$

Although this result is somehow different from experimental data but could be accountable for the tininess of their sizes with this equality of the up and down quark size [14] is well established.

$$\text{and}\ \ r_e \sim 0.22 \times 10^{-19} m.$$

This calculation for electron radius is similar to the experimentally obtained $r_e < 10^{-17} cm$, which is the prescribed upper limit of electrons physical radius [15].

The equation (35) may be valid for any other leptons. In case of hadrons like the proton and neutron, the charge contribution of their corresponding constituent's quarks as of the standard model is applicable.

The Intrinsic Magnetic Moment

For a highly relativistic case, the magnetic field at the observation point perpendicular to the direction of motion due to a moving mass particle from TDGEM can be given for unique polarization of angular momentum along Z axis as shown in Figure 2. The associated magnetic field at point 'P' will be

$$B_z = -\frac{Gm|(\hat{r} \times v)|}{r^2} \frac{v}{c} \cos\theta \, \hat{z} \tag{38}$$
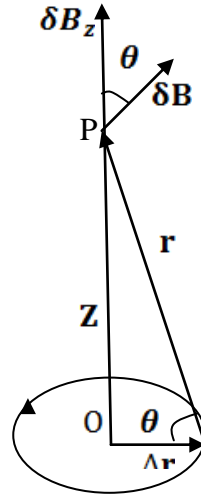
Figure 4.

$$\delta B_z = -\frac{Gm|(\hat{r} \times v)|}{r^2} \frac{v}{c} \frac{\Delta r}{r} \hat{z} \tag{39}$$

But for a magnetic dipole moment μ magnetic field $\delta B = \frac{\mu}{4\pi\epsilon_0 c^2 r^3}$ (40)

Taking (r~z) for a large distance compared to the linear dimension of the loop, the associate magnetic dipole moment for the loop from Figure 2. will be

$$\mu = -4\pi\epsilon_0 cGm|(\hat{r} \times v)|v\Delta r\hat{z} \tag{41}$$

$$= -\left(4\pi\epsilon_0 G \frac{p^2}{m}\right)\frac{\Delta r \times p}{m}\left(\frac{c}{v}\right) \tag{42}$$

$$\mu = -\left(4\pi\epsilon_0 G \frac{L^2}{m\Delta r^2}\right)\frac{L_z}{m}\left(\frac{c}{v}\right) \tag{43}$$

Here L_z is the dynamical variable which indicates the angular momentum of the tiny particle.

Next, changing the dynamical variable $\mathbf{L_z}$ into the quantum mechanical observable $\hat{\mathbf{J}}_z$ and $\hat{\mathbf{J}}_z|\psi> = J\hbar|\psi>$ also $[\hat{\mathbf{J}}_z, \hat{\mathbf{J}}^2] = 0$. Then $\hat{\mathbf{J}}_z$ and $\hat{\mathbf{J}}^2$ are both simultaneously measureable.

$$\boldsymbol{\mu} = -\left(4\pi\epsilon_0 G \frac{<\psi|\hat{\mathbf{J}}^2|\psi>}{m\Delta r^2}\right) \frac{<\psi|\hat{\mathbf{J}}_z|\psi>}{m}\left(\frac{c}{v}\right) \qquad (44)$$

Now in the preceding section, the elementary particle is considered to be the lump of self bounded photonic masses which follow the quantum mechanical properties. Then the bounded relativistic masses will show the minimum intrinsic or spin angular momentum $<\psi|\hat{\mathbf{J}}_z|\psi> = \hbar/2$, which is obvious from Dirac's formulation [13] for a stationary electron like particle in relativistic quantum mechanics.

$$\mu = \frac{q\hbar}{2m}\frac{c}{v} \qquad (45)$$

The appearance of c/v term in the equation (45) may be dropped out for the ultra relativistic case v~c

Now for electron's (q= -e) intrinsic magnetic moment

$$\mu_e = -\frac{e\hbar}{2m_e}\left(1 - \frac{1}{\gamma^2}\right)^{-\frac{1}{2}} \qquad (46)$$

Ignoring the higher order term of $1/\gamma^2$

$$\boldsymbol{\mu}_s = -\frac{g_e\mu_B\mathbf{S}}{\hbar} \qquad (47)$$

$\mu_B = -\frac{e\hbar}{2m_e}$, is the Bohr magnetron and $\mathbf{S} = \pm 1/2\,\hbar$ is the spin quantum number of electron. The 'g' factor for electron $g_e=2$ as prescribed by Dirac if we ignore all $1/\gamma^2$ term from equation (46).

