Gravitational Interactional Wave Theory (Teoria ODG)

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Abstract :

In 2015 I published the ODG Theory on my personal blog (www.gliargonauti.altervista.org), before the detection of the first signal of a gravitational wave occurred in 2016.
In the years that followed I wrote and published additionals chapters to the theory that I groupe in this single articol during the coronavirus quarantine. The ODG Theory is based on the ideas of General Relativity (GR) of Albert Einstein (AE), i.e. curved spacetime, but not on the equations of GR, i.e. tensors. The basic idea is that the gravitational interaction is trasmitted by gravitational waves and predicts the existence of negative gravity. The equations of the ODG Theory are invariant for Lorentz trasformation, and in perfect agreement with the weak field approximation of the RG given by gravitoelectromagnetism equations.
Moreover in the ODG Theory the AE equivalence principle is respected, both weak and strong.

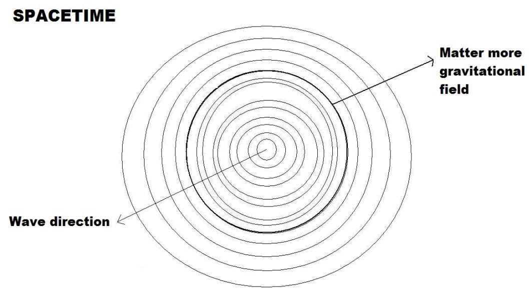
Introduction :

The description given by AE in the GR for the gravitational field is that it represents the spacetime geometry.
In one empty spacetime you have a flat spacetime or Minkowski's spacetime.
When in a flat spacetime appears one density of matter, the latter perturbs the spacetime geometry and this perturbation represents the gravitational field.
The motion of density of matter (body) generates the gravitational wave.

At this point a reflection would say :
if any body exists then it must be part of the spacetime and the spacetime exists inside and outside of the body.
Denying what has been said is to deny the very existence of spacetime inside of any body.

With this considetation it is obvious that the perturbation exists inside and outside of the body.
Then it is equally obvious to think that the gravitational wave starts from the center of the body, and interact with everythink that meets.

My guess is that it is precisely the wave to transfer everything that meets what we call gravitational interaction.



Chapter I : Foundamental Equations .

The Gauss Theorem for the flux of the vector $\vec{g}$ is :

$$\Phi_S(\vec{g})=\int_S d\,\Phi(\vec{g})=\int_S \vec{g}\,d\vec{S}-\int_S GM\frac{\cos(\theta)\,dS}{r^2} \quad (1.1)$$

$$\Phi_S(\vec{g})=-\int_S GMd\,\Omega=-GM\int_S d\,\Omega=-4\pi GM \quad (1.2)$$

where $d\,\Omega=\frac{\cos(\theta)\,dS}{r^2}$ is solid angle of the cone that has as its base the element *dS*.

Generalizing "M" in the continuous :

$$\Phi_S(\vec{g})=-4\pi GM=-4\pi G\int_V \rho\,dV \quad (1.3)$$

The divergence theorem for the vector $\vec{g}$ is : $\Phi_s(\vec{g})=\int_S \vec{g}\,d\vec{S}=\int_V \vec{\nabla}\vec{g}\,dV$ (1.4)

Equating the divergence theorem with that of Gauss :

$$\Phi_S(\vec{g})=-\int_V 4\pi G\rho\,dV=\int_V \vec{\nabla}\vec{g}\,dV \quad (1.5)$$

so :

$$\vec{\nabla}\bullet\vec{g}=-4\pi G\rho \quad (1.6)$$

The equation 1.6 is the **first fundamental equation** for this theory.

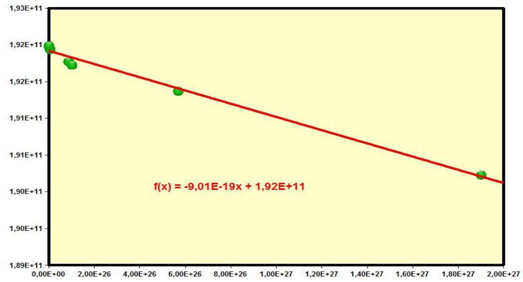
Ohm's low in the electromagnetism is : $\Delta V=RI$.
Where : ΔV is unlike electrostatic potential, *I* is the electrical current and *R* is the electrical resistance.

Now we study the gravitational case using the solar sistem data.
In our case, the potential difference will be :

$$\Delta V=V_{sun}-V_{planet}=\frac{GM_{sun}}{r_{sun}}-\frac{GM_{planet}}{r_{planet}} \quad (1.7)$$

where the potentials are expressed in the absolute value.

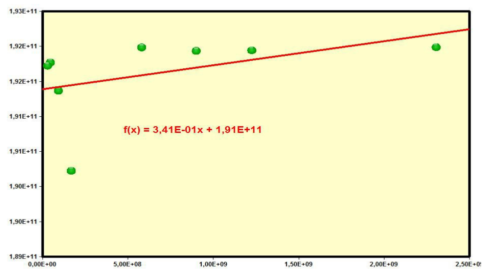
We set up a chart and study the relationship $\frac{\Delta V}{m_{planet}}$:



As seen from the fit :

$$\Delta V=-9\bullet10^{-19}m_{planet}+1{,}92\bullet10^{11} \quad (1.8)$$

Since the eccentricity of the orbits of the planets of the solar system are very low, it is possible to approximate the orbits in circle.
In this way we can take the average speed of the planets to study the relationship between the potential of the sun, calculated on the distance between the sun and the planet under investigation, and the quadric speed average.
Now we substitute the sun potential with the potential difference ΔV and we study the relationship $\frac{\Delta V}{v^2}$:



In this case the fit is :

$$\Delta V=\frac{1}{3}v^2+1{,}91\bullet10^{11} \quad (1.9)$$

Equating the 1.8 with the 1.9 :

$$v^2=-2{,}7\bullet10^{-18}m \quad (1.10)$$

Differentiating respect to time :

$$\frac{dv^2}{dt}=-2{,}7\bullet10^{-18}\frac{dm}{dt} \quad \rightarrow$$

$$\rightarrow \quad 2\vec{v}\,\vec{g} = -2{,}7\cdot 10^{-18}\frac{dm}{dt} \quad \rightarrow$$

$$\rightarrow \quad \vec{v}\,\vec{g} = -1{,}35\cdot 10^{-18}\frac{dm}{dt} \quad \rightarrow$$

$$\rightarrow \quad \vec{g}\frac{d\vec{r}}{dt} = -1{,}35\cdot 10^{-18}\frac{dm}{dt} \qquad (1.11)$$

Integrating with respect to time, you have :

$$\int \vec{g}\, d\vec{r} = \int -k\, dm \quad \rightarrow \quad \int \vec{g}\, d\vec{r} = -k\, m$$

$$\rightarrow \quad \int \vec{g}\, d\vec{r} = -k \int_V \rho\, dV \qquad (1.12)$$

where $k = 1{,}35\cdot 10^{-18}\frac{m^2}{kg\, s^2}$.

As seen the element $d\vec{r}$ is the path space from *m* on the orbit and therefore it is reasonable to consider the integran on the first member calculated on a closed line :

$$\oint g_{\vec{sun}}\, d\vec{r} = -k \int_V \rho_{planet}\, dV \qquad (1.13)$$

Applying the Stoke theorem :

$$\int_S \vec{\nabla}\, x\, g_{\vec{sun}}\, d\vec{S} = -k \int_V \rho_{planet}\, dV \qquad (1.14)$$

From 1.3 :

$$\int_V \rho\, dV = -\left(\frac{\Phi_S(\vec{g})}{4\pi G}\right) \quad \rightarrow$$

$$\rightarrow \quad \int_V \rho\, dV = -\left(\frac{\int_S \vec{g}\, d\vec{S}}{4\pi G}\right) \qquad (1.15)$$

So :

$$\int_S \vec{\nabla}\, x\, g_{\vec{sun}}\, d\vec{S} = \int_S \left(\frac{k}{4\pi G} g_{\vec{planet}}\right) d\vec{S} \qquad (1.16)$$

