The Simplest Method to Control the Gravity

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In this Appendix, it is shown that the *gravitational masses* of the bodies can be strongly decreased when ELF electric currents pass through them. In this way, it is possible to control the gravitational masses of the bodies and also the gravity *above* them, as predicted by the *Gravity Shielding Effect* [1]. This is therefore *the simplest method* to control the local gravity and the weight of a body.

Consider a body with mass density ρ and the following electric characteristics: $\mu_r, \varepsilon_r, \sigma$ (relative permeability, relative permittivity and electric conductivity, respectively). Through this body, passes an electric current I, which is the sum of a sinusoidal current $i_{osc} = i_0 \sin \omega t$ and the DC current I_{DC}, i.e., $I = I_{DC} + i_0 \sin \omega t$; $\omega = 2\pi f$. If $i_0 << I_{DC}$ then $I \cong I_{DC}$. Thus, the current I varies with the frequency f, but the variation of its intensity is quite small in comparison with I_{DC}, i.e., I will be practically constant (Fig. 1A). This is of fundamental importance for maintaining the value of the gravitational mass of the body, m_g, sufficiently stable during all the time.

The *gravitational mass* of the *body* is given by [1]

$$m_g = \left\{1 - 2\left[\sqrt{1 + \left(\frac{n_r U}{m_{i0} c^2}\right)^2} - 1\right]\right\} m_{i0} \qquad (A1)$$

where U, is the electromagnetic energy absorbed by the body and n_r is the index of refraction of the body.

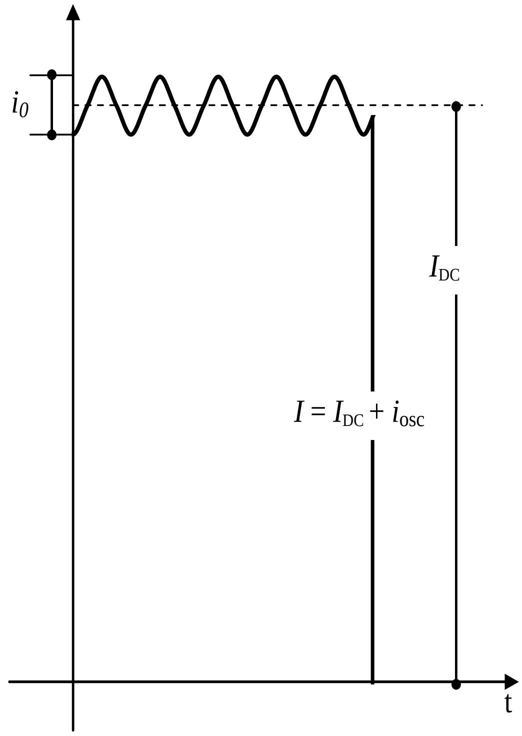

Fig. A1 - The electric current I varies with frequency f. But the variation of I is quite small in comparison with I_{DC} due to $i_o << I_{DC}$. In this way, we can consider $I \cong I_{DC}$.

Equation (A1) can also be rewritten in the following form

$$\frac{m_g}{m_{i0}} = \left\{1 - 2\left[\sqrt{1 + \left(\frac{n_r W}{\rho c^2}\right)^2} - 1\right]\right\} \qquad (A2)$$

where, $W = U/V$ is the *density of electromagnetic energy* and $\rho = m_{i0}/V$ is the density of inertial mass.

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

$$W = \tfrac{1}{2}\varepsilon\, E^2 + \tfrac{1}{2}\mu H^2 \qquad (A3)$$

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 $B = \mu H$, $E/B = \omega/k_r$ [11] and

$$v = \frac{dz}{dt} = \frac{\omega}{\kappa_r} = \frac{c}{\sqrt{\frac{\varepsilon_r \mu_r}{2}\left(\sqrt{1+(\sigma/\omega\varepsilon)^2}+1\right)}} \qquad (A4)$$

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($\varepsilon = \varepsilon_r \varepsilon_0$; $\varepsilon_0 = 8.854 \times 10^{-12} F/m$; $\mu = \mu_r \mu_0$ where $\mu_0 = 4\pi \times 10^{-7} H/m$). It is known that for *free-space* $\sigma = 0$ and $\varepsilon_r = \mu_r = 1$. Then Eq. (A4) gives

$$v = c$$

From (A4), we see that the *index of refraction* $n_r = c/v$ is given by

$$n_r = \frac{c}{v} = \sqrt{\frac{\varepsilon_r \mu_r}{2}\left(\sqrt{1+(\sigma/\omega\varepsilon)^2}+1\right)} \qquad (A5)$$

Equation (A4) shows that $\omega/\kappa_r = v$. Thus, $E/B = \omega/k_r = v$, i.e.,

$$E = vB = v\mu H \qquad (A6)$$

Then, Eq. (A3) can be rewritten in the following form:

$$W = \tfrac{1}{2}\left(\varepsilon v^2 \mu\right)\mu H^2 + \tfrac{1}{2}\mu H^2 \qquad (A7)$$

For $\sigma << \omega\varepsilon$, Eq. (A4) reduces to

$$v = \frac{c}{\sqrt{\varepsilon_r \mu_r}}$$

Then, Eq. (A7) gives

$$W = \tfrac{1}{2}\left[\varepsilon\left(\frac{c^2}{\varepsilon_r \mu_r}\right)\mu\right]\mu H^2 + \tfrac{1}{2}\mu H^2 = \mu H^2$$

This equation can be rewritten in the following forms:

$$W = \frac{B^2}{\mu} \qquad (A8)$$

or

$$W = \varepsilon\, E^2 \qquad (A9)$$

For $\sigma >> \omega\varepsilon$, Eq. (A4) gives

$$v = \sqrt{\frac{2\omega}{\mu\sigma}} \qquad (A10)$$

Then, from Eq. (A7) we get

$$W = \tfrac{1}{2}\left[\varepsilon\left(\frac{2\omega}{\mu\sigma}\right)\mu\right]\mu H^2 + \tfrac{1}{2}\mu H^2 = \left(\frac{\omega\varepsilon}{\sigma}\right)\mu H^2 + \tfrac{1}{2}\mu H^2 \cong$$
$$\cong \tfrac{1}{2}\mu H^2 \qquad (A11)$$

Since $E = vB = v\mu H$, we can rewrite (A11) in the following forms:

$$W \cong \frac{B^2}{2\mu} \qquad (A12)$$

or

$$W \cong \left(\frac{\sigma}{4\omega}\right)E^2 \qquad (A13)$$

By comparing equations (A8) (A9) (A12) and (A13), we can see that Eq. (A13) shows that the best way to obtain a strong value of W *in practice* is by applying an *Extra Low-Frequency* (ELF) *electric field* $(w = 2\pi f << 1Hz)$ through a *medium with high electrical conductivity*.

Substitution of Eq. (A13) into Eq. (A2), gives

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

$$= \left\{1 - 2\left[\sqrt{1 + \left(\frac{\mu_0}{256\pi^3 c^2}\right)\left(\frac{\mu_r \sigma^3}{\rho^2 f^3}\right) E^4} - 1\right]\right\} m_{i0} =$$

$$= \left\{1 - 2\left[\sqrt{1 + 1.758 \times 10^{-27}\left(\frac{\mu_r \sigma^3}{\rho^2 f^3}\right) E^4} - 1\right]\right\} m_{i0} \qquad (A14)$$

Note that $E = E_m \sin \omega t$. The average value for E^2 is equal to $\frac{1}{2}E_m^2$ because E varies sinusoidaly (E_m is the maximum value for E). On the other hand, $E_{rms} = E_m / \sqrt{2}$. Consequently we can change E^4 by E_{rms}^4, and the equation above can be rewritten as follows

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

Substitution of the well-known equation of the *Ohm's vectorial Law*: $j = \sigma E$ into (A14), we get

$$m_g = \left\{1 - 2\left[\sqrt{1 + 1.758 \times 10^{-27} \frac{\mu_r j_{rms}^4}{\sigma \rho^2 f^3}} - 1\right]\right\} m_{i0} \qquad (A15)$$

where $j_{rms} = j / \sqrt{2}$.

Consider a 15 cm square *Aluminum thin foil* of *10.5 microns thickness* with the following characteristics: $\mu_r = 1$; $\sigma = 3.82 \times 10^7 S.m^{-1}$; $\rho = 2700\, Kg.m^{-3}$. Then, (A15) gives

$$m_g = \left\{1 - 2\left[\sqrt{1 + 6.313 \times 10^{-42} \frac{j_{rms}^4}{f^3}} - 1\right]\right\} m_{i0} \qquad (A16)$$

Now, consider that the ELF electric current $I = I_{DC} + i_0 \sin \omega t$, $(i_0 << I_{DC})$ passes through that Aluminum foil. Then, the current density is

$$j_{rms} = \frac{I_{rms}}{S} \cong \frac{I_{DC}}{S} \qquad (A17)$$

where

$$S = 0.15m\left(10.5 \times 10^{-6} m\right) = 1.57 \times 10^{-6} m^2$$

If the ELF electric current has frequency $f = 2\mu Hz = 2 \times 10^{-6} Hz$, then, the gravitational mass of the aluminum foil, given by (A16), is expressed by

$$m_g = \left\{1 - 2\left[\sqrt{1 + 7.89 \times 10^{-25} \frac{I_{DC}^4}{S^4}} - 1\right]\right\} m_{i0} =$$

$$= \left\{1 - 2\left[\sqrt{1 + 0.13 I_{DC}^4} - 1\right]\right\} m_{i0} \qquad (A18)$$

Then,

$$\chi = \frac{m_g}{m_{i0}} \cong \left\{1 - 2\left[\sqrt{1 + 0.13 I_{DC}^4} - 1\right]\right\} \qquad (A19)$$

For $I_{DC} = 2.2A$, the equation above gives

$$\chi = \left(\frac{m_g}{m_{i0}}\right) \cong -1 \qquad (A20)$$

This means that *the gravitational shielding* produced by the aluminum foil can change the gravity acceleration *above* the foil down to

$$g' = \chi\, g \cong -1g \qquad (A21)$$

Under these conditions, the Aluminum foil works basically as a Gravity Control Cell (GCC).

In order to check these theoretical predictions, we suggest an experimental set-up shown in Fig.A2.

A 15cm square Aluminum foil of *10.5 microns thickness* with the following composition: Al 98.02%; Fe 0.80%; Si 0.70%; Mn 0.10%; Cu 0.10%; Zn 0.10%; Ti 0.08%; Mg 0.05%; Cr 0.05%, and with the following characteristics: $\mu_r = 1$; $\sigma = 3.82 \times 10^7 S.m^{-1}$; $\rho = 2700 Kg.m^{-3}$, is fixed on a 17 cm square *Foam Board* * plate of 6mm thickness as shown in Fig.A3. This device (the simplest Gravity Control Cell GCC) is placed on a pan balance shown in Fig.A2.

Above the Aluminum foil, a *sample* (any type of material, any mass) connected to a dynamometer will check the decrease of the *local gravity acceleration* upon the sample $(g' = \chi\ g)$, due to the gravitational shielding produced by the decreasing of gravitational mass of the Aluminum foil $(\chi = m_g / m_{i0})$. Initially, the sample lies 5 cm above the Aluminum foil. As shown in Fig.A2, the board with the dynamometer can be displaced up to few meters in height. Thus, the initial distance between the Aluminum foil and the sample can be increased in order to check the reach of the gravitational shielding produced by the Aluminum foil.

In order to generate the ELF electric current of $f = 2\mu Hz$, we can use the widely-known Function Generator HP3325A (Op.002 High Voltage Output) that can generate sinusoidal voltages with *extremely-low* frequencies down to $f = 1\times10^{-6}Hz$ and amplitude up to 20V ($40V_{pp}$ into 500Ω load). The maximum output current is $0.08A_{pp}$; output impedance <2Ω at ELF .

