# Ultra-Conductive Magnesium

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The improvement of the electrical conductivity of usual metals is limited by the *purity* of the metal and the ability to grow single crystal structures. Also, it was observed that the AC conductivity of the metal increases when the frequency of the electrical current applied on the conductor increases. Here, we show that the pure *Magnesium* metal can exhibit an *ultrahigh* electrical conductivity when it is subjected to 360K temperature, and an electrical current with frequency of the order of 1GHz.

**Key words:** Ultra-conductivity, Pure Magnesium, GHz.

## INTRODUCTION

There is a search for conductors with *ultrahigh* electrical conductivity because they can lead to higher efficiency and less energy consumption in a wide range of applications.

By embedding graphene in metals (Cu, Al, and Ag), it was recently obtained a maximum electrical conductivity three orders of magnitude higher than the highest on record (more than 3,000 times higher than that of Cu, i.e., $\cong 10^{11}\,S/m$) is obtained in such embedded graphene [1]. The improvement of the electrical conductivity of usual conductors is basically limited by the purity of the metal. However, experimental studies show that the AC conductivity of some metals *increase* when the *frequency* of the electrical current applied on the metal *increases* [2]. It is here shown that the pure *Magnesium* metal can exhibit an *ultrahigh* electrical conductivity when subjected to 360K (87°C) temperature, and an electrical current with frequency of the order of 1GHz. Why prioritize the *Magnesium*? First because, is relatively easy to obtain Magnesium highly pure (99.999%). Second because, *ultra-conductive Magnesium* can be fundamental for the building of several novel devices, such as *Gravitational Motors*, *Gravitational Thruster of Fluids*, production of *Microgravity environments*, and a *Cooling and Heating Gravitational System* [3].

## THEORY

The AC electric conductivity is the electric conductivity originated from a potential dependent of time (For example, when AC current is *applied* on a conductor). The DC electric conductivity does not depend on the time; this conductivity is the well-known electrical conductivity that arises when a DC source is applied on the conductor. Thus, total electrical conductivity of a conductor is given by [2].

$$\sigma_{total} = \sigma_0 + \sigma_{AC} \tag{1}$$

where $\sigma_0$ is the part of the total conductivity which value is frequency-*independent* and temperature-dependent, it which arises from the drift mobility of electric charge carriers. So $\sigma_0$ is actually DC electrical conductivity; $\sigma_{AC}$ is the part of the total conductivity which value is the frequency - and temperature – dependent, and is correlated to dielectric relaxation produced by localized electric charge carriers; usually $\sigma_{AC}$ is expressed by

$$\sigma_{AC} = \sigma^*\left(\frac{\omega}{\omega_0}\right)^s = k\sigma_{DC}\left(\frac{\omega}{\omega_0}\right)^s = \sigma_{DC}\left(\frac{\omega^s}{\omega_c^s}\right) \tag{2}$$

where $\sigma^*$ and $s$ are composition – and temperature-dependent parameters; $0 < s < 1$ [2]. $w = 2\pi f$ ; $\omega_c = 2\pi f_c$, where $f_c$ is a critical value to be determined.

Substitution of Eq. (2) into Eq. (1) gives

$$\sigma_{total} = \sigma_{DC}\left(1 + \frac{f^s}{f_c^s}\right) \tag{3}$$

Therefore, the total electrical conductivity of a conductor is directly proportional to the *frequency* $f$ *of the electrical current applied* on the conductor [4].

In the particular case of $f^s / f_c^s >> 1$ Eq. (3) reduces to

$$\sigma_{total} \cong \left(\frac{f}{f_c}\right)^s \sigma_{DC} \tag{4}$$

Experimental studies have revealed that

below 10 *GHz* the frequency as well as the temperature effect is negligible [2] (*this point to a value of the order of* 10 *GHz for critical frequency* $f_c$ *at room temperature*). At higher temperature, however, there is an increasing contribution resulting from ion mobility and crystal imperfection mobility. Also, at a higher temperature, *conductivity effect becomes dominant*. As the temperature increases, AC electrical conductivity increase due to increase in the drift mobility of thermally activated electrons [5], and *reaches a maximum value at a critical temperature* $T_C \cong$ *360K* (87°C), then decreases with temperature [2]. On the other hand, since Eq. (2) tells us that

$$\omega_c^s = \frac{\omega_0^s}{k} = \frac{(2\pi f_0)^s}{k} = (2\pi f_c)^s \qquad (5)$$

where $k = \sigma^* / \sigma_{DC}$ (See Eq. 2). Then, Eq. (5) gives

$$f_c^s = \frac{f_0^s}{k} = f_0^s\left(\frac{\sigma_{DC}}{\sigma *}\right) \qquad (6)$$

or

$$f_c = f_0\left(\frac{\sigma_{DC}}{\sigma *}\right)^{\frac{1}{s}} \qquad (7)$$

It is well-known that $\sigma^*$ is temperature – dependent, and that it *increases much more* with the increase of the *temperature* than $\sigma_{DC}$ [2]. Then, assuming that

$$\sigma_{DC} = \sigma F(T) \approx \sigma \qquad (F(T) \approx 1) \qquad (8)$$

$$\sigma^* = \sigma F^*(T) \cong \sigma f_0^{s\left(\frac{T}{T_C}\right)} \qquad \left(F^*(T) \cong f_0^{s\left(\frac{T}{T_C}\right)}\right) \qquad (9)$$

where $F(T)$ and $F^*(T)$ are, respectively, temperature-functions of $\sigma_{DC}$ and $\sigma^*$, and $T_C \cong$ *360K* (87°C) is the *critical temperature* previously mentioned.

