IOSR Journal of Applied Physics (IOSR-JAP)
e-ISSN: 2278-4861.Volume 12, Issue 1 Ser. II (Jan. – Feb. 2020), PP 45-57
www.iosrjournals.org

Electrogravitodynamics Principles

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Abstract: *Electrogravitodynamics (EGD) is presented as the electromagnetic radiation study in a gravitational environment considering, in terms of particles, the gravitons influence on photons and, vice versa. Similar to the electromagnetic field structure composed of two individual fields, the electric and the magnetic, the gravitational field as an influence and relatable to the electromagnetic, cannot have a single component; the gyrotation field* $\vec{\Omega}$ *, associated with the irrotational gravitation field* $\vec{g}$*, is justified so, defined as a solenoid field analogous to the magnetic field and function of the rotation and mass of the material object/particle carrying the sources of such fields. The combination of the gravitational field* $\vec{g}$ *with the gyrotation field* $\vec{\Omega}$ *in a gyrogravitational field* $\vec{G}$ *form, constitutes the structure that justifies the interrelation sought in electrogravitodynamics. Gyrogravitation equations in vector and differential format will be developed, demonstrating the relationship between the gyrotation* $\vec{\Omega}$ *and gravitational* $\vec{g}$ *fields. From here, interrelation definitive equations between electromagnetic field and gyrogravitation field, component by component, including the specific generation sources for each field and the possibility of influence between them will be presented. The concept of "electric mass" is introduced.*

Keywords: *Electrogravitodynamics, EGD, Gyrogravitation, Graviton, Photon, Fields, Electric Mass.*

Date of Submission: 17-01-2020 Date of Acceptance: 04-02-2020

I. Introduction

It is observed that the electromagnetic radiation study and its description, in origin, go through the classical electrodynamics development, designed for this purpose the Maxwell equations based on the Galileo transformations. Intrinsic asymmetries associated with own Galileo transformations are resolved in relativistic electrodynamics, by using Lorentz transformations and the invariance principle with respect to them. However, the relativism incorporation in electrodynamics does not provide the ability to adequately deal with accelerated charges, again appearing important asymmetry problems, such as "radiation damping" [1] for which there is no explanation in relativistic theory. Supposedly, the quantum electrodynamics (QED) arrival solves the aforementioned problems through purely formal artifice (renormalization). Nonetheless, experience tells us that there are no "free" photons, as they are treated by this theory. That is, the observation confirms that necessarily a real photon is emitted and absorbed [2]. QED defines electrodynamics precisely based on free physical entities, associated with single-frequency monochromatic electromagnetic waves, which is far away from reality, introducing inconsistencies in its theoretical model in relation to the actual accelerated charged particles with discrete bandwidth not void. QFT field theory [3] saves these problems between theoretical (free) and real photons using the concept of quantized fields as a scientific basis.

However, any study on electromagnetic interactions should be done considering the appropriate presence and inevitable influence of gravity, which none of the above proposals, including QFT, has taken into account [4]. Gravitational fields are always present in the environment of electromagnetic fields, so that the possible effect of surrounding gravitational energy should always be incorporated into the measurement and observation of electromagnetic energy.

Electrogravitodynamics (EGD) will be defined as the electromagnetic radiation study in a gravitational environment and, vice versa. That is, in terms of particle theories, it is about considering the gravitons influence on photons and, on the contrary. For this, the way forward should be one analogous to that used by classical electrodynamics, as indicated above. That is, to start with a vector and differential development of the electric, magnetic and gravitational fields combination without relativistic considerations. Based on these premises, an estimate of the gravitons amount that is necessary to have a minimum energy photon with detectable frequency is achieved in [5]. In addition, there it is raise a equations set of subquantum electrogravitodynamics that are intended to represent the internal photon description and its relationship with the gravitons, expressed through gravitational and electromagnetic interactions, both in a vacuum and material environment. Through this initial study, it becomes plausible that, like the electromagnetic field structure is the composition of two individual fields, the electric and the magnetic, the gravitational field presented as an influence and related to the electromagnetic field cannot have a single component. Thus, gravitation is presented as a field of two components $\vec{G}_E$ and $\vec{G}_B$, around which a non-definitive descriptive equations set of the graviton-photon interrelationships is constructed.

The current work, based on the previous one indicated, begins by justifying the so-called gyrotation field $\vec{\Omega}$ associated with gravitation, introduced by T.D. Mees in papers like [6]. The gyrotation $\vec{\Omega}$ is a field analogous to the magnetic field, defined by precisely replacing the magnetic field approximated to a magnetic dipole in a rotating solid body, superseding the electric charge with the mass and putting the magnetic permeability μ_0 function of the universal gravitation constant *G*. A description will be made of the gravitational field $\vec{g}$ and the gyrotation field $\vec{\Omega}$ specific generation sources. It will be demonstrated that the combination of gravitational field $\vec{g}$ with gyrotation field $\vec{\Omega}$, in the form of a gyrogravitational field $\vec{G}$, represents the appropriate structure to justify the interrelation sought in electrogravitodynamics. Thus, gyrogravitation equations will be developed, demonstrating the relationship between the gravitation components $\vec{G}_E$ and $\vec{G}_B$ and the gyrotation $\vec{\Omega}$ and gravitational $\vec{g}$ fields, respectively. With this base, we will present interrelation definitive equations between electromagnetic field and gyrogravitation field in vector and differential format, component by component, which include the specific generation sources for each field, and the possibility of influence between them. Finally, the concept of "electrical mass" and its use in the electromagnetism and gyrogravitation interrelation are defined.

II. Gyrotation Field $\vec{\Omega}$: Sense and Formal Development

The electromagnetic field is composed of the combination of an irrotational field $\vec{E}$ and a solenoid field $\vec{B}$. If we accept behavior similarities between electromagnetic interaction and gravitational interaction (long-distance action, intensity proportional to $1/_{r^2}$, action at the speed of light) we must look for structural similarities between both that justify them. Thus, the gravitational field $\vec{g}$ is an irrotational field that, traditionally, we attempt to compare unsuccessfully with the electromagnetic field, combination of an irrotational field with a solenoid field. It may be more reasonable to compare the gravitational field $\vec{g}$ only with the electric field $\vec{E}$, both of an irrotational nature and, to prove the existence of an additional solenoid field, analogous to the magnetic field $\vec{B}$, which combined with the gravitational field provides a structure to gravity as a whole similar to that of the electromagnetic field. This is how the idea of the gyrotation field $\vec{\Omega}$ arises [6]: it must be resemblant to the magnetic field $\vec{B}$, where formally the charge is replaced by the mass parameter and the object or particle considered has a rotation movement, associated with an angular momentum $\vec{L}$, necessary for the generation of such a field.

The combination of the irrotational gravitational field $\vec{g}$ with the solenoid gyrotation field $\vec{\Omega}$ provides the gyrogravitational field, similar in structure to the electromagnetic field and, as we will see, allows the interrelation between the two.

On the other hand, it is shown that the gyrotation field $\vec{\Omega}$ is proportional to the angular momentum $\vec{L}$, similar to the magnetic field $\vec{B}$ with the magnetic moment $\vec{m}$. Both, magnetic moment and angular momentum are related through the gyromagnetic ratio, which is a function of the relationship between charge *q* and mass *m* by means of a constant expression for solid bodies and particles (*q/2m*). Thus, in a rotating solid body or particle, the associated magnetic field $\vec{B}$ is a function of the rotation angular speed *w*, while the gyrotation field $\vec{\Omega}$ can be described for the same physical entity as a function of angular momentum $\vec{L}$. Both solenoidal fields are related through the gyromagnetic ratio.