And :

$$\vec{\nabla}\, x\, g_{\vec{sun}} = \frac{k}{4\pi G} g_{\vec{planet}} \quad \rightarrow$$

$$\rightarrow \quad \vec{\nabla}\, x\, g_{\vec{sun}} = \frac{k}{4\pi G}\frac{d\, v_{\overrightarrow{tangential\ speed\ of\ the\ sun}}}{dt}$$

$$\rightarrow \quad \vec{\nabla}\, x\, \vec{g} = \frac{k}{4\pi G}\frac{\partial \vec{v}}{\partial t} \qquad (1.17)$$

where it was used the definition of total derivative.
The equation 1.17 is the **second fundamental equation.**

The equation 1.8 can be rewritten as :

$$\Delta V - k'' = -k' \int_V \rho\, dV \qquad (1.18)$$

where :

$$\rho = \rho_{planet}\, ;\, k' = 9\cdot 10^{-19}\frac{m^2}{kg\, s^2}\, ;\, k'' = 1{,}92\cdot 10^{11}\frac{m^2}{s^2}$$

And 1.13 as :

$$\frac{2}{3}\oint g_{\vec{sole}}\, d\vec{r} = -k' \int_V \rho_{pianeta}\, dV \qquad (1.19)$$

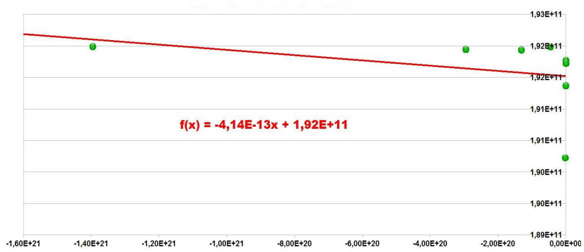
where : $k = \frac{3}{2}k'$.

Therefore :

$$\frac{2}{3}\oint g_{\vec{sole}}\, d\vec{r} = \Delta V - k'' \qquad (1.20)$$

From 1.11 $\vec{v}\,\vec{g} = -1{,}35\cdot 10^{-18}\frac{dm}{dt}$ it's possible calculate $\frac{dm}{dt}$ knowing $\vec{v} = planet\ velocity$ and $\vec{g} = gravitational\ field\ of\ the\ sun$.

Now study ΔV / $\frac{dm}{dt}$:



The fit is :

$$\Delta V = -A\frac{dm}{dt} + k'' \qquad (1.21)$$

where : $A = 4{,}14 \bullet 10^{-13} \dfrac{m^2}{kg\, s}$

$k'' = 1{,}92 \bullet 10^{11} \dfrac{m^2}{s^2}$.

Therefore :

$$\frac{2}{3}\oint g_{\vec{sole}}\, d\vec{r} = -A\frac{dm}{dt} + k'' - k'' = -A\frac{dm}{dt}$$

(1.22)

$$\frac{2}{3}\oint g_{\vec{sole}}\, d\vec{r} = -A\frac{d}{dt}\int_V \rho\, dV = -A\int_V \left(\frac{\partial \rho}{\partial t}\right) dV$$

(1.24)

since $\dfrac{d\,m}{d\,t} = \dfrac{\partial\, m}{\partial t} + \vec{u}\,\vec{\nabla}\, m$ and $\vec{\nabla}\, m = 0$.

From the continuity equation of the mass you have :

$$\vec{\nabla}\vec{J} + \frac{\partial \rho}{\partial t} = 0 \qquad (1.23)$$

and integrating the whole volume :

$$\int_V \vec{\nabla}\vec{J}\, dV = -\int_V \left(\frac{\partial \rho}{\partial t}\right) dV \qquad (1.24)$$

and for the divergence theorem :

$$\int_S \vec{J}\, d\vec{S} = -\int_V \left(\frac{\partial \rho}{\partial t}\right) dV \qquad (1.25)$$

Therefore :

$$\frac{2}{3}\oint g_{\vec{sole}}\, d\vec{r} = A\int_S \vec{J}\, d\vec{S} \qquad (1.30)$$

and applying the curl theorem :

$$\int_S \vec{\nabla}\, x\, \vec{g}_s\, d\vec{S} = \eta\int_S \vec{J}\, d\vec{S} \quad \rightarrow$$

$$\rightarrow \quad \vec{\nabla}\, x\, \vec{g}_s = \eta\vec{J} \qquad (1.31)$$

where $\eta = \dfrac{3}{2} A = 6{,}21 \bullet 10^{-13} \dfrac{m^2}{kg\, s}$.

Using the continuity equation and the 1.6 you have :

$$\vec{\nabla}\vec{J} + \frac{\partial}{\partial t}\left(\frac{-1}{4\pi G}\vec{\nabla}\vec{g}\right) = 0 \quad \rightarrow$$

$$\rightarrow \quad \vec{\nabla}\vec{J} - \vec{\nabla}\left(\frac{1}{4\pi G}\frac{\partial \vec{g}}{\partial t}\right) = 0 \quad \rightarrow$$

$$\rightarrow \quad \vec{\nabla}\left(\vec{J} - \frac{1}{4\pi G}\frac{\partial \vec{g}}{\partial t}\right) = 0 \qquad (1.32)$$

The 1.32 is a generalization of the vector $\vec{J}$, in that it considers the momentum density both in the stationary case $\dfrac{\partial \vec{g}}{\partial t} = 0$ and in the more general case $\dfrac{\partial \vec{g}}{\partial t} \neq 0$.

Therefore the 1.31 generalized is :

$$\vec{\nabla}\, x\, \vec{g} = \eta\left(\vec{J} - \frac{1}{4\pi G}\frac{\partial \vec{g}}{\partial t}\right) \quad \rightarrow$$

$$\rightarrow \quad \vec{\nabla}\, x\, \vec{g} = \eta\vec{J} - \frac{\eta}{4\pi G}\frac{\partial \vec{g}}{\partial t} \qquad (1.33)$$

with $\eta = 6{,}21 \bullet 10^{-13} \dfrac{m^2}{kg\, s}$.

The equation 1.33 is the **third fundamental equation.**

Equating the 1.17 with the 1.33 you find the mass contuinity equation $\vec{\nabla}\vec{J} + \dfrac{\partial \rho}{\partial t} = 0$.

Furthermore from GR drift the GEM Theory (GravitoElectroMagnetism) :

$$\vec{\nabla} \bullet \vec{E}_g = -4\pi G\rho \qquad (1.34)$$

$$\vec{\nabla} \bullet \vec{B}_g = 0 \qquad (1.35)$$

$$\vec{\nabla}\, x\, \vec{E}_g = -\left(\frac{1}{2c}\right)\frac{\partial \vec{B}_g}{\partial t} \qquad (1.36)$$

$$\vec{\nabla}\, x\, \vec{B}_g = -\left(\frac{8\pi G}{c}\right)\vec{J} + \frac{2}{c}\frac{\partial \vec{E}_g}{\partial t} \qquad (1.37)$$

Equating the 1.17 with 1.36 you have that $\vec{B} = -z\,\vec{v}$ and $\dfrac{1}{2c} = \dfrac{k}{4\pi G z}$ with $z = 1\, s^{-1}$.

Instead if equating 1.33 with 1.36 you obtain the mass continuity equation $\vec{\nabla}\vec{J} + \dfrac{\partial \rho}{\partial t} = 0$.

Chapter II : Gravitational wave.

The fundamental equations in the vacunum :

2.1 $\vec{\nabla} \bullet \vec{g} = 0$;

2.2 $\vec{\nabla} x \vec{g} = \frac{k}{4\pi G} \frac{\partial \vec{v}}{\partial t}$;

2.3 $\vec{\nabla} x \vec{g} = \frac{-\eta}{4\pi G} \frac{\partial \vec{g}}{\partial t}$.

Applying the curl operator to 2.2 you have :

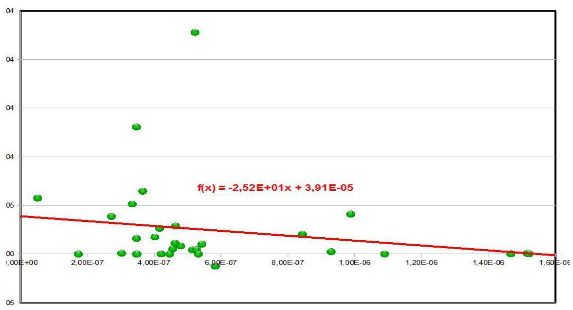
$$-\nabla^2 \vec{g} + \vec{\nabla}(\vec{\nabla} \vec{g}) = \frac{k}{4\pi G} \frac{\partial}{\partial t}(\vec{\nabla} x \vec{v}) \quad (2.4)$$

So you have :

$$-\nabla^2 \vec{g} = \frac{k}{2\pi G} \frac{\partial \vec{\omega}}{\partial t} \quad (2.5)$$

Now we study what kind of relationship binds the orbital angular velocity of a body with its gravitational field.
To do this we'll use the solar system, therefore the planets and major moons.
The kind of relationship that we'll study will be : $\vec{\omega} = A \frac{\vec{g}}{r} + B$

where :
A and B are costant to be determined ;
$\vec{\omega}$ is the orbital angular velocity ;
$\vec{g}$ is the orbiting gravitational field ;
r is the scalar of the radius of the sherical body.