Figure A4 shows the equivalent electric circuit for the experimental set-up. The electromotive forces are: ε_1(HP3325A) and ε_2 (*12V* DC Battery).The values of the *resistors* are : $R_1 = 500\Omega - 2W$; $r_{i1} < 2\Omega$; $R_2 = 4\Omega - 40W$; $r_{i2} < 0.1\Omega$; $R_p = 2.5\times10^{-3}\Omega$; *Rheostat* (0≤ R ≤10Ω - 90W). The *coupling transformer* has the following characteristics: air core with diameter $\phi = 10mm$; area $S = \pi\phi^2/4 = 7.8\times10^{-5}m^2$; wire#12AWG; $N_1 = N_2 = N = 20$; $l = 42mm$; $L_1 = L_2 = L = \mu_0 N^2(S/l) = 9.3\times10^{-7}H$ .Thus, we get

$$Z_1 = \sqrt{(R_1 + r_{i1})^2 + (\omega L)^2} \cong 501\Omega$$

and

$$Z_2 = \sqrt{(R_2 + r_{i2} + R_p + R)^2 + (\omega L)^2}$$

For $R = 0$ we get $Z_2 = Z_2^{\min} \cong 4\Omega$; for $R = 10\Omega$ the result is $Z_2 = Z_2^{\max} \cong 14\Omega$. Thus,

$$Z_{1,total}^{\min} = Z_1 + Z_{1,reflected}^{\min} = Z_1 + Z_2^{\min}\left(\frac{N_1}{N_2}\right)^2 \cong 505\Omega$$

$$Z_{1,total}^{\max} = Z_1 + Z_{1,reflected}^{\max} = Z_1 + Z_2^{\max}\left(\frac{N_1}{N_2}\right)^2 \cong 515\Omega$$

The maxima *rms* currents have the following values:

$$I_1^{\max} = \tfrac{1}{\sqrt{2}} 40V_{pp} \Big/ Z_{1,total}^{\min} = 56mA$$

(The maximum output current of the Function Generator HP3325A (Op.002 High Voltage Output) is $80mA_{pp} \cong 56.5mA_{rms}$);

$$I_2^{\max} = \frac{\varepsilon_2}{Z_2^{\min}} = 3A$$

and

$$I_3^{\max} = I_2^{\max} + I_1^{\max} \cong 3A$$

The new expression for the *inertial forces*, (Eq.5) $\vec{F}_i = M_g \vec{a}$, shows that the inertial forces are proportional to *gravitational mass*. Only in the

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* *Foam board* is a very strong, *lightweight* (density: 24.03 kg.m^{-3}) and easily cut material used for the mounting of photographic prints, as backing in picture framing, in 3D design, and in painting. It consists of three layers — an inner layer of polystyrene clad with outer facing of either white clay coated paper or brown Kraft paper.

particular case of $m_g = m_{i0}$, the expression above reduces to the well-known Newtonian expression $\vec{F}_i = m_{i0}\vec{a}$. The equivalence between gravitational and inertial forces $\left(\vec{F}_i \equiv \vec{F}_g\right)$ [1] shows then that a balance measures the *gravitational mass* subjected to acceleration $a = g$. Here, the decrease in the *gravitational mass* of the Aluminum foil will be measured by a pan balance with the following characteristics: range 0-200g; readability 0.01g.

The mass of the Foam Board plate is: $\cong 4.17g$, the mass of the Aluminum foil is: $\cong 0.64g$, the total mass of the ends and the electric wires of connection is $\cong 5g$. Thus, *initially* the balance will show $\cong 9.81g$. According to (A18), when the electric current through the Aluminum foil (resistance $r_p^* = l/\sigma S = 2.5\times10^{-3}\Omega$) reaches the value: $I_3 \cong 2.2A$, we will get $m_{g(Al)} \cong -m_{i0(Al)}$. Under these circumstances, the balance will show:

$$9.81g - 0.64g - 0.64g \cong 8.53g$$

and the gravity acceleration g' *above* the Aluminum foil, becomes $g' = \chi\ g \cong -1g$.

It was shown [1] that, when the gravitational mass of a particle is reduced to the gravitational mass ranging between $+0.159M_i$ to $-0.159M_i$, it becomes *imaginary*, i.e., the gravitational and the inertial masses of the particle become *imaginary*. Consequently, the particle *disappears* from our ordinary space-time. This phenomenon can be observed in the proposed experiment, i.e., *the Aluminum foil will disappear* when its gravitational mass becomes smaller than $+0.159M_i$. It will become visible again, only when its gravitational mass becomes smaller than $-0.159M_i$, or when it becomes greater than $+0.159M_i$.

Equation (A18) shows that the gravitational mass of the Aluminum foil, $m_{g(Al)}$, goes *close to zero* when $I_3 \cong 1.76A$. Consequently, the gravity acceleration *above* the Aluminum foil also goes close to zero since $g' = \chi\ g = m_{g(Al)}/m_{i0(Al)}$. Under these circumstances, the Aluminum foil remains *invisible*.

Now consider a rigid Aluminum wire # 14 AWG. The area of its cross section is

$$S = \pi\left(1.628\times10^{-3}m\right)^2/4 = 2.08\times10^{-6}m^2$$

If an ELF electric current with frequency $f = 2\mu Hz = 2\times10^{-6}Hz$ passes through this wire, its gravitational mass, given by (A16), will be expressed by

$$m_g = \left\{1-2\left[\sqrt{1+6.313\times10^{-42}\frac{j_{rms}^4}{f^3}}-1\right]\right\}m_{i0} \quad (A16)$$

$$m_g = \left\{1-2\left[\sqrt{1+6.313\times10^{-42}\frac{j_{rms}^4}{f^3}}-1\right]\right\}m_{i0} =$$
$$= \left\{1-2\left[\sqrt{1+7.89\times10^{-25}\frac{I_{DC}^4}{S^4}}-1\right]\right\}m_{i0} =$$
$$= \left\{1-2\left[\sqrt{1+0.13I_{DC}^4}-1\right]\right\}m_{i0} \quad (A22)$$

For $I_{DC} \cong 3A$ the equation above gives

$$m_g \cong -3.8 m_{i0}$$

Note that we can replace the Aluminum foil for this wire in the experimental set-up shown in Fig.A2. It is important also to note that an ELF electric current that passes through a wire - which makes a spherical form, as shown in Fig A5 - reduces the gravitational mass of the wire (Eq. A22), and the gravity *inside sphere* at the same proportion, $\chi = m_g / m_{i0}$, (Gravitational Shielding Effect). In this case, that effect can be checked by means of the Experimental set-up 2 (Fig.A6). Note that the spherical form can be transformed into an ellipsoidal form or a disc in order to coat, for example, a Gravitational Spacecraft. It is also possible to coat with a wire several forms, such as cylinders, cones, cubes, etc.

All of these systems work with Extra-Low Frequencies $\left(f <<10^{-3} Hz\right)$. Now, we show that, by simply changing *the geometry of the surface of the Aluminum foil*, it is possible to increase the working frequency f up to more than *1Hz*.

Consider the Aluminum foil, now with several semi-spheres stamped on its surface, as shown in Fig. A7 . The semi-spheres have radius $r_0 = 0.9\ mm$, and are joined one to another. The Aluminum foil is now coated by an insulation layer with relative permittivity ε_r and dielectric strength k. A voltage source is connected to the Aluminum foil in order to provide a voltage V_0 (rms) with frequency f. Thus, the electric potential V at a distance r, in the interval from r_0 to a, is given by

$$V = \frac{1}{4\pi\varepsilon_r\varepsilon_0}\frac{q}{r} \qquad (A23)$$

In the interval $a < r \le b$ the electric potential is

$$V = \frac{1}{4\pi\varepsilon_0}\frac{q}{r} \qquad (A24)$$

since for the air we have $\varepsilon_r \cong 1$.

Thus, on the surface of the metallic spheres $(r = r_0)$ we get

$$V_0 = \frac{1}{4\pi\varepsilon_r\varepsilon_0}\frac{q}{r_0} \qquad (A25)$$

Consequently, the electric field is

$$E_0 = \frac{1}{4\pi\varepsilon_r\varepsilon_0}\frac{q}{r_0^2} \qquad (A26)$$

By comparing (A26) with (A25), we obtain

$$E_0 = \frac{V_0}{r_0} \qquad (A27)$$

The electric potential V_b at $r = b$ is

$$V_b = \frac{1}{4\pi\varepsilon_0}\frac{q}{b} = \frac{\varepsilon_r V_0 r_0}{b} \qquad (A28)$$

Consequently, the electric field E_b is given by

$$E_b = \frac{1}{4\pi\varepsilon_0}\frac{q}{b^2} = \frac{\varepsilon_r V_0 r_0}{b^2} \qquad (A29)$$

From $r = r_0$ up to $r = b = a + d$ *the electric field is approximately constant* (See Fig. A7). Along the distance d it will be called E_{air}. For $r > a + d$, the electric field stops being constant. Thus, the intensity of the electric field at $r = b = a + d$ is approximately equal to E_0, i.e., $E_b \cong E_0$. Then, we can write that

$$\frac{\varepsilon_r V_0 r_0}{b^2} \cong \frac{V_0}{r_0} \qquad (A30)$$

whence we get

$$b \cong r_0\sqrt{\varepsilon_r} \qquad (A31)$$

Since the intensity of the electric field through the air, E_{air}, is $E_{air} \cong E_b \cong E_0$, then, we can write that

$$E_{air} = \frac{1}{4\pi\varepsilon_0}\frac{q}{b^2} = \frac{\varepsilon_r V_0 r_0}{b^2} \qquad (A32)$$

If the intensity of this field is greater than the dielectric strength of the air $(3\times10^6 V/m)$ there will occur the well-known *Corona effect*. Here, this effect is necessary in order to increase the electric conductivity of the air at this region (layer with thickness *d*). Thus, we will assume

$$E_{air}^{min} = \frac{\varepsilon_r V_0^{min} r_0}{b^2} = \frac{V_0^{min}}{r_0} = 3\times10^6 V/m$$

and

$$E_{air}^{max} = \frac{\varepsilon_r V_0^{max} r_0}{b^2} = \frac{V_0^{max}}{r_0} = 1\times10^7 V/m \quad (A33)$$

The electric field $E_{air}^{min} \le E_{air} \le E_{air}^{max}$ will produce an *electrons flux* in a direction and an *ions flux* in an opposite direction. From the viewpoint of electric current, the ions flux can be considered as an "electrons" flux at the same direction of the real electrons flux. Thus, the current density through the air, j_{air}, will be the *double* of the current density expressed by the well-known equation of Langmuir-Child

$$j = \frac{4}{9}\varepsilon_0\sqrt{\frac{2e}{m_e}}\frac{V^{\frac{3}{2}}}{d^2} = \alpha\frac{V^{\frac{3}{2}}}{d^2} = 2.33\times10^{-6}\frac{V^{\frac{3}{2}}}{d^2} \qquad (A34)$$

where $\alpha = 2.33\times10^{-6}$ is the called *Child's constant*.

