Quantum Gravitational Shielding

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We propose here a new type of Gravitational Shielding. This is a quantum device because results from the behaviour of the matter and energy on the subatomic length scale. From the technical point of view this Gravitational Shielding can be produced in laminas with positive electric charge, subjected to a magnetic field sufficiently intense. It is easy to build, and can be used to develop several devices for gravity control.

Key words: Gravitation, Gravitational Mass, Inertial Mass, Gravitational Shielding, Quantum Device.

1. Introduction

Some years ago [1] I wrote a paper where a correlation between gravitational mass and inertial mass was obtained. In the paper I pointed out that the relationship between gravitational mass, m_g, and *rest* inertial mass, m_{i0}, is given by

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1+\left(\frac{\Delta p}{m_{i0}c}\right)^2} - 1\right]\right\} =$$

$$= \left\{1 - 2\left[\sqrt{1+\left(\frac{Un_r}{m_{i0}c^2}\right)^2} - 1\right]\right\} =$$

$$= \left\{1 - 2\left[\sqrt{1+\left(\frac{Wn_r}{\rho c^2}\right)^2} - 1\right]\right\} \qquad (1)$$

where Δp is the variation in the particle's *kinetic momentum*; U is *the electromagnetic energy absorbed or emitted by the particle;* n_r is the index of refraction of the particle; W is the density of energy on the particle (J/kg); ρ is the matter density $\left(kg/m^3\right)$ and c is the speed of light.

Also it was shown that, if the *weight* of a particle in a side of a lamina is $\vec{P} = m_g\vec{g}$ ($\vec{g}$ perpendicular to the lamina) then the weight of the same particle, in the other side of the lamina is $\vec{P}' = \chi m_g\vec{g}$, where $\chi = m_g/m_{i0}$ (m_g and m_{i0} are respectively, the gravitational mass and the inertial mass of the lamina). Only when $\chi = 1$, the weight is equal in both sides of the lamina. The lamina works as a Gravitational Shielding. This is the *Gravitational Shielding effect*. Since $P' = \chi P = (\chi m_g)g = m_g(\chi g)$, we can consider that $m'_g = \chi m_g$ or that $g' = \chi g$.

In the last years I have proposed several types of Gravitational Shieldings. Here, I describe the Quantum Gravitational Shielding. This quantum device is easy to build and can be used in order to test the correlation between gravitational mass and inertial mass previously obtained.

2. Theory

Consider a conducting spherical shell with outer radius r. From the subatomic viewpoint the region with thickness of ϕ_e (diameter of an electron) in the border of the spherical shell (See Fig.1 (a)) contains an amount, N_e, of electrons. Since the number of atoms per m^3, n_a, in the spherical shell is given by

$$n_a = \frac{N_0\rho_s}{A_s} \qquad (2)$$

where $N_0 = 6.02214129 \times 10^{26}\, atoms/kmole$, is the Avogadro's number; ρ_s is the matter density of the spherical shell (in kg/m^3) and A_s is the molar mass ($kg.kmole^{-1}$). Then, at a volume ϕS of the spherical shell, there are N_a atoms per m^3, where

