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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

$$\begin{aligned} \chi = \frac{m_g}{m_{i0}} &= \left\{ 1 - 2 \left[\sqrt{1 + \left(\frac{\Delta p}{m_{i0} c} \right)^2} - 1 \right] \right\} = \\ &= \left\{ 1 - 2 \left[\sqrt{1 + \left(\frac{U n_r}{m_{i0} c^2} \right)^2} - 1 \right] \right\} = \\ &= \left\{ 1 - 2 \left[\sqrt{1 + \left(\frac{W n_r}{\rho c^2} \right)^2} - 1 \right] \right\} \end{aligned} \quad (1)$$

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

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

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

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

where k_r is the real part of the *propagation vector* \vec{k} (also called *phase constant*); $k = |\vec{k}| = k_r + ik_i$; ε , μ and σ , are the electromagnetic characteristics of the medium in

which the incident (or emitted) radiation is propagating ($\varepsilon = \varepsilon_r \varepsilon_0$; $\varepsilon_0 = 8.854 \times 10^{-12} F/m$; $\mu = \mu_r \mu_0$ where $\mu_0 = 4\pi \times 10^{-7} H/m$). From Eq. (3), we see that the *index of refraction* $n_r = c/v$ is given by

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

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

$$\begin{aligned} W &= \frac{1}{2} \varepsilon E^2 + \frac{1}{2} \mu \left(\frac{E}{v\mu} \right)^2 = \\ &= \frac{1}{2} \varepsilon E^2 + \frac{1}{2} \left(\frac{1}{v^2 \mu} \right) E^2 = \\ &= \frac{1}{2} \left(\varepsilon + \frac{1}{v^2 \mu} \right) E^2 \end{aligned} \quad (5)$$

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

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

Substitution of Eq. (6) into Eq. (5) gives

$W = \frac{1}{2} (\varepsilon + \sigma/2\omega) E^2$. Since $\sigma \gg \omega\varepsilon$, i.e., $\sigma/\omega \gg \varepsilon$, then we can write that

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

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

$$\begin{aligned} m_g &= \left\{ 1 - 2 \left[\sqrt{1 + \frac{\mu}{4c^2} \left(\frac{\sigma}{4\pi f} \right)^3 \frac{E^4}{\rho^2}} - 1 \right] \right\} m_{i0} = \\ &= \left\{ 1 - 2 \left[\sqrt{1 + \left(\frac{\mu_0}{256\pi^3 c^2} \right) \left(\frac{\mu_r \sigma^3}{\rho^2 f^3} \right) E^4} - 1 \right] \right\} m_{i0} = \\ &= \left\{ 1 - 2 \left[\sqrt{1 + 1.758 \times 10^{-27} \left(\frac{\mu_r \sigma^3}{\rho^2 f^3} \right) E^4} - 1 \right] \right\} m_{i0} \end{aligned} \quad (8)$$

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 sinusoidally (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

$$m_g = \left\{ 1 - 2 \left[\sqrt{1 + 1.758 \times 10^{-27} \left(\frac{\mu_r \sigma^3}{\rho^2 f^3} \right) E_{rms}^4} - 1 \right] \right\} m_{i0} \quad (9)$$

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

Ferrites 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: $\rho = 5000 \text{ kg/m}^3$; $\mu_r = 5000$; $\sigma = 2 \times 10^3 \text{ S/m}$. Applying across the above mentioned ferrite lamina an oscillating

electric field, E_{rms} , with extra-low frequency, $f = 1 \text{ Hz}$ (See Fig.1), then according to Eq. (9), we get

$$m_g = \left\{ 1 - 2 \left[\sqrt{1 + 2.8 \times 10^{-21} E_{rms}^4} - 1 \right] \right\} m_{i0} \quad (11)$$

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

$$E_{rms}^{\max} = 180 \text{ V/mm} = 1.8 \times 10^5 \text{ V/m} \quad (12)$$

Eq. (11) gives

$$\chi = m_g / m_{i0} \cong -1 \quad (13)$$

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., ($\geq 360 \text{ V}$). 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].

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 ($E = q/2S\epsilon_0$), is the electric field across the ferrite, $E_{ferrite}$, i.e.,

$$E_{ferrite} = \frac{q}{2S\epsilon_0} = \frac{CV}{2S\epsilon_0} = \frac{\epsilon_r(S/d)V}{2S\epsilon_0} = \frac{\epsilon_r V}{2d} \quad (14)$$

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 $E_{rms}^{\max} = 1.8 \times 10^5 \text{ V/m}$, then in order to obtain $E_{ferrite(rms)}^{\max} = E_{rms}^{\max}$, we must have

$$E_{ferrite(rms)}^{\max} = \frac{\epsilon_r V_{rms}^{\max}}{2d} = E_{rms}^{\max} = 1.8 \times 10^5 \text{ V/m} \quad (15)$$

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

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

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).