Electromagnetic Radiation from Accelerated Mass

The Field Tensors for the Non-uniformly Moving Mass Particle
Using (1) and (2) for non-uniformly moving mass particle field tensor comes to:

$$F^{\mu\nu} = \left[\frac{\partial(\delta\varphi_g)}{\partial x^\mu}U^\nu - \frac{\partial(\delta\varphi_g)}{\partial x^\nu}U^\mu\right] + \left(\delta\varphi_g\right)\left[\frac{\partial U^\nu}{\partial x^\mu} - \frac{\partial U^\mu}{\partial x^\nu}\right] \qquad (48)$$

In equation (48), right hand side, the term in the first square bracket is as usual gravity induced electromagnetic field tensors for a uniformly moving mass [1]. The second term within the square bracket gives an additional contribution to the induced field over the value of non uniform velocity.

The Useful Parameters for Accelerated Mass Particle

In the following Figure 1. an observer at the field point(P) in present time(t) can have the information about the moving source(S) only for its retarded position and time(t'). Here the corresponding field at the field point will be given in terms of the retarded value of the moving object's velocity and acceleration.

Figure 5. *The Retarded Position of Source S* (x_i', t') *with Respect to Field Point P* (x_i, t) *at the Present Time*
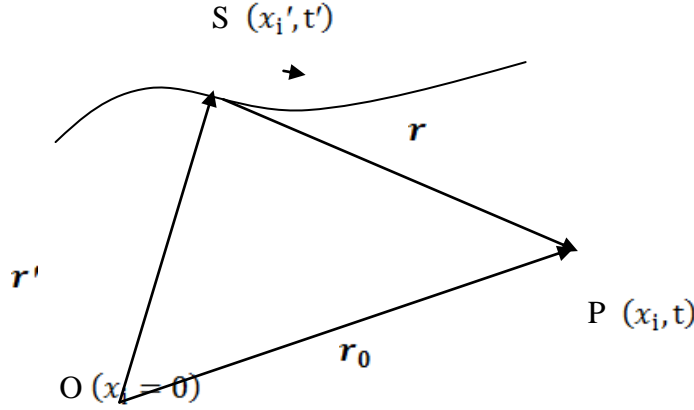
Figure 5.

$$\text{Here retarded velocity of the source, } \frac{dr'}{dt'} = \boldsymbol{u} \tag{49}$$

$$\text{And retarded acceleration, } \frac{d^2 r'}{dt'^2} = \dot{\boldsymbol{u}} \tag{50}$$

$$\text{But from Figure 1., } \boldsymbol{r} = \boldsymbol{r_0} - \boldsymbol{r}' \tag{55}$$

$$\boldsymbol{r}.\boldsymbol{r} = (\boldsymbol{r_0} - \boldsymbol{r}').(\boldsymbol{r_0} - \boldsymbol{r}') \tag{56}$$

Retarded velocity of source with respect to the fixed observer or field point

$$\left(\frac{\partial r}{\partial t'} \right)_{x_i} = -\frac{\boldsymbol{r}.\boldsymbol{u}}{r} \tag{57}$$

Also retarded distance $'r'$ is traversed by the information signal with optical velocity in the time difference$(t - t')$

$$\text{Hence, } r = c(t - t') \tag{58}$$

Differentiating partially (58) with respect to present time t

$$\frac{\partial r}{\partial t} = \frac{\partial r}{\partial t'}\frac{\partial t'}{\partial t} = c\left(1 - \frac{\partial t'}{\partial t}\right)$$