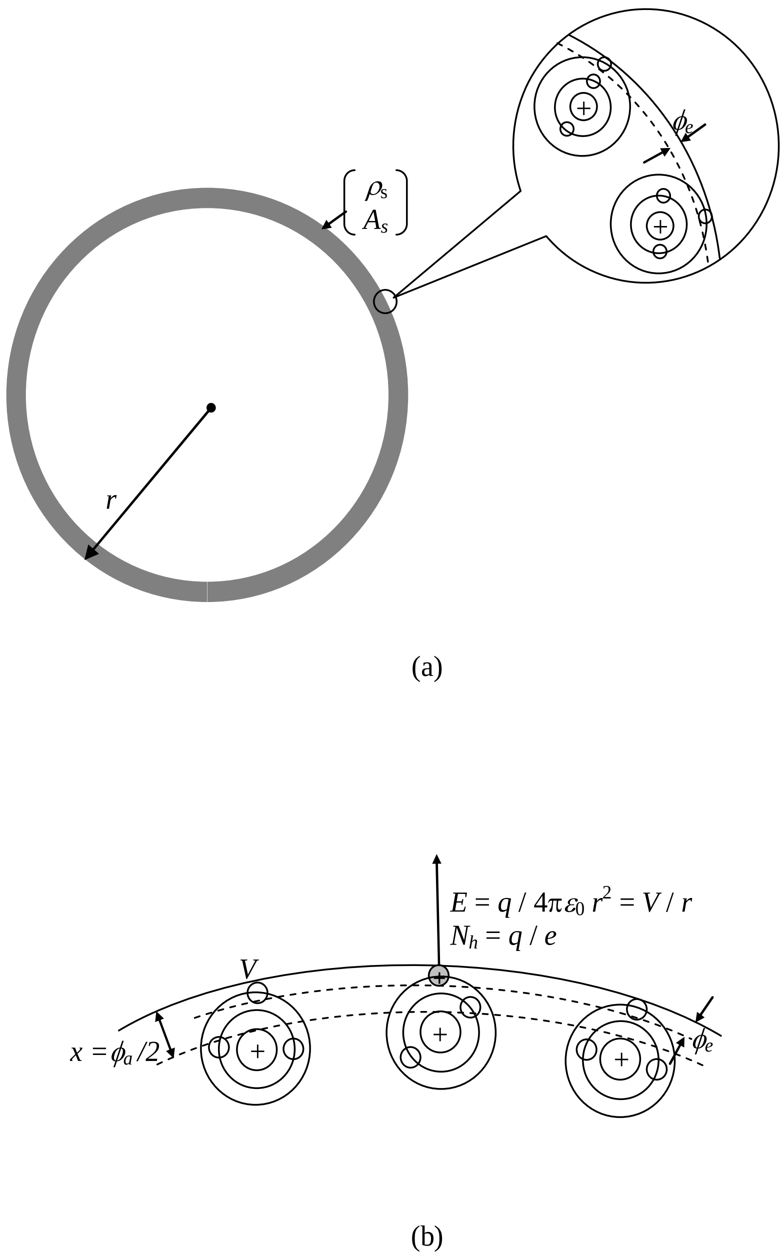

Fig.1 – Subatomic view of the border of the conducting spherical shell.

$$N_a = n_a \phi S \quad (3)$$

Similarly, if there are n_e electrons per m^3 in the same volume ϕS, then we can write that

$$N_e = n_e \phi S \quad (4)$$

By dividing both sides of Eq. (3) by N_e, given by Eq. (4), we get

$$n_e = n_a \left(\frac{N_e}{N_a} \right) \quad (5)$$

Then, the amount of electrons, in the border of the spherical shell, at the region with thickness of ϕ_e is

$$N_e(\phi_e) = n_e \phi_e S = \frac{N_0 \rho_s}{A_s} \left(\frac{N_e}{N_a} \right) \phi_e S \quad (6)$$

Assuming that in the border of the spherical shell, at the region with thickness of $x \cong \phi_a/2$ (See Fig.1 (b)), *each atom* contributes with approximately $Z/2$ electrons (Z is the atomic number). Thus, the total number of electrons, *in this region*, is $N_e(x) = (Z/2) N_e(\phi_e)$. Thus, we can write that

$$N_e(x) = \left(\frac{Z}{2} \right) N_e(\phi_e) = \left(\frac{Z}{2} \right) \frac{N_0 \rho_s}{A_s} \left(\frac{N_e}{N_a} \right)_x \phi_e S \quad (7)$$

where $(N_e/N_a)_x \cong Z/2$.

Now, if a potential V is applied on the spherical shell an amount of electrons, N_h, is removed from the mentioned region. Since $N_h = q/e$ and $E = q/4\pi\varepsilon_r\varepsilon_0 r^2$, then we obtain

$$N_h = \frac{(4\pi r^2)\varepsilon_r \varepsilon_0 E}{e} = \frac{S \varepsilon_r \varepsilon_0 E}{e} \quad (8)$$