Substitution of Eq. (8) and Eq. (9) into Eq. (7) yields

$$f_c^s = f_0^s\left(\frac{f_0^s}{f_0^s}\frac{\sigma}{\sigma f_0^{s\left(\frac{T}{T_C}\right)}}\right) = \left(\frac{f_0^s}{f_0^{s\left(\frac{T}{T_C}\right)}}\right) = \left(f_0^{1-\frac{T}{T_C}}\right)^s \qquad (10)$$

whence

$$f_c = f_0^{\left(1-\frac{T}{T_C}\right)} \qquad T \le T_C \qquad (11)$$

As we have seen, $f_c \cong 10GHz$ at room temperature $(T = 25°C)$. Then, assuming that $T_C \cong 87°C$, we obtain from Eq. (11):

$$f_0 \cong 10^{14}\,Hz \qquad (12)$$

Therefore, according to Eq. (11), we have

For $T = 0°C \Rightarrow f_C = 10^{14}\,Hz$ ;

For $T = \frac{1}{4}T_c \cong 21.7°C \Rightarrow f_C = 31GHz$

For $T = \frac{1}{3}T_c \cong 29°C \Rightarrow f_C = 2.1GHz$

For $T = \frac{1}{2}T_c \cong 43.5°C \Rightarrow f_C = 10MHz$

For $T = T_c \cong 87°C \Rightarrow f_C = 1Hz$

Therefore, based on Eq. (11), we can conclude that $f_c$ strongly *decreases with the increasing of the temperature* $T$. At $T = T_C$ the value of the critical frequency $f_c$ should reach the maximum decrease, reducing down to 1Hz only. Under these conditions, for $f \approx 1GHz$, the factor $f/f_c$ (See Eq. 4) should reach a value of the order of $10^9$. Increasing therefore, the total electrical conductivity of the Magnesium for a value of the order of $10^{16}\,S/m$, since the DC electrical conductivity of Mg is about $2.2\times10^7\,S/m$. Note that the ultra-conductivity in this case is about $10^5$ times higher than the record of $\cong 10^{11}\,S/m$, which it was obtained in the case of embedded graphene, mentioned in the introduction of this paper.

When Magnesium is in its metal form it will burn very easily in air. However, in order to start the reaction (the burning) the Magnesium metal needs a source of energy. The flame provides a source of heat so that the Magnesium metal atoms can overcome their activation energy. The ignition temperature of Magnesium is approximately 744 K (471 °C).

Glass ampoule (Magnesium in this ampoule with argon will remain shiny forever.)

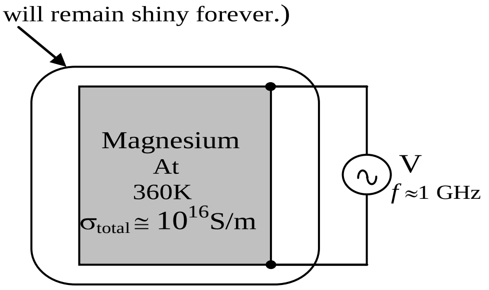


Fig.1 – *Ultra-conductive Magnesium* - Magnesium metal 99.999% pure should exhibits an electrical conductivity of the order of $10^{16}$ S/m when subjected to 360K temperature, and an electrical current with frequency of the order of 1GHz.

**CONCLUSION**

Only experimental studies can determine with precision the value of $f_c$ at around 360K. Thus, in conclusion, we suggest that experiments be carried out in order to verify the theoretical results here obtained.