Thus, we have

$$j_{air} = 2\alpha\frac{V^{\frac{3}{2}}}{d^2} \qquad (A35)$$

where d, in this case, is the thickness of the air layer where the electric field is approximately constant and V is the voltage drop given by

$$V = V_a - V_b = \frac{1}{4\pi\varepsilon_0}\frac{q}{a} - \frac{1}{4\pi\varepsilon_0}\frac{q}{b} =$$

$$= V_0 r_0 \varepsilon_r\left(\frac{b-a}{ab}\right) = \left(\frac{\varepsilon_r r_0 d}{ab}\right)V_0 \qquad (A36)$$

By substituting (A36) into (A35), we get

$$j_{air} = \frac{2\alpha}{d^2}\left(\frac{\varepsilon_r r_0 d V_0}{ab}\right)^{\frac{3}{2}} = \frac{2\alpha}{d^{\frac{1}{2}}}\left(\frac{\varepsilon_r r_0 V_0}{b^2}\right)^{\frac{3}{2}}\left(\frac{b}{a}\right)^{\frac{3}{2}} =$$

$$= \frac{2\alpha}{d^{\frac{1}{2}}}E_{air}^{\frac{3}{2}}\left(\frac{b}{a}\right)^{\frac{3}{2}} \qquad (A37)$$

According to the equation of the *Ohm's vectorial Law*: $j = \sigma E$, we can write that

$$\sigma_{air} = \frac{j_{air}}{E_{air}} \qquad (A38)$$

Substitution of (A37) into (A38) yields

$$\sigma_{air} = 2\alpha\left(\frac{E_{air}}{d}\right)^{\frac{1}{2}}\left(\frac{b}{a}\right)^{\frac{3}{2}} \qquad (A39)$$

If the insulation layer has thickness $\Delta = 0.6\ mm$, $\varepsilon_r \cong 3.5$ (1-60Hz), $k = 17kV/mm$ (Acrylic sheet 1.5mm thickness), and the semi-spheres stamped on the metallic surface have $r_0 = 0.9\ mm$ (See Fig.A7) then $a = r_0 + \Delta = 1.5\ mm$. Thus, we obtain from Eq. (A33) that

$$V_0^{min} = 2.7kV$$

$$V_0^{max} = 9kV \qquad (A40)$$

From equation (A31), we obtain the following value for b:

$$b = r_0\sqrt{\varepsilon_r} = 1.68\times10^{-3} m \qquad (A41)$$

Since $b = a + d$ we get

$$d = 1.8\times10^{-4} m$$

Substitution of a, b, d and A(32) into (A39) produces

$$\sigma_{air} = 4.117\times10^{-4} E_{air}^{\frac{1}{2}} = 1.375\times10^{-2} V_0^{\frac{1}{2}}$$

Substitution of σ_{air}, $E_{air}(rms)$ and $\rho_{air} = 1.2\ kg.m^{-3}$ into (A14) gives

$$\frac{m_{g(air)}}{m_{i0(air)}} = \left\{1 - 2\left[\sqrt{1 + 1.758\times10^{-27}\frac{\sigma_{air}^3 E_{air}^4}{\rho_{air}^2 f^3}} - 1\right]\right\} =$$

$$= \left\{1 - 2\left[\sqrt{1 + 4.923\times10^{-21}\frac{V_0^{5.5}}{f^3}} - 1\right]\right\} \quad (A42)$$

For $V_0 = V_0^{max} = 9kV$ and $f = 2Hz$, the result is

$$\frac{m_{g(air)}}{m_{i0(air)}} \cong -1.2$$

Note that, by increasing V_0, the values of E_{air} and σ_{air} are increased. Thus, as show (A42), there are two ways for decrease the value of $m_{g(air)}$: increasing the value of V_0 or decreasing the value of f.

Since $E_0^{max} = 10^7 V/m = 10kV/mm$ and $\Delta = 0.6\ mm$ then the dielectric strength of the insulation must be $\geq 16.7kV/mm$. As mentioned above, the dielectric strength of the acrylic is $17kV/mm$.

In order to coat the Aluminum semi-spheres with acrylic in the necessary dimensions $(\Delta = a - r_0)$, we propose the following method. First, take an Aluminum plate with $21cm \times 29.1cm$ (A4 format). By means of a convenient process, several semi-spheres can be stamped on its surface. The semi-spheres have radius $r_0 = 0.9\ mm$, and are joined one to another. Next, take an acrylic sheet (A4 format) with 1.5mm thickness (See Fig.8 (a)). Put a heater below the Aluminum plate in order to heat the Aluminum (Fig.8 (b)). When the Aluminum is sufficiently heated up, the acrylic sheet and the Aluminum plate are pressed, one against the other, as shown in Fig. 8 (c). The two D devices shown in this figure are used in order to impede that the press compresses the acrylic and the aluminum to a distance shorter than $y + a$. After some seconds, remove the press and the heater. The device is ready to be subjected to a voltage V_0 with frequency f, as shown in Fig.9. Note that, in this case, the balance is not necessary, because *the substance that produces the gravitational shielding* is an *air layer* with thickness d *above* the acrylic sheet. This is, therefore, more a type of Gravity Control Cell (GCC) with *external gravitational shielding*.

It is important to note that this GCC can be made very thin and as flexible as a fabric. Thus, it can be used to produce *anti- gravity clothes*. These clothes can be extremely useful, for example, to walk on the surface of high gravity planets.

Figure A11 shows some geometrical forms that can be stamped on a metallic surface in order to produce a Gravitational Shielding effect, similar to the produced by the *semi-spherical form*.

An obvious evolution from the semi-spherical form is the *semi-cylindrical* form shown in Fig. A11 (b); Fig.A11(c) shows *concentric metallic rings* stamped on the metallic surface, an evolution from Fig.A11 (b). These geometrical forms produce the same effect as the semi-spherical form, shown in Fig.A11 (a). By using concentric metallic rings, it is possible to build *Gravitational Shieldings* around bodies or spacecrafts with several formats (spheres, ellipsoids, etc); Fig. A11 (d) shows a Gravitational Shielding around a Spacecraft with *ellipsoidal form*.

The previously mentioned Gravitational Shielding, produced on a thin layer of ionized air, has a *behavior different from* the Gravitational Shielding produced on a *rigid substance.* When the gravitational masses of the air molecules, inside the shielding, are reduced to within the range $+0.159m_i < m_g < -0.159m_i$, they go to the *imaginary space-time*, as previously shown in this article. However, the electric field E_{air} stays at the real space-time. Consequently, the molecules return immediately to the real space-time in order to return soon after to the *imaginary* space-time, due to the action of the electric field E_{air}.

In the case of the Gravitational Shielding produced on a *solid substance*, when the molecules of the substance go to the *imaginary* space-time, *the electric field that produces the effect, also goes to the imaginary space-time together with them,* since in this case, the substance of the Gravitational Shielding is rigidly connected to the metal that produces the electric field. (See Fig. A12 (b)). This is the fundamental difference between the *non-solid* and *solid* Gravitational Shieldings.

Now, consider a Gravitational Spacecraft that is able to produce an *Air* Gravitational Shielding and also a *Solid* Gravitational Shielding, as shown in Fig. A13 (a) †. Assuming that the intensity of the electric field, E_{air}, necessary to reduce the gravitational mass of the *air molecules* to within the range $+0.159m_i < m_g < -0.159m_i$, *is much smaller* than the intensity of the electric field, E_{rs}, necessary to reduce the gravitational mass of the *solid substance* to within the range $+0.159m_i < m_g < -0.159m_i$, then we conclude that the Gravitational Shielding made of ionized air goes to the imaginary space-time *before* the Gravitational Shielding made of *solid substance*. When this occurs the spacecraft does not go to the imaginary space-time together with the Gravitational Shielding of air, because the air molecules are not rigidly connected to the spacecraft. Thus, while the air molecules go into the imaginary space-time, the spacecraft stays in the *real space-time*, and remains subjected to the effects of the Gravitational Shielding around it, since the shielding does not stop to work, due to its extremely short

† The *solid* Gravitational Shielding can also be obtained by means of *an ELF electric current through a metallic lamina* placed *between the semi-spheres and the Gravitational Shielding of Air* (See Fig.A13 (a)). The gravitational mass of the solid Gravitational Shielding will be controlled just by means of the intensity of the ELF electric current. Recently, it was discovered that Carbon nanotubes (CNTs) can be added to *Alumina* (Al_2O_3) to convert it into a good electrical conductor. It was found that the electrical conductivity increased up to 3375 S/m at 77°C in samples that were 15% nanotubes by volume [12]. It is known that the density of α-Alumina is $3.98 kg.m^{-3}$ and that it can withstand 10-20 KV/mm. Thus, these values show that the Alumina-CNT can be used to make a *solid* Gravitational Shielding. In this case, the electric field produced by means of the semi-spheres will be used to control the gravitational mass of the Alumina-CNT.

permanence at the imaginary space-time. Under these circumstances, the gravitational mass of the Gravitational Shielding can be reduced to $m_g \cong 0$. For example, $m_g \cong 10^{-4} kg$. Thus, if the *inertial mass* of the Gravitational Shielding is $m_{i0} \cong 1kg$, then $\chi = m_g / m_{i0} \cong 10^{-4}$. As we have seen, this means that *the inertial effects on the spacecraft* will be reduced by $\chi \cong 10^{-4}$. Then, in spite of the effective acceleration of the spacecraft be, for example, $a = 10^5 m.s^{-2}$, the effects on the crew of the spacecraft will be equivalent to an acceleration of only

$$a' = \frac{m_g}{m_{i0}} a = \chi \ a \approx 10 m.s^{-1}$$

This is the magnitude of the acceleration upon the passengers in a contemporary commercial jet.

Then, it is noticed that Gravitational Spacecrafts can be subjected to enormous *accelerations* (or *decelerations*) without imposing any harmful impacts whatsoever on the spacecrafts or its crew.

Now, imagine that the intensity of the electric field that produces the Gravitational Shielding around the spacecraft is *increased* up to reaching the value E_{rs} that reduces the gravitational mass of the *solid* Gravitational Shielding to within the range $+0.159 m_i < m_g < -0.159 m_i$. Under these circumstances, the *solid* Gravitational Shielding goes to the imaginary space-time and, since it is rigidly connected to the spacecraft, also the spacecraft goes to the imaginary space-time together with the Gravitational Shielding. Thus, the spacecraft can travel within the imaginary space-time and make use of the Gravitational Shielding around it.

As we have already seen, the maximum velocity of propagation of the interactions in the imaginary space-time is *infinite* (in the real space-time this limit is equal to the light velocity c). This means that *there are no limits for the velocity of the spacecraft in the imaginary space-time*. Thus, the acceleration of the spacecraft can reach, for example, $a = 10^9 m.s^{-2}$, which leads the spacecraft to attain velocities $V \approx 10^{14} m.s^{-1}$ (about 1 million times the speed of light) after one day of trip. With this velocity, after 1 month of trip the spacecraft would have traveled about $10^{21} m$. In order to have idea of this distance, it is enough to remind that the diameter of our Universe (visible Universe) is of the order of $10^{26} m$.

Due to the extremely low density of the *imaginary* bodies, the collision between them cannot have the same consequences of the collision between the real bodies.

Thus, *for a Gravitational Spacecraft in imaginary state, the problem of the collision in high-speed doesn't exist.* Consequently, the Gravitational Spacecraft can transit freely in the imaginary Universe and, in this way, reach easily any point of our real Universe once they can make the transition back to our Universe by only increasing the gravitational mass of the Gravitational Shielding of the spacecraft in such way that it leaves the range of $+0.159 M_i$ to $-0.159 M_i$.

The return trip would be done in similar way. That is to say, the spacecraft would transit in the imaginary Universe back to the departure place where would reappear in our Universe. Thus, trips through our Universe that would delay millions of years, at speeds close to the speed of light, could be done in just a few *months* in the imaginary Universe.

In order to produce the acceleration of $a \approx 10^9 m.s^{-2}$ upon the spacecraft we propose a Gravitational Thruster with 10 GCCs (10 Gravitational Shieldings) of the type with several semi-spheres stamped on the metallic surface, as previously shown, or with the *semi-cylindrical* form shown in Figs. A11 (b) and (c). The 10 GCCs are filled with air at 1 atm and 300K. If the insulation layer is made with *Mica* $(\varepsilon_r \cong 5.4)$ and has thickness $\Delta = 0.1\ mm$, and the semi-spheres stamped on the metallic surface have $r_0 = 0.4\ mm$ (See Fig.A7) then $a = r_0 + \Delta = 0.5\ mm$. Thus, we get

$$b = r_0\sqrt{\varepsilon_r} = 9.295\times10^{-4} m$$

and

$$d = b - a = 4.295\times10^{-4} m$$

Then, from Eq. A42 we obtain

$$\chi_{air} = \frac{m_{g(air)}}{m_{i0(air)}} = \left\{1 - 2\left[\sqrt{1 + 1.758\times10^{-27}\frac{\sigma_{air}^3 E_{air}^4}{\rho_{air}^2 f^3}} - 1\right]\right\} =$$

$$= \left\{1 - 2\left[\sqrt{1 + 1.0\times10^{-18}\frac{V_0^{5.5}}{f^3}} - 1\right]\right\}$$

For $V_0 = V_0^{max} = 15.6kV$ and $f = 0.12Hz$, the result is

$$\chi_{air} = \frac{m_{g(air)}}{m_{i0(air)}} \cong -1.6\times10^4$$

Since $E_0^{max} = V_0^{max}/r_0$ is now given by $E_0^{max} = 15.6kV/0.9mm = 17.3kV/mm$ and $\Delta = 0.1\ mm$ then the dielectric strength of the insulation must be $\geq 173 kV/mm$. As shown in the table below[‡], *0.1mm - thickness of* Mica *can withstand 17.6 kV* (that is greater than $V_0^{max} = 15.6kV$), in such way that the dielectric strength is *176 kV/mm*.