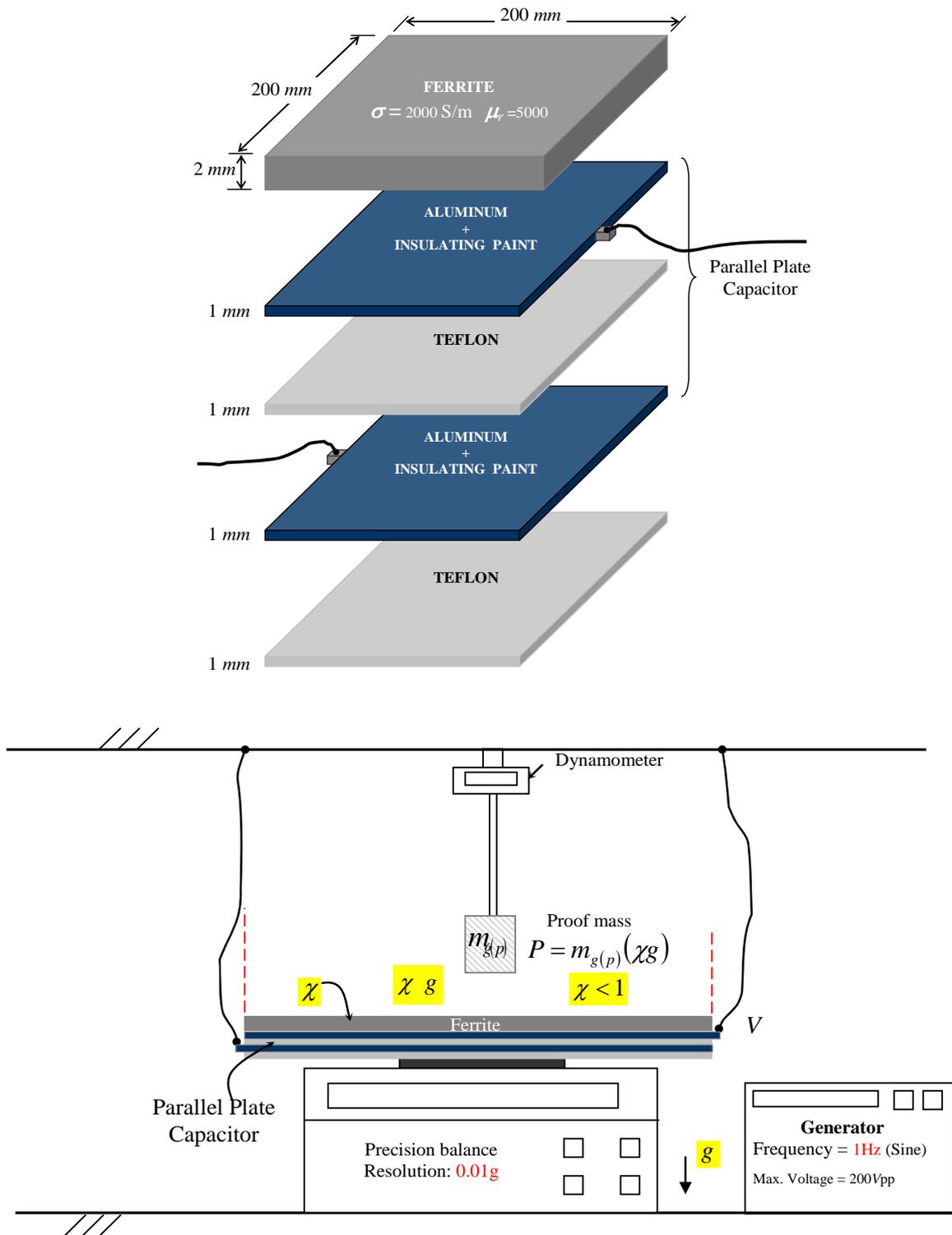


Fig. 1 – Experimental set up for controlling the *Gravitational Mass* of the Ferrite Lamina, and the *Gravity* acceleration above it. Note that the Ferrite Lamina has inertial mass $m_{i(\text{ferrite})} = 0.20 \times 0.20 \times 2 \times 10^{-3} \times 5000 = 0.4 \text{ kg}$. Thus, the precision balance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

