A System to convert Gravitational Energy directly into Electrical Energy

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We show that it is possible to produce strong gravitational accelerations on the free electrons of a conductor in order to obtain electrical current. This allows the conversion of gravitational energy directly into electrical energy. Here, we propose a system that can produce several tens of kilowatts of electrical energy converted from the gravitational energy.

Key words: Modified theories of gravity, Electric fields effects on material flows, Electron tubes, Electrical instruments.

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1. Introduction

In a previous paper [1], we have proposed a system to convert gravitational energy into rotational kinetic energy (Gravitational Motor), which can be converted into electrical energy by means of a conventional electrical generator. Now, we propose a novel system to convert gravitational energy directly into electrical energy.

It is known that, in some materials, called conductors, the free electrons are so loosely held by the atom and so close to the neighboring atoms that they tend to drift randomly from one atom to its neighboring atoms. This means that the electrons move in all directions by the same amount. However, if some outside force acts upon the free electrons their movement becomes not random, and they move from atom to atom at the same direction of the applied force. This flow of electrons (their electric charge) through the conductor produces the electrical current, which is defined as a flow of electric charge through a medium [2]. This charge is typically carried by moving electrons in a conductor, but it can also be carried by ions in an electrolyte, or by both ions and electrons in a plasma [3].

Thus, the electrical current arises in a conductor when an outside force acts upon the free electrons. This force is called, in a generic way, of electromotive force (EMF). Usually, it is of electrical nature (F = eE).

Here, it is shown that the electrical flow can also be achieved by means of gravitational forces (F = mg). The Gravitational Shielding Effect (BR Patent Number: PI0805046-5, July 31, 2008 [4]), shows that a battery of Gravitational Shieldings can strongly intensify the gravitational acceleration in any direction and, in this way, it is possible to produce strong gravitational accelerations on the free electrons of a conductor in order to obtain electrical current.

2. Theory

From the quantization of gravity it follows that the gravitational mass mg and the inertial mass mi are correlated by means of the following factor [1]:

\[ \chi = \frac{m_g}{m_i} = \left(1 - 2\sqrt{1 + \left(\frac{\Delta p}{m_i c}\right)^2} - 1\right) \]

where \( m_i \) is the rest inertial mass of the particle and \( \Delta p \) is the variation in the particle’s kinetic momentum; \( c \) is the speed of light.

When \( \Delta p \) is produced by the absorption of a photon with wavelength \( \lambda \), it is expressed by \( \Delta p = h/\lambda \). In this case, Eq. (1) becomes
\[ \frac{m_g}{m_{i0}} = \left\{ 1 - 2 \left[ \sqrt{1 + \left( \frac{h}{m_{i0} c} \right)^2} - 1 \right] \right\} \]

where \( \lambda_0 = \frac{h}{m_{i0} c} \) is the De Broglie wavelength for the particle with rest inertial mass \( m_{i0} \).

It has been shown that there is an additional effect - Gravitational Shielding effect - produced by a substance whose gravitational mass was reduced or made negative [5]. The effect extends beyond substance (gravitational shielding), up to a certain distance from it (along the central axis of gravitational shielding). This effect shows that in this region the gravity acceleration, \( g_1 \), is reduced at the same proportion, i.e., \( g_1 = \chi_1 g \) where \( \chi_1 = m_g / m_{i0} \) and \( g \) is the gravity acceleration before the gravitational shielding. Consequently, after a second gravitational shielding, the gravity will be given by \( g_2 = \chi_2 g_1 = \chi_1 \chi_2 g \), where \( \chi_2 \) is the value of the ratio \( m_g / m_{i0} \) for the second gravitational shielding. In a generalized way, we can write that after the \( n \)th gravitational shielding the gravity, \( g_n \), will be given by

\[ g_n = \chi_1 \chi_2 \chi_3 \cdots \chi_n g \tag{3} \]

This possibility shows that, by means of a battery of gravitational shieldings, we can make particles acquire enormous accelerations. In practice, this can lead to the conception of powerful particles accelerators, kinetic weapons or weapons of shockwaves.

