



HAL
open science

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

Fran de Aquino

► **To cite this version:**

Fran de Aquino. Electromagnetic Control of the Gravitational Mass of a Ferrite Lamina, and the Gravity Acceleration above it. 2018. hal-01956680v1

HAL Id: hal-01956680

<https://hal.science/hal-01956680v1>

Preprint submitted on 16 Dec 2018 (v1), last revised 18 Jan 2019 (v2)

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

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

Fran De Aquino

Professor Emeritus of Physics, Maranhao State University, UEMA.
Titular Researcher (R) of National Institute for Space Research, INPE
Copyright © 2018 by Fran De Aquino. All Rights Reserved.

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 $v = \frac{dz}{dt} = \frac{\omega}{\kappa_r} = \frac{c}{\sqrt{\frac{\varepsilon_r \mu_r}{2} \left(\sqrt{1 + (\sigma/\omega\varepsilon)^2} + 1 \right)}}$ (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 $10^{-13} S/m$), 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: $\rho = 5000 kg/m^3$; $\mu_r = 5000$; $\sigma = 2 \times 10^3 S/m$. Applying across the above mentioned ferrite lamina an oscillating

electric field, E_{rms} , with extra-low frequency, $f = 1Hz$ (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

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

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., ($\geq 360V$). 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].

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

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

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

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

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).

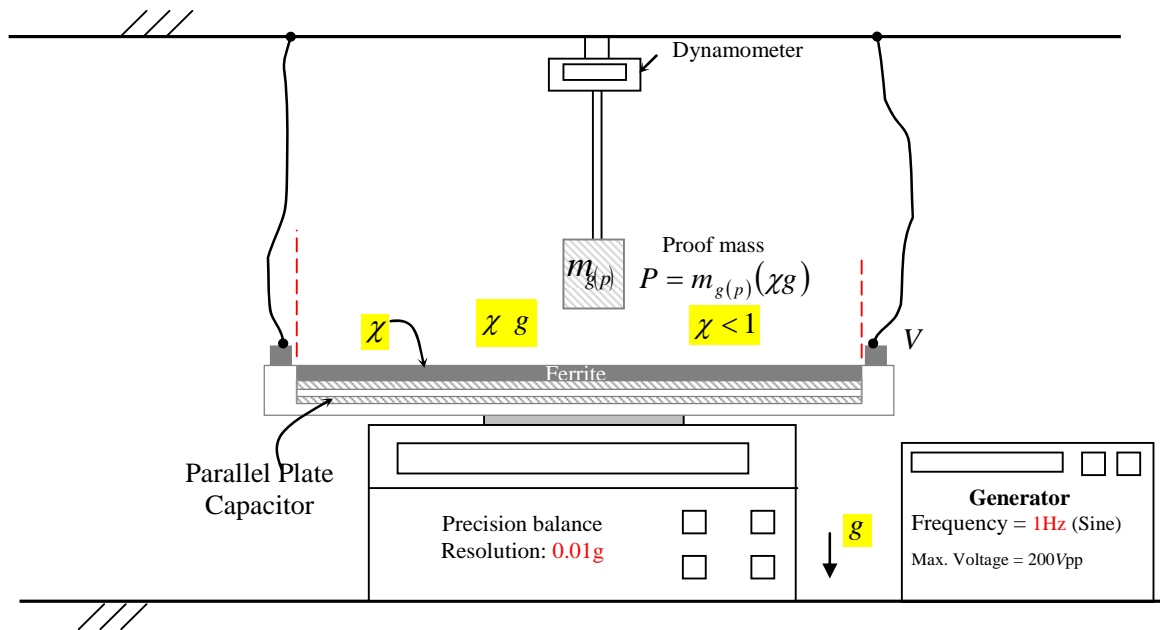


Fig. 1 – Experimental set up for controlling the *Gravitational Mass* of the Ferrite Lamina, and the *Gravity* acceleration above it. Note that the Ferrite Lamina has inertial mass $m_{i(\text{ferrite})} = 0.20 \times 0.20 \times 2 \times 10^{-3} \times 5000 = 0.4\text{kg}$. Thus, the precision balance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

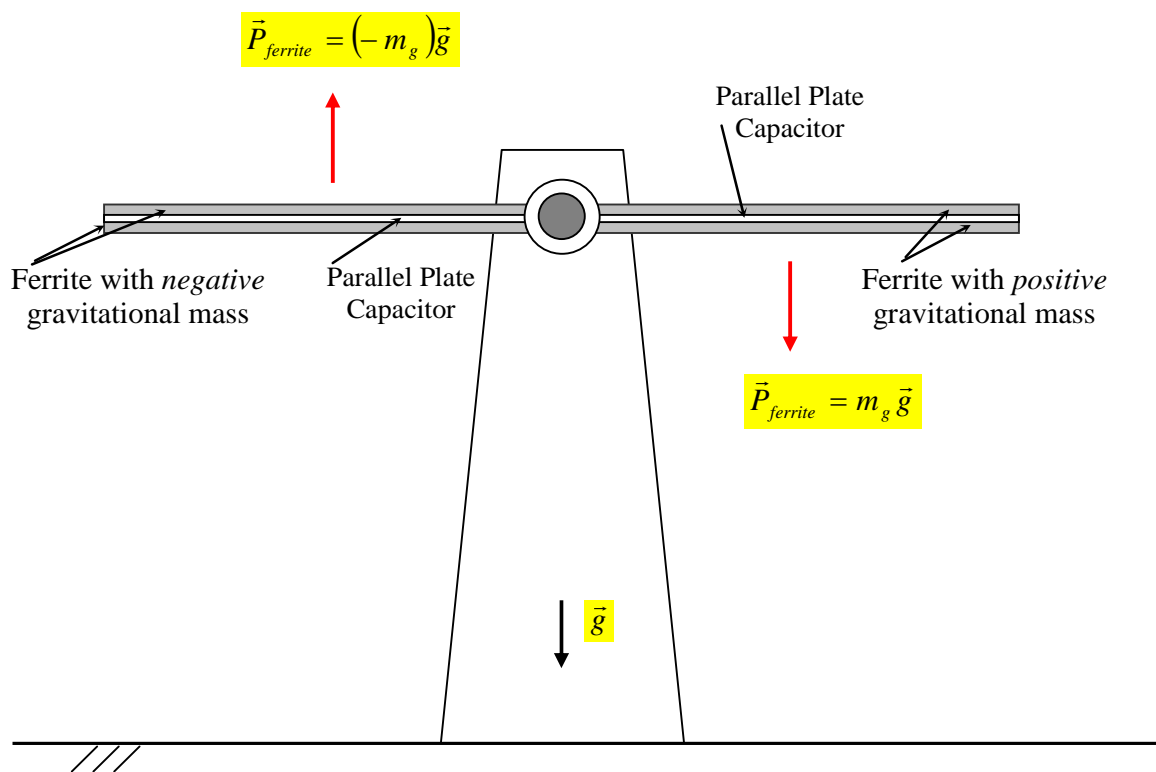


Fig. 2 – *Gravitational Motor*. Conversion of Gravitational Energy into Rotational Energy/Electric Energy.

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.