It assumes a charge *Q* distributed evenly in the volume of a sphere of radius *R* that rotates with angular speed *w*. Using the general expression for the magnetic field $\vec{B}$ function of the potential vector $\vec{A}$, approximated to a magnetic dipole, we have,

$$\vec{B}(\vec{r}) = \vec{\nabla} \mathrm{x} \vec{A} \text{ , where } \vec{A} = \vec{A}(\vec{r}) = \frac{\mu_0}{4\pi}\frac{\vec{m} \mathrm{x} \vec{r}}{r^3} \quad (1)$$

It is demonstrated in [7] that,

If $r \geq R$ then, the potential vector module values,

$$A_{ext} = \frac{\mu_0}{4\pi}\frac{QwR^2}{5}\frac{sin\theta}{r^2} \quad (2)$$

Where,

$$\vec{m}(A_{ext}) = \frac{Q\vec{w}R^2}{5} = \frac{QwR^2}{5}\vec{u}_w \quad (3)$$

Being,

$$\vec{u}_w = \frac{\vec{w}}{w} \quad (4)$$

$\theta = (\widehat{\vec{w},\vec{r}})$ (5)

If $r \leq R$ then, the potential vector module values,

$A_{int} = \frac{\mu_0}{4\pi}\frac{Qw}{R^3} sin\theta \left[\frac{-3r^3}{10} + \frac{rR^2}{2}\right]$ (6)

Where,

$\vec{m}(A_{int}) = \frac{Qwr^2}{R^3}\left[\frac{-3r^3}{10} + \frac{rR^2}{2}\right]\vec{u}_w$ (7)

Developing (1), we reach the following general expression of the magnetic field,

$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi}\frac{3(\vec{m}.\vec{r})\vec{r} - r^2\vec{m}}{r^5}$ (8)

Applying (8) to the outside and innerside of the charged sphere considered in the study, we get,

- <u>Outside</u> ($r \geq R$): Far magnetic field, entering (3) in (8),

$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi}\frac{QR^2}{5}\left[\frac{3}{5}(\vec{w}.\vec{r})\vec{r} - r^2\frac{\vec{w}}{5}\right]$ (9)

Taking into account that the distributed charge Q can be set function to the charge density ρ,

$Q = \rho\frac{4}{3}\pi R^3$ (10)

Then the magnetic field in (9) can be expressed as,

$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi}\frac{4\pi\rho R^5}{5r^3}\left[\frac{(\vec{w}.\vec{r})\vec{r}}{r^2} - \frac{\vec{w}}{3}\right]$ (11)

Equation (11) can also be set as,

$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi}\frac{4\pi\rho R^5}{5r^3} w\left[cos\theta\vec{u}_r - \frac{\vec{u}_w}{3}\right]$ (12)

Where θ and $\vec{u}_w$ are given by (5) and (4), respectively and, $\vec{u}_r$ is

$\vec{u}_r = \frac{\vec{r}}{r}$ (13)

On the sphere surface, using (9) for the far magnetic field, we get,

$\vec{B}_{Ext}(\vec{R}) = \vec{B}(\vec{r} = \vec{R}) = \frac{\mu_0}{4\pi}\frac{Q}{5R}\left[\frac{3(\vec{w}.\vec{R})\vec{R}}{R^2} - \vec{w}\right]$ (14)

Also, more generically, (14) can be expressed as,

$\vec{B}_{Ext}(R) = \frac{\mu_0}{4\pi}\frac{2Q}{5R}\vec{w}$ (15)

- <u>Innerside</u> ($r \leq R$): Near magnetic field, entering (7) in (8),

$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi}\frac{Q}{R^3}\left[-\frac{9}{10}(\vec{w}.\vec{r})\vec{r} + \frac{3}{10}r^2\vec{w} + \frac{3R^2}{2r^2}(\vec{w}.\vec{r})\vec{r} - \frac{R^2}{10}\vec{w}\right]$ (16)

Considering the value of the charge Q in (10), the magnetic field in (16) can be expressed as,

$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi}4\pi\rho\left[(\vec{w}.\vec{r})\vec{r}\left(-\frac{3}{10} + \frac{R^2}{2r^2}\right) + \vec{w}\left(\frac{r^2}{10} - \frac{R^2}{6}\right)\right]$ (17)

Equation (17) can also be set as,

$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi}4\pi\rho w\left[\left(\frac{r^2}{10} - \frac{R^2}{6}\right)\vec{u}_w + \left(-\frac{3r^2}{10} + \frac{R^2}{2}\right)cos\theta\vec{u}_r\right]$ (18)

Where θ and the vectors $\vec{u}_w$ and $\vec{u}_r$ are given by (5), (4) and (13), respectively.

On the surface of the sphere, using (16) for the near magnetic field, we get,

$\vec{B}_{Int}(\vec{R}) = \vec{B}(\vec{r} = \vec{R}) = \frac{\mu_0}{4\pi}\frac{Q}{R^3}\left[\frac{3}{5}(\vec{w}.\vec{R})\vec{R} - \frac{\vec{w}}{5}R^2\right]$ (19)

Fixing (19) can be set as,

$\vec{B}_{Int}(\vec{R}) = \frac{\mu_0}{4\pi}\frac{Q}{5R}\left[\frac{3(\vec{w}.\vec{R})\vec{R}}{R^2} - \vec{w}\right]$ (20)

Note that (20) coincides with (14), since obviously it must be,

$\vec{B}_{Int}(\vec{R}) = \vec{B}_{Ext}(\vec{R})$ (21)

Equations (12) and (18) representative of the magnetic field outside and inside, respectively, from the sphere considered, can also be expressed as,

$\vec{B}_{Ext}(\vec{r},\vec{w}) = -\frac{\mu_0}{4\pi}\frac{QR^2}{5r^3}w[\vec{u}_w - 3cos\theta\vec{u}_r]$ (22)

$\vec{B}_{Int}(\vec{r},\vec{w}) = -\frac{\mu_0}{4\pi}\frac{Q}{R^3}w\left[\left(\frac{R^2}{2} - \frac{3r^2}{10}\right)\vec{u}_w + \left(\frac{9r^2}{10} - \frac{3R^2}{2}\right)cos\theta\vec{u}_r\right]$ (23)

Given that the magnetic permeability μ_0 values,

$\mu_0 = \frac{4\pi K_0}{c^2}$ (24)

We can put (24) as,

$\frac{\mu_0}{4\pi_0} = \frac{K_0}{c^2}$ (25)

For the gyrotation field $\vec{\Omega}$ determination in the homogeneous sphere in rotation considered, in (22) and (23) the distributed charge Q is replaced by the mass m in the same volume, in addition to replace the electric constant K_0 with the gravitation constant G. So, we get,

$$\vec{\Omega}_{Ext}(\vec{r},\vec{w}) = -\frac{G}{c^2}\frac{mR^2}{5r^3}w[\vec{u}_w - 3cos\theta\vec{u}_r] \quad (26)$$

$$\vec{\Omega}_{Int}(\vec{r},\vec{w}) = -\frac{G}{c^2}\frac{m}{R^3}w\left[\left(\frac{R^2}{2}-\frac{3r^2}{10}\right)\vec{u}_w + \left(\frac{9r^2}{10}-\frac{3R^2}{2}\right)cos\theta\vec{u}_r\right] \quad (27)$$