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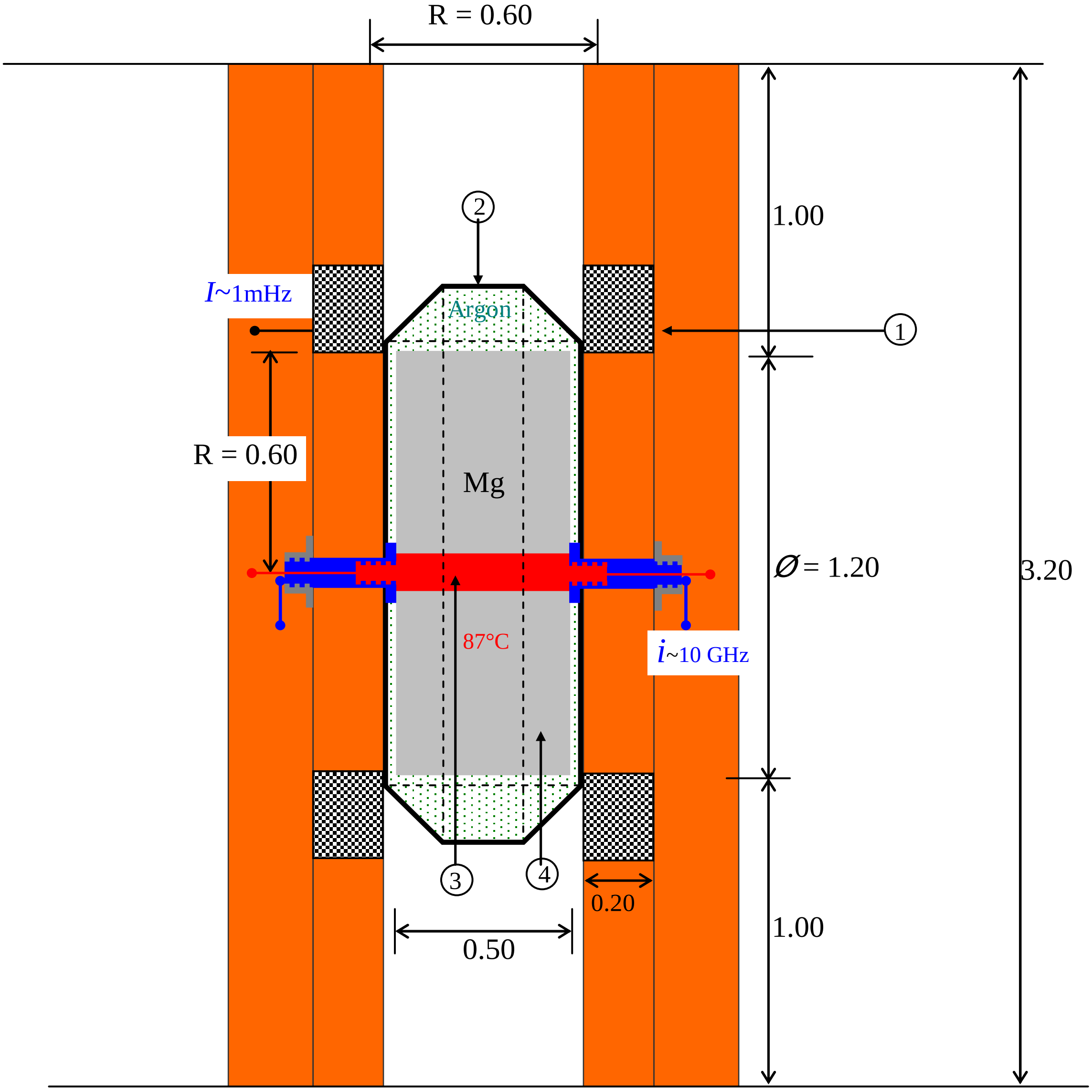
**APPENDIX A: The Reactor for Gravitational Spacecraft.**




1 Helmholtz Coils ( $N$ turns, $I$ ELF, $f_H$ =1mHz); 2 Polyhedron of Acrylic Crystal; 3 Heater (Titanium); 4 99.999% Pure Magnesium Cylinder.

$$B = 0.7\left(\mu_r \mu_0 NI/R\right) \quad \text{(Helmholtz Coils)}$$

For $N = 3200\,turns$; $I = 150\,A$; $\mu_r \cong 1$; $R = 0.60\,m$, we get $B_{rms} \cong 0.6\ T$.

Since $$\chi = \frac{m_{g(Mg)}}{m_{i0(Mg)}} = \left\{1 - 2\left[\sqrt{1 + \left(\frac{\sigma}{4\pi\ f_H \mu_0 \rho_{Mg}^2 c^2}\right) B_{rms}^4} - 1\right]\right\}$$

then, for $f \approx 10GHz \Rightarrow f/f_C \approx 10^{10} \Rightarrow \sigma \cong 1\times10^{18}\,s/m$, $f_H = 1mHz$, $\rho = 1738\,kg/m^3$ (Magnesium) and $B_{rms} \cong 0.6\ T$, equation above gives

$$\chi = \left(m_{g(Mg)}/m_{i0(Mg)}\right) \cong -8$$

Since $m_{i0(Mg)} = \rho_{Mg} V_{Mg} = 1738 \times 0.565 = 982\,kg$; $\Rightarrow \chi\ m_{i0(Mg)} \cong -7800\ kg$

**APPENDIX B:**

Now we repeat here some topics shown in the paper: **“**Deceasing of Gravitational Mass of the *Magnesium* subjected to an Alternating Magnetic Field of Extremely Low Frequency (2021)”. The objective is to compare the efficiency of the devices shown in the mentioned topics, when they use *Magnesium* simply, or *Ultra-conductive Magnesium*.