The Gravitational Thrusters are positioned at the spacecraft, as shown in Fig. A13 (b). Then, when the spacecraft is in the *intergalactic space*, the gravity acceleration upon the gravitational mass m_{gt} of the bottom of the thruster (See Fig.A13 (c)), is given by [2]

$$\vec{a} \cong (\chi_{air})^{10}\vec{g}_M \cong -(\chi_{air})^{10} G\frac{M_g}{r^2}\hat{\mu}$$

where M_g is the gravitational mass in front of the spacecraft.

For simplicity, let us consider just the effect of a hypothetical volume $V = 10\times10^3\times10^3 = 10^7 m^3$ of intergalactic matter in front of the spacecraft $(r \cong 30m)$. The average density of matter in the *intergalactic medium (IGM)* is $\rho_{ig} \approx 10^{-26} kg.m^{-3}$)[§]. Thus, for $\chi_{air} \cong -1.6\times10^4$ we get

‡ The *dielectric strength* of some dielectrics can have different values in lower thicknesses. This is, for example, the case of the *Mica*.

Dielectric	*Thickness* (mm)	*Dielectric Strength* (kV/mm)
Mica	0.01 mm	200
Mica	**0.1 mm**	**176**
Mica	1 mm	61

§ Some theories put the average density of the Universe as the equivalent of *one hydrogen atom per cubic meter*[13,14] The density of the universe, however, is clearly not uniform. Surrounding and stretching between galaxies, there is a rarefied plasma[15] that is thought to possess a cosmic filamentary structure[16] and that is slightly denser than the average density in the universe. This material is called the *intergalactic medium (IGM)* and is mostly ionized hydrogen; i.e. a plasma consisting of equal numbers of electrons and protons. The IGM is thought to exist at a density of 10 to 100 times the average density of the Universe (10 to 100 hydrogen atoms per cubic meter, i.e., $\approx 10^{-26} kg.m^{-3}$).

$$a = -\left(-1.6\times10^{4}\right)^{10}\left(6.67\times10^{-11}\right)\left(\frac{10^{-19}}{30^{2}}\right) =$$
$$= -10^{9}\, m.s^{-2}$$

In spite of this gigantic acceleration, the inertial effects for the crew of the spacecraft can be strongly reduced if, for example, the gravitational mass of the Gravitational Shielding is reduced down to $m_g \cong 10^{-6}kg$ and its inertial mass is $m_{i0} \cong 100kg$. Then, we get $\chi = m_g / m_{i0} \cong 10^{-8}$. Therefore, *the inertial effects on the spacecraft* will be reduced by $\chi \cong 10^{-8}$, and consequently, the inertial effects on the crew of the spacecraft would be *equivalent to* an acceleration a' of only

$$a' = \frac{m_g}{m_{i0}} a = \left(10^{-8}\right)\left(10^{9}\right) \approx 10 m.s^{-2}$$

Note that the Gravitational Thrusters in the spacecraft must have a very small diameter (of the order of *millimeters*) since, obviously, the hole through the Gravitational Shielding cannot be large. Thus, these thrusters are in fact, *Micro-Gravitational Thrusters*. As shown in Fig. A13 (b), it is possible to place several micro-gravitational thrusters in the spacecraft. This gives to the Gravitational Spacecraft, several degrees of freedom and shows the enormous superiority of this spacecraft in relation to the contemporaries spacecrafts.

The density of matter in the *intergalactic medium (IGM)* is about *10 $^{-26}$ kg.m^{-3}* , which is very less than the density of matter in the *interstellar medium* (*~10^{-21} kg.m^{-3}*) that is less than the density of matter in the *interplanetary medium* (*~10^{-20} kg.m^{-3}*). The density of matter is enormously increased inside the Earth's atmosphere (1.2*kg.m^{-3}* near to Earth's surface). Figure A14 shows the gravitational acceleration acquired by a Gravitational Spacecraft, in these media, using Micro-Gravitational thrusters.

In relation to the *Interstellar* and *Interplanetary medium*, the *Intergalactic medium* requires the greatest value of χ_{air} (χ inside the *Micro-Gravitational Thrusters*), i.e., $\chi_{air} \cong -1.6\times10^{4}$. This value strongly decreases when the spacecraft is within the Earth's atmosphere. In this case, it is sufficient only** $\chi_{air} \cong -10$ in order to obtain:

$$a = -\left(\chi_{air}\right)^{10} G \frac{\rho_{atm} V}{r^{2}} \cong$$
$$\cong -(-10)^{10}\left(6.67\times10^{-11}\right)\frac{1.2\left(10^{7}\right)}{(20)^{2}} \cong 10^{4}\, m.s^{-2}$$

With this acceleration the Gravitational Spacecraft can reach about *50000 km/h* in a few seconds. Obviously, the Gravitational Shielding of the spacecraft will reduce strongly *the inertial effects upon the crew* of the spacecraft, in such way that the inertial effects of this strong acceleration will not be felt. In addition, the *artificial atmosphere*, which is possible to build around the spacecraft, by means of gravity control technologies shown in this article (See Fig.6) and [2], will protect it from the *heating* produced by the friction with the Earth's

** This value is within the range of values of χ $\left(\chi < -10^{3}.\ \ See\ \ Eq.A15\right)$, which can be produced by means of *ELF electric currents* through metals as *Aluminum*, etc. This means that, in this case, if convenient, we can replace *air* inside the GCCs of the Gravitational Micro-thrusters by metal laminas with *ELF electric currents* through them.

atmosphere. Also, the gravity can be controlled inside of the Gravitational Spacecraft in order to maintain a value close to the Earth's gravity as shown in Fig.3.

Finally, it is important to note that a Micro-Gravitational Thruster does not work *outside* a Gravitational Shielding, because, in this case, *the resultant upon the thruster is null* due to the symmetry (See Fig. A15 (a)). Figure A15 (b) shows a micro-gravitational thruster inside a Gravitational Shielding. This thruster has 10 Gravitational Shieldings, in such way that the gravitational acceleration upon the *bottom* of the thruster, due to a gravitational mass M_g *in front* of the thruster, is $a_{10} = \chi_{air}^{10} a_0$ where $a_0 = -GM_g/r^2$ is the gravitational acceleration acting on the front of the micro-gravitational thruster. *In the opposite direction*, the gravitational acceleration upon the bottom of the thruster, produced by a gravitational mass M_g, is

$$a'_0 = \chi_s\left(-GM_g/r'^2\right) \cong 0$$

since $\chi_s \cong 0$ due to the Gravitational Shielding around the micro-thruster (See Fig. A15 (b)). Similarly, the acceleration in front of the thruster is

$$a'_{10} = \chi_{air}^{10} a'_0 = \left[\chi_{air}^{10}\left(-GM_g/r'^2\right)\right]\ \chi_s$$

where $\left[\chi_{air}^{10}\left(-GM_g/r'^2\right)\right] < a_{10}$, since $r' > r$. Thus, for $a_{10} \cong 10^9 m.s^{-2}$ and $\chi_s \approx 10^{-8}$ we conclude that $a'_{10} < 10 m.s^{-2}$. This means that $a'_{10} << a_{10}$. Therefore, we can write that the resultant on the micro-thruster can be expressed by means of the following relation

$$R \cong F_{10} = \chi_{air}^{10} F_0$$

Figure A15 (c) shows a Micro-Gravitational Thruster with *10 Air Gravitational Shieldings* (10 GCCs). Thin Metallic laminas are placed after each *Air* Gravitational Shielding in order to retain the electric field $E_b = V_0/x$, produced by metallic *surface behind* the semi-spheres. The laminas with semi-spheres stamped on its surfaces are connected to the ELF voltage source V_0 and the thin laminas in front of the Air Gravitational Shieldings are grounded. The air inside this Micro-Gravitational Thruster is at 300K, 1atm.

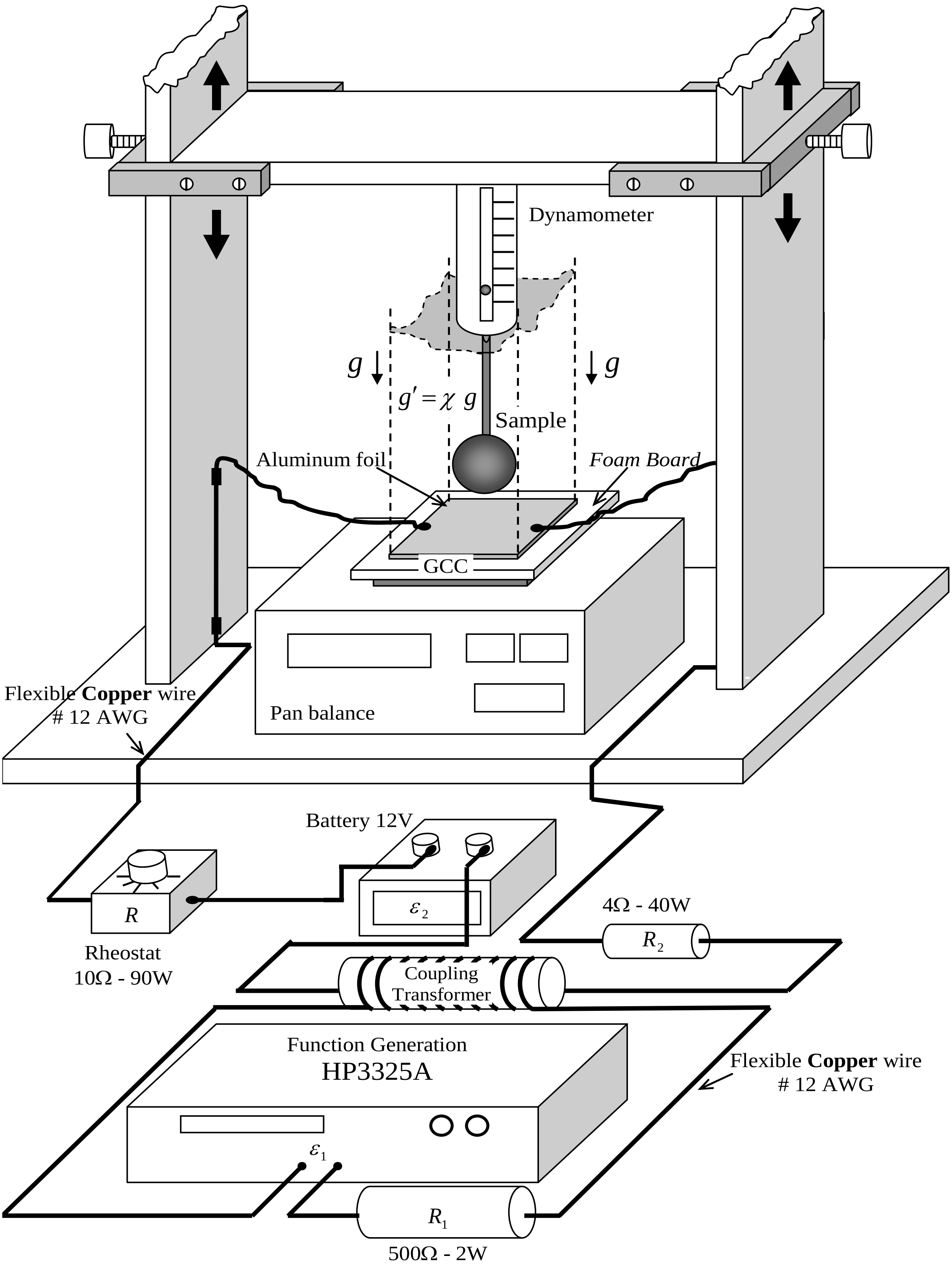
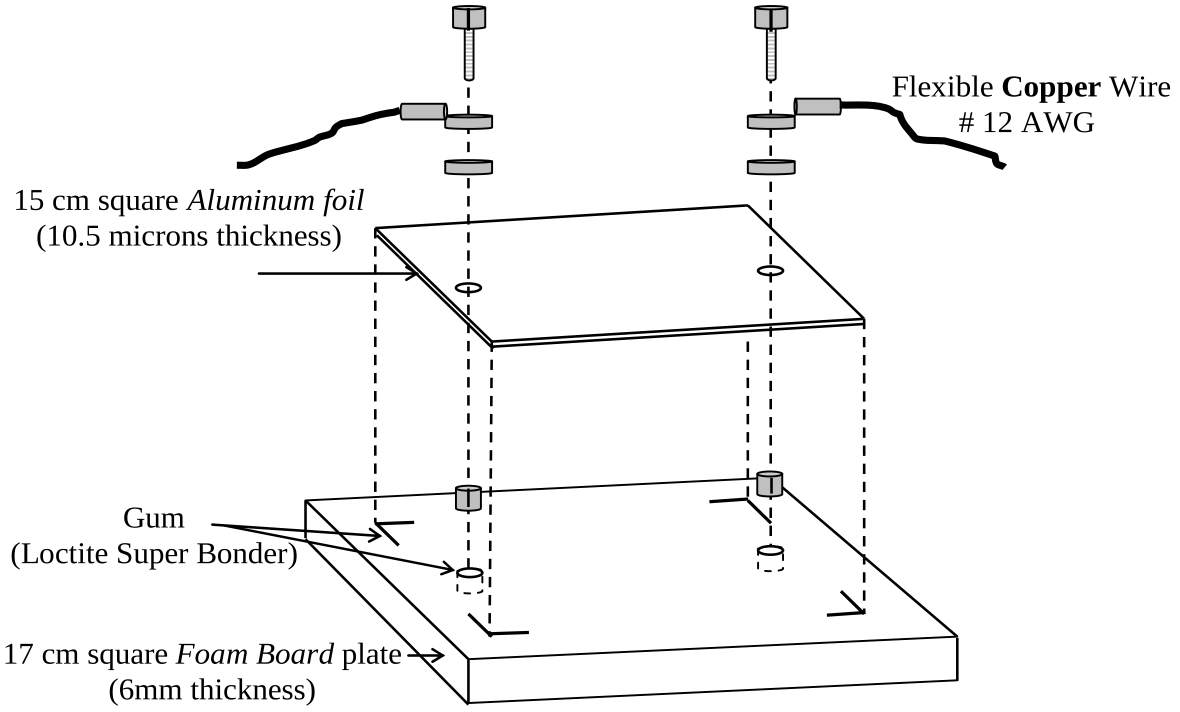