To a solid homogeneous mass *m* sphere and rotating around an axis with *w* corresponds the inertia moment *I* with respect such axis, so,

$$I = \frac{2}{5}mR^2 \quad (28)$$

At the same time, we have as angular momentum $\vec{L}$, the following,

$$\vec{L} = I\vec{w} = \frac{2}{5}mR^2\vec{w} = L\vec{u}_L \quad (29)$$

Where,

$$L = \frac{2}{5}mR^2 w \quad (30)$$

$$\vec{u}_L = \frac{\vec{L}}{L} = \vec{u}_w \quad (31)$$

The gyrotation field $\vec{\Omega}$ in the homogeneous rotating sphere considered in (26) and (27) can be described as a function of angular momentum $\vec{L}$, applying (29) and (31), such that,

$$\vec{\Omega}_{Ext}(\vec{r},\vec{L}) = -\frac{G}{c^2}\frac{L}{2r^3}[\vec{u}_L - 3cos\theta\vec{u}_r] \quad (32)$$

$$\vec{\Omega}_{Int}(\vec{r},\vec{L}) = -\frac{G}{c^2}\frac{L}{4R^3}\left[\left(5-\frac{3r^2}{R^2}\right)\vec{u}_L + \left(\frac{9r^2}{R^2}-15\right)cos\theta\vec{u}_r\right] \quad (33)$$

Where now,

$$\theta = \left(\widehat{\vec{L},\vec{r}}\right) \quad (34)$$

Note that,

$$\vec{\Omega}_{Ext}(\vec{R},\vec{L}) = \vec{\Omega}_{Int}(\vec{R},\vec{L}) = -\frac{G}{c^2}\frac{L}{2R^3}[\vec{u}_L - 3cos\theta\vec{u}_R] \quad \text{with } \vec{u}_R = \frac{\vec{R}}{R} \quad (35)$$

In different works of T.D. Mees are studied the physical properties of the gyrotation field $\vec{\Omega}$ application both, in macroscopic entities on solid bodies [6] [8] and at the microscopic level on particles [9]. These works are practice contributions for the justification of the gyrotation field $\vec{\Omega}$ existence.

III. Electromagnetism and Gyrogravitation: Generation Sources

According to [10], Maxwell's equations cannot be used as is, because they lack a series of implicit considerations to them. Specifically, O.D. Jefimenko states that "*the electromagnetic field must be considered as a physical entity of two components which act simultaneously using common sources, such that, in reality, the electric field $\vec{E}$ neither depends, nor does create the magnetic field $\vec{B}$ and, vice versa; the important things are the charge density ρ and the current density $\vec{J}$, as generating sources of both fields*". In addition, he emphasizes the time delay between each term of each Maxwell equation, due to the signals propagation at finite speed, so "*we must consider that there is no instantaneous simultaneity in the induction of one term in another*".

There are analogies in Jefimenko's terms between the electromagnetic field and the gyrogravitational field. There is no evidence of direct dependence between the gravitational field $\vec{g}$ and the gyrotational field $\vec{\Omega}$, at least as regards its origins, so it is reasonable to think that they do not create each other. That is, it does not seem that $\vec{g}$ generates $\vec{\Omega}$ and, vice versa. The fields that create gyrogravitation come from specific sources, as in electromagnetism.

<u>Electromagnetism sources:</u>

$$\rho \Rightarrow \vec{E} \text{ and } \vec{J} \Rightarrow \vec{B} \quad (36)$$

<u>Gyrogravitation sources</u>:

$$\rho_m \Rightarrow \vec{g} \text{ and } \vec{J}_m \Rightarrow \vec{\Omega} \quad (37)$$

Note that the symbol ⇒ represents that one term in the equation is inductive and the other term is induced (where the arrow points to).

In (37) ρ_m and $\vec{J}_m$ represent the density and current density associated with the mass *m*, respectively. The mass current density $\vec{J}_m$ is defined analogously to the electric current density $\vec{J}$, as the mass flow that travels through the volume of a material object in its displacement, that is, the mass amount per unit of time travelling through each characteristic cross section of the material volume considered. Thus, in the sphere case of radius *R* rotating around an axis, the mass current density $\vec{J}_m$ would be,

$$\vec{J}_m = \rho_m\frac{d\vec{r}}{dt} \quad (38)$$

Where $\vec{r}$ is taken perpendicular to the sphere rotation axis considered from 0 to *R*.

Assume a generic particle P of mass m and charge q. The P particle can be described as a two-way generating source:

1. Static Source,

$$\mathrm{P(m,q)} \equiv \{\rho(q), \rho_m(m)\} \tag{39}$$

2. Dynamic Source,

$$\mathrm{P(m,q,\vec{v})} \equiv \{\rho(q), \vec{\mathrm{J}}(q,\vec{\mathrm{v}}), \rho_m(m), \vec{\mathrm{J}}_{\mathrm{m}}(m,\vec{\mathrm{v}})\} \tag{40}$$

In practice, only the dynamic situation is applicable and, therefore, equation (40), in which P moves with velocity $\vec{\mathrm{v}}$. Without velocity $\vec{\mathrm{v}}$, in static situation, there is no direct generation source of the magnetic field $\vec{\mathrm{B}}$ and of gyrotation field $\vec{\Omega}$, although indirectly there is, by temporal variation induction of the respective associated field.

The gyrogravitational field $\vec{\mathrm{G}}$ will be formally defined as,

$$\vec{G} = \vec{g}\mathrm{x}\vec{\Omega} \tag{41}$$

The gyrogravitational field $\vec{G}$ is similar to the electromagnetic field ($\vec{E}\mathrm{x}\vec{B}$) in propagation (vector direction, sign, speed of light c) and structure (irrotational component vector product solenoid component). It is intended to relate the components of the gyrogravitational field $\vec{G}$, gravitational field $\vec{g}$ and gyrotation field $\vec{\Omega}$, with the components $\vec{\mathrm{G}}_E$ and $\vec{\mathrm{G}}_B$ that associate gravitation with the photon structure, described in [5].

Field propagation vector equations of electromagnetism and gravitation components, respectively, are given by,

$$\vec{B}\mathrm{x}\vec{c} = \vec{E} \tag{42}$$

$$\vec{c}\mathrm{x}\vec{\mathrm{G}}_B = \vec{\mathrm{G}}_E \tag{43}$$

Where, in addition,

$$\vec{\mathrm{G}}_E = -\vec{B} \tag{44}$$

$$c^2\vec{\mathrm{G}}_B = -\vec{E} \tag{45}$$

It is observed that, according to (44) and (45), vector pairs ($\vec{\mathrm{G}}_E$, $\vec{B}$) and ($\vec{\mathrm{G}}_B$, $\vec{E}$) have the same director vector, respectively. So, it seems reasonable that, as these vectors at each pair are physical entities always relating in the same way, they must share geometric properties. So,

- $\vec{B}$ is a solenoid field generating closed force lines and, therefore, $\vec{\mathrm{G}}_E$ must also be.
- $\vec{E}$ is a divergent irrotational field with opened force lines and, therefore, $\vec{\mathrm{G}}_B$ must also be.