From Electrodynamics we know that when an electromagnetic wave with frequency \( f \) and velocity \( c \) incides on a material with relative permittivity \( \varepsilon_r \), relative magnetic permeability \( \mu_r \) and electrical conductivity \( \sigma \), its velocity is reduced to \( v = c / n_r \) where \( n_r \) is the index of refraction of the material, given by [6]

\[ n_r = c \sqrt{\frac{\varepsilon_r \mu_r}{2}} \left( \frac{1}{1 + \left( \frac{\sigma}{\omega \varepsilon_r} \right)^2} + 1 \right) \tag{4} \]

If \( \sigma >> \omega \varepsilon_r \), \( \omega = 2\pi f \), Eq. (4) reduces to

\[ n_r = \sqrt{\frac{\mu_r \sigma}{4\pi \varepsilon_0 f}} \tag{5} \]

Thus, the wavelength of the incident radiation (See Fig. 1) becomes

\[ \lambda_{mod} = \frac{v}{f} = \frac{c/f}{n_r} = \frac{\lambda}{\sqrt{4\pi f \sigma}} \tag{6} \]

Fig. 1 - Modified Electromagnetic Wave. The wavelength of the electromagnetic wave can be strongly reduced, but its frequency remains the same.

If a lamina with thickness equal to \( \xi \) contains \( n \) atoms/m³, then the number of atoms per area unit is \( n' \xi \). Thus, if the electromagnetic radiation with frequency \( f \) incides on an area \( S \) of the lamina it reaches \( nS' \xi \) atoms. If it incides on the total area of the lamina, \( S_f \), then the total number of atoms reached by the radiation is \( N = nS_f \xi \). The number of atoms per unit of volume, \( n \), is given by

\[ n = \frac{N_0 \rho}{A} \tag{7} \]

where \( N_0 = 6.02 \times 10^{26} \text{ atoms/k mole} \) is the Avogadro’s number; \( \rho \) is the matter density of the lamina (in kg/m³) and \( A \) is the molar mass (kg/kmole).

When an electromagnetic wave incides on the lamina, it strikes \( N_f \) front atoms, where \( N_f = |nS_f| \phi_m \), \( \phi_m \) is the “diameter” of the atom. Thus, the electromagnetic wave incides effectively on an area \( S = N_f S_m \), where \( S_m = \frac{1}{4} \pi \phi_m^2 \) is the cross section area of one atom.
After these collisions, it carries out $n_{\text{collisions}}$ with the other atoms (See Fig.2).

![Diagram of atom collision with wave](image)

**Fig. 2 – Collisions inside the lamina.**

Thus, the total number of collisions in the volume $S_\xi$ is

$$N_{\text{collisions}} = N_f + n_{\text{collisions}} = n_S \phi_m + (n_S \xi - n_S \phi_m) = n_S \xi$$  \hfill (8)

The power density, $D$, of the radiation on the lamina can be expressed by

$$D = \frac{P}{S} = \frac{P}{N_f S_m}$$  \hfill (9)

We can express the total mean number of collisions in each atom, $n_1$, by means of the following equation

$$n_1 = \frac{n_{\text{total photons}} N_{\text{collisions}}}{N}$$  \hfill (10)

Since in each collision a momentum $\frac{h}{\lambda}$ is transferred to the atom, then the total momentum transferred to the lamina will be $\Delta p = (n_f N) \frac{h}{\lambda}$. Therefore, in accordance with Eq. (1), we can write that

$$\frac{m_{g(l)}}{m_{0(l)}} = 1 - 2 \left[ 1 + \left( \frac{n_f N \frac{\lambda_0}{\lambda} \xi}{\lambda} \right) \right] - 1 \right] = 1 - 2 \left[ 1 + \left[ \frac{n_{\text{total photons}} N_{\text{collisions}} \frac{\lambda_0}{\lambda} \xi}{\lambda} \right] - 1 \right]$$  \hfill (11)