Implying equation (57)

$$\text{or} \qquad -\frac{\boldsymbol{r}.\boldsymbol{u}}{r}\frac{\partial t'}{\partial t} = c\left(1 - \frac{\partial t'}{\partial t}\right)$$

$$\text{Introducing, } l = r - \frac{\boldsymbol{r}.\boldsymbol{u}}{c}, \frac{\partial}{\partial t} = \frac{r}{l}\frac{\partial}{\partial t'} \tag{59}$$

Also as the gradient at the field point needs to be carried for the constant present time (t) then using (58)

$$\boldsymbol{\nabla} r = -c\boldsymbol{\nabla} t' \tag{60}$$

Since the retarded position(r) of the source relative to field point is the function of both field point and retarded time (t') then

$$\frac{\partial r(x_i, t')}{\partial x_i} = \left(\frac{\partial r}{\partial x_i}\right)_{t'} + \left(\frac{\partial r}{\partial t'}\right)_{x_i} \cdot \frac{\partial t'}{\partial x_i} \tag{61}$$

Then using equations (11) and (12)

$$\nabla r = -c\nabla t' = \nabla' r - \frac{r.u}{r}\nabla t' \tag{62}$$

$$\nabla t' = -\frac{r}{lc} \tag{63}$$

The Gravity Induced Electric Field for the Accelerated Point Mass

From equation (3) the transformed field tensors

$$F^{i0} = \left[\frac{\partial(\delta\varphi_g)}{\partial x^i}U^0 - \frac{\partial(\delta\varphi_g)}{\partial x^0}U^i\right] + (\delta\varphi_g)\left[\frac{\partial U^0}{\partial x^i} - \frac{\partial U^i}{\partial x^0}\right] \tag{64}$$

Where 'i' stands for the spatial parts and '0' is for temporal part
Using, $U^0 = \gamma c$, $U^i = \gamma u^i$, $\partial x^0 = c\partial t$ with this $F^{i0} = -\frac{E_1}{c}$ [1] in equation (64) we have

$$\sum_{i=1}^{3} F^{i0} = \sum_{i=1}^{3}\left[\frac{\partial(\delta\varphi_g)}{\partial x^i}(\gamma c) - \frac{\partial(\delta\varphi_g)}{c\partial t}(\gamma u^i)\right] + \sum_{i=1}^{3}(\delta\varphi_g)\left[\frac{\partial(\gamma c)}{\partial x^i} - \frac{\partial(\gamma u^i)}{c\partial t}\right] \tag{65}$$

In equation (65), the first term in the square bracket gives the induced field$\left(-\frac{E_{uni}}{c}\right)$for a uniformly moving mass particle with retarded velocity (u), already described in TDGEM. The second additional contribution to the electric field$\left(-\frac{E_{adl}}{c}\right)$ needs to be calculated where

$$-\frac{E}{c} = -\frac{E_{uni}}{c} - \frac{E_{adl}}{c} \tag{66}$$

Now, $\quad -\frac{E_{adl}}{c} = (\delta\varphi_g)\left[\nabla(\gamma c) - \frac{\partial(\gamma u)}{c\partial t}\right] \tag{67}$

$$-\frac{E_{adl}}{c(\delta\varphi_g)} = \nabla(\gamma c) - \frac{r}{lc}\frac{\partial(\gamma u)}{\partial t'} \tag{68}$$

$$\nabla\gamma = \nabla\left(1 - \frac{u^2}{c^2}\right)^{-\frac{1}{2}}$$
$$= \frac{1}{2}\frac{\gamma^3}{c^2}\nabla(u.u) \tag{69}$$

Using vector algebra

$$\nabla(u.u) = 2[u \times (\nabla \times u) + (u.\nabla)u] \tag{70}$$

Since u is function of retarded time(t')

$$\nabla \times u(t') = -\epsilon_{ijk}.\hat{\imath}\left(\frac{\partial u_j}{\partial t'}\frac{\partial t'}{\partial x_k}\right)$$
$$(\nabla \times u) = -\dot{u} \times \nabla t' \tag{71}$$