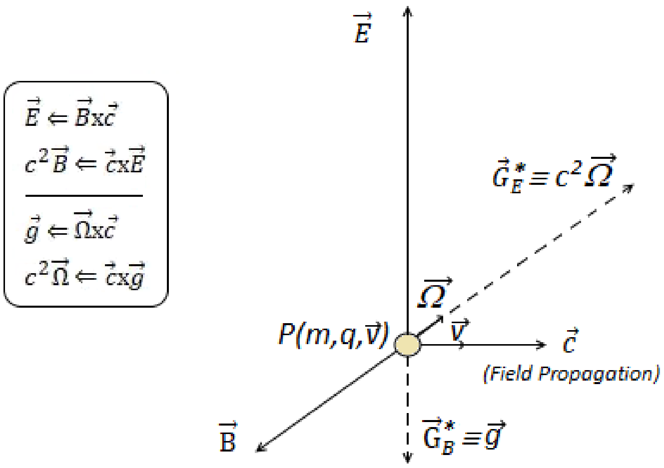

Fig.1: Formalism and initial vector representation (not definitive) of the fields interrelation, electric $\vec{E}$, magnetic $\vec{B}$, gravitational $\vec{g}$ and gyrotation $\vec{\Omega}$, produced by a charged particle moving in a vacuum.

Considering the gyrogravitational field $\vec{G}$, composed of the fields $\vec{\mathrm{G}}_E$ and $\vec{\mathrm{G}}_B$, defined in turn by the $\vec{\Omega}$ solenoid and $\vec{g}$ irrotational fields, then,

$$\vec{\mathrm{G}}_E \sim \vec{\Omega} \tag{46}$$

$$\vec{\mathrm{G}}_B \sim \vec{g} \tag{47}$$

Taking into account (46) and (47) incorporated in (43), to be a homogeneous equation it is necessary that (46) be replaced by,

$$\vec{\mathrm{G}}_E \sim c^2\vec{\Omega} \tag{48}$$

Thus, it is obtained by applying (47) and (48) in (43),

$\vec{c}\text{x}\vec{g} = c^2\vec{\Omega}$ (49)

From the previous results (48) and (47), proportional gravitational fields $\vec{G}_E^*$ and $\vec{G}_B^*$ will be defined, such that,

$\vec{G}_E^* = c^2\vec{\Omega}$ (50)

$\vec{G}_B^* = \vec{g}$ (51)

In conclusion, in Fig.1 we propose a graphic representation and formalism of the relationship between electromagnetic field components and gyrogravitational field components generated by the displacement of a charged particle *P*, propagating in a vacuum with the speed of light *c*. This representation is not definitive, since it is necessary to provide the description using the values of the fields $\vec{G}_E$ and $\vec{G}_B$ and not of the proportional fields $\vec{G}_E^*$ and $\vec{G}_B^*$.

IV. Structural Equations of Electromagnetism and Gyrogravitation

A formal structure for the gyrogravitation field is proposed below, analogous to that of the electromagnetic field in a vacuum, defined through,

- Table 1, set of initial parameters describing the gravitational permittivity ξ and permeability τ, the relationship between the density ρ_m and the mass current density $\vec{J}_m$ and the force around the mass *m* generated by the combination of the gravitational field $\vec{g}$ and the gyrotational field $\vec{\Omega}$.
- Table 2, descriptive of the equations equivalent to those of Maxwell, interrelation between components of the gyrogravitational field and its relationship with the generating sources.
- Table 3, which provides conversion of gyrogravitational field components, relating them through their propagation speed.

Table 1: Definitions and parameters of electromagnetism (in a vacuum) and gyrogravitation

Nomenclature	Electromagnetism (EM)	Gyrogravitation (GG)
Lorentz's Force	$\vec{F} \Leftarrow q\left(\vec{E} + \vec{v}\text{x}\vec{B}\right)$	$\vec{F} \Leftarrow m\left(\vec{g} + \vec{v}\text{x}\vec{\Omega}\right)$
Field Propagation Speed	$c = \left(\frac{1}{\mu_0\epsilon_0}\right)^{1/2}$	$c = \left(\frac{1}{\xi\tau}\right)^{1/2}$
Permittivity Constant	$\epsilon_0 = \frac{1}{4\pi K_0}$ (electric)	$\xi = \frac{1}{4\pi G}$ (gravitational)
Permeability Constant	$\mu_0 = \frac{4\pi K_0}{c^2}$ (magnetic)	$\tau = \frac{4\pi G}{c^2}$ (gyrotation)
Flow/Density Ratio (Continuity equation)	$\vec{\nabla}.\vec{J} = -\frac{\partial\rho}{\partial t}$ (charge conservation)	$\vec{\nabla}.\vec{J}_m = -\frac{\partial\rho_m}{\partial t}$ (mass conservation)

Table 2: Relationship characteristic equations between generating sources and associated fields and interrelation equations between electromagnetism (in a vacuum) and gyrogravitation fields

Nomenclature	Electromagnetism (EM)	Gyrogravitation (GG)
Irrotational Field and Associated Source	$\vec{\nabla}.\vec{E} \Leftarrow \frac{\rho}{\epsilon_0}$	$\vec{\nabla}.\vec{g} \Leftarrow \frac{\rho_m}{\xi}$
Solenoid Field	$\vec{\nabla}.\vec{B} = 0$	$\vec{\nabla}.\vec{\Omega} = 0$
Lenz's Law	$\vec{\nabla}\text{x}\vec{E} \Leftarrow -\frac{\partial\vec{B}}{\partial t}$	$\vec{\nabla}\text{x}\vec{g} \Leftarrow -\frac{\partial\vec{\Omega}}{\partial t}$
Ampere's Law	$c^2\vec{\nabla}\text{x}\vec{B} \Leftarrow \frac{\vec{J}}{\epsilon_0} + \frac{\partial\vec{E}}{\partial t}$	$c^2\vec{\nabla}\text{x}\vec{\Omega} \Leftarrow \frac{\vec{J}_m}{\xi} + \frac{\partial\vec{g}}{\partial t}$

Table 3: Components conversion and their relationship with the field propagation speed of electromagnetism (in a vacuum) and gyrogravitation

Nomenclature	Electromagnetism (EM)	Gyrogravitation (GG)
Irrotational Field Composition	$\vec{E} \Leftarrow \vec{B}\text{x}\vec{c}$	$\vec{g} \Leftarrow \vec{\Omega}\text{x}\vec{c}$
Solenoid Field Composition	$c^2\vec{B} \Leftarrow \vec{c}\text{x}\vec{E}$	$c^2\vec{\Omega} \Leftarrow \vec{c}\text{x}\vec{g}$

We assume again a charge *Q* distributed uniformly in the volume of a sphere with radius *R* and mass *M* which rotates with angular velocity *w*, as shown in Fig. 2. If we take in the sphere a mass differential dm that represents a charge differential dq, the force differential $d\vec{F}_T$ around it can be described as the force differentials contribution of the corresponding fields that affect it, such that,

$d\vec{F}_T = dF_T\vec{u}_R = d\vec{F}_\Omega + d\vec{F}_g + d\vec{F}_B + d\vec{F}_E + d\vec{F}_c cos\alpha$, with $\vec{u}_R = \frac{\vec{R}}{R}$ (52)

Incorporating in (52) the value of Lorentz forces for the gyrogravitational and electromagnetic fields, in addition to that of the centrifugal force, we obtain,

$$d\vec{F}_T = dm\left(\vec{v}\text{x}\vec{\Omega} + \vec{g}\right) + dq\left(\vec{v}\text{x}\vec{B} + \vec{E}\right) + dm\frac{v^2}{r}cos\alpha\vec{u}_R \quad (53)$$

The force differential module $d\vec{F}_T$ can be set as,

$$dF_T = dm\,(v\Omega - g) + dq(E - vB) + dm\frac{v^2}{R} \quad (54)$$

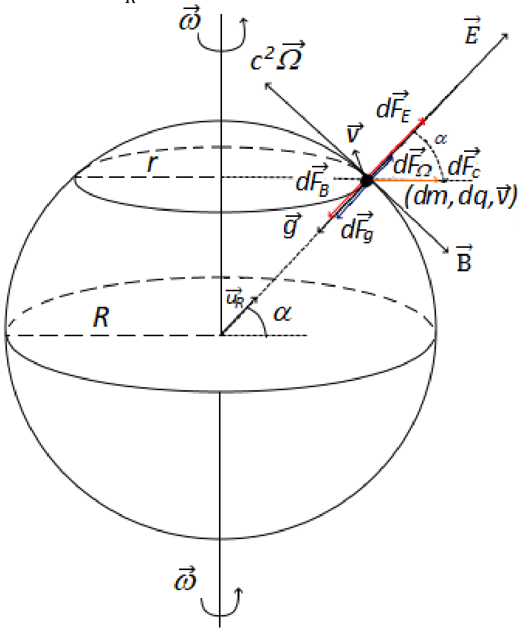

Fig.2: Sphere with mass *M* and charge *Q* distributed inside it, that rotates with angular velocity *w*, such that at each point of the same (*dm*) appears a forces set corresponding to components of electromagnetic fields and gyrogravitation, giving rise to the force differential $d\vec{F}_T$.