Since Eq. (8) gives $N_{\text{collisions}} = n_S \xi$, we get

$$n_{\text{total photons}} N_{\text{collisions}} = \left( \frac{P}{\hbar f^2} \right) (n_i S_\xi)$$  \hfill (12)

Substitution of Eq. (12) into Eq. (11) yields

$$\frac{m_{g(l)}}{m_{0(l)}} = 1 - 2 \left[ 1 + \left( \frac{P}{\hbar f^2} \right) \left( n_i S_\xi \frac{\lambda_0}{\lambda} \right) \xi \right] - 1 \right]$$  \hfill (13)

Substitution of $P$ given by Eq. (9) into Eq. (13) gives

$$\frac{m_{g(l)}}{m_{0(l)}} = 1 - 2 \left[ 1 + \left( \frac{n_f S_m D}{m_{0(l)} \xi} \right) \frac{\lambda_0}{\lambda} \right] - 1 \right]$$  \hfill (14)

Substitution of $N_f \equiv n_i S_f \phi_m$ and $S = N_f S_m$ into Eq. (14) results

$$\frac{m_{g(l)}}{m_{0(l)}} = 1 - 2 \left[ 1 + \left( \frac{n_f S_m D}{m_{0(l)} \xi} \right) \frac{\lambda_0}{\lambda} \right] - 1 \right]$$  \hfill (15)

where $m_{0(l)} = \rho_0 V_{(l)}$.

Now, considering that the lamina is inside an ELF electromagnetic field with $E$ and $B$, then we can write that [7]

$$D = \frac{n_r(l) E^2}{2 \mu_0 c}$$  \hfill (16)

Substitution of Eq. (16) into Eq. (15) gives

$$\frac{m_{g(l)}}{m_{0(l)}} = 1 - 2 \left[ 1 + \left( \frac{n_r(l) n_i^3 S_f^2 S_m^2 \xi^2 \lambda_0}{2 \mu_0 m_{0(l)} E^2 f^2 \lambda} \right) \frac{\lambda_0}{\lambda} \right] - 1 \right]$$  \hfill (17)

In the case in which the area $S_f$ is just the area of the cross-section of the lamina ($S_\alpha$), we obtain from Eq. (17), considering that $m_{0(l)} = \rho_0 S_\alpha$, the following expression
\[
\frac{m_{g(l)}}{m_{0(l)}} = \left\{1 - 2\left[1 + \frac{n_{g(l)}^{2}S_{g}S_{a}^{4}A^{2}E_{rms}^{4}}{2\mu_{0}\rho_{m}c^{2}E^{2}}\right]\right\}^{2} - 1 \right\} \tag{18}
\]

If the electrical conductivity of the lamina, \(\sigma_{(l)}\), is such that \(\sigma_{(l)} \gg \omega \varepsilon\), then the value of \(\lambda\) is given by Eq. (6), i.e.,

\[
\lambda = \frac{4\pi}{\mu f \sigma} \tag{19}
\]

Substitution of Eq. (19) into Eq. (18) gives

\[
\frac{m_{g(l)}}{m_{0(l)}} = \left\{1 - 2\left[1 + \frac{n_{g(l)}^{2}S_{g}S_{a}^{4}A^{2}E_{rms}^{4}}{16\pi\mu_{0}\rho_{m}c^{2}E^{2}}\right]\right\}^{2} - 1 \right\} \tag{20}
\]

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 sinusoidally (\(E_{m}\) 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

\[
\chi = \frac{m_{g(l)}}{m_{0(l)}} = \left\{1 - 2\left[1 + \frac{n_{g(l)}^{2}S_{g}S_{a}^{4}A^{2}E_{rms}^{4}}{16\pi\mu_{0}\rho_{m}c^{2}E^{2}}\right]\right\}^{2} - 1 \right\} \tag{21}
\]

Now consider the system shown in Fig.3. It was designed to convert Gravitational Energy directly into Electrical Energy. Thus, we can say that it is a Gravitational EMF Source.