So you have : $\vec{\omega} = -w \frac{\vec{g}}{r} + B$ (2.6)

Differentiating : $\frac{d\omega}{dt} = -w \frac{d}{dt}\left(\frac{\vec{g}}{r}\right)$ (2.7)

where $w = 25{,}2 s$.

Inserting 2.7 in 2.5 :

$$-\nabla^2 \vec{g} = \frac{-kw}{2\pi G} \frac{1}{r} \left(\frac{\partial \vec{g}}{\partial t}\right) \quad (2.8)$$

Using the identity :

$$\nabla^2(fg) = (\nabla^2 f) g + 2(\vec{\nabla} f)(\vec{\nabla} g) + f(\nabla^2 g)$$

you have :

$$\nabla^2(r\vec{g}) - \frac{kw}{2\pi G} \frac{\partial \vec{g}}{\partial t} = 0 \quad (2.9)$$

The first member of the 19 can be written as :

$$\nabla^2(r\vec{g}) = \nabla^2(V) = \vec{\nabla}\vec{\nabla} V = \vec{\nabla}(-\vec{g}) = -\vec{\nabla}\vec{g} \quad (2.10)$$

where consider the absolut value of the field as if you are on the surface of the source that generates the field.

Accordingly, it has :

$$\vec{\nabla}\vec{g} + \frac{kw}{2\pi G} \frac{\partial \vec{g}}{\partial t} = 0 \quad (2.11)$$

The 2.11 is the equation of the gravitational wave.

The only condition is that both :

$$v = \frac{2\pi G}{kw} = 1{,}23 * 10^7 \frac{m}{s} < c \quad (2.12)$$

The solutions of 2.11 are of the type :

$$\vec{g}(\vec{d}, t) = \vec{g} \cos(\vec{k}\vec{d} - \omega t) \quad (2.13)$$

Considering that the wave is spherical, you will have the type solutions:

$$\vec{g}(\vec{d}, t) = \frac{1}{d} \vec{g} \cos(\vec{k}\vec{d} - \omega t) \quad (2.14)$$

where "*d*" is the distance from the source.

The simplest configuration is the plane wave approximation ($\nabla \rightarrow \frac{\partial}{\partial x}$) , and in this way all the derivatives with respect to "y" and "z" are zeroed.

So in the vacunum :

$$\vec{\nabla}\bullet\vec{g}=0 \quad\rightarrow\quad \frac{\partial g_x}{\partial x}=0 \qquad (2.15)$$

$$\vec{\nabla}x\vec{g}=\frac{k}{4\pi G}\frac{\partial\vec{v}}{\partial t} \quad :$$

$$\frac{\partial g_z}{\partial y}-\frac{\partial g_y}{\partial z}=\frac{k}{4\pi G}\frac{\partial v_x}{\partial t} \quad\rightarrow\quad \frac{\partial v_x}{\partial t}=0 \qquad (2.16)$$

$$\frac{\partial g_x}{\partial z}-\frac{\partial g_z}{\partial x}=\frac{k}{4\pi G}\frac{\partial v_y}{\partial t} \quad\rightarrow$$
$$\frac{\partial g_z}{\partial x}=-(\frac{k}{4\pi G})\frac{\partial v_y}{\partial t} \qquad (2.17)$$

$$\frac{\partial g_y}{\partial x}-\frac{\partial g_x}{\partial y}=\frac{k}{4\pi G}\frac{\partial v_z}{\partial t} \quad\rightarrow$$
$$\frac{\partial g_y}{\partial x}=\frac{k}{4\pi G}\frac{\partial v_z}{\partial t} \qquad (2.18)$$

$$\vec{\nabla}x\vec{g}=-(\frac{\eta}{4\pi G})\frac{\partial\vec{g}}{\partial t} \quad :$$

$$\frac{\partial g_z}{\partial y}-\frac{\partial g_y}{\partial z}=-(\frac{\eta}{4\pi G})\frac{\partial g_x}{\partial t} \quad\rightarrow\quad \frac{\partial g_x}{\partial t}=0 \qquad (2.19)$$

$$\frac{\partial g_x}{\partial z}-\frac{\partial g_z}{\partial x}=-(\frac{\eta}{4\pi G})\frac{\partial g_y}{\partial t} \quad\rightarrow$$
$$\frac{\partial g_z}{\partial x}=\frac{\eta}{4\pi G}\frac{\partial g_y}{\partial t} \qquad (2.20)$$

$$\frac{\partial g_y}{\partial x}-\frac{\partial g_x}{\partial y}=-(\frac{\eta}{4\pi G})\frac{\partial g_z}{\partial t} \quad\rightarrow$$
$$\frac{\partial g_y}{\partial x}=-(\frac{\eta}{4\pi G})\frac{\partial g_z}{\partial t} \qquad (2.21)$$

As you can see the gravitational waves are transversal.
For completeness we also study the field $\vec{v}$ that appears in 1.17 . If apply the nabla operator to 1.17 :

$$\vec{\nabla}\bullet\vec{v}=0 \quad\rightarrow\quad \frac{\partial v_x}{\partial x}=0 \qquad (2.22)$$

And $\vec{\nabla}x\vec{v}=2\vec{\omega}$:

$$\frac{\partial v_z}{\partial y}-\frac{\partial v_y}{\partial z}=2\omega_x \quad\rightarrow\quad \omega_x=0 \qquad (2.23)$$

$$\frac{\partial v_x}{\partial z}-\frac{\partial v_z}{\partial x}=2\omega_y \quad\rightarrow\quad \frac{\partial v_z}{\partial x}=-2\omega_y \qquad (2.24)$$

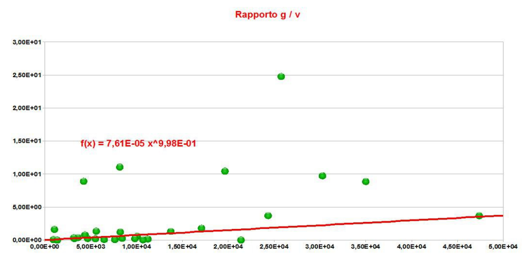
$$\frac{\partial v_y}{\partial x}-\frac{\partial v_x}{\partial y}=2\omega_z \quad\rightarrow\quad \frac{\partial v_y}{\partial x}=2\omega_z \qquad (2.25)$$

From 2.24, 2.25 and 2.17, 2.18 you see that v_y and v_z have corresponding part in ω_y and ω_z but also in g_y and g_z .
From which it can be deduced that a part of the wave or even a second wave generates a vortex around the source of the wave. This phenomenon is better known as gravitomagnetic field.

Another consideration should be made for 2.17 and 2.20 or 2.18 and 2.21. Infact you have :

$$-(\frac{k}{\eta})=\frac{g_y}{v_y}=\frac{g_z}{v_z} \quad\rightarrow\quad \frac{k}{\eta}=2{,}174\bullet 10^{-6}s^{-1} \qquad (2.26)$$

In the solar sistem for the planets and the major moons :



so :

$$\vec{g}=7{,}61\bullet 10^{-5}\vec{v} \qquad (2.27)$$

The difference between 2.26 and 2.27 depends on the value of the field $\vec{g}$ which decreases as $1/r^2$. The best result is obtained if the value of $\vec{g}$ is calculated at a distance of *"6r"*, infact you have : $\vec{g}=2{,}11\bullet 10^{-6}\vec{v}$.
When we consider the distance of *"6r"* from the center of the source we are in the vicinity of the relative geostationary orbits.

Chapter III. Energy density of $\vec{g}$.