V. Differential Equations in Gyrogravitation

We will apply Jefimenko's principles on the description of the graviton-photon relationship without photons in [11], where it is proposed that "*any variation in the gravitational fields $\vec{G}_E$ or $\vec{G}_B$ induces rotational circulation of $\vec{G}_B$ or $\vec{G}_E$, respectively*". Therefore, the descriptive equations of such a situation can be put as,

$$\vec{\nabla}\text{x}\vec{G}_E \Leftarrow \frac{\partial\vec{G}_B}{\partial t} \quad (55)$$

$$c^2\vec{\nabla}\text{x}\vec{G}_B \Leftarrow -\frac{\partial\vec{G}_E}{\partial t} \quad (56)$$

In the definition of the gravitational fields values $\vec{G}_E$ and $\vec{G}_B$, given in (48) and (47), respectively, the same constant of proportionality S is considered in both equations, taking into account equal structural relationship between pairs of components ($\vec{G}_E$, $\vec{\Omega}$) and ($\vec{G}_B$, $\vec{g}$), since their generation comes from a common physical entity, carrier of the generating sources. Then, (48) and (47) can be converted, respectively in the following,

$$\vec{G}_E = Sc^2\vec{\Omega} \quad (57)$$

$$\vec{G}_B = S\vec{g} \quad (58)$$

Applying (57) and (58) in (55) and (56), we obtain the differential equations for gyrogravitation,

$$c^2\vec{\nabla}\text{x}\vec{\Omega} \Leftarrow \frac{\partial\vec{g}}{\partial t} \quad (59)$$

$$\vec{\nabla}\text{x}\vec{g} \Leftarrow -\frac{\partial\vec{\Omega}}{\partial t} \quad (60)$$

Note that in the first gyrogravitation equation in (59) the influence of the direct source $\vec{J}_m$ mass current density has not been considered, only the induction of the gravitational field $\vec{g}$ variation in the gyrotation field $\vec{\Omega}$. The Ampere Law for complete gyrogravitation has been indicated in Table 2.

VI. Electrogravitodynamics (EGD): Electromagnetism and Gyrogravitation Interrelation Equations

We will use again Jefimenko principles on the graviton-photon relationship description without photons given in [11], where it is proposed that "*in the absence of photons in a vacuum, the interaction between gravitons generating changes over time in the components of the gravitational field $\vec{G}$, can cause rotational* *circulation of the field $\vec{G}_E$, sufficient for the electric field $\vec{E}$ acquisition and magnetic field $\vec{B}$ generation by induction or through the field $\vec{G}_B$*". That is, formally these statements can be expressed as follows,

$$\vec{\nabla}\mathrm{x}\vec{E} \Leftarrow \frac{\partial \vec{G}_E}{\partial t} \quad (61)$$

$$\vec{\nabla}\mathrm{x}\vec{B} \Leftarrow -\frac{\partial \vec{G}_B}{\partial t} \quad (62)$$

$$\vec{\nabla}.\vec{G}_E = 0 \quad (63)$$

$$\vec{\nabla}.\vec{G}_B \Leftarrow -\mu\rho \quad (64)$$

To accurately define the differential equations interrelation of electromagnetism with gyrogravitation, it is necessary to find the value of the proportionality constant *S* that structurally relates the component pairs $(\vec{G}_E, \vec{\Omega})$ and $(\vec{G}_B, \vec{g})$, just as it is described in (57) and (58), respectively. Taking into account (44) and (45) over (57) and (58), the proportionality constant *S* can be set as,

$$S = -\frac{\vec{B}}{c^2\vec{\Omega}} \quad (65)$$

$$S = -\frac{\vec{E}}{c^2\vec{g}} \quad (66)$$

If each of these equations (65) and (66) are studied dimensionally, the proportionality constant *S* must have the following dimensions,

$$[S] = \frac{[\vec{B}]}{[c^2][\vec{\Omega}]} = kgm^{-2}sA^{-1} = kgm^{-2}s^2C^{-1} \quad (67)$$

$$[S] = \frac{[\vec{E}]}{[c^2][\vec{g}]} = kgm^{-2}s^2C^{-1} \quad (68)$$

The interactions and associated fields proposed so far for electromagnetism and gyrogravitation have universal character and, therefore, the proportionality constant *S*, which relates the components of photon-graviton interrelation fields, must be based on universal constants. Thus, using universal constants to define the proportionality constant *S* and, based on its dimensions, must be,

$$S = \frac{1}{c^2}\sqrt{\frac{K}{G}} \quad (69)$$

In a vacuum, the proportionality constant *S* values using $K = K_0$,

$$S = 1.29105.10^{-7}kgm^{-2}s^2C^{-1} \quad (70)$$

Where, we have used,

$$\sqrt{\frac{K_0}{G}} = 1.1604.10^{10}kgC^{-1} \quad (71)$$

In this way, the gravitational fields $\vec{G}_E$ and $\vec{G}_B$ can be described, substituting (69) in (57) and (58), respectively, as

$$\vec{G}_E = \vec{\Omega}\sqrt{\frac{K}{G}} \quad (72)$$

$$\vec{G}_B = \frac{\vec{g}}{c^2}\sqrt{\frac{K}{G}} \quad (73)$$

Substituting the values of the gravitational fields $\vec{G}_E$ and $\vec{G}_B$ posed in (72) and (73) in the descriptive equations of the generic electromagnetism-gravitation interrelation given by (61), (62), (63) and (64), the final equations of the electromagnetism-gyrogravitation interrelation are obtained,

$$\vec{\nabla}\mathrm{x}\vec{E} \Leftarrow \sqrt{\frac{K}{G}}\frac{\partial\vec{\Omega}}{\partial t} \quad (74)$$

$$c^2\vec{\nabla}\mathrm{x}\vec{B} \Leftarrow -\sqrt{\frac{K}{G}}\frac{\partial\vec{g}}{\partial t} \quad (75)$$

$$\vec{\nabla}.\vec{\Omega} = 0 \quad (76)$$

$$\sqrt{\frac{K}{G}}\vec{\nabla}.\vec{g} \Leftarrow -\frac{\rho}{\epsilon} \quad \text{or,} \quad \sqrt{\frac{\epsilon}{4\pi G}}\vec{\nabla}.\vec{g} \Leftarrow -\rho \quad (77)$$

That is, the temporal variation of the gyrotation field $\vec{\Omega}$ or the gravitation field $\vec{g}$ induces rotational circulation of electric field $\vec{E}$ or magnetic field $\vec{B}$, respectively. Furthermore, according to (77), the electric charge ρ accumulation in material medium with permittivity ϵ can be a source of gravitational field $\vec{g}$.