Inside the system there is a dielectric tube (\(\varepsilon_{r} \cong 1\)) with the following characteristics:

- \(\alpha = 8\text{mm}\) (diameter), \(S_{a} = \pi\alpha^{2}/4 = 5.03\times10^{3}\text{m}^{2}\).
- Inside the tube there is a Lead sphere (\(\rho_{s} = 11340\text{Kg/m}^{3}\)) with 4mm radius and mass \(M_{gs} = 3.04\times10^{3}\text{kg}\). The tube is filled with air at ambient temperature and 1atm. Thus, inside the tube, the air density is

\[
\rho_{air} = 1.2\text{ kg/m}^{3} \tag{22}\]

The number of atoms of air (Nitrogen) per unit of volume, \(n_{air}\), according to Eq.(7), is given by

\[
n_{air} = \frac{N_{0}\rho_{air}}{A_{N}} = 5.16\times10^{22}\text{atoms/m}^{3} \tag{23}\]

The parallel metallic plates (p), shown in Fig.3 are subjected to different drop voltages. The two sets of plates \((D)\), placed on the extremes of the tube, are subjected to \(V_{D} = 3.847\text{kV}\) at \(f = 60\text{Hz}\), while the central set of plates \((A)\) is subjected to \(V_{A} = 7.827\text{kV}\) at \(f = 60\text{Hz}\). Since \(d = 14\text{mm}\), then the intensity of the electric field, which passes through the 36 cylindrical air laminas (each one with 5mm thickness) of the two sets \((D)\), is

\[
E_{(D)rms} = \frac{V_{D}rms}{d} = 2.748\times10^{5}\text{V/m} \]

and the intensity of the electric field, which passes through the 19 cylindrical air laminas of the central set \((A)\), is given by

\[
E_{(A)rms} = \frac{V_{A}rms}{d} = 5.591\times10^{5}\text{V/m} \]

Note that the metallic rings (5mm thickness) are positioned in such way to block the electric field out of the cylindrical air laminas. The objective is to turn each one of these laminas into a Gravity Control Cells (GCC) [5]. Thus, the system shown in Fig. 3 has 3 sets of GCC. Two with 18 GCC each, and one with 19 GCC. The two sets with 18 GCC each are positioned at the extremes of the tube \((D)\). They work as gravitational decelerator while the other set with 19 GCC \((A)\) works as a gravitational accelerator, intensifying the gravity acceleration produced by the mass \(M_{gs}\) of the Lead sphere. According to Eq. (3), this gravity, after the 19th GCC becomes \(g_{19} = \chi^{19}g_{r}/r_{0}^{2}\), where \(\chi = m_{g(l)}/m_{0(l)}\) given by Eq. (21) and \(r_{0} = 9\text{mm}\) is the distance between the center of the Lead sphere and the surface of the first GCC of the set \((A)\).

The objective of the sets \((D)\), with 18 GCC each, is to reduce strongly the value of the external gravity along the axis of the tube. In this case, the value of the external gravity, \(g_{ext}\), is reduced by the factor \(\chi_{d}^{18}g_{ext}\), where \(\chi_{d} = 10^{-2}\). For example, if the base BS of the system is positioned on the Earth.
Fig. 3 – A Gravitational EMF Source (Developed from a process patented in July, 31 2008, PI0805046-5)
surface, then \( g_{\text{ext}} = 9.81 \text{m/s}^2 \) is reduced to \( \chi_{d}^{18} g_{\text{ext}} \) and, after the set A, it is increased by \( \chi^{19} \). Since the system is designed for \( \chi = -6.4138 \), then the gravity acceleration on the on the sphere becomes \( \chi_{d}^{18} g_{\text{ext}} = 2.1 \times 10^{20} \text{m/s}^2 \), this value is much smaller than \( g_{\text{sphere}} = G M_{\text{gs}}/r_{0}^2 \approx 1.27 \times 10^4 \text{m/s}^2 \).