Also, $(u.\nabla)u = u_i\frac{\partial t'}{\partial x_i}\frac{\partial u}{\partial t'}$

$$= (u.\nabla t')\dot{u} \tag{72}$$

Using (70), (71) and (72) in (69)

$$\nabla\gamma = \frac{\gamma^3}{c^2}[-u \times (\dot{u} \times \nabla t') + (u.\nabla t')\dot{u}] \tag{73}$$

Now from equation (63) putting $\nabla t' = -\dfrac{r}{lc}$ the equation (73) reduces to

$$\nabla\gamma = \frac{\gamma^3}{c^2}\left[\frac{r}{lc}(\boldsymbol{u}.\dot{\boldsymbol{u}})\right] \tag{74}$$

From equation (68) using (74)

$$-\frac{E_{adl}}{c(\delta\varphi_g)} = \nabla(\gamma c) - \frac{r}{lc}\frac{\partial(\gamma u)}{\partial t'} = \frac{\gamma^3}{lc^2}r(\boldsymbol{u}.\dot{\boldsymbol{u}}) - \frac{r}{lc}.\frac{\gamma^3}{c^2}\boldsymbol{u}(\boldsymbol{u}.\dot{\boldsymbol{u}}) - \frac{\gamma r}{lc}\dot{\boldsymbol{u}} \tag{75}$$

$$\text{But, } \gamma^{-2}c^2 = c^2 - (\boldsymbol{u}.\boldsymbol{u})$$

$$-\frac{E_{adl}}{c(\delta\varphi_g)} = \frac{\gamma^3}{lc^3}\left[r(\boldsymbol{u}.\dot{\boldsymbol{u}})c - ru(\boldsymbol{u}.\dot{\boldsymbol{u}}) + r\dot{\boldsymbol{u}}(\boldsymbol{u}.\boldsymbol{u})' - rc^2\dot{\boldsymbol{u}}\right] \tag{76}$$

Now the extra potential $(\delta\varphi_g)$ from TDGEM in terms of retarded potential $\varphi_g = \dfrac{Gm}{r}$, gives

$$(\delta\varphi_g) = \varphi_g\frac{r.u}{rc} = \frac{Gm}{r}\left(\frac{r.u}{rc}\right) \tag{77}$$

G is the gravitational constant and m is the mass of the particle.
From equations (76) and (77)

$$E_{adl} = \frac{Gm\gamma^3}{lc^2}\left(\frac{r.u}{rc}\right)\left[\boldsymbol{u}\times(\boldsymbol{u}\times\dot{\boldsymbol{u}}) + c^2\dot{\boldsymbol{u}} - \hat{r}(\boldsymbol{u}.\dot{\boldsymbol{u}})c\right] \tag{78}$$

This equation (78) shows that $E_{adl}\sim\dfrac{1}{r}$ unlike from a uniformly moving point mass TDGEM $E_{uni}\sim\dfrac{1}{r^2}$. From the concept of electrical energy in free medium $\epsilon_0 E^2$ over a large sphere [7] for the condition $E_{uni}\sim\dfrac{1}{r^2}$ results in $\oint_{0,r\to\infty}^{4\pi}\dfrac{1}{r^4}.r^2 d\Omega = 0$. So, field component for uniform retarded velocity does not contribute to radiation. However, $E_{adl}\sim\dfrac{1}{r}$ gives $\oint_{0,r\to\infty}^{4\pi}\dfrac{1}{r^2}.r^2 d\Omega \neq 0$, and does not vanish. Hence, it may be conferred E_{adl} as E_{rad}, the radiative field for the electrical energy.
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The Gravity Induced Magnetic Field for the Accelerated Point Mass
    Further from equation (48) the tensors responsible for the magnetic field are

$$F^{ij} = \left[\frac{\partial(\delta\varphi_g)}{\partial x^i}U^j - \frac{\partial(\delta\varphi_g)}{\partial x^j}U^i\right] + (\delta\varphi_g)\left[\frac{\partial U^j}{\partial x^i} - \frac{\partial U^i}{\partial x^j}\right] \tag{79}$$