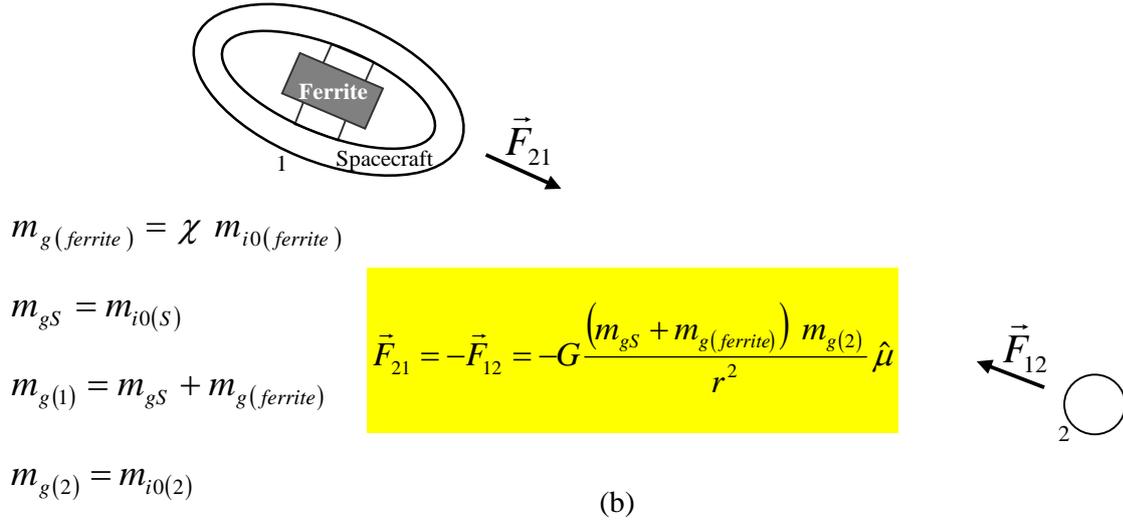
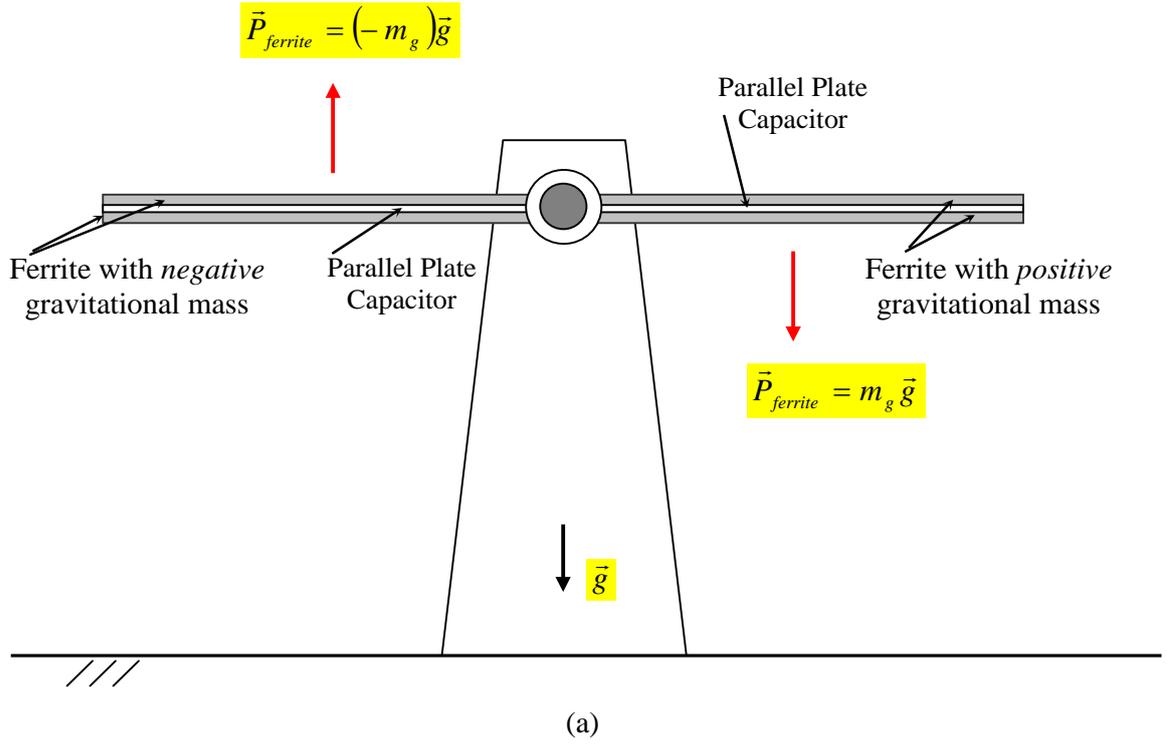


Fig. 2 – (a) *Gravitational Motor* - Conversion of Gravitational Energy into Rotational Energy/Electric Energy.

(b) *Gravitational Spacecraft* – Gravitational Thrust. If $m_{s(\text{ferrite})}$ becomes *negative*, i.e., if $\chi < 0$, and $|\chi| > m_{i0(S)}/m_{i0(\text{ferrite})}$, $(|m_{gS(\text{ferrite})}| > |m_{gS}|)$ 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* ($g = 9.8m.s^{-2}$), 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 $\chi^n G(m_g/r^2)$ (See Eq. (10)). Thus, for example, if $G(m_g/r^2) \approx 10^{-11}$ the gravity on the floor can be made of the order of $10m.s^{-2}$ by making $n = 12$ and $|\chi| \cong 10$.

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.