The electrical conductivity of air, inside the dielectric tube, is equal to the electrical conductivity of Earth’s atmosphere near the land, whose average value is \( \sigma_{\text{air}} \approx 1 \times 10^{-14} \text{S/m} \) [8]. This value is of fundamental importance in order to obtain the convenient values of the electrical current \( i \) and the value of \( \chi \) and \( \chi_{d} \), which are given by Eq. (21), i.e.,

\[
\chi = \left\{ \begin{array}{l}
1 - 2 \left[ \frac{n_{a}^{2} S_{a}^{4} \phi_{a}^{4} \sigma_{a} \text{E}_{(a)\text{rms}}}{16 \pi \mu_{a} \phi_{a}^{2} \text{E}^{4}} - 1 \right] \\
\end{array} \right.
\]

\[
= 1 - 2\sqrt{\frac{1 + 2.165 \times 10^{-22} \text{E}^{4}}{1 - 1}}
\]  

(24)

\[
\chi_{d} = \left\{ \begin{array}{l}
1 - 2 \left[ \frac{n_{a}^{2} S_{a}^{4} \phi_{a}^{4} \sigma_{a} \text{E}_{(a)\text{rms}}}{16 \pi \mu_{a} \phi_{a}^{2} \text{E}^{4}} - 1 \right] \\
\end{array} \right.
\]

\[
= 1 - 2\sqrt{\frac{1 + 2.165 \times 10^{-22} \text{E}_{(a)\text{rms}}^{4}}{1 - 1}}
\]  

(25)

where \( n_{a} = \sqrt{\varepsilon, \mu} \approx 1 \), since \( (\sigma \ll \omega \varepsilon) \); \( n_{\text{air}} = 5.16 \times 10^{25} \text{atoms/m}^3 \), \( \phi_{a} = 1.55 \times 10^{-10} \text{m} \), \( S_{a} = \pi \phi_{a}^{4} A = 1.88 \times 10^{-20} \text{m}^2 \) and \( f = 60 \text{Hz} \).

Since \( \text{E}_{(a)\text{rms}} = 5.591 \times 10^{-5} \text{V/m} \) and \( \text{E}_{(d)\text{rms}} = 2.748 \times 10^{-3} \text{V/m} \), we get

\[
\chi = -6.4138
\]  

(26)

and

\[
\chi_{d} \approx 10^{-2}
\]  

(27)

Note that there is a uniform magnetic field, \( B \), through the Iron rod. Then, the gravitational forces due to the gravitational mass of the sphere \( (M_{gs}) \) acting on electrons \( (F_{e}) \), protons \( (F_{p}) \) and neutrons \( (F_{n}) \) of the Iron rod, are respectively expressed by the following relations

\[
F_{e} = m_{e} a_{e} = \chi_{Be} m_{e} \left( \chi G M_{gs} \right) / r_{0}^{2}
\]  

(28)

\[
F_{p} = m_{p} a_{p} = \chi_{Bp} m_{p} \left( \chi G M_{gs} \right) / r_{0}^{2}
\]  

(29)

\[
F_{n} = m_{n} a_{n} = \chi_{Bn} m_{n} \left( \chi G M_{gs} \right) / r_{0}^{2}
\]  

(30)

The factors \( \chi_{B} \) are due to the electrons, protons and neutrons are inside the magnetic field \( B \).

In order to make null the resultant of these forces in the Iron (and also in the sphere) we must have \( F_{e} = F_{p} + F_{n} \), i.e.,

\[
m_{e} \chi_{Be} = m_{p} \chi_{Bp} + m_{n} \chi_{Bn}
\]  

(31)

It is important to note that the set with 19 GCC (A) cannot be turned on before the magnetic field \( B \) is on. Because the gravitational accelerations on the Iron rod and Lead sphere will be enormous \( \chi^{19} G M_{gs}/r_{0}^{2} \approx 5.4 \times 10^{6} \text{m/s}^2 \), and will explode the device.