Let us first consider a system of point masses arranged in a fixed and known configuration, and we calculate the energy of gravitational interaction owned by the system.
Initially the masses are all endlessly and we calculate the work required to bring them into the configuration chosen.
The work will be accomplished by an external force $\vec{F}^e$.
The positioning of the first mass can be effected by considering the zero work, because in the space initially considered this is not a gravitational field (assuming flat spacetime).
The positioning of the second mass from infinity to a distance r_{12} from the first mass, it is performed by moving the second mass within the gravitational field of the first mass.
The work that serves to position the second mass carried out by the external force by braking against the mutual attraction between the masses, and therefore the external force will be equal to $\vec{F}^e = -m_2 g_1$.
The work accomplished by the external force will be :

$$L_2 = -\int_{\infty}^{r_{12}} m_2 \vec{g}_1 d\vec{r} = \frac{G m_1 m_2}{r_{12}} \qquad (3.1)$$

If we now bring a third mass from infinity to its position, the work to be accomplished against the gravitational fields of the first two masses will be :

$$L_3 = \frac{G m_1 m_3}{r_{13}} + \frac{G m_2 m_3}{r_{23}} \qquad (3.2)$$

So the ***U*** energy possessed by a system of three masses will be :

$$U = L_2 + L_3 = \frac{1}{2} \sum_{(i \neq j)1}^{3} \left(\frac{G m_i m_j}{r_{ij}}\right) \qquad (3.3)$$

where the number $\frac{1}{2}$ it was introduced because the summation includes each term twice since $\frac{Gm_1 m_2}{r_{12}} = \frac{Gm_2 m_1}{r_{21}}$.

In the more general case of a system of N point masses, the gravitational energy of the system will be:

$$U = \frac{1}{2} \sum_{(i \neq j)1}^{N} \left(\frac{G m_i m_j}{r_{ij}}\right) \qquad (3.4)$$

The 3.4 can be written as :

$$U = \frac{1}{2} \sum_{(i \neq j)1}^{N} \left(\frac{G m_i m_j}{r_{ij}}\right) = \frac{1}{2} \sum_{i=1}^{N} m_i \sum_{(j \neq i)1}^{N} \left(\frac{Gm_j}{r_{ij}}\right) \qquad (3.5)$$

Pointing to the second sum with $V_i = \sum_{(j \neq i)1}^{N} \left(\frac{Gm_j}{r_{ij}}\right)$ let's say that V_i it represents the potential generated in the position occupied by all the other masses.
Equality $V_i = \sum_{(j \neq i)1}^{N} \left(\frac{Gm_j}{r_{ij}}\right)$ is true since $i \neq j$ and then $r_{ij} \neq 0$, and in this way you do not have infinite terms ($r \neq 0$).

Therefore we rewrite the 3.5 as :

$$U = \frac{1}{2} \sum_{i=1}^{N} m_i V_i \qquad (3.6)$$

In the general case of macroscopic masses is convenient to go to the continuous case :

$$U = \frac{1}{2} \int_{\tau} \rho V \, d\tau \qquad (3.7)$$

where $\rho(x, y, z)$ is the density in the point *(x,y,z)*, *V* is the sum of the potential of all other masses involved in the point *(x,y,z)*, and $d\tau$ is the volume element around the point *(x,y,z)*.
From 1.6 $\vec{\nabla} \vec{g} = -4\pi G \rho$ you have $\rho = \frac{-\vec{\nabla} \vec{g}}{4\pi G}$, so :

$$U = \frac{-1}{8\pi G} \int_{\tau} (\vec{\nabla} \vec{g}) V \, d\tau \qquad (3.8)$$

A general property of the operator $\vec{\nabla}$ says $\vec{\nabla}(V\vec{g}) = (\vec{\nabla} V)\vec{g} + V(\vec{\nabla}\vec{g})$, but $\vec{\nabla} V = -\vec{g}$ and $\vec{g}\vec{g} = g^2$, then :

$$\vec{\nabla}(V\vec{g}) = -g^2 + V(\vec{\nabla}\vec{g}) \qquad (3.9)$$

so :

$$U=\frac{-1}{8\pi G}\int_{\tau}\vec{\nabla}(V\vec{g})\,d\tau-\frac{1}{8\pi G}\int_{\tau}g^2\,d\tau \qquad (3.10)$$

For the divergence theorem :

$$U=\frac{-1}{8\pi G}\int_{S}V\vec{g}\,d\vec{S}-\frac{1}{8\pi G}\int_{\tau}g^2\,d\tau \qquad (3.11)$$

where τ is any volume that includes all the distribution of mass in its interior, and S is the surface that encloses.

Fixed mass distribution, its total gravitational energy U is the sum of two terms that appear to the right of the 112 independently of the volume considered to perform the calculation. However, the second term of the right of 112 $\int_{\tau}g^2\,d\tau$, increasing the volume is increasing, at least until it does not contain the whole volume in which $\vec{g}\neq 0$.
In other words: we consider more volume and more gravitational field consider , at least until $\vec{g}\neq 0$.
At the same time diminishes the first term ie the surface integral.
If we consider the volume becomes so large as to contain all the space in which $\vec{g}\neq 0$, then the first term allora il primo termine will tend to zero $\int_{S}V\vec{g}\,d\vec{S}\rightarrow 0$:

$$U=\int_{\text{all the space}}\left(\frac{-g^2}{8\pi G}\right)d\tau=\int_{\tau}u_g\,d\tau \qquad (3.12)$$

where :

$$u_g=\frac{-g^2}{8\pi G} \qquad (3.13)$$

The 3.13 J/m^3 represents the **energy density** of the field $\vec{g}$ present throughout the volume in wich $\vec{g}\neq 0$.

Chapter IV: Poynting vector of $\vec{g}$.

Consider a closed surface S of constant shape inside which are contained the field $\vec{g}$.
Then the total energy U contained in S will be given by 3.12 $U=\int_{\tau}\left(\frac{-g^2}{8\pi G}\right)d\tau$ where $d\tau$ is the volume element contained in *S*.

Differentiating with respect to time 3.12 :

$$\frac{dU}{dt}=\int_{\tau}\left(\frac{-1}{8\pi G}\frac{dg^2}{dt}\right)d\tau \qquad (4.1)$$

and :

$$\frac{dU}{dt}=\int_{\tau}\left(\frac{-1}{4\pi G}\vec{g}\frac{d\vec{g}}{dt}\right)d\tau \qquad (4.2)$$

From 2.7 you have :

$$\frac{d\vec{g}}{dt}=-\left(\frac{1}{w}\right)\left(r\frac{d\vec{\omega}}{dt}\right) \qquad (4.3)$$

so :

$$\frac{dU}{dt}=\int_{\tau}\left(\frac{-1}{4\pi G}\vec{g}\right)\left(\frac{-1}{w}r\frac{d\vec{\omega}}{dt}\right)d\tau \qquad (4.4)$$

and :

$$\frac{dU}{dt}=\int_{\tau}\left(\frac{1}{4\pi Gw}\vec{g}(r\vec{a})\right)d\tau \rightarrow$$

$$\rightarrow \frac{dU}{dt}=\int_{\tau}\left(\frac{1}{4\pi Gw}(-\vec{\nabla}V)(\vec{A})\right)d\tau \qquad (4.5)$$

where $V=\text{gravitational potential}$, $\vec{A}=r\vec{a}$, $\vec{a}=\text{orbital angular acceleration}$ and $r=\text{radius of the body}$.

