The Intrinsic Magnetic Field of Magnetic Materials and Gravitomagnetization

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Magnetic materials are composed of microscopic regions called *magnetic domains* that act like tiny permanent magnets. Before an external magnetic field to be applied on the material, the domains' magnetic fields are oriented randomly. Most of the domains' magnetic fields cancel each other out, and so the resultant magnetic field is very small. Here we derive the expression of this *intrinsic magnetic filed*, which can be used to calculate the magnitude of the Earth's magnetic field at the center of the Earth's inner core. In addition, it is also described a *magnetization* process using *gravity*. This is *gravitational magnetization process* (or *gravitomagnetization* process) since the magnetization is produced starting from gravity. It is absolutely new and unprecedented in the literature.

Key words: Gravitomagnetization, High Saturation Magnetization, Earth's Magnetic Field, Magnetic Domains.

1. Introduction

Before an external magnetic field to be applied on the material, the domains' magnetic fields are oriented randomly. Most of the domains' magnetic fields cancel each other out, and so the resultant magnetic field is very small. Here we derive the expression of this *intrinsic magnetic filed*. This equation is very important because can be used to calculate the magnitude of the Earth's magnetic field at the center of the Earth's inner core, and because leads to a *magnetization* process using *gravity*. Basically this process consists in the following: a magnetic material is placed on a *Gravity Control Cell* (GCC)* [1]. When it is actived, the magnetic material is magnetized and acquires a magnetic field, whose intensity is proportional to the *square* correlation factor, $\chi_{(GCC)} = m_g/m_{i0}$, between gravitational mass (m_g) and rest inertial mass (m_{i0}) of GCC's *nucleus*. Thus, by increasing the factor $\chi_{(GCC)}$ it is possible to obtain a high level of magnetization. This is highly relevant because it makes possible to produce *permanent magnets* of low cost with *ultra-high magnetic fields*† .

Since the magnetization is produced starting from gravity we can say that this is a *gravitational magnetization process* (or *gravitomagnetization* process), which is a process absolutely new and unprecedented in the literature.

2. Theory

It was shown that correlation factor, $\chi = m_g/m_{i0}$, between gravitational mass and rest inertial mass can be put in the following forms [3]:

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

$$\chi = \frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1 + \left(\frac{W}{\rho\, c^2}n_r\right)^2} - 1\right]\right\} \tag{2}$$

where U is the electromagnetic energy absorbed by the particle and n_r is its index of refraction; W is the density of electromagnetic energy on the particle (J/m^3); ρ is the matter density of the particle; c is the speed of light.

In a previous paper it was shown that the *Stefan-Boltzmann* equation is a particular case of the expression below, which contains the correlation factor, $\chi = m_g/m_{i0}$ [4]:

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* The GCC is a device of gravity control based on a gravity control process patented on 2008 (BR Patent Number: PI0805046-5, July 31, 2008[2]).

† Magnetic fields of several Tesla can of course be generated by copper coils. But this requires some *megawatts* of energy. For certain applications like magnetic bearings and motors the use of *magnets represents solutions more elegant and also less expensive.*

$$D=\chi^4\sigma_B T^4 \quad (3)$$

where D is the surface power density (in $watts\,.m^{-2}$); $\sigma_B = 5.67\times10^{-8}\, watts/m^2\,{}^\circ K^4$ is the *Stefan-Boltzmann's constant*, and T is the absolute temperature (in *K*).

Electrodynamics tells us that D can be expressed by means of the following expression:

$$D=\frac{c}{4}W \quad (4)$$

where $W=\frac{1}{2}\varepsilon_r\varepsilon_0E^2+\frac{1}{2}\mu_r\mu_0H^2$ is the well-known expression for the volumetric density of electromagnetic energy; E and H are respectively, the electric field and magnetic field, whose produce the surface power density D; ε_r is the relative permittivity of the mean; μ_r is the relativity permeability of the mean; $\varepsilon_0 = 8.854\times10^{-12}F/m$; $\mu_0 = 4\pi\times10^{7}H/m$.

