Electromagnetic Control of the Gravitational Mass of a Ferrite Lamina, and the Gravity Acceleration above it.

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Here we show that it is possible controlling the gravitational mass of a specific ferrite lamina, and the gravity acceleration above it, simply applying an extra-low frequency electromagnetic field through it.

Key words: Gravitational Interaction, Gravitational Mass, Gravity Control.

1. Introduction

In a previous paper [1] we shown that there is a correlation between the gravitational mass, m_g, and the rest inertial mass m_{i0}, which 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 (kg/m^3) and c is the speed of light.

The *instantaneous values* of the density of electromagnetic energy in an *electromagnetic* field can be deduced from Maxwell's equations and has the following expression

$$W = \tfrac{1}{2}\varepsilon E^2 + \tfrac{1}{2}\mu H^2 \qquad (2)$$

where $E = E_m \sin\omega t$ and $H = H \sin\omega t$ are the *instantaneous values* of the electric field and the magnetic field respectively.

It is known that $B = \mu H$, $E/B = \omega/k_r$ [2] and

$$v = \frac{dz}{dt} = \frac{\omega}{\kappa_r} = \frac{c}{\sqrt{\frac{\varepsilon_r \mu_r}{2}\left(\sqrt{1+(\sigma/\omega\varepsilon)^2}+1\right)}} \qquad (3)$$

where k_r is the real part of the *propagation vector* $\vec{k}$ (also called *phase constant*); $k = \left|\vec{k}\right| = k_r + ik_i$; ε , μ and σ, are the electromagnetic characteristics of the medium in which the incident (or emitted) radiation is propagating ($\varepsilon = \varepsilon_r\varepsilon_0$; $\varepsilon_0 = 8.854\times10^{-12} F/m$; $\mu = \mu_r\mu_0$ where $\mu_0 = 4\pi\times10^{-7} H/m$). From Eq. (3), we see that the *index of refraction* $n_r = c/v$ is given by

$$n_r = \frac{c}{v} = \sqrt{\frac{\varepsilon_r\mu_r}{2}\left(\sqrt{1+(\sigma/\omega\varepsilon)^2}+1\right)} \qquad (4)$$

Equation (3) shows that $\omega/\kappa_r = v$. Thus, $E/B = \omega/k_r = v$, i.e.,

$$E = vB = v\mu H$$

Then, Eq. (2) can be rewritten as follows

$$W = \tfrac{1}{2}\varepsilon E^2 + \tfrac{1}{2}\mu\left(\frac{E}{v\mu}\right)^2 = \\ = \tfrac{1}{2}\varepsilon E^2 + \tfrac{1}{2}\left(\frac{1}{v^2\mu}\right)E^2 = \\ = \tfrac{1}{2}\left(\varepsilon + \frac{1}{v^2\mu}\right)E^2 \qquad (5)$$

For $\sigma >> \omega\varepsilon$, Eq. (3) gives

$$v^2 = \frac{2\omega}{\mu\sigma} \quad \Rightarrow \quad v^2\mu = \frac{2\omega}{\sigma} \qquad (6)$$

Substitution of Eq. (6) into Eq. (5) gives $W = \tfrac{1}{2}(\varepsilon + \sigma/2\omega)E^2$. Since $\sigma >> \omega\varepsilon$, i.e., $\sigma/\omega >> \varepsilon$, then we can write that

$$W \cong \tfrac{1}{2}(\sigma/2\omega)E^2 \qquad (7)$$

Substitution of Eq. (7) into Eq. (1), yields

$$m_g = \left\{1-2\left[\sqrt{1+\frac{\mu}{4c^2}\left(\frac{\sigma}{4\pi f}\right)^3\frac{E^4}{\rho^2}}-1\right]\right\}m_{i0} = \\ = \left\{1-2\left[\sqrt{1+\left(\frac{\mu_0}{256\pi^3c^2}\right)\left(\frac{\mu_r\sigma^3}{\rho^2 f^3}\right)E^4}-1\right]\right\}m_{i0} = \\ = \left\{1-2\left[\sqrt{1+1.758\times10^{-27}\left(\frac{\mu_r\sigma^3}{\rho^2 f^3}\right)E^4}-1\right]\right\}m_{i0} \qquad (8)$$