From identity $\vec{\nabla}(V\vec{A})=(\vec{\nabla}V)\vec{A}+V(\vec{\nabla}\vec{A})$ you have :

$$-\left(\frac{dU}{dt}\right)=\int_{\tau}\left(\frac{1}{4\pi Gw}(\vec{\nabla}(V\vec{A})-V(\vec{\nabla}\vec{A}))\right)d\tau \qquad (4.6)$$

But the vector $\vec{A}=r\vec{a}$ is the scalar product between two constant terms.
Infact *r=radius of the body* has a constant value, while $\vec{a}$ is a constant of the motion. So also the vector $\vec{A}=r\vec{a}=constant$ and consequently $\vec{\nabla}\vec{A}=0$, then :

$$-\left(\frac{dU}{dt}\right)=\int_{\tau}\left(\frac{\vec{\nabla}(V\vec{A})}{4\pi Gw}\right)d\tau \qquad (4.7)$$

Applying the divergence theorem to 4.7 :

$$-\left(\frac{dU}{dt}\right)=\int_{S}\left(\frac{V\vec{A}}{4\pi Gw}\right)d\vec{S} \qquad (4.8)$$

As we see the 4.8 says that, over time, the *variation of energy contained in the closed surface that incloses the volume* τ *, it is negative; then it meansthat there is a decrease of energy.*

This energy per unit area is represented of the term inside of the integral 4.8, which we can be considered as a Poynting vector $\vec{I}$ *:*

$$\vec{I}=\frac{V\vec{A}}{4\pi Gw} \quad (4.9)$$

Infact the size of the vector $\vec{I}$ *are* W/m^2 .
The vector $\vec{I}$ can be writes as :

$$\vec{I}=\frac{\vec{A}}{4\pi Gw}\vec{d}\,\vec{g} \quad (4.10)$$

where the vector $\vec{d}$ is the point to distance *"d"*, from the source, where we considered the potential *"V"*.
And using the 2.14 you have :

$$\vec{I}=\frac{\vec{A}}{4\pi Gw}\vec{d}\left(\frac{1}{d}\vec{g}\cos(\vec{k}\vec{d}-\omega t)\right) \quad (4.11)$$

$$\vec{I}=\frac{\vec{A}}{4\pi G w}\vec{u}_d\,\vec{g}\cos(\vec{k}\vec{d}-\omega t) \quad (4.12)$$

where $\vec{u}_d=\frac{\vec{d}}{d}$ is the unit vector of vector $\vec{d}$
Considering that the average value over a priod of the cosine squared is $1/2$, the average intensity of $\bar{I}$ of the wave is :

$$\bar{I}=\frac{r\,a\,g}{4\pi G w\sqrt{2}} \quad (4.13)$$

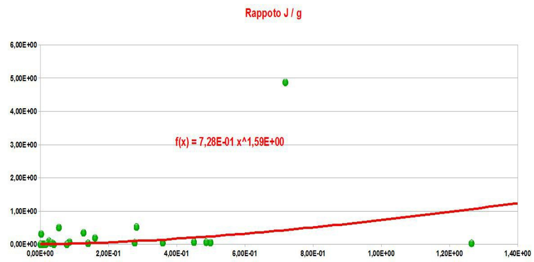
Chapter V: Direct evidence.

Consider a volume element inside which there are "n" particles of mass "m" per unit of volume, equipped with velocity $\vec{v}$:

$$\vec{J}=n\,m\,\vec{v} \quad (5.1)$$

$\vec{J}$ is the momentum density.

If we take for example the moons of the planet of the solar sistem we see that the momentum density of a moon, calculated on the volume of the sphere which as the radius of the planet-moon distance, is propotional to the gravitational field of its planet calculated at planet-moon distance :



Infact is :

$$\vec{J}=p(\vec{g})^{\frac{5}{3}} \quad \text{with} \quad p=0{,}73\frac{kg^3 s^7}{m^{11}} \quad (5.2)$$

So :

$$\vec{g}\vec{J}=p(\vec{g})^{\frac{5}{3}}\vec{g} \quad \rightarrow \quad W_v=p(g)^{\frac{8}{3}} \quad (5.3)$$

where $W_v=power\,density$.

Since 5.3 strictly depens on 3.13, let's study :

$$\frac{W_v}{u_g}=p(g)^{\frac{8}{3}}\left(\frac{-8\pi G}{g^2}\right)=-8\pi G\,p(g)^{\frac{2}{3}} \quad (5.4)$$

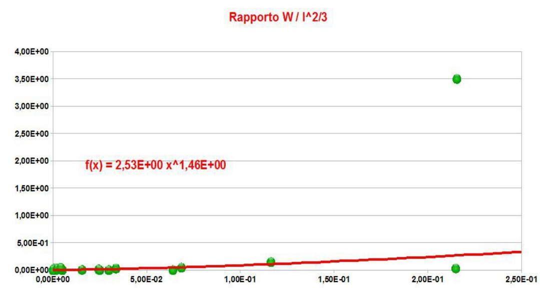
If, as assumed, gravitational radiation is actually a gravitational wave , then there must be a relationship between 4.10 and W_v .
But considering 5.4 now we will study relationship beteween W_v and (4.13)^(2/3) .
For the power density it is necessary to keep in mind that the celestial bodies turn on themselves, therefore :

$$W_v=\frac{1}{Volume}(mvg+\Omega\omega) \quad (5.5)$$

and

$$(\bar{I})^{\frac{2}{3}}=\left(\frac{r\,a\,g}{4\pi G w\sqrt{2}}\right)^{\frac{2}{3}} \quad (5.6)$$

so in the solar sistem the relationship between 5.5 and 5.6 is :



As is evident :

$$W_v = 2{,}53(\overline{I}^{\frac{2}{3}})^{\frac{3}{2}} = 2{,}53\,\overline{I} = \sigma\,\overline{I} \qquad (5.7)$$

The equation 5.7 highlights the proportionality that exists between the wave intensity and the power density that exists on the wavefront that we are considering.
<u>This is the direct evidence that gravitational interaction is transmitted through gravitational waves.</u>

Chapter VI : Negative Gravity.

In chapter II i derived the equation 2.5
$-\vec{\nabla}^2\vec{g} = \frac{k}{2\pi G}\frac{\partial\vec{\omega}}{\partial t} = \frac{k}{2\pi G}\vec{a}$ where
$\vec{a} = orbital\ angular\ acceleration$.

Consider a point mass that orbits around a center with an angular acceleration $\vec{a}$. If we add other point masses all connected to each other like a rigid body and fill all the space between the center and the first mass, then we will have a set of masses that all orbit with the same acceleration. In other words we will have a gyroscope. So we can consider the acceleration $\vec{a}$ of 2.5 as the acceleration of a gyroscope.
The first member $-\vec{\nabla}^2\vec{g}$ of the 2.5 gives us an idea of the curvature of the field $\vec{g}$, and in terms of derivatives it is nothig more than the second derivative with respect to the position of the field :

$$-\vec{\nabla}^2\vec{g} = -\left(\frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} + \frac{\partial^2}{z^2}\right)(g_x + g_y + g_z) \qquad (6.1)$$

therefore :

$$f''(g) = -\left(\frac{6Gm}{r^4}\right) \qquad (6.2)$$

and :

$$-\vec{\nabla}^2\vec{g} = -\left(-\left(\frac{6Gm}{r^4}\right)\right) = \frac{6Gm}{r^4} = -\vec{g}\,\frac{6}{r^2} \qquad (6.3)$$

consequently :

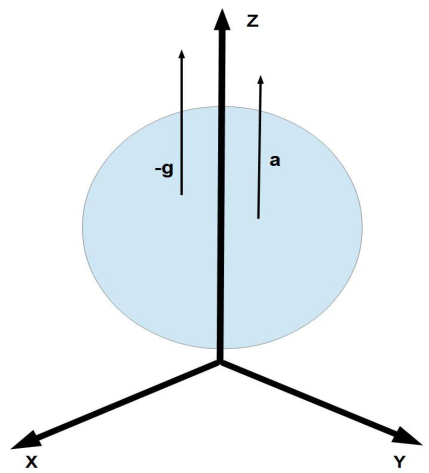
$$-\vec{g} = \frac{k}{12\pi G}r^2\vec{a} \qquad (6.4)$$

with $\frac{k}{12\pi G} = 5{,}3688\cdot 10^{-10} m^{-1}$

where $-\vec{g}$ is the **negative gravity** ; *"r"* is the distance between the center of mass of the source and the point where we are considering the value of $-\vec{g}$; while $\vec{a}$ is the angular acceleration on its axis of the source.

The 6.4 tells us that to have negative gravity one needs to have angular acceleration, and that the field $-\vec{g}$ has the same direction as $\vec{a}$. In fact if we use the rigth hand rule and say that the rotation axis is directed along *"z"*, we will a positive value $\vec{a}$ of a which will be

directed along *"z"* and will have a positive direction concordant with the positive direction of *"z"*. With these consideration it is easy to note that the field $-\vec{g}$ will have the same direction of $\vec{a}$:



In fact gravity has a double face a bit like in the electric and magnetyic field, it has both an attractive and a repulsive component.
In the gravitational case, however, the repulsive component appears if the field source rotates on itself.