On the other hand, applying (72) and (73) in (44) and (45), respectively, it is obtained that,

$$\vec{\Omega}\sqrt{\frac{K}{G}} = -\vec{B} \quad (78)$$

$$\vec{g}\sqrt{\frac{K}{G}} = -\vec{E} \tag{79}$$

If we also apply (45) and (44) in the descriptive differential equations of gyrogravitation (59) and (60), the induction equations of the electromagnetism component fields in the gyrogravitation component fields are obtained, that is,

$$\sqrt{\frac{K}{G}}c^2\vec{\nabla}\text{x}\vec{\Omega} \Leftarrow -\frac{\partial\vec{E}}{\partial t} \tag{80}$$

$$\sqrt{\frac{K}{G}}\vec{\nabla}\text{x}\vec{g} \Leftarrow \frac{\partial\vec{B}}{\partial t} \tag{81}$$

Note that (74), (75), (76), (77), (80) and (81) constitute the differential equations set interrelation of electromagnetic fields and gyrogravitation fields (see Fig. 3), such that:

- (74) and (75) define the induction of the gyrogravitation component fields on the electromagnetism component fields.
- (77) defines the electric charge as a possible source of gravitational field $\vec{g}$.
- (80) and (81) define the induction of the component fields of electromagnetism on the component fields of gyrogravitation.

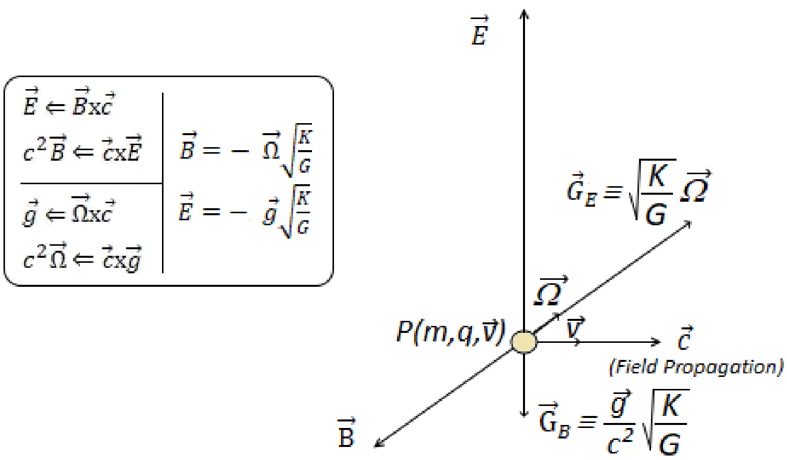

Fig.3: Formalism and definitive vector representation of the interrelation, electric $\vec{E}$, magnetic $\vec{B}$, gravitational $\vec{g}$ and gyrotation $\vec{\Omega}$ fields produced by a charged particle moving in a vacuum

VII. Electric Mass

When talking about electrostatic forces or gravitational forces, the convention used consist of the sources generating both forces come from the parameters electric charge and mass, respectively, associated with the material object/particle considered. Note that the definitions of electric charge and mass are a standard that decisively influences over the formulation adjustment of electric force and gravitational force, through the electric *K* and gravitational *G*, respectively, universal constants. In reality, both forces have similar origins and characteristics: they are generated by irrotational fields with the same propagation speed, based on material parameters whose long-distance action is proportional to $1/_{r^2}$; The main difference between both forces, electric and gravitational, is that the first can be both attractive and repulsive and the second is only attractive. In any case, it is possible to describe the electric force in a concept terms of "electric mass", adjusting properly the universal electric constant *K*, so that, as in both cases, electric and gravitational, we talk about action forces with same properties and units (*[F]=N*), the generating sources can have the same definition too (and same unit, *kg*), although with different and specific connotations in each case. That is, for the electric forces we could have standardized as a generating source a parameter with unit the same as for the gravitational forces (*kg*) but with particular connotations for each situation and, therefore, to name it differently, as electric mass, for the electrical case.

For a generic material object/particle of mass m_i and charged with q_i, we will call m_{Ei} the electric mass equivalent to the charge considered with respect to mass m_i. Formally, m_{Ei} will be defined as the mass proportional to the electric charge considered, as follows,

$m_{Ei} = q_i P$, with *P* the electrical proportionality constant (82)

The electrical proportionality constant *P* represents the relationship between electric mass and charge, constant for every particle, in the same medium of equal electrical permittivity ϵ, since it is an equivalence of charge conversion (*C*) to mass (*kg*).

Assume two particles of masses m_1 and m_2 charged with q_1 and q_2, respectively, separated by a distance r. The electrostatic force $\vec{F}_{E12}$ between the two is given by,

$$\vec{F}_{E12} = K\frac{q_1 q_2}{r^2}\vec{u}_r \ , \ \text{ with } \vec{u}_r = \frac{\vec{r}}{r} \tag{83}$$

Applying (82) in (83), the electrostatic force $\vec{F}_{E12}$ can be set as,

$$\vec{F}_{E12} = K\frac{\frac{m_{E1}}{P}\frac{m_{E2}}{P}}{r^2}\vec{u}_r = \frac{K}{P^2}\frac{m_{E1}m_{E2}}{r^2}\vec{u}_r \tag{84}$$

The term $\frac{K}{P^2}$ in (84) is constant. In addition, the magnitude of the electrostatic force $\vec{F}_{E12}$ is indistinguishable from the gravitational force between two masses of values m_{E1} and m_{E2}. Therefore, if the electrostatic force $\vec{F}_{E12}$ described in (84) is expressed as equivalent to a gravitational force, it should be set as,

$$\vec{F}_{E12} = G\frac{m_{E1}m_{E2}}{r^2}\vec{u}_r \tag{85}$$

Where m_{E1} and m_{E2} are considered masses (not electrical masses). And, therefore, comparing (85) with (84), the value of the electrical proportionality constant P is obtained,

$$\frac{K}{P^2} = G \Rightarrow P = \sqrt{\frac{K}{G}} \tag{86}$$

In this way, the generic electric mass m_{Ei} is definitely left, applying (86) in (82), as,

$$m_{Ei} = q_i\sqrt{\frac{K}{G}} \tag{87}$$

As in (87) the electrical charge q_i can be positive or negative, then the electrical mass m_{Ei} is also signed. Thus, in (85) positive electrical forces represent repulsion between electrical masses; and with negative sign, attraction forces similar to gravitational.

Note that the value of P obtained in (86) in a vacuum can also be a ratio function of planck mass m_p and planck charge q_p, since,

$$\frac{m_P}{q_P} = \left(\frac{\hbar c/_{2G}}{\hbar c/_{2K_0}}\right)^{1/2} = \sqrt{\frac{K_0}{G}} \tag{88}$$

That is, in a vacuum, the electric mass and electric charge ratio, can be set as,

$$\frac{m_{Ei}}{q_i} = \frac{m_P}{q_P} \tag{89}$$

If, for example, we consider an electron with mass m_{e-} and charge q^-, its electric mass $m_{E_{e-}}$ in a vacuum, using (87), as well as its electric mass to mass ratio would be ,

$$m_{E_{e-}} = -1.8592147.\,10^{-9}kg \tag{90}$$

$$\frac{m_{E_{e-}}}{m_{e-}} = -2.040988.\,10^{21} \tag{91}$$

Where, it has been used,

$$q^- = -1.602176565.\,10^{-19}C \ \text{ and } \ m_{e-} = 9.10938291.\,10^{-31}kg \tag{92}$$

Note that the proton electrical mass $m_{E_{p+}}$ is the same as that of the electron $m_{E_{e-}}$, in absolute value in a vacuum, but not so, its electric mass to mass ratio,

$$m_{E_{p+}} = 1.8592147.\,10^{-9}kg \tag{93}$$

$$\frac{m_{E_{p+}}}{m_{p+}} = 1.1115571.\,10^{18} \tag{94}$$

Where, it has been used,

$$q^+ = 1.602176565.\,10^{-19}C \ \text{ y } \ m_{p+} = 1.672621898.\,10^{-27}kg \tag{95}$$

That is, particles with the same charge have the same electrical mass, regardless of their mass. However, the electric mass to mass ratio does depend on the mass.