Thus, we can express the matter density, ρ, in the border of the spherical shell, at the region with thickness of $x \cong \phi_a/2$, by means of the following equation

$$\rho = \frac{(N_e(x) - N_h) m_{e0}}{Sx} = \frac{(N_e(x) - N_h) 2m_{e0}}{S\phi_a} =$$

$$= \left[\left(\frac{Z}{2} \right)^2 \frac{N_0 \rho_s}{A_s} \left(\frac{\phi_e}{\phi_a} \right) - \frac{\varepsilon_r \varepsilon_0 E}{e \phi_a} \right] 2m_{e0}$$

or

$$\rho = \left[\left(\frac{Z}{2} \right)^2 \frac{N_0 \rho_s}{A_s} \left(\frac{\phi_e}{\phi_a} \right) - \frac{\varepsilon_r \varepsilon_0 V}{r e \phi_a} \right] 2m_{e0} \quad (9)$$

since $E = V/r$.

If the spherical shell is made of *Lithium* ($Z = 3$, $\rho_s = 534 kg.m^{-3}$, $A_s = 6.941 kg/kmole$, $\phi_a = 3.04 \times 10^{-10} m$ and outer radius $r = 0.10 m$) and covered with a thin layer ($20 \mu m$) of Barium titanate* ($BaTiO_3$), whose relative permittivity at 20°C is $\varepsilon_r = 1250$, then Eq. (9) gives

$$\rho = (3.4310685 \times 10^{38} \phi_e - 2.2725033 \times 10^{21} V) 2m_{e0} \quad (10)$$

Assuming that the electron is a sphere with radius r_e and surface charge $-e$, and that *at an atomic orbit* its total energy $E \cong m_{e0}c^2$ is equal to the potential electrostatic energy of the surface charge, $E_{pot} = e^2/8\pi\varepsilon_0 r$ [2], then these conditions determine the radius $r \equiv r_e$: $r_e = e^2/2.4\pi\varepsilon_0 m_{e0} c^2 \cong 1.4 \times 10^{-15} m$ †, which is equal to the radii of the protons and neutrons. Thus, we can conclude that *in the atom*, electrons, protons and neutrons have the same radius. Thus, substitution of $\phi_e = 2r_e = 2.8 \times 10^{-15} m$ into Eq. (10) gives

$$\rho = (9.6069918 \times 10^{23} - 2.2725033 \times 10^{21} V) 2m_{e0} \quad (11)$$

For $V = 422.7493$ *volts*, Eq. (11) gives

$$\rho = (6.8 \times 10^{14}) 2m_{e0} = 1.2 \times 10^{-15} kg.m^{-3} \quad (12)$$

Note that the voltage $V = 422.7493$ *volts* is only a theoretical value resulting from inaccurate values of the constants present in the Eq. (11), and that leads to the *critical value* 6.8×10^{14} shown in Eq. (12), which is fundamental to obtain a low density, ρ. However, if for example, $V = 422.7$ *volts*, then the critical value increases to 1.1×10^{20} (more than 100,000 times the initial value) and, therefore the system shown in

* Dielectric Strength: $6 kV/mm$, density: 6,020kg/m^3.

† The radius of the electron depends on the circumstances (energy, interaction, etc) in which it is measured. This is because its structure is easily deformable. For example, the radius of a *free electron* is of the order of $10^{-13} m$ [3], when accelerated to 1GeV total energy it has a radius of $0.9 \times 10^{-16} m$ [4].

Fig.2 will require a magnetic field 402 times more intense. In practice, the value of V, which should lead to the critical value 6.8×10^{14} or *a close value*, must be found by using a *very accurate voltage source* in order to apply accurate voltages around the value $V = 422.7493\ volts$ at ambient temperature of 20°C.

Substitution of the value of ρ, given by Eq. (12), into Eq. (1) yields

$$\chi = \left\{1-2\left[\sqrt{1+\left(9.3\times10^{-3}W\right)^2}-1\right]\right\} \qquad (13)$$

Substitution of

$$W=\tfrac{1}{2}\varepsilon_0 E^2+\tfrac{1}{2}\mu_0 H^2=\tfrac{1}{2}\varepsilon_0 c^2 E^2+\tfrac{1}{2}\left(B^2/\mu_0\right)=B^2/\mu_0$$

into Eq. (13) gives

$$\chi = \left\{1-2\left[\sqrt{1+5.4\times10^{7}B^4}-1\right]\right\} \qquad (14)$$