<u>*First Postulate :*</u>
<u>*all bodies with mass manifest positive or attractive gravity, and if equipped with angular acceleration on its axis then they also manifest negative or repulsive gravity.*</u>

As is evident from 6.4, fixed an angular acceleration $\vec{a}$, the intensity of $-\vec{g}$ it grows with increasing distance. From which it follows that at a certain distance from the source we will always have a condition of the

type $|-\vec{g}|>|+\vec{g}|$, that is, the gravitational effects will be mainly repulsive !
This effect could well explane the galactic rotation curves seriously questioning the existence of dark matter, as well as dark energy which is considered responsible for the acceleration of the expansion of the universe. Negative gravity excludes the existence of both the phenomena mentioned !!
The internal rotating systems of a galaxy produce the negative gravity necessary to increase the speed of external systems, while the whole galaxy behaves like a huge gyroscope that produce the negative gravity necessary to make galaxies move away from each other. The same goes for the clusters galaxies and gradually the larger systems, up to and including the whole universe.

Furthermore, it will always be possible to have a condition of the type $|-\vec{g}|=|+\vec{g}|$, i.e. the gravitational effects are cancelled in all points that are at the distance whereby $|-\vec{g}|=|+\vec{g}|$: Einstein's strong equivalence principle applies!!

Chapter VII : Helmholtz theorem for negative gravity.

As for the divergence, let's start by applying the operator $\vec{\nabla}$ to 6.4 :

$$\vec{\nabla}(-\vec{g})=\vec{\nabla}\left(\frac{k}{12\pi G}r^2\vec{a}\right) \quad (7.1)$$

from identity $\vec{\nabla}(f\vec{A})=(\vec{\nabla}f)\vec{A}+f(\vec{\nabla}\vec{A})$:

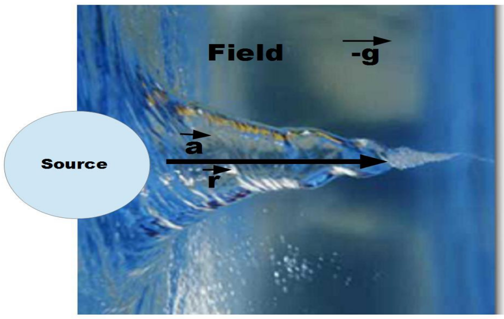
$$\vec{\nabla}(-\vec{g})=\frac{k}{12\pi G}(\vec{\nabla}r^2)\vec{a}+\frac{k}{12\pi G}r^2\vec{\nabla}\vec{a} \quad (7.2)$$

As is evident from 6.4 it must not be $\vec{r}\perp\vec{a}$. So if we say that both the vector $\vec{r}$ and $\vec{a}$ are directed along the "z" axis as $\vec{r}=(0,0,r)$ and $\vec{a}=(0,0,a)$ we'll have $\vec{\nabla}r^2=2\mathrm{r}$ and $\vec{\nabla}\vec{a}=\vec{\nabla}\left(\frac{-2\pi}{T^2}\right)=0$, so :

$$\vec{\nabla}(-\vec{g})=\frac{k}{6\pi G}\vec{r}\vec{a} \quad (7.3)$$

The 7.3 is the **divergence of the field** $\vec{-g}$.

According to 7.3 it seems that the field $\vec{-g}$ is presented in the form of a vortex, and better still a spacetime vortex. The rotary motion of the source twists the spacetime around the source and the twisting produces a cone-shaped vortex where the intensity increases with increasing distance from the source :



On the other hand, if we apply the Gauss theorem for the flux to 6.4 we have :

$$\int_S \vec{-g}\,d\vec{S}=\int_S\left(\frac{k}{12\pi G}\right)r^2\vec{a}\,d\vec{S}=\int_V\left(\frac{k}{12\pi G}\right)\vec{r}\,\vec{a}\,dV \quad (7.4)$$

And if we aplly the divergence theorem to 6.4 :

$$\Phi_s(\vec{-g})=\int_S \vec{-g}\,d\vec{S}=\int_V \vec{\nabla}(\vec{-g})\,dV \quad (7.5)$$

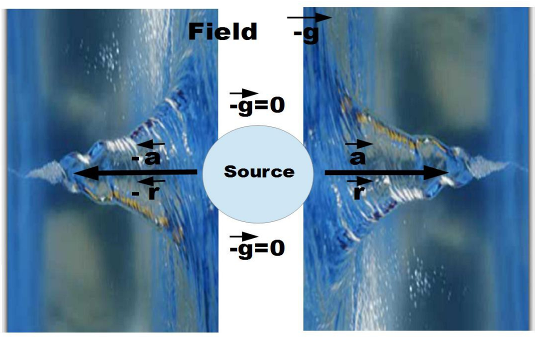
Equating 7.4 and 7.5 :

$$\vec{\nabla}(-\vec{g})=\frac{k}{12\pi G}\vec{r}\vec{a} \quad (7.6)$$

That is, 7.3 is double the 7.6 :

$$\vec{\nabla}(-\vec{g})=2\frac{k}{12\pi G}\vec{r}\vec{a}=\frac{k}{6\pi G}\vec{r}\vec{a} \quad (7.7)$$

Therefore there are two vortex :



Instead as regards the curl of the field $\vec{-g}$, apply $\vec{\nabla}x$ to 6.4 :

$$\vec{\nabla}x(-\vec{g})=\vec{\nabla}x\left(\frac{k}{12\pi G}r^2\vec{a}\right) \quad (7.8)$$

using $\vec{\nabla} x(f\vec{A})=(\vec{\nabla} f)x\vec{A}+f(\vec{\nabla} x\vec{A})$:

$$\vec{\nabla} x(-\vec{g})=\frac{k}{12\pi G}(\vec{\nabla} r^2)x\vec{a}+\frac{k}{12\pi G}r^2\vec{\nabla} x\vec{a} \quad (7.9)$$

and :

$$\vec{\nabla} x(-\vec{g})=\frac{k}{12\pi G}r^2(\vec{\nabla} x\vec{a}) \quad (7.10)$$

where $\vec{\nabla} r^2=2\vec{r}$, and $\vec{r}x\vec{a}=0$ for $\vec{r}\|\vec{a}$.

The 7.10 is the curl of the field $-\vec{g}$.

Indeed if we calculate $\vec{\nabla} x\vec{a}$ with $\vec{a}=(0,0,a)$:

$$\vec{\nabla} x\vec{a}=i(\frac{\partial a_z}{\partial y})+j(-(\frac{\partial a_z}{\partial x})) \quad (7.11)$$

and $\vec{\nabla} x(-\vec{g})$ with $(-\vec{g})=(0,0,-g)$:

$$\vec{\nabla} x(-\vec{g})=i(\frac{\partial(-g_z)}{\partial y})+j(-(\frac{\partial(-g_z)}{\partial x})) \quad (7.12)$$

the two scalar equations are obtained :

$$\frac{\partial(-g_z)}{\partial y}=\frac{k}{12\pi G}r^2\frac{\partial a_z}{\partial y} \quad (7.13)$$

$$\frac{\partial(-g_z)}{\partial x}=\frac{k}{12\pi G}r^2\frac{\partial a_z}{\partial x} \quad (7.14)$$

which integrated by quadrature :

$$-g_z=\frac{k}{12\pi G}r^2 a_z \quad (7.15)$$

lead us back to 6.4 .

If we compare the 7.10 with the curl of gravitomagnetic field given by 1.37 $\vec{\nabla} x\vec{B}_g=-(\frac{8\pi G}{c})\vec{J}+\frac{2}{c}\frac{\partial\vec{E}_g}{\partial t}$ through the relation $\vec{B}=-z\vec{v}=-\vec{g}$ we find the mass continuity equation $\vec{\nabla}\vec{J}+\frac{\partial\rho}{\partial t}=0$.

Chapter VIII. Energy density of $-\vec{g}$.