Using the same notion as of equation (64) the total magnetic field

$$\boldsymbol{B} = \boldsymbol{B}_{uni} + \boldsymbol{B}_{adl} \tag{80}$$

$$\boldsymbol{B}_{adl} = (\delta\varphi_g)[\nabla\times(\gamma\boldsymbol{u})] \tag{81}$$

$$\frac{\boldsymbol{B}_{adl}}{(\delta\varphi_g)} = \nabla\gamma\times\boldsymbol{u} + \gamma\nabla\times\boldsymbol{u} \tag{82}$$

Putting the value $\nabla\gamma = \dfrac{\gamma^3}{c^2}[-\boldsymbol{u}\times(\dot{\boldsymbol{u}}\times\nabla t') + (\boldsymbol{u}.\nabla t')\dot{\boldsymbol{u}}]$ and using

$(\nabla \times \boldsymbol{u}) = -\dot{\boldsymbol{u}} \times \nabla t'$, equation (82) comes to

$$\frac{B_{adl}}{(\delta\varphi_g)} = \frac{\gamma^3}{c^2}[-\boldsymbol{u} \times (\dot{\boldsymbol{u}} \times \nabla t') + (\boldsymbol{u}.\nabla t')\dot{\boldsymbol{u}}] \times \boldsymbol{u} - \gamma(\dot{\boldsymbol{u}} \times \nabla t') \quad (83)$$

Further using (63) $\nabla t' = -\frac{r}{lc}$ in equation (34)

$$\frac{B_{adl}}{(\delta\varphi_g)} = \frac{\gamma^3}{lc^3}\boldsymbol{r} \times [\boldsymbol{u}(\boldsymbol{u}.\dot{\boldsymbol{u}}) - \dot{\boldsymbol{u}}(\boldsymbol{u}.\boldsymbol{u}) + c^2\dot{\boldsymbol{u}}] \quad (84)$$

Ultimately using the same notion as in the preceding section the additional gravity induced magnetic field contributes to radiation and from (84)

$$\boldsymbol{B}_{rad} = \frac{Gm\gamma^3}{lc^3}\left(\frac{r.u}{rc}\right)\hat{\boldsymbol{r}} \times [\boldsymbol{u} \times (\boldsymbol{u} \times \dot{\boldsymbol{u}}) + c^2\dot{\boldsymbol{u}}] \quad (85)$$

Now without any loss of generality of equation (85) we can introduce an extra term $-\hat{\boldsymbol{r}}(\boldsymbol{u}.\dot{\boldsymbol{u}})c$ in the square bracket such that the cross product with position vector does not hamper the actual induced magnetic radiation field.

$$\boldsymbol{B}_{rad} = \frac{Gm\gamma^3}{lc^3}\left(\frac{r.u}{rc}\right)\hat{\boldsymbol{r}} \times [\boldsymbol{u} \times (\boldsymbol{u} \times \dot{\boldsymbol{u}}) + c^2\dot{\boldsymbol{u}} - \hat{\boldsymbol{r}}(\boldsymbol{u}.\dot{\boldsymbol{u}})c] \quad (86)$$

From equations (78) and (86) the expected form for the radiative magnetic fields is

$$\boldsymbol{B}_{rad} = \hat{\boldsymbol{r}} \times \frac{\boldsymbol{E}_{rad}}{c} \quad (87)$$

Gamma Ray Bursts (GRB) in the Light of Matter Induced Radiation

The Process during the GRB

From astrophysical observations, gamma ray burst comes from a massive star, at the end of supernova, when the massive stars core with mass greater than Chandrasekhar limit (1.44 solar mass) undergoes gravitational collapse into itself. The collapse is so powerful that electrons are captured by protons to form a stable neutron star or perhaps a black hole in totality. After attaining maximum collapse velocity, it ceases to be zero (compared to initial magnitude) with a bounce [16]. Such an event occurs in very short time, for a few seconds, and results in extremely high deceleration.