Fig. A2 – Experimental Set-up 1.



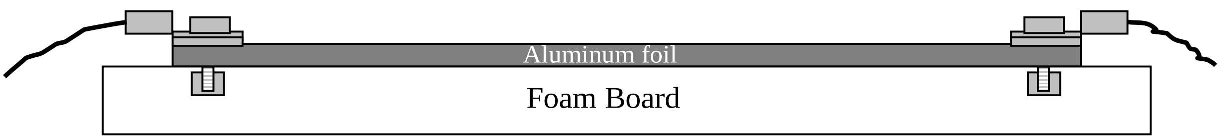
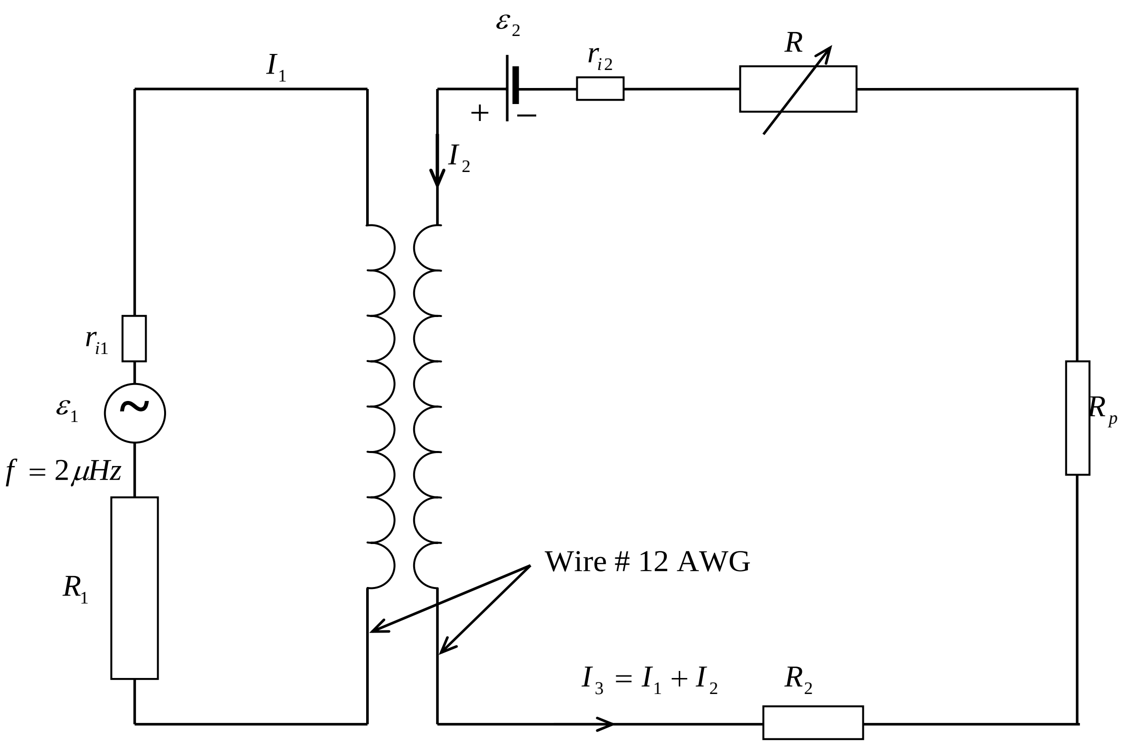


Fig. A3 – The Simplest *Gravity Control Cell* (GCC).



ε_1 Function Generator HP3325A(*Option* 002 High Voltage Output)

$r_{i1} < 2\Omega$

$R_1 = 500\Omega - 2\ W$

$\varepsilon_2 = 12V\ \ DC$

$r_{i2} < 0.1\Omega\ (Battery)$

$R_2 = 4\Omega - 40W$

$R_p = 2.5 \times 10^{-3}\Omega$

$Reostat = 0 \leq R \leq 10\Omega - 90W$

$I_1^{\max} = 56mA\ (rms)$

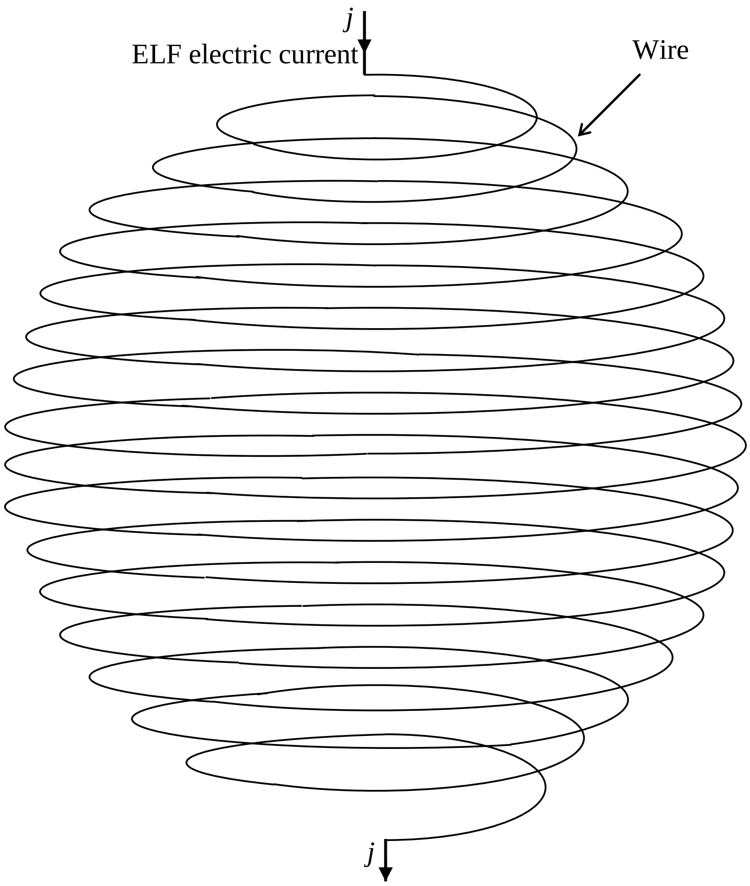
$I_2^{\max} = 3A$

$I_3^{\max} \cong 3A\ (rms)$

Coupling Transformer to isolate the *Function Generator* from the Battery

• Air core 10 - mm diameter; wire #12 AWG; $N_1 = N_2 = 20; l = 42mm$

Fig. A4 – Equivalent Electric Circuit



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

Fig. A5 – An ELF electric current through a wire, that makes a spherical form as shown above, reduces the gravitational mass of the wire and the gravity inside sphere at the same proportion $\chi = m_g / m_{i0}$ (Gravitational Shielding Effect). Note that this spherical form can be transformed into an ellipsoidal form or a disc in order to coat, for example, a Gravitational Spacecraft. It is also possible to coat with a wire several forms, such as cylinders, cones, cubes, etc. The characteristics of the wire are expressed by: μ_r, σ, ρ; j is the electric current density and f is the frequency.

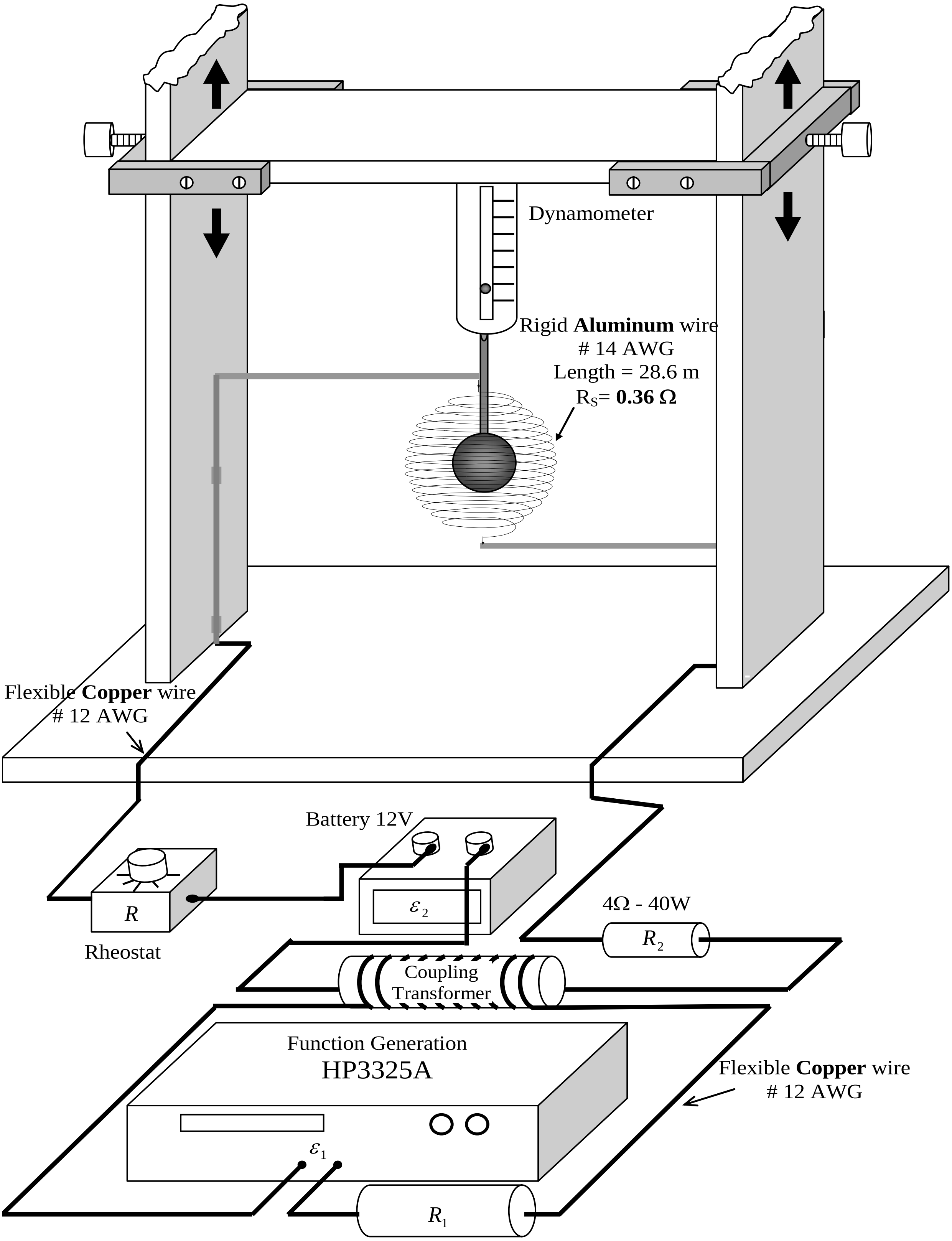


Fig. A6 – Experimental set-up 2.