Note that if $E = E_m \sin\omega t$ .Then, the average value for E^2 is equal to $\frac{1}{2}E_m^2$ because E varies sinusoidaly (E_m is the maximum value for E). On the other hand, we have $E_{rms}=E_m/\sqrt{2}$. Consequently, we can change E^4 by E_{rms}^4, and the Eq. (8) can be rewritten as follows

$$m_g = \left\{1-2\left[\sqrt{1+1.758\times10^{-27}\left(\frac{\mu_r\sigma^3}{\rho^2 f^3}\right)E_{rms}^4}-1\right]\right\}m_{i0} \quad (9)$$

Also, it was shown in the previously mentioned paper [1] 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 $\chi = m_g^l/m_{i0}^l$ (m_g^l and m_{i0}^l are respectively, the gravitational mass and the rest inertial mass *of the lamina*). Only when $\chi=1$, is that the weight is equal in both sides of the lamina. Thus, the lamina can control the gravity acceleration above it, and in this way, it can work as a *Gravity Controller Device*.

Since the gravitational mass of a body above the lamina is $m_g = m_{i0}$, then we can conclude that $P' = m_{i0}(\chi g)$. Therefore, this means that the gravity acceleration above the lamina is

$$g' = \chi g \quad (10)$$

Here we show that it is possible controlling the gravitational mass of a ferrite lamina, and the gravity acceleration above it (χg), simply applying an extra-low frequency electromagnetic field through it, according to Eq.(9) and Eq. (10).

2. The Device

F*errites* are ceramic materials electrically *non*-conductive [3]. Usually all ferrites are electrically *insulator* (*the electrons in ferrites are not free* [4]). But the order of resistivity is different for different ferrites. The resistivity of ferrites varies in the range of 10^{-3} ohm-cm to 10^{11}ohm-cm ($10^5\,S/m$ to $10^{-9}\,S/m$), at room temperature [5].

Consider a ferrite lamina with $2mm$ thickness 200mm, width and 200mm length; coated with a insulating paint, and with the following characteristics: $\rho = 5000kg/m^3$; $\mu_r = 5000$; $\sigma = 2\times10^3\,S/m$. Applying across the above mentioned ferrite lamina an oscillating electric field, E_{rms}, with frequency, $f = 1Hz$ (See Fig.1), then according to Eq. (9), we get

$$m_g = \left\{1-2\left[\sqrt{1+2.8\times10^{-21}E_{rms}^4}-1\right]\right\}m_{i0} \quad (11)$$

For a maximum electric field, E_{rms}^{max}, given by

$$E_{rms}^{max} = 180V/mm = 1.8\times10^5\,V/m \quad (12)$$

Eq. (11) gives

$$\chi = m_g/m_i \cong -1 \quad (13)$$

Considering the value of the maximum electric field ($180V/mm$), and that the ferrite lamina has $2mm$ thickness, then, in order to obtain the above result, the *breakdown voltage* of the ferrite lamina must be greater than $360V$, i.e., ($\gtrsim 360V$). This is a low breakdown voltage for a ferrite because several of them have breakdown voltage of the order of some kV and maximum electric field of some kV/mm [6].

There is a polyvinyl chloride (PVC) compound, called Duracap™ 86103, that has a strong dielectric strength (3.87 *KV/mm*) and similar characteristics to the above mentioned ferrite: $\sigma = 33333S/m$, $\rho = 1400kg.m^{-3}$, $\mu_r = 1$.