## Below, the above mentioned Topics

**INERTIAL PROPERTIES**

Now, we will show how the *Inertial Properties* of a Spacecraft can be strongly reduced.

Consider the schematic diagram of a spacecraft shown in Fig. 1. At the center of the spacecraft there is a *Magnesium Core, subjected* to an alternating magnetic field $B_{rms}$ with *Extra-low frequency*, $f$ *. According to Eq. (10), the *gravitational mass of the Magnesium core,* $m_{gC}$, is expressed by the following equation:

$$m_{gC}=\left\{1-2\left[\sqrt{1+\frac{5.1\times10^{-12}B_{rms}^{4}}{f}}-1\right]\right\}m_{i0C} \qquad (14)$$

In the equation (14), $m_{i0C}$ is the *rest* inertial mass of the Magnesium Core.

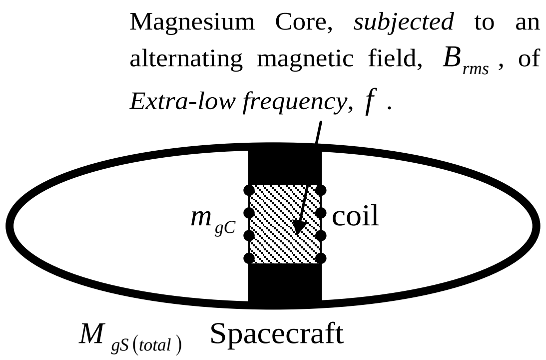



Fig.1 – Schematic diagram of an Ellipsoidal Spacecraft

Then, the *total* gravitational mass of the spacecraft, $M_{gS(total)}$, can be expressed by means of the following expression:

$$M_{gS(total)}=M_{gS}+m_{gC} \qquad (15)$$

where $M_{gS}$ is the total gravitational mass of the spacecraft *without* the gravitational mass of the Magnesium core. Assuming that density of *external* electromagnetic energy in $M_{gS}$ is negligible, then we can write that $M_{gS}\cong M_{i0S}$, where $M_{i0S}$ is the *rest* inertial mass of the spacecraft (without the Magnesium core). Thus, Eq. (15) can be rewritten as follows:

$$M_{gS(total)}\cong M_{i0S}+m_{gC}=$$

$$\cong M_{i0S}+\left\{1-2\left[\sqrt{1+\frac{5.1\times10^{-12}B_{rms}^{4}}{f}}-1\right]\right\}m_{i0C} \qquad (16)$$

Therefore, for $\left(5.1\times10^{-12}B_{rms}^{4}/f\right)>>1$, we get

$$M_{gS(total)}\cong M_{i0S}-\left[\sqrt{\frac{5.1\times10^{-12}B_{rms}^{4}}{f}}\right]m_{i0C} \qquad (17)$$

For example, if $M_{gS}\cong M_{i0S}=10{,}000kg$; $m_{i0C}=5{,}000kg$; $f=0.1Hz$ and, $B_{rms}\cong 529T$ , then Eq. (17) yields

$$M_{gS(total)}<8kg.$$

This means that the weight of the spacecraft becomes less than 80N.

Now, using *Ultra-conductive Magnesium*, ($\sigma\cong1\times10^{18}s/m$); $\rho=1738kg/m^{3}$, we get

$$m_{gC}=\left\{1-2\left[\sqrt{1+\left(\frac{\sigma}{4\pi\ f\mu_0\rho^2c^2}\right)B_{rms}^{4}}-1\right]\right\}m_{i0C}=$$

$$=\left\{1-2\left[\sqrt{1+\left(0.23\frac{B_{rms}^{4}}{f}\right)}-1\right]\right\}m_{i0C}$$

Compare with Eq. (14). Note that, with just $B_{rms}=1.14T$, it is possible to obtain the same value that is given by Eq. (17) for $B_{rms}\cong529T$.

*Mach’s principle* predicts that *inertial forces* acting on a particle are the result from the *gravitational* interaction between the particle and the other particles of the Universe. Thus, the inertial forces $F_{ii}$ acting on a particle are

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* Note that, another possibility is to apply the magnetic field *through the entire spacecraft*. In this case the coil must be, obviously, positioned in the *edges* of the spacecraft.

proportional to *gravitational mass*, $m_g$, of the particle, i.e., $F_{ii} = m_g a_i$ [1]. This fact shows that the inertial effects upon a spacecraft can be strongly reduced because, as we have seen, the *gravitational mass* of the spacecraft $M_{gS\,(total)}$ can be strongly reduced ($F_{ii} = M_{gS\,(total)} a_i$). In practice, it means that will be possible to become *quasi*-null the inertial properties of the spacecraft.

Under these circumstances, the spacecraft can describe incredible trajectories, and to make super accelerations and super decelerations in a very short time interval (<1s), without be destructed (See *The Gravitational Spacecraft* [4]).