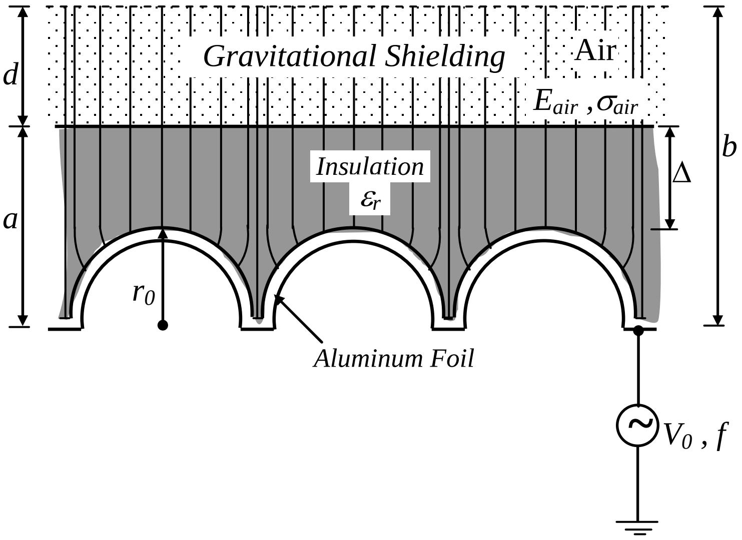


Fig A7 – *Gravitational shielding produced by semi-spheres stamped on the Aluminum foil* - By simply changing the geometry of the surface *of* the Aluminum foil it is possible to increase the working frequency f up to more than *1Hz*.

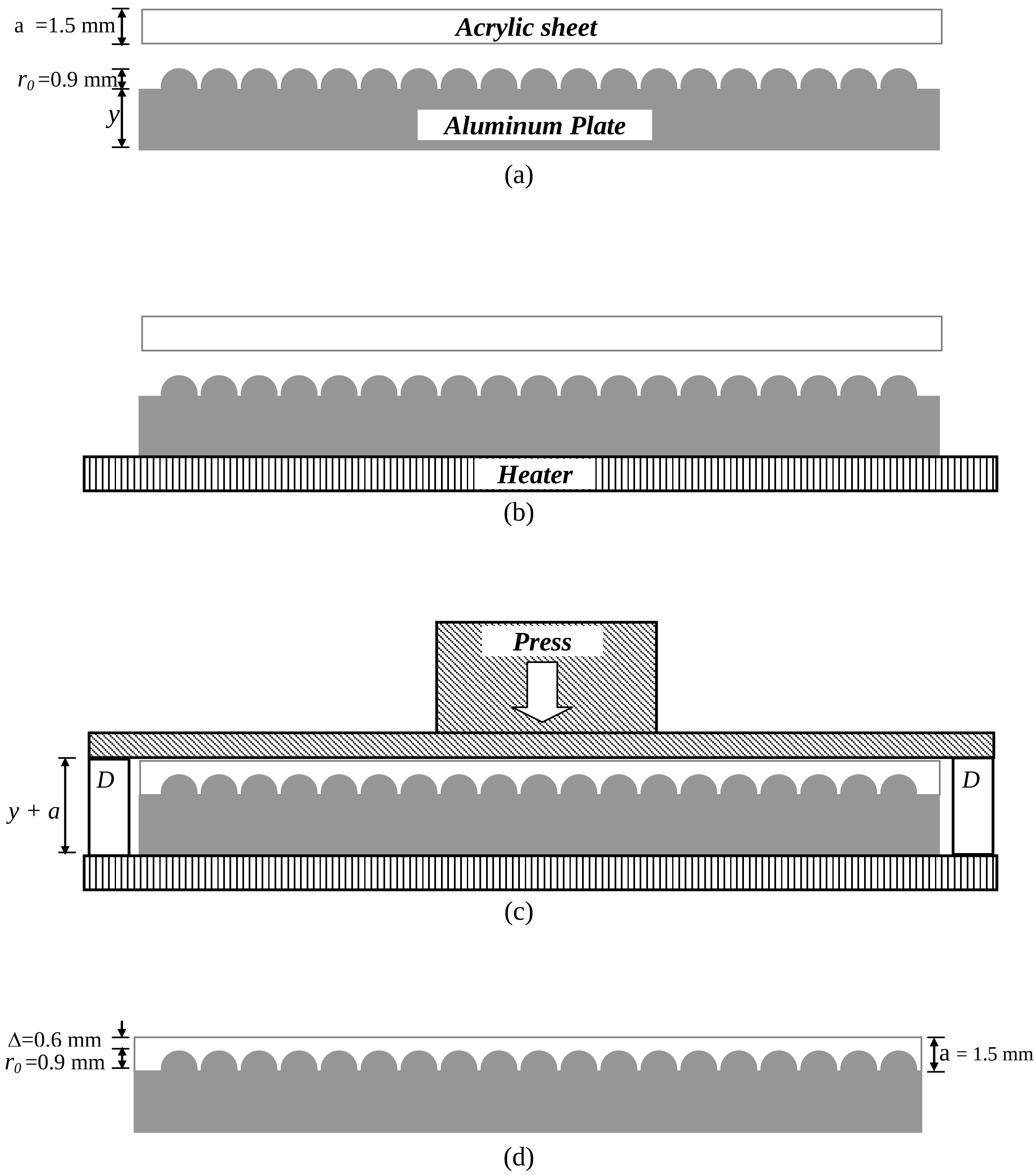


Fig A8 – *Method to coat the Aluminum semi-spheres with acrylic* $(\Delta = a - r_0 = 0.6mm)$. (a)Acrylic sheet (A4 format) with 1.5mm thickness and an Aluminum plate (A4) with several semi-spheres (radius $r_0 = 0.9\ mm$) stamped on its surface. (b)A heater is placed below the Aluminum plate in order to heat the Aluminum. (c)When the Aluminum is sufficiently heated up, the acrylic sheet and the Aluminum plate are pressed, one against the other (The two D devices shown in this figure are used in order to impede that the press compresses the acrylic and the aluminum besides distance $y + a$). (d)After some seconds, the press and the heater are removed, and the device is ready to be used.

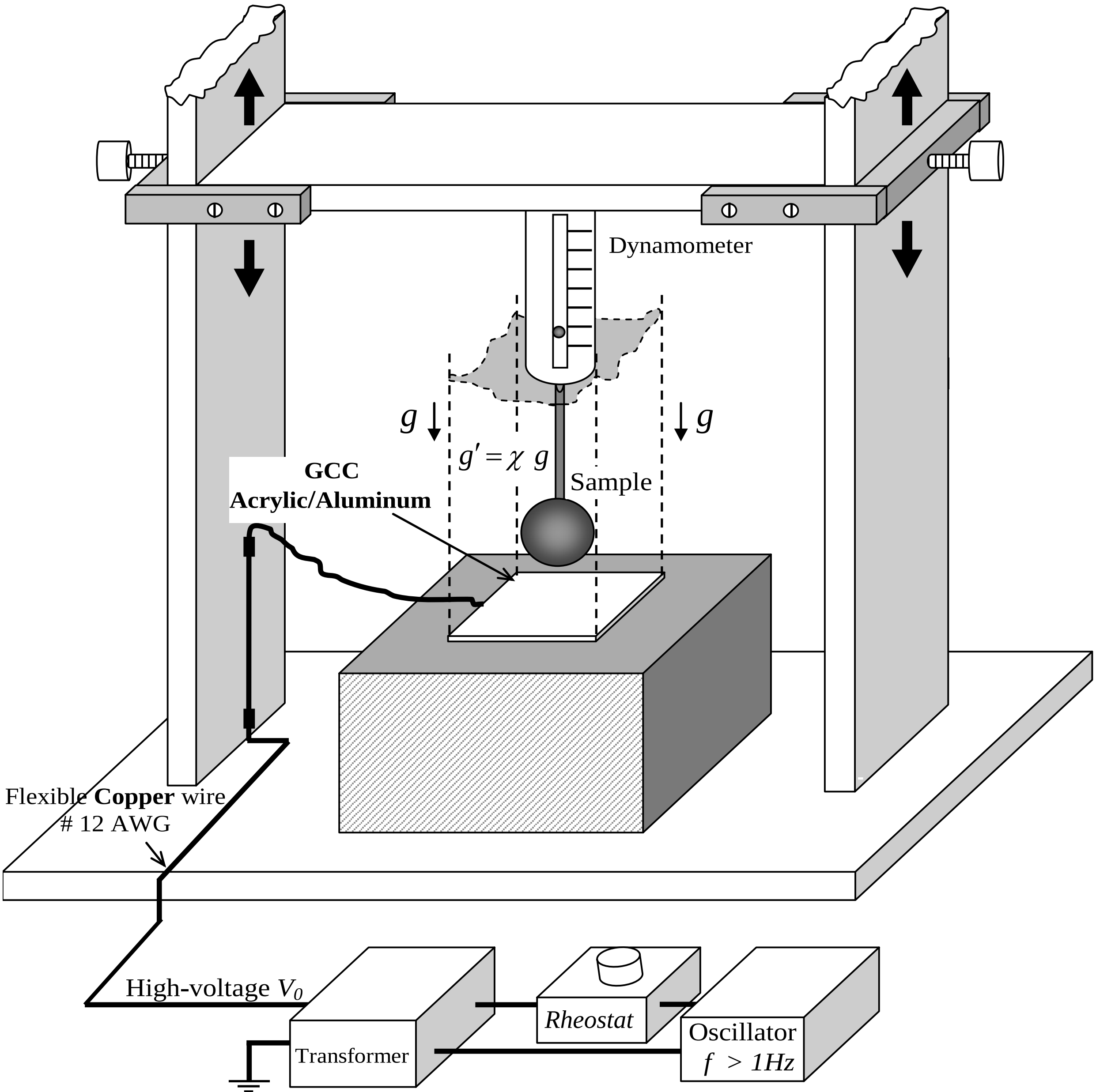


Fig. A9 – *Experimental Set-up using a GCC subjected to high-voltage* V_0 *with frequency* $f > 1Hz$. Note that in this case, the pan balance is not necessary because the substance of the Gravitational Shielding is an *air layer* with thickness d *above* the acrylic sheet. This is therefore, more a type of Gravity Control Cell (GCC) with *external gravitational shielding*.