Figure 1 shows an experimental set up in order to verify the decreasing of the *Gravitational Mass* of the ferrite lamina, and the decreasing of the *gravity acceleration above the ferrite lamina*. The ferrite lamina is attached over one of the plates of a parallel plates capacitor (See Fig.1).Under these conditions, the electric field close to the capacitor plate $(E = q/2S\varepsilon_0)$, is the electric field across the ferrite, $E_{ferrite}$, i.e.,

$$E_{ferrite} = \frac{q}{2S\varepsilon_0} = \frac{CV}{2S\varepsilon_0} = \frac{\varepsilon_r(S/d)V}{2S\varepsilon_0} = \frac{\varepsilon_r V}{2d} \quad (14)$$

where ε_r is the relative permittivity of the dielectric of the *capacitor*; V is the voltage difference between the plates of the *capacitor*, and d the distance between them.

Since $E_{rms}^{max} = 1.8\times10^5\,V/m$, then in order to obtain $E_{ferrite\,(rms)}^{max} = E_{rms}^{max}$, we must have

$$E_{ferrite\,(rms)}^{max} = \frac{\varepsilon_r V_{rms}^{max}}{2d} = E_{rms}^{max} = 1.8\times10^5\,V/m \quad (15)$$

If $\varepsilon_r = 2.03$ (Teflon), and $d = 1mm$, then Eq. (15) shows that the maximum rms voltage difference between the plates of the *capacitor* must be given by

