Decreasing of the *Gravitational Mass* of *Lithium* and *Magnesium*, when subjected to an Alternating Magnetic Field of 0.01μHz.

Fran De Aquino
Professor Emeritus of Physics, Maranhao State University, UEMA.
Titular Researcher (R) of National Institute for Space Research, INPE

http://users.elo.psi.br/~deaquino/ ; deaquino@elointernet.com.br

Function Generators capable of generating sine waves down to $0.01\mu Hz$ frequency have recently emerged only. This means that, just now we can carry out experiments to check the decreasing of *Gravitational Mass* of a body, when subjected to alternating magnetic fields with frequency less than $1\mu Hz$ (Minimum technological limit for frequency of the previous Function Generators). Here, we propose experiments to check the decreasing of *Gravitational Mass* of light metals *Lithium* and *Magnesium*, when subjected to magnetic fields with $0.01\mu Hz$ frequency.
Key words: Gravitational Mass, Magnetic Field of Extremely Low Frequency.

INTRODUCTION

In previous papers, we have proposed experiments to check the decreasing of *Gravitational Mass* of the *Magnesium* [1] and Superconductor LK-99 [2], when subjected to alternating magnetic fields of Extremely Low Frequency (down to $1\mu Hz$).

Now, with the appearing of the Function Generators capable of generating sine waves down to $0.01\mu Hz = 10^{-8}\,Hz$ frequency [3], we propose experiments to check the decreasing of *Gravitational Mass* of light metals *Lithium* and *Magnesium*, when subjected to magnetic fields with specific frequency of $0.01\mu Hz$.

THEORY

We have show that there is a correlation between the gravitational mass, m_g, and the rest inertial mass m_{i0}, which is given by [4]

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

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.

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 $B = \mu H$, $E/B = \omega/k_r$ [5] 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 $\mu_0 = 4\pi\times10^{-7}\,H/m$; σ is the electrical conductivity in *S/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.,

$$E = vB = v\mu H \qquad (5)$$

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

$$W = \tfrac{1}{2}\varepsilon\, v^2\mu^2 H^2 + \tfrac{1}{2}\mu H^2 = \\ = \tfrac{1}{2}\mu H^2\left(\varepsilon v^2 \mu\right) + \tfrac{1}{2}\mu H^2 = \mu H^2 \qquad (6)$$

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

$$n_r^2 = \frac{c^2}{v^2} = \frac{\mu\sigma}{2\omega}c^2 \qquad (7)$$

Substitution of Eqs. (6) and (5) into Eq. (1) gives

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1+\left(\frac{\mu^3\sigma}{4\pi f\rho^2 c^2}\right)H^4} - 1\right]\right\} \qquad (8)$$

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

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1+\left(\frac{\mu^4\sigma}{4\pi\ \mu\ f\rho^2 c^2}\right)H_{rms}^4} - 1\right]\right\} =$$

$$= \left\{1 - 2\left[\sqrt{1+\left(\frac{\sigma}{4\pi\ f\mu\rho^2 c^2}\right)B_{rms}^4} - 1\right]\right\} \qquad (9)$$

NEW SUGGESTED EXPERIMENT

Consider the schematic diagram of the system shown in Fig.1.

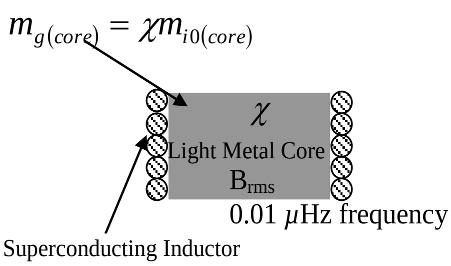

Fig. 1 - Superconducting inductor with light metal core (*Lithium* or *Magnesium*).