According to classical electrodynamics, particles with the same mass to charge ratio $\frac{m_i}{q_i}$ being subjected to the action of magnetic and/or electric fields, travel in a vacuum with the same trajectories [12].

$$\left(\frac{m_i}{q_i}\right)\vec{a} = \vec{E} + \vec{v}\text{x}\vec{B} \tag{96}$$

Moreover, (96) indicates that two particles with the same mass to charge ratio $\frac{m_i}{q_i}$ behave dynamically, in equal electromagnetic environment, in the same way.

The relationship between analog components of the gyrogravitational and electromagnetic fields for a given material object or particle must be proportional to its mass to charge ratio, associated with such fields through the corresponding generation sources:

- The gravitational $\vec{g}$ and electric $\vec{E}$ fields, both irrotational, are related to mass-charge ratio through their sources, mass density ρ_m and charge density ρ,

$$\rho_m = \frac{m_i}{V} \tag{97}$$

$\rho = \frac{q_i}{V}$ (98)

And, therefore, the relationship between (97) and (98) provides, for a volume *V*,

$\frac{\rho_m}{\rho} = \frac{m_i}{q_i}$ (99)

As according to (36) and (37), ρ_m and ρ are the sources of the fields $\vec{g}$ and $\vec{E}$, respectively, then (99) indicates that,

$\frac{\vec{g}}{\vec{E}} \sim \frac{m_i}{q_i}$ (100)

- The gyrotation $\vec{\Omega}$ and magnetic $\vec{B}$ fields, both solenoid, are related to the mass-charge ratio through their sources, mass current density $\vec{J}_m$ and electrical current density $\vec{J}$,

$\vec{J}_m = \rho_m \frac{d\vec{r}}{dt} = \frac{m_i}{V}\frac{d\vec{r}}{dt}$ (101)

$\vec{J} = \rho \frac{d\vec{r}}{dt} = \frac{q_i}{V}\frac{d\vec{r}}{dt}$ (102)

And, therefore, the relationship between (101) and (102) provides,

$\frac{\vec{J}_m}{\vec{J}} = \frac{m_i}{q_i}$ (103)

As according to (36) and (37), $\vec{J}_m$ and $\vec{J}$ are the sources of the $\vec{\Omega}$ and $\vec{B}$ fields, respectively, then (103) indicates that,

$\frac{\vec{\Omega}}{\vec{B}} \sim \frac{m_i}{q_i}$ (104)

What does it mean that two particles have the same electric mass to charge ratio $\frac{m_{Ei}}{q_i}$?

Note that applying (78) and (79) in the definition given in (87) for the electric mass to charge ratio $\frac{m_{Ei}}{q_i}$, we get,

$-\frac{m_{Ei}}{q_i} = \frac{\vec{E}}{\vec{g}} = \frac{\vec{B}}{\vec{\Omega}}$ (105)

On the other hand, if in (78) it is taken into account that the vectors $\vec{B}$ and $\vec{\Omega}$ have the same direction, it can be stated that,

$\frac{\vec{B}}{\vec{\Omega}} = \frac{\vec{v}\mathrm{x}\vec{B}}{\vec{v}\mathrm{x}\vec{\Omega}}$ (106)

Therefore, considering (105) in (106) it is obtained that,

$\frac{\vec{E}}{\vec{g}} = \frac{\vec{v}\mathrm{x}\vec{B}}{\vec{v}\mathrm{x}\vec{\Omega}}$ (107)

Thus, using (87) in (107), it can be concluded that,

$-\sqrt{\frac{K}{G}} = \frac{\vec{E}+\vec{v}\mathrm{x}\vec{B}}{\vec{g}+\vec{v}\mathrm{x}\vec{\Omega}}$ (108)

Also (108) can be set as,

$\left(\frac{m_{Ei}}{q_i}\right)\left(\vec{g} + \vec{v}\mathrm{x}\vec{\Omega}\right) = -\left(\vec{E} + \vec{v}\mathrm{x}\vec{B}\right)$ (109)

Equation (108) indicates that the electric mass to charge ratio, constant for the medium considered, represents the relationship between the gyrogravitational forces and the electromagnetic forces. All those particles in an environment with the same electrical permittivity ϵ maintain the same electric mass to charge ratio and, therefore, the relationship between gyrogravitational fields and associated electromagnetic fields is also the same.

If for the example of Fig. 2 and with (54) we consider an electron, the force module on it by the effect of the gyrogravitational and electromagnetic fields and their inertia, without relativistic considerations, would be given by,

$F_{T_{e-}} = m_{e-}\,(v\Omega - g) + q_{e-}(E - vB) + m_{e-}\frac{v^2}{R}$ (110)

Applying (87) in (110), we have to,

$F_{T_{e-}} = m_{e-}\,(v\Omega - g) + m_{E_{e-}}\left(\frac{E}{\sqrt{\frac{K}{G}}} - \frac{vB}{\sqrt{\frac{K}{G}}}\right) + m_{e-}\frac{v^2}{R}$ (111)

If (78) and (79) are now considered in (111), the electromagnetic field components can be put in function of the gyrogravitational field components, such that,

$F_{T_{e-}} = m_{e-}\,(v\Omega - g) - m_{E_{e-}}(v\Omega - g) + m_{e-}\frac{v^2}{R}$ (112)

Fixing (112), it is achieved,

$F_{T_{e-}} = \left(m_{e-} - m_{E_{e-}}\right)(v\Omega - g) + m_{e-}\frac{v^2}{R}$ (113)

If we also take into account the vector equation (49), we can put that,

$\Omega = g/c$ (114)

And, therefore, applying (114), we have,

$v\Omega - g = g\left(\frac{v-c}{c}\right)$ (115)

If we also consider the intensity of the gravitational field g for the electron as,

$g = G\frac{m_{e-}}{R^2}$ (116)

Using (116) and (115) over (113), the following result is obtained,

$F_{T_{e-}} = G\frac{m_{e-}}{R^2}\left(m_{E_{e-}} - m_{e-}\right)\left(\frac{c-v}{c}\right) + m_{e-}\frac{v^2}{R}$ (117)

Take into account the following conclusions on (117):

- $F_{T_{e-}}$ is the radial force module on the orbiting electron with direction $\vec{u}_R$, positive outward and negative inward.
- The electrical mass $m_{E_{e-}}$ is negative and, therefore, its value together with that of the mass m_{e-} are negative force contributions contrary to the positive centrifuge force.
- If the considered electron is in stable orbit, the value of $F_{T_{e-}}$is null. Applied in (117), we have,

$\frac{G}{c}\left(\left|m_{E_{e-}}\right| + m_{e-}\right) = \frac{R}{c-v}v^2$ (118)

- If $v << c$ then, (117) can be set as,

$F_{T_{e-}} = \frac{m_{e-}}{R}\left[-\frac{G}{R}\left(\left|m_{E_{e-}}\right| + m_{e-}\right) + v^2\right]$ (119)

And, for stable electron orbit, (118) remains as,

$G\left(\left|m_{E_{e-}}\right| + m_{e-}\right) = Rv^2$ (120)

VIII. Conclusions

The electromagnetic radiation study in a gravitational environment and, vice versa, is the basis of **electrogravitodynamics (EGD)**. It considers the gravitons influence on photons and, on the contrary. The way forward begins with a vector and differential combination development of electric field, magnetic field and its relationship with the gravitational field, without relativistic considerations.