$$V_{rms}^{max} = 177.34V \quad (16)$$

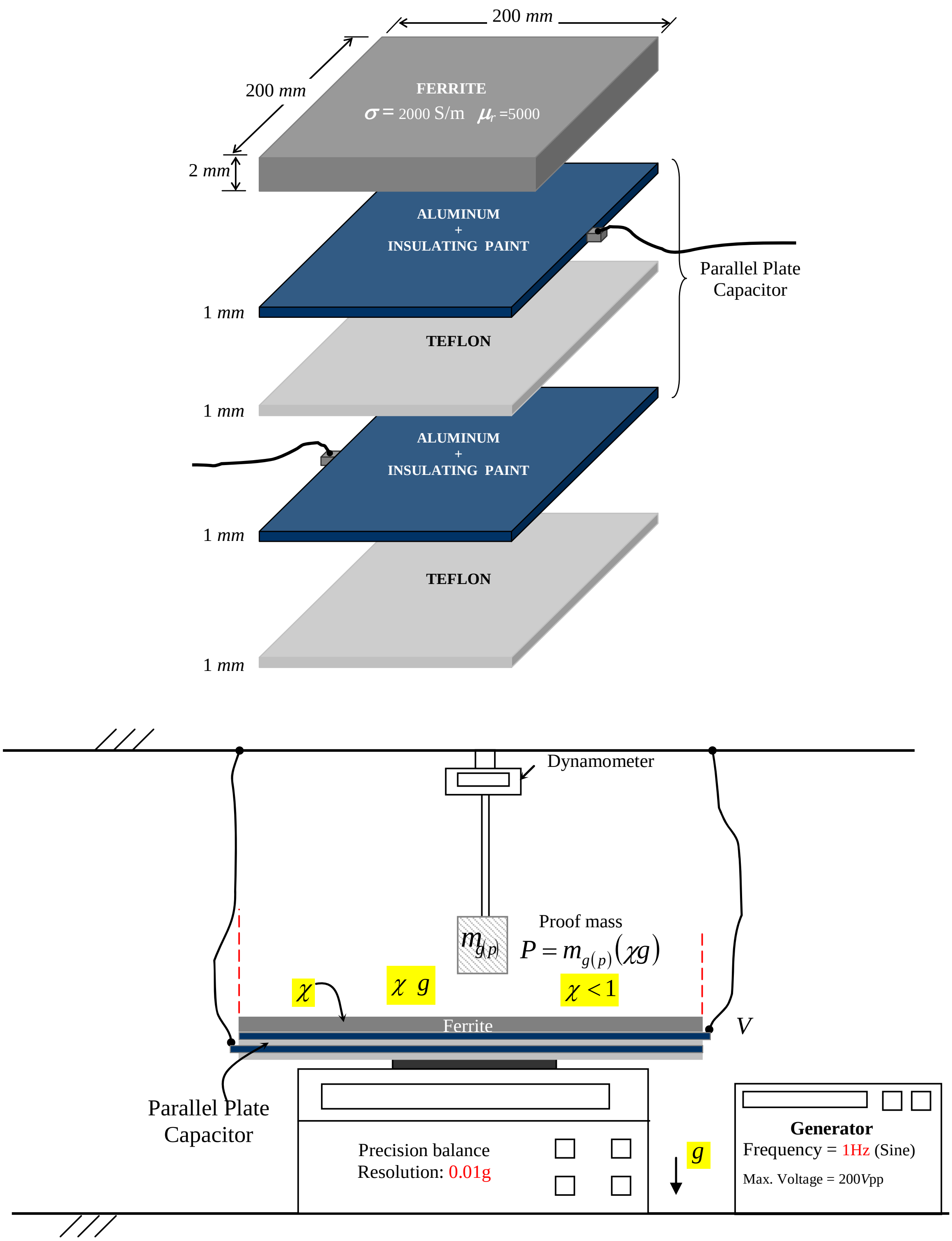
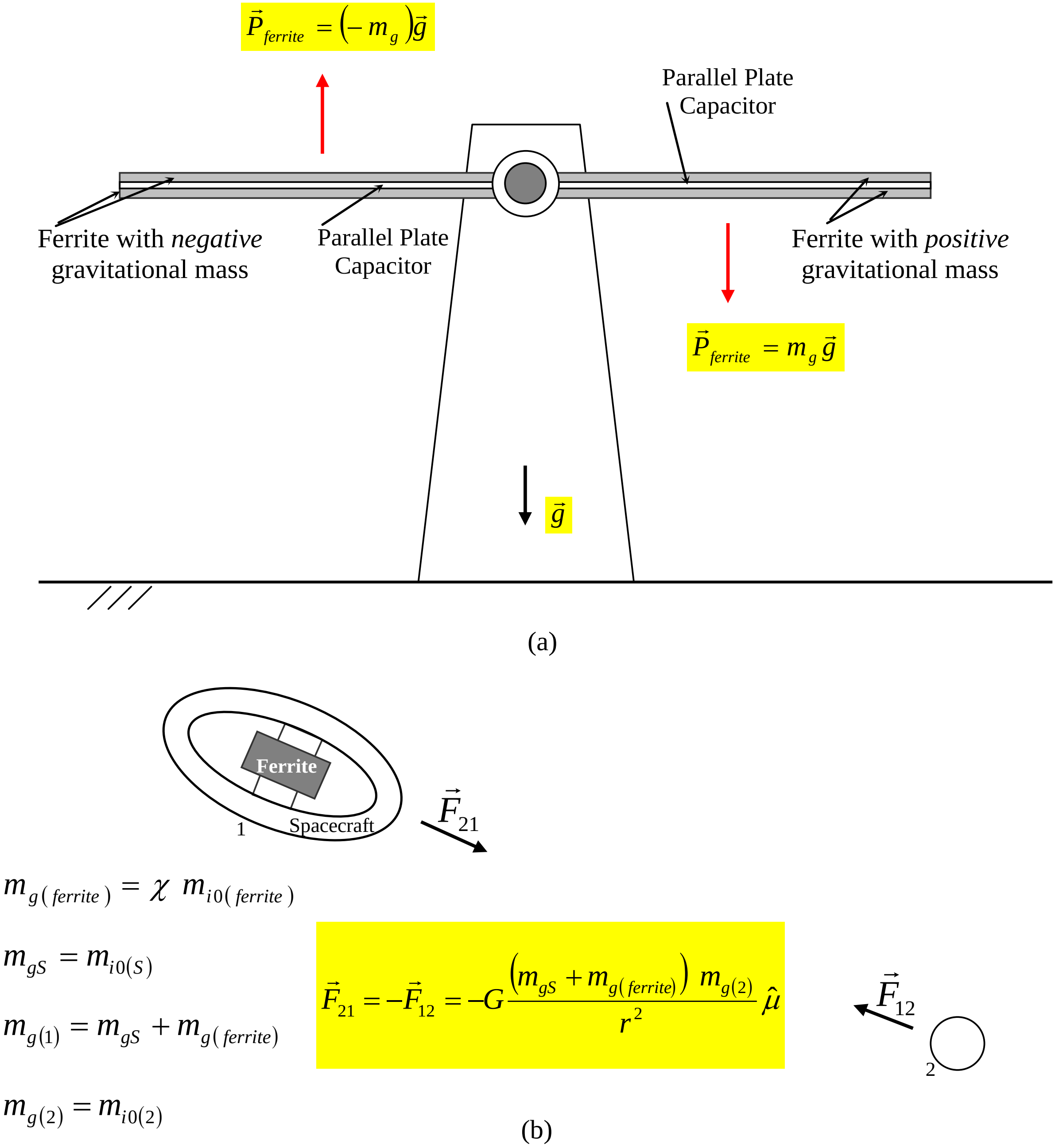