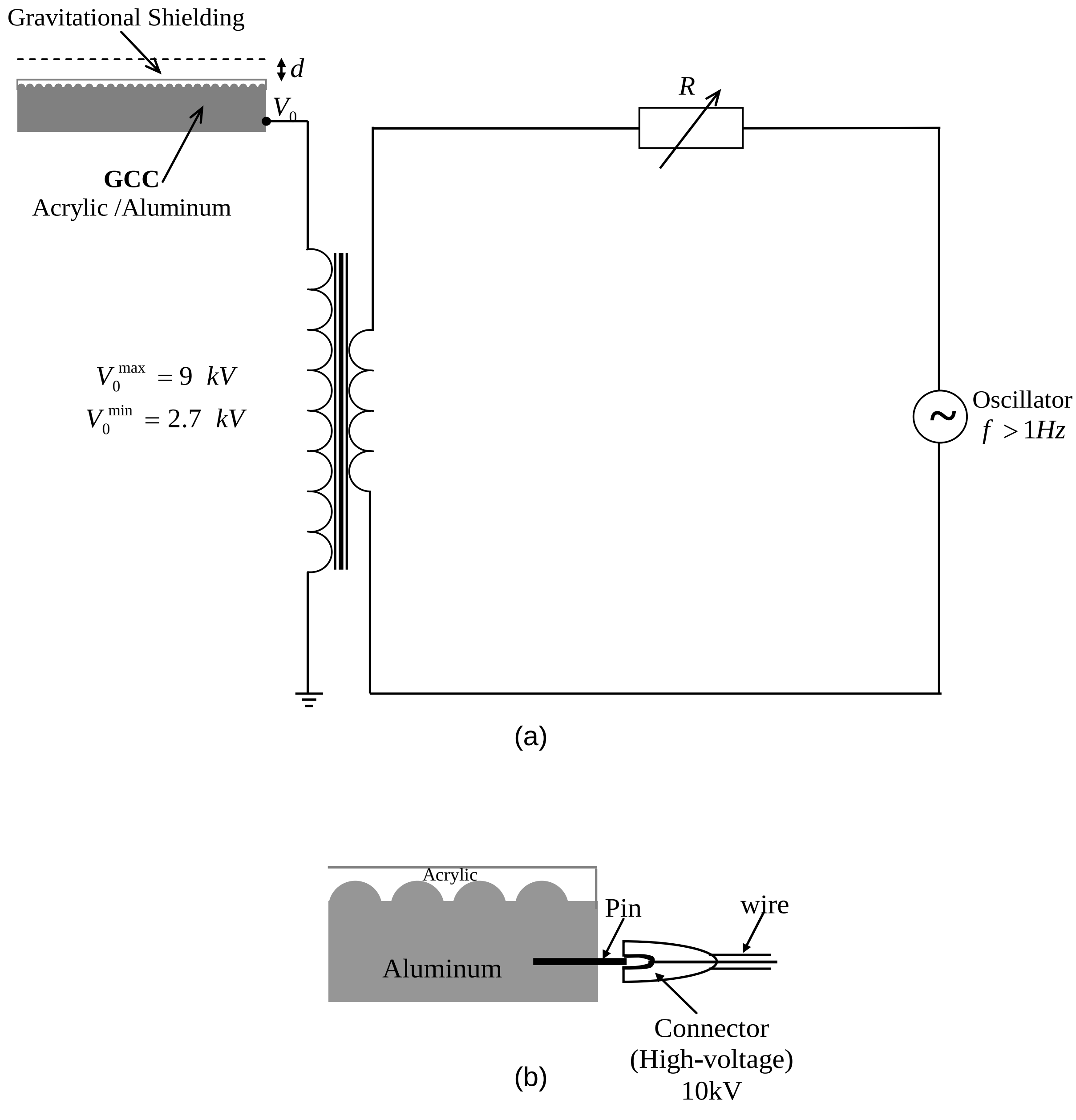


Fig. A10 – (a) *Equivalent Electric Circuit.* (b) Details of the electrical connection with the Aluminum plate. Note that others connection modes (by the top of the device) can produce destructible interference on the electric lines of the E_{air} field.

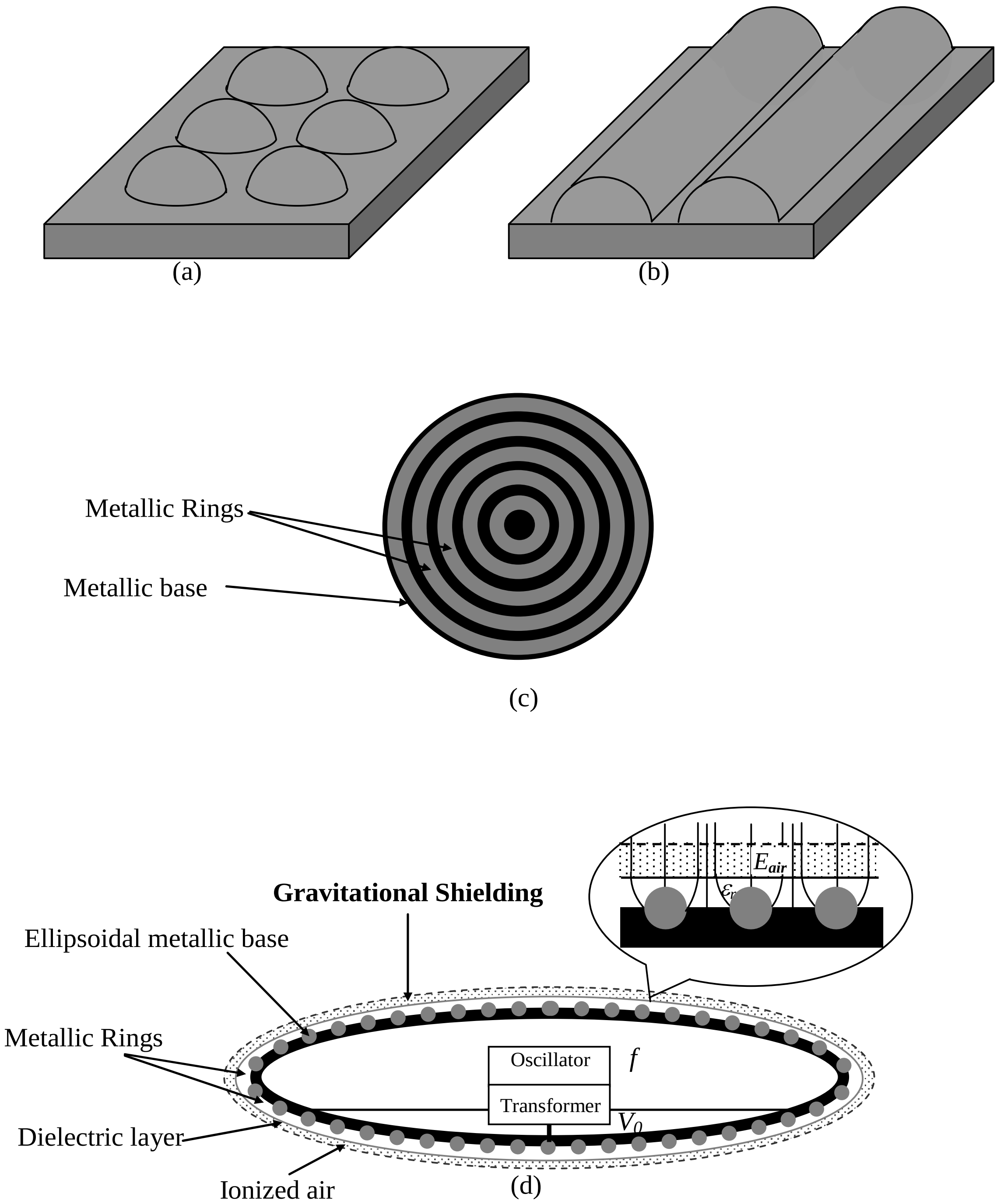


Fig. A11 – *Geometrical forms with similar effects as those produced by the semi-spherical form* – (a) shows the semi-spherical form stamped on the metallic surface; (b) shows the *semi-cylindrical* form (an obvious evolution from the semi-spherical form); (c) shows *concentric metallic rings* stamped on the metallic surface, an evolution from semi-cylindrical form. These geometrical forms produce the same effect as that of the semi-spherical form, shown in Fig.A11 (a). By using concentric metallic rings, it is possible to build *Gravitational Shieldings* around bodies or spacecrafts with several formats (spheres, ellipsoids, etc); (d) shows a Gravitational Shielding around a Spacecraft with *ellipsoidal form*.

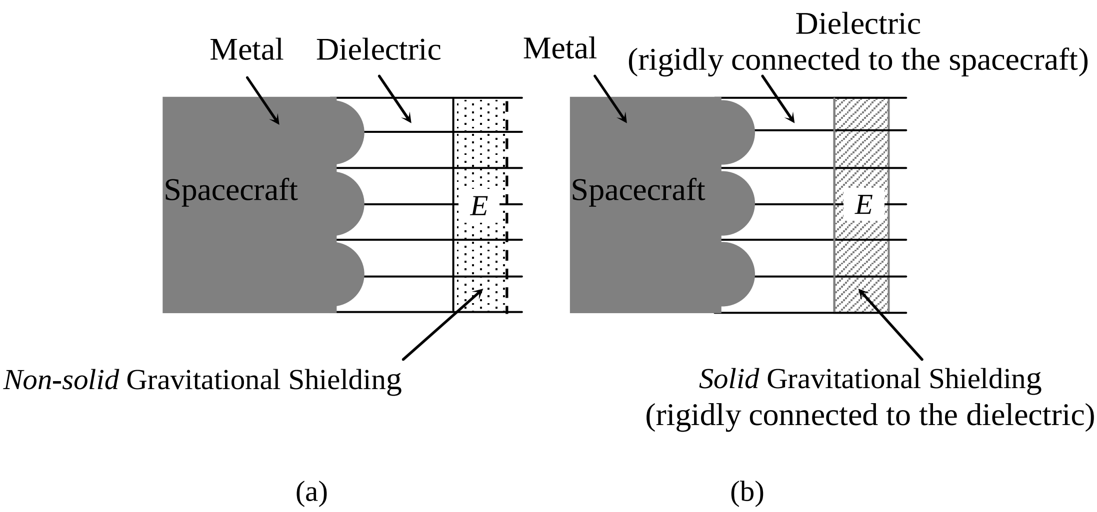
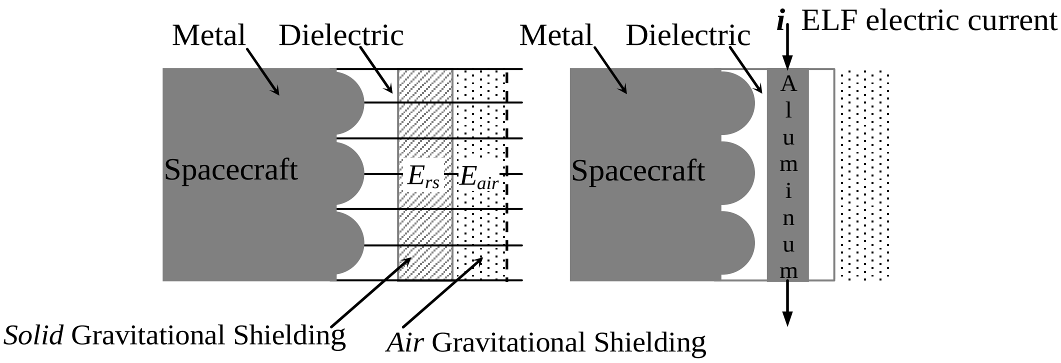
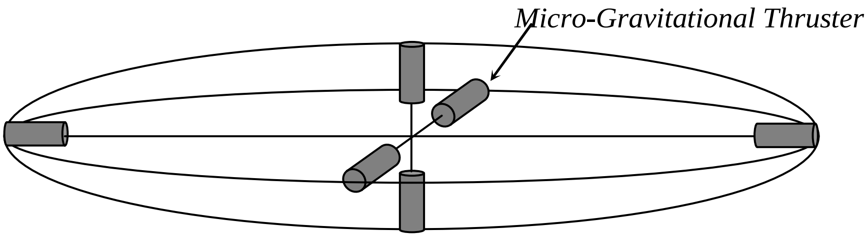