## GRAVITY MULTIPLIER

In a previous paper [5] it was shown that, when the gravitational mass, $m_{g1}$, of a plate (*very thin plate*) is reduced by the factor $\chi_1 = m_{g1}/m_{i01}$, then the gravity acceleration *after* the plate, $g_1$, is reduced at the same proportion, i.e., $g_1 = \chi_1 g$ where $g$ is the gravity acceleration *before* the plate (See Fig. 2).

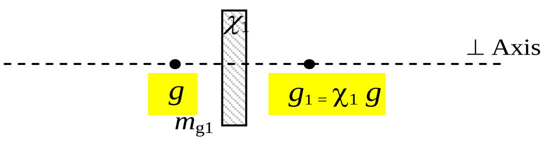


Fig. 2 - The gravity acceleration *after* the plate is $g_1 = \chi_1 g$ where $g$ is the gravity acceleration *before* the plate. The perpendicular axis of the plate can be in any direction.

Consequently, *after* a *second* plate, with gravitational mass, $m_{g2}$, the gravity becomes: $g_2 = \chi_2 g_1 = \chi_1 \chi_2 g$, where $\chi_2 = m_{g2}/m_{i02}$. In a generalized way, we can write that *after* the *nth* plate the gravity, $g_n$, will be given by

$$g_n = \chi_1 \chi_2 \chi_3 \cdots \chi_n g \tag{18}$$

If $\chi_1 = \chi_2 =, ..., = \chi_n = \chi < -1$, and $n$ is *odd* then, the gravitational forces, $F$, between a body B *before* the *first* plate and another body A *after* the *nth* plate are *repulsive* (See Fig.3), and given by

$$F = m_{gA} g_n = m_{gA}\left(\chi^n g\right) = m_{gA}\left(-\left|\chi^n\right|\right)\left(-G\frac{M_{gB}}{r^2}\right) =$$
$$= +\left|\chi^n\right| G \frac{M_{gB} m_{gA}}{r^2} \tag{19}$$

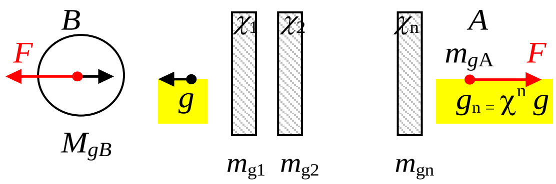


Fig. 3 – The gravity after a battery of plates

In this case, the plates have the same dimensions (with the same inertial mass $m_{i0P}$), and they are made of *Magnesium*, *subjected* to an alternating magnetic field, $B_{rms}$, with *Extra-low frequency*, $f$. If the gravitational masses of the plates are, $m_{gP}$, then, according to Eq. (10), we can write that

$$\chi = \frac{m_{gP}}{m_{i0P}} = \left\{1 - 2\left[\sqrt{1 + \frac{5.1\times10^{-12} B_{rms}^4}{f}} - 1\right]\right\} \tag{20}$$

If $f = 0.1Hz$ and $B_{rms} = 600\ T$, , Eq. (20) gives

$$\chi = m_{gP}/m_{i0P} \cong -2.5 \tag{21}$$

Then, the gravity after the $n = 5$ plate is

$$\chi^n = (-2.5)^5 = -97.6$$

Therefore, we get

$$g_n = \chi^n g = -97.6g \tag{22}$$

Thus, this system multiply the gravity, $g$, by $97.6\ times$.

Now, using *Ultra-conductive Magnesium*, ($\sigma \cong 1\times10^{18} s/m$); $\rho = 1738 kg/m^3$, we get

$$\chi = \left\{1 - 2\left[\sqrt{1 + \left(\frac{\sigma}{4\pi\ f\mu_0 \rho^2 c^2}\right) B_{rms}^4} - 1\right]\right\} =$$
$$= \left\{1 - 2\left[\sqrt{1 + \left(0.23\frac{B_{rms}^4}{f}\right)} - 1\right]\right\}$$

Compare with Eq. (20). Note that, with just $B_{rms} = 1.3T$, it is possible to obtain the same value that is given by Eq. (20) for $B_{rms} \cong 600T$.

We can use the Gravity Multipliers to convert *gravitational energy* into *rotational kinetic energy* by means of a Gravitational Motor, which design can be similar to the Internal Combustion Engine. In that Gravitational

Motor, the pistons can be designed as shown in Fig. 4.

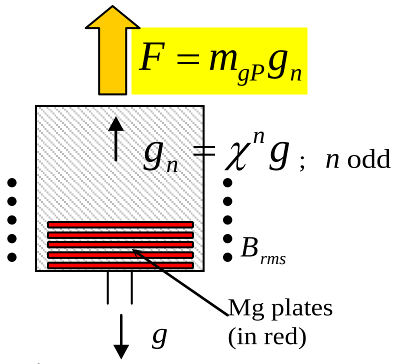


Fig. 4 – Gravitational Piston.
( $m_{gP}$ is the mass of the piston.)