By studying the energy density of the field $-\vec{g}$ as done for the field $\vec{g}$ in chapter III, with the only condition thatthe masses are rotating masses, we obtain :

$$L_2=\int_{\infty}^{r_{12}} m_2(-\vec{g}_1)d\vec{r}=\frac{k}{36\pi G}m_2\vec{a}_1 r_{12}^3 \quad (8.1)$$

where it is assumed that $-(\frac{1}{3}\infty^3)\to 0$, and :

$$L_3=\frac{k}{36\pi G}m_3\vec{a}_1 r_{13}^3+\frac{k}{36\pi G}m_3\vec{a}_2 r_{23}^3 \quad (8.2)$$

so :

$$U=\frac{k}{36\pi G}\sum_{(j=i+1)1}^{N}(\vec{a}_i m_j r_{ij}) \quad (8.3)$$

and in the more general case of macroscopic masses :

$$U=\int_{\tau}(\frac{k}{36\pi G}\rho\vec{a}r^3)d\tau \quad (8.4)$$

where ρ in the density of all bodies distributed in the volume τ except the first :
$\vec{a}$ is the sum of all accelerations ;
r^3 in the cube of all distances between the bodies of the distribution;
$d\tau$ is the volume element.

Now using the 7.3 and the identity $\vec{\nabla}(f\vec{A})=(\vec{\nabla} f)\vec{A}+f(\vec{\nabla}\vec{A})$ you have :

$$U=\int_{\tau}(\frac{1}{6})\vec{\nabla}(-\rho r^2\vec{g})d\tau+\int_{\tau}(\frac{1}{6})(\vec{g}2r\rho)d\tau \quad (8.5)$$

and using the divergence theorem :

$$U=\int_{S}(\frac{1}{6})(-\rho r^2\vec{g})d\vec{S}+\int_{\tau}(\frac{1}{3})(\vec{g}r\rho)d\tau \quad (8.6)$$

With the same considerations made in chapter III we come to consider that :

$$\int_{S}(\frac{1}{6})(-\rho r^2\vec{g})d\vec{S}\to 0 \quad (8.7)$$

so :

$$U=\int_{all\ the\ space}\left(\frac{\vec{g}\,r\,\rho}{3}\right)d\tau \quad (8.9)$$

From 6.4 :

$$-\vec{g}=\frac{k}{12\pi G}r^2\vec{a} \quad \rightarrow \quad \vec{g}=-\left(\frac{k}{12\pi G}r^2\vec{a}\right) \quad (8.10)$$

therefore :

$$U=\int_\tau\left(-\left(\frac{k}{36\pi G}\rho r^3\vec{a}\right)\right)d\tau=\int_\tau u_{-g}\,d\tau \quad (8.11)$$

where τ is all the space in which $-\vec{g}\neq 0$, and $u_{-g}=J/m^3$ represents the energy density of the field $\vec{-g}$.

If, hypothetically, we consider a region of spacetime in which both gravitational fields are present (positive and negative) and have the same intensity, then we will a condition of the type :

$$u_g=u_{-g} \quad \rightarrow \quad -\left(\frac{g^2}{8\pi G}\right)=-\left(\frac{k}{36\pi G}\rho r^3\vec{a}\right)$$

$$\rightarrow \quad \left(\frac{g^2}{8\pi G}\right)-\left(\frac{k}{36\pi G}\rho r^3\vec{a}\right)=0 \quad (8.12)$$

The 8.12 highlights a very important relationship, in fact the two quantities are equivalent then the total energy density will be equal to zero. This means that : the gravitational effects can be cancelled!!
In practice, the spacetime vortex generated by negative gravity tries to flatten the spacetime curvature of positive gravity in its surroundings.

Second Postulate :
if in any point of spacetime there is a condition of the type $u_g=u_{-g}$ *, then at that point there will be no type of gravitational acceleration neither actrattive nor repulsive;*
which is equivalent to having, for that point, an inertial system condition unless other accelerations due to effects other than gravity.

Chapter IX : Poynting vector of $\vec{-g}$.

Consider a closed surface S of constant shape inside which are contained the field $\vec{-g}$.
Then the total energy U contained in S will be given by 8.11 .
Differentiating with respect to time 8.11 :

$$\frac{\partial U}{\partial t}=\int_\tau\left(\frac{\partial}{\partial t}\left(\frac{-k}{36\pi G}\rho r^3\vec{a}\right)\right)d\tau \quad (9.1)$$

studying :

$$\frac{\partial}{\partial t}(\rho\vec{a}r^3)=\frac{\partial\rho}{\partial t}\vec{a}r^3+\rho\frac{\partial}{\partial t}(\vec{a}r^3) \quad (9,2)$$

$$\frac{\partial}{\partial t}(\rho\vec{a}r^3)=\frac{\partial\rho}{\partial t}\vec{a}r^3+\rho\frac{\partial\vec{a}}{\partial t}r^3+\rho\frac{\partial r^3}{\partial t}\vec{a} \quad (9.3)$$

$$\frac{\partial r^3}{\partial t}=3r^2\frac{\partial\vec{r}}{\partial t} \quad (9.4)$$

finally :

$$\frac{\partial}{\partial t}(\rho\vec{a}r^3)=r^3\vec{a}\frac{\partial\rho}{\partial t}+3\rho\vec{a}r^2\frac{\partial\vec{r}}{\partial t} \quad (9.5)$$

where $\frac{\partial\vec{a}}{\partial t}=0$ because $\vec{a}$ ia a constant of motion.

So using the continuity equation :

$$\frac{\partial U}{\partial t}=\int_\tau\left(-\left(\frac{k}{36\pi G}\left(r^3\vec{a}(-\vec{\nabla}\vec{J})+3\rho r^2\vec{a}\vec{v}\right)\right)\right)d\tau \quad (9.6)$$

where $\vec{v}$ is the variation of the distance between the sources.

Using 6.4 in to 9.6 :

$$\frac{\partial U}{\partial t}=\int_\tau\left(\frac{1}{3}(\vec{-g})\vec{r}(\vec{\nabla}\vec{J})\right)d\tau-\int_\tau(\vec{-g})\rho\vec{v}\,d\tau \quad (9.7)$$

Applying $f(\vec{\nabla}\vec{A})=\vec{\nabla}(f\vec{A})-(\vec{\nabla}f)\vec{A}$ to the first integral of 9.7 :

$$\frac{1}{3}(\vec{-g})\vec{r}\vec{\nabla}\vec{J}=\vec{\nabla}\left(\frac{1}{3}(\vec{-g})\vec{r}\vec{J}\right)-\left(\vec{\nabla}\frac{1}{3}(\vec{-g})\vec{r}\right)\vec{J} \quad (9.8)$$

and :

$$\left(\vec{\nabla}\frac{1}{3}(\vec{-g})\vec{r}\right)=\frac{1}{3}\vec{r}\vec{\nabla}(\vec{-g})+\frac{1}{3}(\vec{-g}) \quad (9.9)$$

Using 7.3 and 6.4 :

$$(\vec{\nabla}\frac{1}{3}(-\vec{g})\vec{r})=\frac{2}{3}(-\vec{g})+\frac{1}{3}(-\vec{g})=(-\vec{g}) \quad (9.10)$$

therefore :

$$\frac{\partial U}{\partial t}=\int_{\tau}(\vec{\nabla}(\frac{1}{3}(-\vec{g})\vec{r}\vec{J})-(-\vec{g})\vec{J}-(-\vec{g})\vec{J})\,d\tau \quad (9.11)$$

and :

$$\frac{\partial U}{\partial t}=\int_{\tau}\vec{\nabla}(\frac{1}{3}(-\vec{g})\vec{r}\vec{J})\,d\tau-\int_{\tau}(2(-\vec{g})\vec{J})\,d\tau \quad (9.12)$$

where in the second integral of 9.7 is $\rho\vec{v}=\vec{J}$.

Applying the divergence theorem to the first integral of 9.12 :

$$\frac{\partial U}{\partial t}=\int_{S}(\frac{1}{3}(-\vec{g})\vec{r}\vec{J})\,d\vec{S}-\int_{\tau}(2(-\vec{g})\vec{J})\,d\tau \quad (9.13)$$

and :

$$-(\frac{\partial U}{\partial t})=-\int_{S}(\frac{1}{3}(-\vec{g})\vec{r}\vec{J})\,d\vec{S}+\int_{\tau}(2(-\vec{g})\vec{J})\,d\tau \quad (9.14)$$

It is easy to see that the second integral of 9.14 is the dissipation of the energy in the volume τ in which $-\vec{g}\neq 0$, because the motion of the sources caused by negative gravity. In fact the integrand represents a volumetric power density W/m^3 ;
while the first integral is an increase of energy in the surface S that incluses the volume τ in which $-\vec{g}\neq 0$, therefore there is no flux of energy through the surface S that incluses the volume τ in which $-\vec{g}\neq 0$.
Namely : **there is no Poynting vector for negative gravity.**

So, summing up, we can say that 9.14 tells us that the energy associated with the field $-\vec{g}$ remains confined in the region of the space where $-\vec{g}\neq 0$ and the dissipation is due exclusively to the motion of the sources of the fields, i.e. only an energy trasformation occurs that is, we pass from the negative gravity energy to the mechanical energy of the sources.