The force \( F_{e} \) is the electromotive force (EMF), which produces the electrical current. Here, this force has gravitational nature. The corresponding force of electrical nature is \( F_{e} = eE \). Thus, we can write that

\[
m_{e} a_{e} = eE
\]  

(32)

The electrons inside the Iron rod (See Fig. 3) are subjected to the gravity acceleration produced by the sphere, and increased by the 19 GCC in the region (A). The result is

\[
a_{e} = \chi^{19} g_{s} = \chi^{19} G M_{gs} / r_{0}^{2}
\]  

(33)

Comparing Eq. (32) with Eq.(33), we obtain

\[
E = \left( \frac{m_{e}}{e} \right) \chi^{19} G M_{gs} / r_{0}^{2}
\]  

(34)

The electron mobility, \( \mu_{e} \), considering various scattering mechanisms can be obtained by solving the Boltzmann equation in the relaxation time approximation. The result is [9].
\[ \mu_e = \frac{e^2}{m_{ge}} \]  
(35)

where \( \langle \tau \rangle \) is the average relaxation time over the electron energies and \( m_{ge} \) is the gravitational mass of electron, which is the effective mass of electron.

Since \( \langle \tau \rangle \) can be expressed by \( \langle \tau \rangle = m_{ge} \sigma / ne^2 \) [10], then Eq. (35) can be written as follows

\[ \mu_e = \sigma / ne \]  
(36)

Thus, the drift velocity will be expressed by

\[ v_d = \mu_e E = \sigma (m_{ge} / e) \chi^{19} G \frac{M_g}{r_r^2} \]  
(37)

and the electrical current density expressed by

\[ j_e = \rho_{qe} v_d = \sigma (m_{ge} / e) \chi^{19} G \frac{M_g}{r_r^2} \]  
(38)

where \( \rho_{qe} = ne \), and \( m_{ge} = \chi_{Be} m_e \).

Therefore, Eq. (38) reduces to

\[ j_e = \sigma (m_{ge} / e) \chi_{Be} \chi^{19} G \frac{M_g}{r_r^2} \]  
(39)

In order to calculate the expressions of \( \chi_{Be}, \chi_{Bp} \) and \( \chi_{Bn} \) we start from Eq. (17), for the particular case of single electron in the region subjected to the magnetic field \( B \) (iron rod). In this case, we must substitute \( n_{r(i)} \) by

\[ n_{r(\text{iron})} = (\mu_{r(\text{iron})} / A \chi_{\text{iron}}) \frac{A n e_d}{f^2} \]  

\[ n_l \text{ by } 1 / V_e = \frac{1}{4} \pi e^3 \]  

\[ (r_e \text{ is the electron radius), } S_f \text{ by } \frac{SSA_e \rho_c}{V_e} \]  

\[ \text{SSA}_e \text{ is the specific surface area for electrons in this case: } \frac{SSA_e}{4} A_e / m_e = \frac{1}{2} A_e / \rho_c V_e = 2 \pi e^2 / \rho_c V_e, \]  

\[ S_m \text{ by } S_c = n^2 / e \text{, } \xi \phi_m = 2 r_e \text{ and } m_{l(\text{iron})} \text{ by } m_e. \]  

The result is

\[ \chi_{Be} = \left\{ 1 - \frac{1}{2} \sqrt{1 + \frac{45.56 \pi^2 r_n^2 E^4}{\mu_{r(\text{iron})}^2 n_{r(\text{iron})}^2 E^4}} - 1 \right\} \]  
(40)