If $E=0$ the expression of W reduces to

$$W=\frac{1}{2}\mu_r\mu_0H^2=\frac{B^2}{2\mu_r\mu_0} \quad (5)$$

Substitution of Eq. (5) into Eq. (4) gives

$$D=\frac{cB^2}{8\mu_r\mu_0} \quad (6)$$

We known that magnetic materials are composed of microscopic regions called *magnetic domains* that act like tiny *permanent magnets*. Most of the domains magnetic fields cancel each other out, and so the magnetic field resultant of the random orientation of the domains' magnetic field is very small. The volumes of the magnetic domains changes with the type of magnetic material. When the volumes are *smaller* the density of magnetic energy, D, in the magnetic material is *higher*, showing that D is *inversely proportional* to the volumes of the magnetic domains. This fact point to the existence of a reference volume V_0 related to the average volume V_d of the magnetic domains, in such way that

$$D=\left(\frac{V_0}{V_d}\right)\frac{cB^2}{8\mu_r\mu_0}=\frac{cB^2}{8\eta\mu_r\mu_0} \quad (7)$$

where $\eta = V_d/V_0$ and B is the intensity of the *intrinsic magnetic field*, which results from the random orientation of the domains' magnetic fields, at the magnetic center of the set of magnetic domains that form the body.

By comparing Eq. (7) with Eq. (3), we get

$$B=\left(\frac{8\eta\mu_r\mu_0\sigma_B}{c}\right)^{\frac{1}{2}}\chi^2T^2 \quad (8)$$

Note that the value of B is usually very small at ambient temperature. For example, in the case of *iron* $(\mu_r \cong 4{,}000)$ at ambient temperature $(T\cong 300K)$, and $\eta\approx1$, $\chi\cong1$, Eq. (8) gives

$$B\approx10^{-4}Tesla \quad (9)$$

This is the order of magnitude of Earth's magnetic field $(B_\oplus \cong 6\times10^{-5}Tesla)$.

In the case of iron, the *Curie temperature* increases dramatically (and also the *melting temperature*) at very high pressures (*Clausius-Clapeyron equation*) [5]. This is the case, for example, of Earth's inner core, which is basically composed of *iron* with about 6% of Nickel [6], and is subjected to pressure of about 360GPa, and temperature of about 5,700*K*. Under these conditions, the Earth's inner core is *solid* and *maintains its magnetic properties* $(\mu_r \cong 4{,}000)$. In this case, the intensity of the magnetic field at the inner core's center, given by Eq. (8), is

$$B\approx10^{-1}Tesla \quad (10)$$

The value of B measured in the *border* of the inner core is $B_{border}=2.5\times10^{-3}Tesla$.

Obviously that, at the center of the inner core, the value of B is much larger than B_{border} .

The *quantization* of gravity shown the existence of the *Gravitational Shielding effect* [3], which is *produced by a substance whose gravitational mass was reduced or made negative*. 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 when $\chi \to 0$. 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 $g' = \chi g$.

If we take two parallel gravitational shieldings, with χ_1 and χ_2 respectively, then the gravitational masses become: $m_{g1} = \chi_1 m_g$, $m_{g2} = \chi_2 m_{g1} = \chi_1 \chi_2 m_g$, and the gravity will be given by $g_1 = \chi_1 g$, $g_2 = \chi_2 g_1 = \chi_1 \chi_2 g$. In the case of multiples gravitational shieldings, with $\chi_1, \chi_2, \ldots, \chi_n$, we can write that, after the n^{th} gravitational shielding the gravitational mass, m_{gn}, and the gravity, g_n, will be given by

$$m_{gn} = \chi_1 \chi_2 \chi_3 \ldots \chi_n m_g \,, \quad g_n = \chi_1 \chi_2 \chi_3 \ldots \chi_n g \qquad (11)$$

This means that, n superposed gravitational shieldings with different $\chi_1, \chi_2, \chi_3, \ldots, \chi_n$ are equivalent to a single gravitational shielding with $\chi = \chi_1 \chi_2 \chi_3 \ldots \chi_n$.