Third Postulate :
all bodies with mass that move through spacetime emit gravitational waves transferring positive or attractive gravity to other bodies through the Poynting vector given by 4.13; if they rotate themselves then they are also sources of negative gravity, but the transfer of energy of negative or repulsive gravity to other bodies occurs only in the region of spacetime where the field $-\vec{g}\neq 0$.

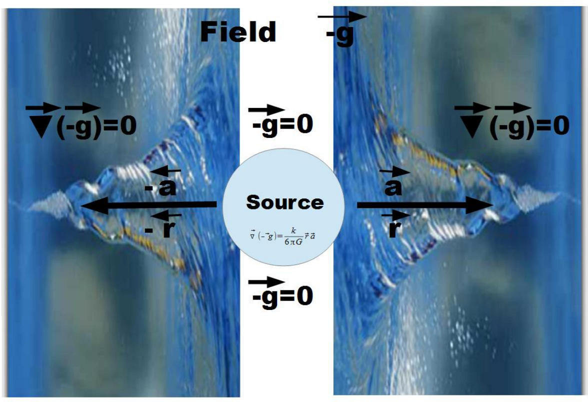
The third postulate implies that it is :

$$\vec{\nabla}(-\vec{g})=0 \quad (9.15)$$

in apparent disagreement with :

$$\vec{\nabla}(-\vec{g})=\frac{k}{6\pi G}\vec{r}\vec{a} \quad (7.3)$$

The explanation is that 7.3 considers flux through the surface of the source, while 9.15 only applies to the surface that encloses the volume in which $-\vec{g}\neq 0$, that is, the surface that incloses the vortices that represent the field $-\vec{g}$:



According to the ralation $\vec{B}=-z\vec{v}=-\vec{g}$ used in chapter 7 to compare 7.10 with 1.37 and find the mass continuity equation

$$\vec{\nabla}\vec{J}+\frac{\partial\rho}{\partial t}=0 \quad .$$

Chapter X : Conclusions.

The equations of the ODG Theory that describe the gravitational field $\pm\vec{g}$ are :

$$\vec{\nabla}\bullet\vec{g}=-4\pi G\rho \quad (10.1)$$

$$\vec{\nabla} x\,\vec{g}=\frac{k}{4\pi G}\frac{\partial\vec{v}}{\partial t} \quad (10.2)$$

$$\vec{\nabla} x\,\vec{g}=\eta\vec{J}-\frac{\eta}{4\pi G}\frac{\partial\vec{g}}{\partial t} \quad (10.3)$$

$$\vec{\nabla}(-\vec{g})=\frac{k}{6\pi G}\vec{r}\,\vec{a} \quad \text{local} \quad (10.4)$$

$$\vec{\nabla}(-\vec{g})=0 \quad \text{general} \quad (10.5)$$

$$\vec{\nabla} x(-\vec{g})=\frac{k}{12\pi G}r^2(\vec{\nabla} x\,\vec{a}) \quad (10.6)$$

with :

$$k=1{,}35\bullet 10^{-18}\frac{m^2}{kg\,s^2} \quad (10.7)$$

$$\eta=6{,}21\bullet 10^{-13}\frac{m^2}{kg\,s} \quad (10.8)$$

and :

10.4 is true for the flux through the surface of the source.

10.5 is true for the flux through the surface of the vortices.

For the 10.1 and 10.4 the **gravitational monopoly exists.**

The equations of the GEM Theory is :

$$\vec{\nabla}\bullet\vec{E}_g=-4\pi G\rho \quad (10.9)$$

$$\vec{\nabla}\bullet\vec{B}_g=0 \quad (10.10)$$

$$\vec{\nabla} x\,\vec{E}_g=-(\frac{1}{2c})\frac{\partial\vec{B}_g}{\partial t} \quad (10.11)$$

$$\vec{\nabla} x\,\vec{B}_g=-(\frac{8\pi G}{c})\vec{J}+\frac{2}{c}\frac{\partial\vec{E}_g}{\partial t} \quad (10.12)$$

Equating 10.2 with 10.11 and 10.5 with 10.10:

$$\vec{B}=-z\,\vec{v}=-\vec{g} \quad (10.13)$$

$$\frac{1}{2c}=\frac{k}{4\pi G z} \quad (10.14)$$

with $z=1\,s^{-1}$.

Equating 10.2 with 10.3, 10.3 with 10.11 and 10.6 with 10.12 you obtain the mass continuity equation :

$$\vec{\nabla}\vec{J}+\frac{\partial\rho}{\partial t}=0 \quad (10.15)$$

The following postulates apply :

First Postulate :
all bodies with mass manifest positive or attractive gravity, and if equipped with angular acceleration on its axis then they also manifest negative or repulsive gravity.

Second Postulate :
if in any point of spacetime there is a condition of the type $u_g=u_{-g}$ *, then at that point there will be no type of gravitational acceleration neither actrattive nor repulsive;*
which is equivalent to having, for that point, an inertial system condition unless other accelerations due to effects other than gravity.

Third Postulate :
all bodies with mass that move through spacetime emit gravitational waves transferring positive or attractive gravity to other bodies through the Poynting vector given by 4.13;
if they rotate themselves then they are also sources of negative gravity, but the transfer of energy of negative or repulsive gravity to other bodies occurs only in the region of spacetime where the field $-\vec{g}\neq 0$ *.*

In summary :

the gravitational field has a double face $\pm\vec{g}$ **:**
the $+\vec{g}$ **field is the attractive gravity with** $|+\vec{g}|=-(\frac{Gm}{r^2})$ **;**
in general the $-\vec{g}$ **field behaves like the gravitomagnetic field** $\vec{B}$ **, but locally it can be considered as repulsive gravity with** $|-\vec{g}|=\frac{k}{12\pi G}r^2 a$ **.**

An observer looking at a reference system with a rotating gravitational source, will observe three different effects:

a) $|+\vec{g}|>|-\vec{g}|$ **: curved spacetime and gravitational effects mainly attractive, the observer will see the test bodies affected by the source fall. In the extreme case** $+\vec{g}\rightarrow\infty$ **it will observe a black all ;**
B) $|+\vec{g}|=|-\vec{g}|$ **: flat spacetime and zero gravitational effect, the observer will see the test bodies as inertial reference system ;**
C) $|+\vec{g}|<|-\vec{g}|$ **: curved spacetime and gravitational effcts mainly repulsive with the force orthogonal to the field** $-\vec{g}$ **as for the gravitomagnetic force of Lorentz, the observer will see the test bodies move away orthogonally to the axis of rotation of the source. In the extreme case** $-\vec{g}\rightarrow\infty$ **it will observe a white hole.**

The effect of gravitomagnetism were experimentally detected thanks to the two satellites : Gravity-Probe-B of 20 april 2004 and Lares of 13 february 2012.
Both satellites experience the effects know as : frame-dragging or Lense-Thirring effect and geodetic effect or precession De Sitter.

To test the effects of negative gravity three experiment would suffice :

1) weight loss of a rotating body;
2) repulsive gravitational thrust given by $-\vec{g}$ field.
3) observation of white holes born from highly rotating black holes in which $|+\vec{g}|<|-\vec{g}|$.

In the second experiment, Lorentz force for the gravitomagnetic field $\vec{B}$ must be taken as the anti-gravity force by replacing the $\vec{B}$ field with $-\vec{g}$ field, as predicted by 10.13 .
The Lorentz force must be considered only in the region of spacetime where the field $-\vec{g}\neq 0$, i.e. inside of the spacetime vortices in accordance with the third postulate.

In this way the ODG Theory will be fully verified.

Unfortunately I don't have the necessary technology to verify the accuracy of my theory.
But the necessary technology already exists and if someone wanted to try to carry out the three experiments that I proposed, I would be happy.
Thank you.