Therefore, if a magnetic field $B = 0.020T$ passes through the spherical shell (See Fig. (2)) the result is

$$\chi \cong -3 \qquad (15)$$

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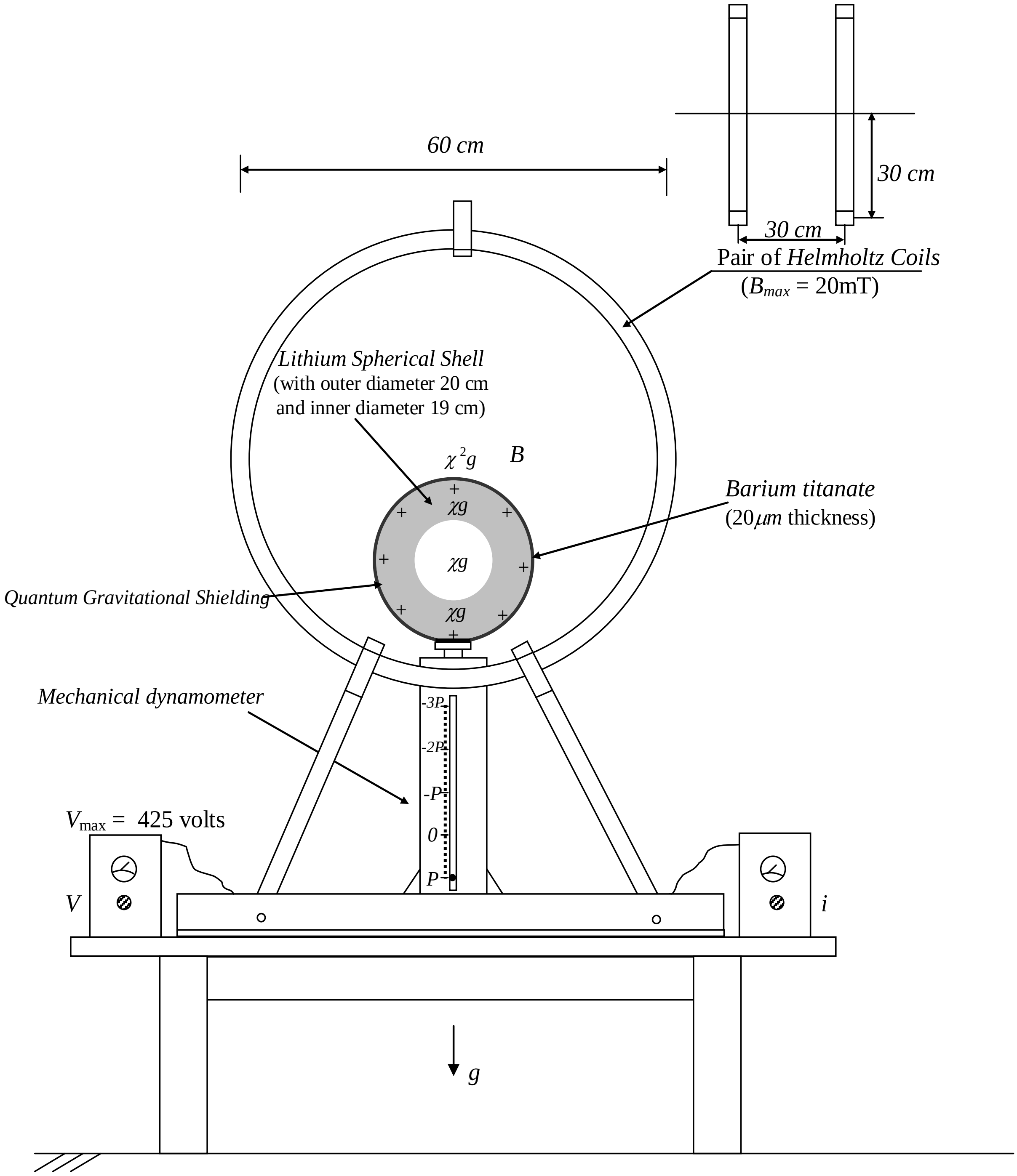

Fig.2 – *Quantum Gravitational Shielding* produced in a *Lithium Spherical Shell* with positive electric charge, subjected to a magnetic field *B*.

References

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