Radiation from Collapsing Star Core with Rotation

Interestingly, we have a scope for a large amount of radiation as the implications of equation (87); i.e. for the GRB, as it follows a huge bounce or deceleration of the massive star core following supernova. Next, considering the collapsing star core into two hemispherical lobes as with the Figure 6., the resultant velocity ($\boldsymbol{u}$) of center of mass (CM), at any instant, consists of inward collapse velocity ($\boldsymbol{u}_c$) and rotational velocity ($\boldsymbol{u}_\rho$) .

$$\boldsymbol{u} = \boldsymbol{u}_c + \boldsymbol{u}_\rho \quad (88)$$

And also the resultant deceleration $(-\dot{u})$ is enhanced by deceleration $(-\dot{u}_\rho)$ for rotational motion (u_ρ)

$$-\dot{u} = -(\dot{u}_c + \dot{u}_\rho) \tag{89}$$

Now $$\dot{u}_\rho = \frac{L^2}{M^2 (\Delta R)^3} \tag{90}$$

Here L is the angular momentum and M is the mass of the collapsing star. If 'L' and 'M' both remain conserved during the collapse then CMs can easily achieve very high induced deceleration $(\dot{u}_\rho)$. This is comparable to deceleration at homologous collapse $(\dot{u}_c)$ squeezing ΔR within a matter of seconds.

The gravity induced electric and magnetic fields are for an accelerated mass m from equation (78) and (87)
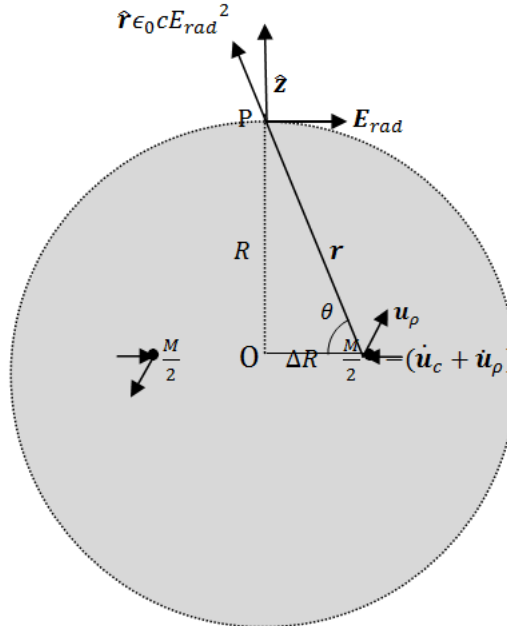
$$E_{rad} = \frac{Gm\gamma^3}{lc^2} \left(\frac{r.u}{rc}\right) [u \times (u \times \dot{u}) + c^2 \dot{u} - \hat{r}(u.\dot{u})c] \tag{91}$$

$$B_{rad} = \hat{r} \times \frac{E_{rad}}{c} \tag{92}$$

For non relativistic consideration u ≪ c and using the conditions as the Figure 1., at the pole (P) the induced radiative electric field for the CM

$$E_{rad} = -\frac{GM}{2rc} (\hat{r}.u_c)[(\dot{u}_c + \dot{u}_\rho)] \tag{93}$$

Figure 6. *The Gravity Radiation Fields for a CM of Collapsing Star with Rotation*