The magnetic field, B_{rms}, with 0.01μHz frequency, generated by the superconducting inductor can strongly reduce the *Gravitational Mass* of light metal core (*Lithium* or *Magnesium*), which, according to Eq. (9), becomes $m_{g(core)} = \chi m_{i0(core)}$, where χ for $f = 0.01\mu Hz = 10^{-8}\,Hz$, is given by

$$\chi = \frac{m_{g(core)}}{m_{i0(core)}} = \left\{1 - 2\left[\sqrt{1+\left(\frac{7\times10^{-5}\sigma}{\rho^2}\right)B_{rms}^4} - 1\right]\right\} \qquad (10)$$

Let us now consider that the core is made with *Lithium* (Li), whose characteristics are given by: $\sigma = 1.08\times10^7\,S/m$; $\rho = 535kg/m^3$. Substitution of theses values into Eq. (10) yields

$$\chi = \frac{m_{g(core)}}{m_{i0(core)}} = \left\{1 - 2\left[\sqrt{1+2.6\times10^{-3}B_{rms}^4} - 1\right]\right\} \qquad (11)$$

For $B_{rms} = 7.85\ T$ * Eq. (11) gives

$$\chi = -3.6 \qquad (12)$$

Thus, the *weight* P of the *Li* cylindrical core becomes

$$P_{(core)} = m_{g(core)}g = \chi\ m_{i0(core)}g \\ = -3.6 m_{i0(core)}g \qquad (13)$$

For example, if $m_{i0(core)} = 6699kg$ ($12.52m^3$ of Li) the result is

$$P_{(core)} = -3.6 m_{i0(core)}g = \\ = -24116.4g = -236{,}34kN \qquad (14)$$

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* Modern *magnetic resonance imaging systems* work with magnetic fields up to 8*T* [6, 7].

On the other hand, if the core is made with *Magnesium (Mg)*, whose characteristics are: $\sigma = 2.2\times10^{7}\,S/m$ and $\rho = 1738kg/m^{3}$, then the substitution of theses values into Eq. (10) gives

$$\chi = \frac{m_{g(core)}}{m_{i0(core)}} = \left\{1 - 2\left[\sqrt{1+5\times10^{-4}B_{rms}^{4}} - 1\right]\right\} \quad (15)$$

For $B_{rms} \cong 11.85\ T$ † Eq. (15) gives

$$\chi = -3.6$$

Thus, the *weight* P of the *Mg* cylindrical core becomes

$$P_{(core)} = m_{g(core)}g = \chi\ m_{i0(core)}g$$
$$= -3.6m_{i0(core)}g \quad (16)$$

For example, if $m_{i0(core)} = 6699kg$ ($3.8m^{3}$ of Mg) the result is

$$P_{(core)} = -3.6m_{i0(core)}g =$$
$$= -24116.4g = -236{,}34kN \quad (17)$$

The system shown in Fig. 1 has many possibilities for various applications. In Fig.2 we show one of them (rockets).

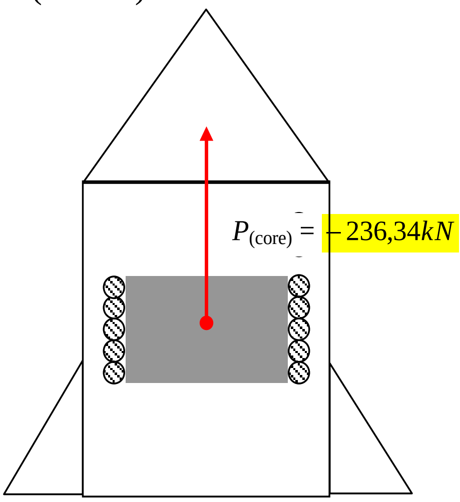

Fig. 2 – Assuming that the rocket inertial mass (without the cylindrical core) is $m_{i0(rocket)} = 15\ ton$, then the acceleration of the rocket will be given by $a_{rocket} = P_{(core)}/m_{i0(rocket)} = 15.7m.s^{-2}$.

† Currently, medical magnetic resonance imaging systems work experimentally with up to 11.7 T [8, 9, 10].

Another application is in the *Gravity Control*. In a previous paper [4], we have show that, if the gravity below a plate is g then, the gravity above the plate is $g' = \chi g$, where χ is given by $\chi = m_{g(plate)}/m_{i0(plate)}$.

CONCLUSION

We have shown in this paper that by using magnetic fields $0.01\mu Hz$ frequency, and with intensities similar to the magnetic fields produced by the medical magnetic resonance imaging systems it is possible to produce strong decreasing of *Gravitational Mass* of light metals *Lithium* and *Magnesium*.

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