Similarly, in the case of proton and neutron we can write that

\[ \chi_{Bp} = \left\{ 1 - \frac{1}{2} \sqrt{1 + \frac{45.56 \pi^2 r_n^4 B_{rms}^4}{\mu_{r(\text{proton})}^2 n_{r(\text{proton})}^2 B_{rms}^4}} - 1 \right\} \]  
(42)

\[ \chi_{Bn} = \left\{ 1 - \frac{1}{2} \sqrt{1 + \frac{45.56 \pi^2 r_n^4 B_{rms}^4}{\mu_{r(\text{neutron})}^2 n_{r(\text{neutron})}^2 B_{rms}^4}} - 1 \right\} \]  
(43)

The radius of free electron is \( r_e = 6.87 \times 10^{-14} m \) (See Appendix A) and the radius of protons inside the atoms (nuclei) is \( r_p = 1.2 \times 10^{-15} m \), \( r_n \equiv r_p \), then we obtain from Eqs. (41) (42) and (43) the following expressions:

\[ \chi_{Be} = \left\{ 1 - \frac{1}{2} \sqrt{1 + 8.49 \times 10^4 \frac{B_{rms}^4}{f^2}} - 1 \right\} \]  
(44)

\[ \chi_{Bp} = \left\{ 1 - \frac{1}{2} \sqrt{1 + 2.35 \times 10^{-9} \frac{B_{rms}^4}{f^2}} - 1 \right\} \]  
(45)

Then, from Eq. (31) it follows that

\[ m_e \chi_{Be} \equiv 2 m_p \chi_{Bp} \]  
(46)

Substitution of Eqs. (44) and (45) into Eq. (46) gives

\[ \begin{align*}
\left\{ 1 - \frac{1}{2} \sqrt{1 + 8.49 \times 10^4 \frac{B_{rms}^4}{f^2}} - 1 \right\} &= 3666.3 \quad (47) \\
\left\{ 1 - \frac{1}{2} \sqrt{1 + 2.35 \times 10^{-9} \frac{B_{rms}^4}{f^2}} - 1 \right\} &= 3666.3 \quad (48)
\end{align*} \]

For \( f = 1 \mu Hz \), we get

\[ \left\{ 1 - \frac{1}{2} \sqrt{1 + 8.49 \times 10^6 \frac{B_{rms}^4}{f^2}} - 1 \right\} = 3666.3 \quad (49) \]

whence we obtain

\[ B_{rms} = 2.5 m T \]  
(49)

Consequently, Eq. (44) and (45) yields

\[ \chi_{Be} = -3666.3 \]  
(50)

and
In order to the forces $F_e$ and $F_p$ have contrary direction (such as occurs in the case, in which the nature of the electromotive force is electrical) we must have $\chi_{Be} < 0$ and $\chi_{Bn} \cong \chi_{Bp} > 0$ (See equations (28) (29) and (30)), i.e.,

$$1-2 \left[ 1 + 8.49 \times 10^5 \frac{B_{rms}^2}{f^2} - 1 \right] < 0$$

and

$$1-2 \left[ 1 + 23.5 \times 10^5 \frac{B_{rms}^4}{f^2} - 1 \right] > 0$$

This means that we must have

$$0.06\sqrt{f} < B_{rms} < 151.86\sqrt{f}$$

In the case of $f = 1 \mu Hz = 10^{-6} Hz$ the result is $6.5 \times 10^{-7} T < B_{rms} < 0.15 T$