Then, the gravitational force, $\vec{F}$, acting on *one* piston (See Fig.4) is

$$\vec{F} = m_{gP}\vec{g}_n \cong m_{i0P}\chi^n \vec{g} ; n \quad odd \qquad (23)$$

and the average power is $\bar{P} = F\bar{v}$, where

$$\bar{v} = \tfrac{1}{2}\sqrt{2aH} = \sqrt{|\chi^n g| H/2} \qquad (24)$$

where $H$ is the *stroke length* of the piston. Thus, we can write that

$$\bar{P} = F\bar{v} = m_{i0P}\sqrt{|\chi^n|^3 g^3 H/2} = m_{i0P}\sqrt{g_n^3 H/2} \quad (25)$$

For $\chi = -2.5$; $n = 5$; $g = 9.81 m.s^{-2}$; $g_n = -97.6g = -956.4$ (See Eq. (22)); $m_{i0P} = 5kg$ and $H = 0.15m$, then Eq.(25) gives

$$\bar{P} = 4\times 10^4 W = 40kW \cong 53HP \qquad (26)$$

For 4 *pistons* the total power is

$$\bar{P} \cong 212\ HP$$

**ANOTHER GRAVITATIONAL MOTOR**

In Fig.5, we show a schematic diagram of another type of Gravitational Motor, with different characteristics to the type previously proposed. Now the Gravitational Motor has 4 *Gravity Multipliers* (GM), which can be made with *plates* of *Magnesium*, *subjected* to an alternating magnetic field, $B_{rms}$, with *Extra-low frequency*, $f$.

The Gravity Multipliers, GM1, GM2 and the GM3 are placed below the rotor (See Fig.5); GM1 and GM2 on the right and GM3 on the left. Above the GM1 the local gravity, $\vec{g}$, is intensified for $\vec{g}' = \chi_1\chi_2\vec{g} = +N\vec{g}$, where $\chi_1 = -N$ and $\chi_2 = -1$ are the correlation factors for GM1 and GM2, respectively. Above the GM3 the local gravity becomes $\vec{g}'' = \chi_3\vec{g} = -N\vec{g}$, where $\chi_3 = -N$. The function of GM4 and GM5 (See Fig.5), is only to revert the gravity down to values very close to $g$.

As the gravity acceleration on the left *half* of the rotor becomes $\vec{g}'' = -N\vec{g}$ while the gravity acceleration on the right *half* of the rotor becomes $\vec{g}' = +N\vec{g}$, the torque on the rotor is

$$T = \left(-\vec{F}'' + \vec{F}'\right)\times\vec{r} = \\ = \left(-\tfrac{1}{2}m_g\vec{g}'' + \tfrac{1}{2}m_g\vec{g}'\right)\vec{r} \qquad (27)$$

( $m_g \cong m_{i0}$ is the mass of the rotor), and the rotor spins with angular velocity $\omega$.

Then, the average power, $P$, of the gravitational motor is given by

$$P = T\omega = Nm_{i0}g\omega\, r \qquad (28)$$

On the other hand, we have that

$$-g'' + g' = \omega^2 r \qquad (29)$$

Therefore the angular speed of the rotor is

$$\omega = \sqrt{2Ng/r} \qquad (30)$$

By substituting (30) into (28) we obtain the expression of the average power of the *gravitational motor*, i.e.,

$$P = Nm_{i0}gr\sqrt{\frac{2Ng}{r}} = m_{i0}\sqrt{2N^3g^3r} \qquad (31)$$

Now consider an electric generator coupling to the gravitational motor in order to produce electric energy. Since $\omega = 2\pi f$ then for $f = 60Hz$ we have

$$\omega = 120\pi rad.s^{-1} = 3600rpm \qquad (32)$$

Therefore for $\omega = 120\pi rad.s^{-1}$ and $\chi_1 = \chi_3 = -N = \chi^n = (-2)^7 = -128$, the Eq. (30) tells us that we must have

$$r = 2Ng/\omega^2 = 0.0176\ m \qquad (33)$$

Since $r = R/3$ and $m_{i0} = \rho\pi R^2 h$ where $\rho$, $R$ and $h$ are respectively the mass density, the *radius* and the height of the rotor then for $h = 0.25m$ and $\rho = 7800 Kg.m^{-3}$ (*Iron*), we get

$$m_{i0} = 17.1kg \qquad (34)$$

Thus, Eq. (31) gives

$$P \cong 1.4\times 10^5 W \cong 140\ kW \cong 187\ HP$$

Note that this electrical energy is produced *without the use of any type of fuel*, because the energy, which moves the Gravitational Motor comes from Earth's gravitational field, i.e., the Gravitational Motor converts directly energy from the Earth's gravitational field into rotational mechanical energy.

Thus, the Gravitational Motors are similar to the turbines of the hydroelectric plants. While the turbines convert energy from the Earth's gravitational field into rotational mechanical energy, by means of water of the rivers, this type of Gravitational Motors convert energy from the Earth's gravitational field *directly* into rotational mechanical energy, by using the GMs.