Fig. 1 – Experimental set up for controlling the *Gravitational Mass* of the Ferrite Lamina, and the *Gravity* acceleration above it. Note that the Ferrite Lamina has inertial mass $m_{i(ferrite)} = 0.20 \times 0.20 \times 2 \times 10^{-3} \times 5000 = 0.4kg$. Thus, the precision balance must have resolution of 0.01g or less.



(a)

(b)

Fig. 2 – (a) *Gravitational Motor* - Conversion of Gravitational Energy into Rotational Energy/Electric Energy. (b) *Gravitational Spacecraft* – Gravitational Thrust. If $m_{s(ferrite)}$ becomes *negative*, i.e., if $\chi < 0$, and $|\chi| > m_{i0(S)}/m_{i0(ferrite)}$, $\left(|m_{gS(ferrite)}| > |m_{gS}|\right)$ then, the gravitational forces $\vec{F}_{21}$ and $\vec{F}_{12}$ become *repulsive*. Note that the gravity *inside* the spacecraft can be made equivalent to *the gravity on the Earth* $\left(g = 9.8m.s^{-2}\right)$, simply putting on the spacecraft floor a set of n ferrite plates (inside the parallel plates of capacitors). In this case, the gravity above the set of ferrite plates will be $\chi^n G\left(m_g/r^2\right)$ (See Eq. (10)). Thus, for example, if $G\left(m_g/r^2\right) \approx 10^{-11}$ the gravity on the floor can be made of the order of $10m.s^{-2}$ by making $n = 12$ and $|\chi| \cong 10$.

The concepts here developed can also be useful to build a Gravitational Motor, which can convert the Gravitational Energy into Rotational/Electric Energy (See Fig.2).

References

[1] De Aquino, F. (2010) *Mathematical Foundations of the Relativistic Theory of Quantum Gravity*, Pacific Journal of Science and Technology,**11** (1), pp. 173-232. Available at https://hal.archives-ouvertes.fr/hal-01128520

[2] Halliday, D. and Resnick, R. (1968) *Physics*, J. Willey & Sons, Portuguese Version, Ed. USP, p.1118.

[3] Carter, C. Barry; Norton, M. Grant (2007). *Ceramic Materials: Science and Engineering.* Springer. pp. 212–15.

[4] Verenkarv, V., (1997) PhD Thesis, chapter IV, p.203 (Electrical properties).

[5] L.G.Van Uitert (1956), Proc. I.R.E. 44, 1294.

[6] Curry, R et al., (2016) *Development of Metamaterial Composites for Compact High Power Microwave Systems and Antennas*, University of Missouri-Columbia, Center for Physical and Power Electronics Electrical and Computer Engineering, p. 65.