The *Gravity Control Cell* (GCC) ‡ is a gravity control device that was developed in order to realize the possibilities of the *Gravitational Shielding effect* [2]. By controlling the *gravitational mass* of the nucleus of the GCC $\left(m_{g(GCC)} = \chi_{(GCC)} m_{i0(GCC)}\right)$ it is possible to control the gravity acceleration just above the GCC, g', since $g' = \chi_{(GCC)} g$; g is the gravity acceleration below the GCC.

‡ BR Patent Number: PI0805046-5, July 31, 2008.

Now consider a *magnetic material* just above a GCC, both GCC and magnetic material are at the same temperature, T, as shown in Fig.1. If the gravitational mass of the nucleus of the GCC is $m_{g(GCC)} = \chi_{(GCC)} m_{i0(GCC)}$. Then, according to Eq. (3), we have

$$D_{GCC} = \chi^4_{GCC} \sigma_B T^4 \qquad (12)$$

Similarly, if the gravitational mass of the magnetic material above the GCC is $m_{g(mm)} = \chi \; m_{i0(mm)}$. Then, considering the gravitational shielding effect produced by the GCC, and Eq.(3), we have the following density, D, in the magnetic material:

$$D = \chi^4_{GCC} \chi^4 \sigma_B T^4 \qquad (13)$$

By comparing Eq. (13) with Eq. (7), we get

$$B = \left(\frac{8 \eta \mu_r \mu_0 \sigma_B}{c} \right)^{\frac{1}{2}} \chi^2_{GCC} \chi^2 T^2 \qquad (14)$$

For $\chi_{GCC} = 1$ (absence of the GCC) this equation reduces to Eq. (8).

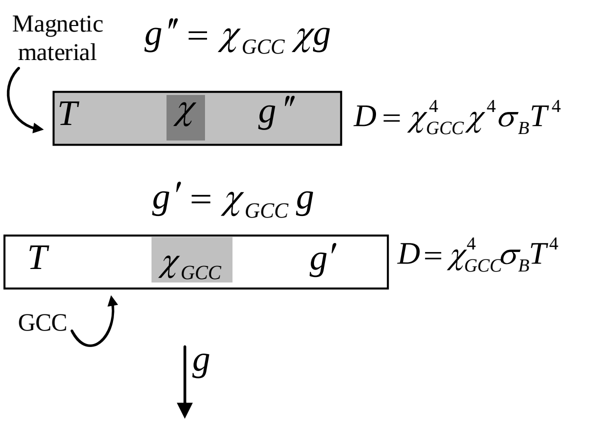

Fig. 1 – *Gravitomagnetization Process*. When a magnetic material is placed just above a Gravity Control Cell (GCC), the surface density, D, inside the magnetic material becomes $D = \chi^4_{GCC} \chi^4 \sigma_B T^4$. The weight of the GCC *nucleus* is $P_{(GCC)} = m_{g(GCC)} g' = m_{i0(GCC)} \left(\chi_{(GCC)} g\right)$, and the weight of the magnetic material is given by $P = m_{g(mm)} g'' = m_{i0(mm)} \left(\chi \chi_{(GCC)} g\right)$.

It is important to note that Eq. (14) tells us that B *can be increased by increasing the factor* χ_{GCC} (also by increasing χ). This means then that the intensity of the magnetic field can be *increased by gravitational action*. Thus, we can conclude that, in this case, we have a *gravitomagnetization* process. However, is also important to note that this increase in the intrinsic magnetic field of the material is limited by the *saturation magnetic field* of the magnetic material. In the case of iron, for example, this limit is of the order of 2 Tesla [7] whereas ferrites saturate at 0.2 – 0.5 Tesla [8]. But, there are magnetic alloys which have the saturation magnetic fields much larger than the of iron. Thus, in practice, it will be possible to produce *permanent magnets* with *very high values of* B simply putting specific magnetic materials just above a GCC, which was developed to produce the desired magnetization.

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