The Poynting vector for radiated energy flux $S = E \times H$ where, $H = \epsilon_0 c^2 B$ now using equations (91) and (92)

$$S = \epsilon_0 c [\hat{r} E_{rad}^2 - E_{rad}(\hat{r}.E_{rad})] \tag{94}$$

The Poynting vector **S** in equation (94) describes the radiated normal flow of energy flux at the pole (P). Using this equation the normal rate of flow of electromagnetic radiation energy

$$S_z = \epsilon_0 c \left[\hat{r} E_{rad}^2 - E_{rad}(\hat{r}.E_{rad}) \right].\hat{z} \tag{95}$$

$$S_z = \epsilon_0 c E_{rad}^2 \sin\theta \tag{96}$$

Considering both the CMs of the lobes and using equation (93)

$$S_z = \frac{\epsilon_0 G^2}{2cr^2} M^2 u_c^2 \cos^2\theta \sin\theta \left[u_c^2 + \left(u_\rho^2 + 2u_c.u_\rho \right) \right] \tag{97}$$

The radiation energy contribution for deceleration of masses at the bounce during the homologous collapse for non rotating $(\boldsymbol{u_\rho} = 0)$ star core after supernova using equation (97)

$$-\frac{dU}{dt} = S_{zi} \oint da = \frac{2\pi\epsilon_0 G^2}{c} M^2 u_c^2 u_c^2 \cos^2\theta \sin^3\theta \tag{98}$$

Where isotropic Poynting flux,

$$S_{zi} = \frac{\epsilon_0 G^2}{2cr^2} M^2 u_c^2 u_c^2 \cos^2\theta \sin\theta \text{ and } \oint da = 4\pi r^2 \sin^2\theta$$

Typically supernova generates for massive star of mass around $M \geq 25 M_\odot$ and mass of the collapsing core is $2M_\odot$ (solar mass $M_\odot = 1.988 \times 10^{30} kg.$) with maximum outer layer of core velocity $70000\ km/sec$ [16] but inner core will not have such high velocity! For the sake of simplicity, considering average momentum density, the initial maximum velocity of CM is $u_0 \sim 10000\ km/sec$. Such an immense collapse causes a bounce whose decelerated duration is of the order $\Delta t' \sim 10sec$. This results in a gravity induced radiation of electromagnetic energy of $\sim 10^{47}$ Joules, using equation (98) estimates to an energy release of $10^{46} joules/sec$!!

The term $u_\rho^2 + 2u_c.u_\rho$ in the parenthesis in equation (97) refers to the collapsing star core at the two opposite poles which create anisotropic energy flow S_{kp} over the isotropic flow for the rotational motion $(u_\rho \neq 0)$

$$S_{zp} = \frac{\epsilon_0 G^2}{2cr^2} M^2 u_c^2 \left(u_\rho^2 + 2u_c.u_\rho \right) \cos^2\theta \sin\theta \tag{99}$$

Equation (99) it is not an impossible condition, following equation (97) when $u_\rho > u_c$, for which the more intense beams of radiation are directed oppositely at the two poles of the rotational axis Z over the isotropic GRBs as in equation (98). Now in terms of spin, angular momentum '**L**' equation (99) reduces to

$$S_{zp} = \frac{\epsilon_0 G^2 L^2}{2cr^2 (\Delta R)^3}.u_c^2 \left[\frac{L^2}{M^2 (\Delta R)^3} + 2u_c \right] \cos^2\theta \sin\theta \tag{100}$$

Thus there will be no jets for the GRBs where the collapsing stars cores

have no significant angular momentum.

Conclusions

In the first section, the notion of gravity induced electromagnetic field for dynamic mass, as postulated by TDGEM, has been introduced mathematically. The origin of the magnetic field of earth and other planets and typically for neutron star or magnetar can be described up to an order of GIGA-Tesla. Not only is TDGEM applicable in large scale, it also holds equally well in quantum regime describing quantization of charge and intrinsic magnetic moments for electrons and quarks.

The last two sections deal with the debatable question regarding mass induced electromagnetic radiation. However, the radiative electromagnetic field can also be derived mathematically for the accelerated mass. In this study, an exercise has been performed to bring out an explanation to understand one of the biggest enigmas – the GRBs, which refer to jets and isotropic radiation of energy 10^{46} Joules/sec.

Thus TDGEM and its extension establish a new horizon of physical perception for its successful application universally from quantum regime to large scale cosmological events.

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