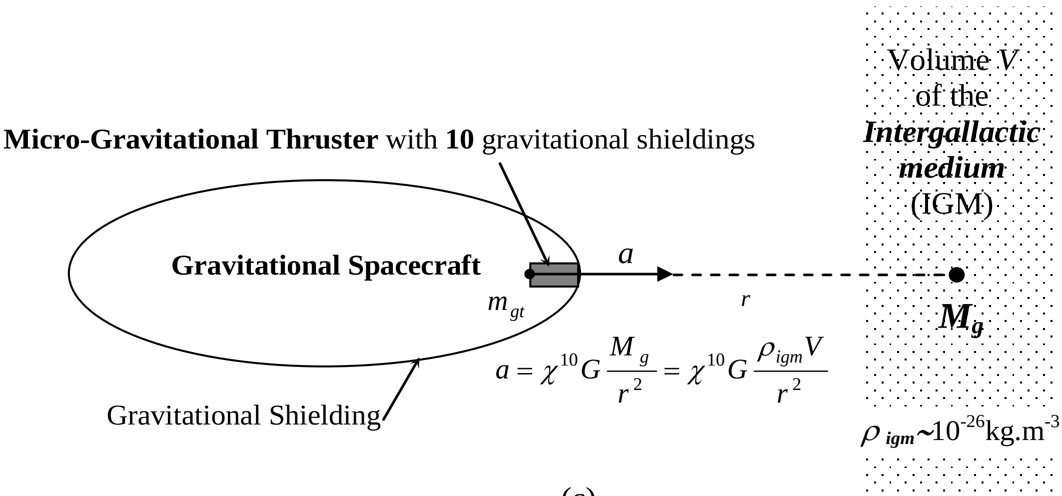
Fig. A12 – *Non-solid and Solid Gravitational Shieldings* - In the case of the Gravitational Shielding produced on a *solid substance* (b), when its molecules go to the *imaginary* space-time, *the electric field that produces the effect also goes to the imaginary space-time together with them*, because in this case, the substance of the Gravitational Shielding is *rigidly connected (by means of the dielectric) to the metal* that produces the electric field. This does not occur in the case of *Air* Gravitational Shielding.



(a)



(b)



(c)

Fig. A13 – *Double Gravitational Shielding and Micro-thrusters* – (a) Shows a double gravitational shielding that makes possible to decrease the *inertial effects* upon the spacecraft when it is traveling both in the *imaginary* space-time and in the *real* space-time. The *solid* Gravitational Shielding also can be obtained by means of *an ELF electric current through a metallic lamina* placed *between the semi-spheres and the Gravitational Shielding of Air* as shown above. (b) Shows 6 *micro-thrusters* placed inside a Gravitational Spacecraft, in order to propel the spacecraft in the directions x, y and z. Note that the Gravitational Thrusters in the spacecraft must have a very small diameter (of the order of *millimeters*) because the hole through the Gravitational Shielding of the spacecraft cannot be large. Thus, these thrusters are in fact *Micro-thrusters*. (c) Shows a micro-thruster inside a spacecraft, and in front of a volume *V* of the intergalactic medium (IGM). Under these conditions, the spacecraft acquires an acceleration *a* in the direction of the volume *V*.

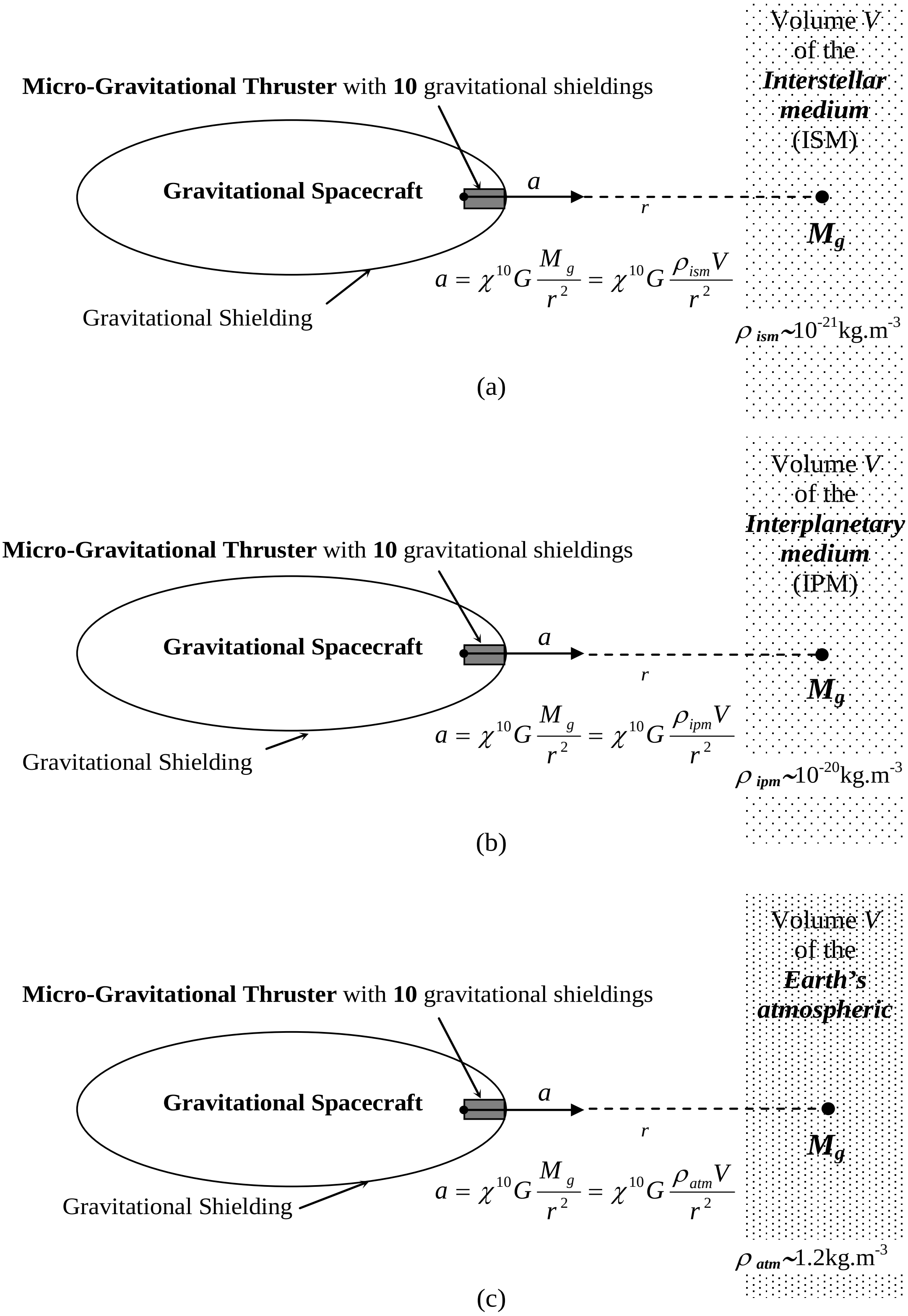


Fig. A14 – *Gravitational Propulsion using Micro-Gravitational Thruster* – (a) Gravitational acceleration produced by a gravitational mass M_g of the *Interstellar Medium*. The density of the Interstellar Medium is about 10^5 times greater than the density of the *Intergalactic Medium* (b) Gravitational acceleration produced in the *Interplanetary Medium*. (c) Gravitational acceleration produced in the *Earth's atmosphere*. Note that, in this case, ρ_{atm} (*near to the Earth's surface*)is about 10^{26} times greater than the density of the *Intergalactic Medium.*

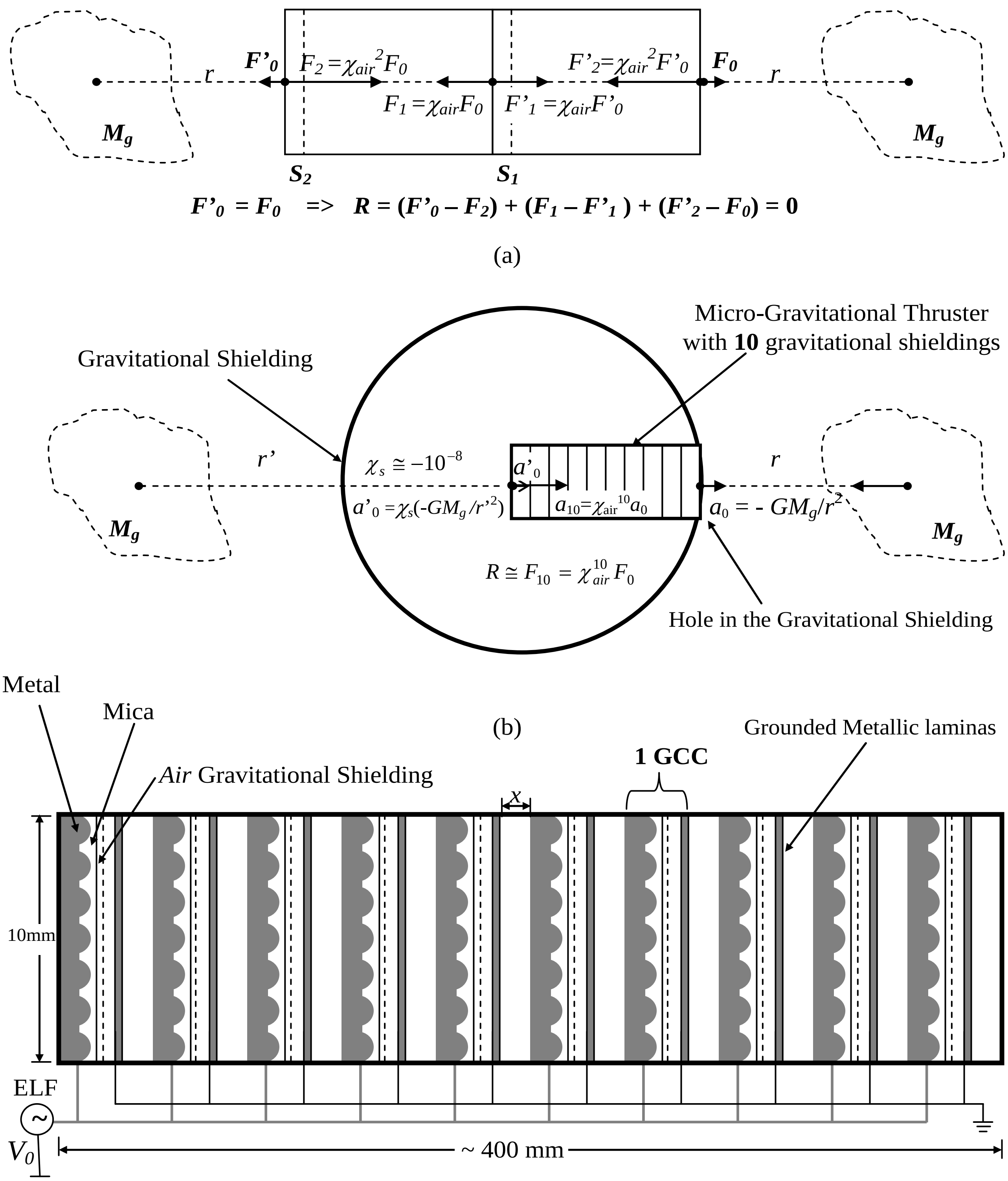


Fig. A15 – *Dynamics and Structure of the Micro-Gravitational Thrusters* - (a) The Micro-Gravitational Thrusters do not work *outside* the Gravitational Shielding, because, in this case, *the resultant upon the thruster is null* due to the symmetry. (b) The Gravitational Shielding $\left(\chi_s \cong 10^{-8}\right)$ reduces strongly the intensities of the gravitational forces acting on the micro-gravitational thruster, except obviously, through the hole in the gravitational shielding. (c) Micro-Gravitational Thruster with *10 Air Gravitational Shieldings* (10GCCs). The grounded metallic laminas are placed so as to retain the electric field produced by metallic surface behind the semi-spheres.

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