The electromagnetic field structure is the two individual fields composition of different properties, the electric and the magnetic, and since the gravitational field represents a physical entity influencing the electromagnetic field, which it relates with, it cannot be defined by a single component. This justifies the existence of the so-called gyrotation field $\vec{\Omega}$, associated elementally with gravitation.

In the study and measurement of the relationship between electromagnetic interaction and gravitational interaction, it is more reasonable to compare the gravitational field $\vec{g}$ only with the electric field $\vec{E}$, both of an irrotational nature and, to prove the existence of an additional solenoid field, analog to the magnetic field $\vec{B}$, which combined with the gravitational field $\vec{g}$ provides a structure to gravity as a whole, similar to that of the electromagnetic field. The gyrotation field $\vec{\Omega}$ must be analogous to the magnetic field $\vec{B}$, where formally the charge is replaced by the mass parameter and the material object or particle considered, as the source of such a field, must have an angular momentum rotation movement $\vec{L}$, necessary for the $\vec{\Omega}$ field generation.

In any object/particle, the electric charge and mass parameters constitute the sources that generate the irrotational electric $\vec{E}$ and gravitational $\vec{g}$ fields, respectively. Such moving sources give rise to the electric current density $\vec{J}$ and the mass current density $\vec{J}_m$, sufficient to produce the solenoid magnetic $\vec{B}$ and gyrotation $\vec{\Omega}$ fields, respectively.

The fields that generate gyrogravitation come from specific sources, as in electromagnetism. The density ρ_m for the gravitational field $\vec{g}$ and the mass current density $\vec{J}_m$ for the gyrotation field $\vec{\Omega}$.

The gyrogravitational field $\vec{G}$ ($\vec{g}$x$\vec{\Omega}$) is analogous to the electromagnetic field ($\vec{E}$x$\vec{B}$) both in propagation specifications (direction, sign, speed of light c) and in those of structure (vectorial product of irrotational component by solenoid component).

A formal structure for the gyrogravitation field is proposed, similar to that of the electromagnetic field in a vacuum, defined through,

- Initial parameters set describing, the gravitational permittivity ξ and permeability τ; the relationship between the density ρ_m; besides, the mass current density $\vec{J}_m$ and the force around the mass m generated by the combination of the gravitational field $\vec{g}$ and the gyrotational field $\vec{\Omega}$.
- Equations equivalent to those of Maxwell, interrelation between components of the gyrogravitational field and its relationship with the generating sources.
- Gyrogravitational field components conversion, relating them through their propagation speed.

Table 4 summarizes the formal relationship between the four component fields of electromagnetism and gyrogravitation, which make up electrogravitodynamics.

Table 4: Electrogravytodynamics (EGD): interrelation equations in a vacuum ($K=K_0$)

↓ Induced / Inductor →	$\vec{E}$	$\vec{B}$	$\vec{\Omega}$	$\vec{g}$
$\vec{E}$	$\vec{\nabla}.\vec{E} = \frac{\rho}{\epsilon_0}$	$\vec{\nabla}\mathrm{x}\vec{E} = -\frac{\partial \vec{B}}{\partial t}$ $\vec{E} = \vec{B}\mathrm{x}\vec{c}$	$\vec{\nabla}\mathrm{x}\vec{E} \Leftarrow \sqrt{\frac{K}{G}}\frac{\partial \vec{\Omega}}{\partial t}$ $\vec{E} \Leftarrow \vec{c}\mathrm{x}\vec{\Omega}\sqrt{\frac{K}{G}}$	$\vec{g}\sqrt{\frac{K}{G}} = -\vec{E}$
$\vec{B}$	$\vec{\nabla}\mathrm{x}\vec{B} = \mu_0\epsilon_0\frac{\partial \vec{E}}{\partial t}$ $\vec{B} = \frac{\vec{c}\mathrm{x}\vec{E}}{c^2}$	$\vec{\nabla}.\vec{B} = 0$	$\vec{\Omega}\sqrt{\frac{K}{G}} = -\vec{B}$	$c^2\vec{\nabla}\mathrm{x}\vec{B} \Leftarrow -\sqrt{\frac{K}{G}}\frac{\partial \vec{g}}{\partial t}$ $c^2\vec{B} \Leftarrow \vec{g}\sqrt{\frac{K}{G}}\mathrm{x}\vec{c}$
$\vec{\Omega}$	$c^2\sqrt{\frac{K}{G}}\vec{\nabla}\mathrm{x}\vec{\Omega} \Leftarrow -\frac{\partial \vec{E}}{\partial t}$ $c^2\sqrt{\frac{K}{G}}\vec{\Omega} \Leftarrow \vec{E}\mathrm{x}\vec{c}$	$-\vec{\Omega} = \vec{B}/\sqrt{\frac{K}{G}}$	$\vec{\nabla}.\vec{\Omega} = 0$	$c^2\vec{\nabla}\mathrm{x}\vec{\Omega} \Leftarrow \frac{\vec{J}_m}{\xi} + \frac{\partial \vec{g}}{\partial t}$ $c^2\vec{\Omega} \Leftarrow \vec{c}\mathrm{x}\vec{g}$
$\vec{g}$	$\sqrt{\frac{K}{G}}\vec{\nabla}.\vec{g} \Leftarrow -\frac{\rho}{\epsilon}$ $\sqrt{\frac{\epsilon}{4\pi G}}\vec{\nabla}.\vec{g} \Leftarrow -\rho$	$\sqrt{\frac{K}{G}}\vec{\nabla}\mathrm{x}\vec{g} \Leftarrow \frac{\partial \vec{B}}{\partial t}$ $\vec{g}\sqrt{\frac{K}{G}} \Leftarrow \vec{c}\mathrm{x}\vec{B}$	$\vec{\nabla}\mathrm{x}\vec{g} \Leftarrow -\frac{\partial \vec{\Omega}}{\partial t}$ $\vec{g} \Leftarrow \vec{\Omega}\mathrm{x}\vec{c}$	$\vec{\nabla}.\vec{g} \Leftarrow \frac{\rho_m}{\xi}$

The electrogravitodynamic study carried out in terms of fields, incorporates not only the interrelation and influence in both directions between component fields of gyrogravitation and component fields of electromagnetism (gyrogravitation induction in electromagnetism and vice versa), but also the own relationship between gyrogravitational fields, thus justifying even the possibility of generating photons from the exclusive interaction between gravitons. The electrical charge is defined as a possible source of the gravitational field $\vec{g}$.

The electric mass m_{Ei} equivalent to the charge q_i considered with respect to the mass m_i is established as the mass proportional to such electric charge.

The electric mass to charge ratio, constant for the medium considered, is shown to represent the relationship between the gyrogravitational forces and the electromagnetic forces. Those particles in an environment of the same electrical permittivity ϵ maintain equal electric mass to charge ratio, so that the relationship between gyrogravitational fields and associated electromagnetic fields is also the same.

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