Finally, note the *small volume* of the rotor of this type Gravitational Motor, it shows that the total volume of the motor can be smaller than 1m3.

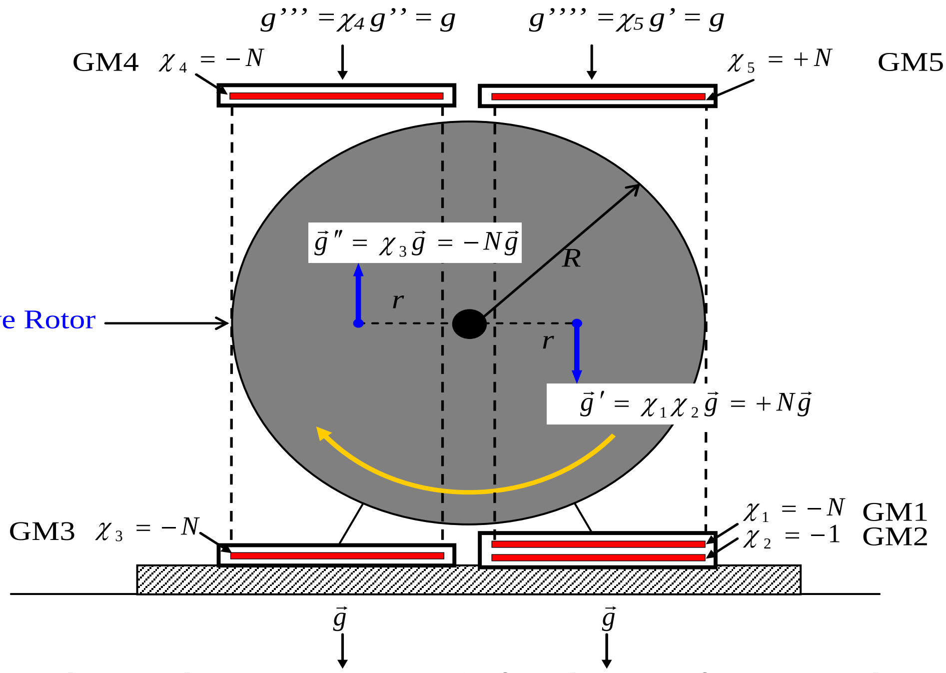


Fig. 5 – Schematic diagram (cross-section) of another type of Gravitational Motor.

## GRAVITATIONAL THRUSTER OF FLUIDS

The *Gravity Multipliers* can be used to make particles acquire enormous accelerations. In practice, this can lead to the conception of a *Gravitational Thruster of Fluids* (See Fig.6). In this case, the gravity acceleration *after* the *nth* plate, $g_n$, for $\chi = -2.5$ (See Eq. (21)), $n = 7$ and $g = 9.8 m.s^{-2}$, is given by

$$g_n = \chi^n g = (-2.5)^7 g \cong -5{,}981 m.s^{-2} \qquad (35)$$

In Fig.7 it is shown a schematic diagram of a *thruster system* - using a *Gravitational Thruster of Fluids*, for spacecrafts in the Earth's atmosphere. This system can be used to propeller the spacecraft in any direction.

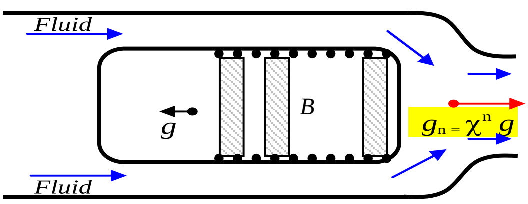


Fig. 6- *Gravitational Thruster of Fluids*

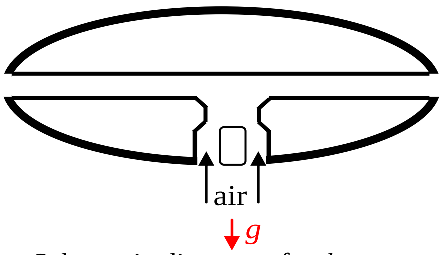


Fig.7 – Schematic diagram of a *thruster system* - using a *Gravitational Thruster of Fluids*, for spacecraft in the Earth's atmosphere.

## MICROGRAVITY ENVIROMENTS

In a previous paper [6] we described a way to produce *microgravity environments* at level of the Earth's surface, in order to "activate" the cellular *autophagy process*. After an infection, autophagy can destroy *bacteria* and *viruses*. Based on the theory here explained, it easy to see that, microgravity environments can be also produced using an *Mg* plate, subjected to an alternating magnetic field $B_{rms}$ with *Extra-low frequency*, $f$ (See Fig.8).

According Eq. (20), we get

$$\chi_1 = m_{gP}/m_{i0P} = \left\{1-2\left[\sqrt{1+5.1\times10^{-12}B_{rms}^4/f}-1\right]\right\}$$

For $B = 395.6715\ T$, and $f = 0.1Hz$ equation above gives $\chi_1 \cong 1.3\times10^{-6}$. Thus, we get $g_1 = \chi_1 g = 1.2\times10^{-5} m.s^{-2}$. The acceleration experienced by a body in a *microgravity* environment, by definition, is one-millionth ($10^{-6}$) of that experienced at Earth's surface (1g). Consequently, a *microgravity* environment is one where the acceleration induced by gravity has little or no measurable effect.

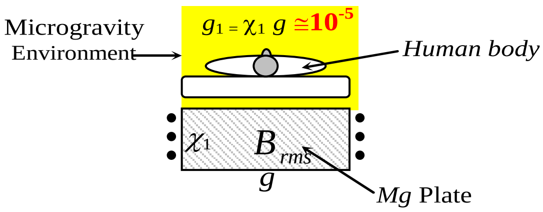


Fig. 8 – *Activation of cellular Autophagy process* in Human bodies.

Now, using *Ultra-conductive Magnesium*, ($\sigma \cong 1\times10^{18} s/m$); $\rho = 1738 kg/m^3$, we get

$$\chi = \left\{1-2\left[\sqrt{1+\left(\frac{\sigma}{4\pi\ f\mu_0\rho^2c^2}\right)B_{rms}^4}-1\right]\right\} =$$

$$= \left\{1-2\left[\sqrt{1+\left(0.23\frac{B_{rms}^4}{f}\right)}-1\right]\right\}$$

Compare with equation above ($\chi_1 = m_{gP}/m_{i0P}$). Note that, with just $B_{rms} = 0.8586T$, it is possible to obtain the same value that is given by Eq. (20) for $B = 395.6715\ T$.

## COOLING AND HEATING GRAVITATIONAL SYSTEM

Consider the system shown in Fig. 9. It has two hollow spheres A and B connected by a tube; inside this system there is a liquid with density $\rho$. Bellow sphere A there is an *Mg* plate (in red Fig.9), subjected to an alternating magnetic field $B_{rms}$ with *Extra-low frequency*, $f$.

The pressure $p_a$ at point *a* (See Fig.9) is

$$\vec{p}_a = \rho h\vec{g}' = \rho h(\chi\vec{g}) \qquad (36)$$

Equation above shows that the pressure inside the sphere A can be *reduced* by *reducing* $\chi$. The decreasing of the pressure causes the *decreasing of the temperature*, $T_A$, in sphere A, $(P'/T' = P/T)$. In this case, the system shown in Fig 9, it can works like a *Cooling Gravitational System.*

By increasing the magnitude of the magnetic field $B_{rms}$, it is possible to make $\chi$ *negative* (See Eq. (20)), and also to increase its magnitude $|\chi|$. In this case, $g'$ will be expressed by $g' = -|\chi|g$, and the pressure $p_b$ at point b becomes

$$\vec{p}_b = \rho h\vec{g}' = -\rho h|\chi|\vec{g} \qquad (37)$$

Note that, the pressure $\vec{p}_b$ is in opposite direction to $\vec{g}$. The increase of $\vec{p}_b$ causes a *increasing of the pressure inside the spherical shell* B, producing consequently, an *increasing of the temperature*, $T_B$, in the spherical shell B. In this case, the system shown in Fig 9 can works like a *Heating Gravitational System.*

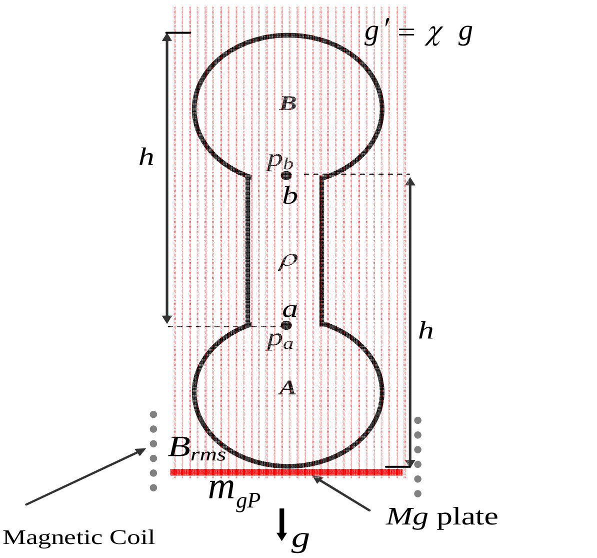


Fig.9 – Schematic Diagram of *one element* of Gravitational System for Cooling and Heating.

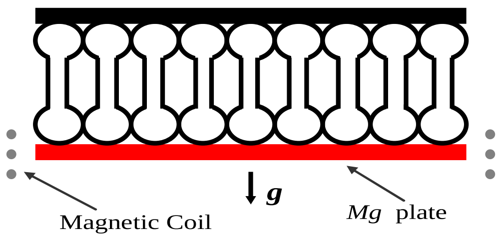


Fig.10 – Schematic Diagram of a Gravitational System for Cooling and Heating.