Note the cylindrical format (1turn, $r = 5 mm$) of the inductor (Figs. 3 and 6). By using only 1 turn it is possible to eliminate the capacitive effect between the turns. This is highly relevant in this case because the extremely-low frequency $f = 1 \mu Hz$ would strongly increase the capacitive reactance $X_c$ associated to the inductor. When a current $i$ passes through this inductor, the value of $B$ inside the Iron rod is given by $B = \mu_r \frac{\mu_0 i}{x_B}$ where $x_B = 100 mm$ is inductor’s length and $\mu_r = 4000$(very pure Iron). However, the effective permeability is defined as $\mu_{eff} = \mu_r [1+(\mu_r-1) N_m]$, where $N_m$ is the average demagnetizing factor [11]. Since the iron rod has 5mm diameter and 100mm height, then we obtain the factor $\gamma = 100 mm / 5 mm = 20$ which gives $N_m = 0.02$ (See table VI[12]). Therefore, we obtain $\mu_{eff} = 49.4$. Thus, for $B_{rms} = 2.5 mT$ (See Eq. (49)) i.e., $B = \mu_{eff} \frac{\mu_0 i}{x_B} = 2.5 mT$, the value of $i$ must be $i = 4 A$. Then, the resistor in Fig.3. must have $20V / 4A = 5 \Omega$. The dissipated power is 80W.

Let us now calculate the current density through the Iron rod (Fig. 3). According to Eq. (39) we have

$$j_e = \sigma_{iron} \left( \frac{m_r}{e} \right) \chi_{Be} \chi^{19} G \frac{M_{gs}}{r_0^3}$$

Since $\sigma_{iron} = 1.03 \times 10^7 S/m$, $\chi = -6.4138$, $\chi_{Be} = 0.0366.3$, $M_{gs} = 3.04 \times 10^{-5} kg$ and $r_0 = 9 mm$, we obtain

$$j_e = 1.164 \times 10^6 A/m^2$$

Given that $S_a = \pi a^2 / 4 = 5.03 \times 10^{-3} m^2$ we get

$$i_{source} = j_e S_a \cong 58.6 A$$

The resistance of the Iron rod is

$$R_{source} = \left( \frac{x_B}{\sigma_{iron} S_a} \right) = 1.93 \times 10^{-4} \Omega$$

Thus, the dissipated power by the Iron rod is

$$P_d = R_{source} i_{source}^2 \cong 0.66 W$$

Note that this Gravitational EMF source is a Current Source. As we known, a Current Source is a device that keeps invariable the electric current between its terminals. So, if the source is connected to an external load, and the resistance of the load varies, then the own source will increase or decrease its output voltage in order to maintain invariable the value of the current in the circuit.

Based on Kirchhoff’s laws we can express the electric voltage between the terminals of the Current Source, $V_s$, by means of the following relation (See Fig.4):

$$V_{source} = R_{source} i_{source} + V$$

where $V$ is the voltage applied on the charge.
designed* to make the voltage \( V = 2.2kV @ 60Hz \). Since \( R_{source} = \frac{V_{source}}{i_{source}} \), then we can write that \( V_{source} \equiv V \). Thus, in the primary circuit, the voltage is \( V_p = V_{source} = 2.2kV \) and the current is \( i_p = i_{source} = 58.6A \); the winding turns ratio is \( N_p / N_s = 10 \); thus, in the secondary circuit the output voltage is \( V_s = 220V @ 60Hz \) and the current is \( i_s = 586A \). Consequently, the source output power is

\[
P = V_s i_s = 128.9kW
\]

Note that, in order to initializing the Gravitational EMF Source, is used an external source, which is removed after the initialization of the Gravitational EMF Source.

Now it will be shown that this Gravitational EMF source can be miniaturized.

We start making \( x_B = 10mm \) and \( \xi = 0.5mm \); \( \alpha = 2mm \), \( d_A = 8mm \), \( d_p = 16mm \) and \( r_0 = 1.5mm \) (See Fig. 5). The sphere with 2mm diameter is now of Tungsten carbide (W+Cobalt) with 15,630kg/m³ density. Then \( M_s = 6.54 \times 10^{-5} \text{kg} \) and \( S_A = 3.14 \times 10^{6} \text{m}^2 \). Thus, for \( f = 1 \mu \text{Hz} \), Eq.(24) gives

\[
\chi = 1 - 2 \left[ \frac{1}{N} \left( 1 + 0.1822 \left( \frac{E_{(rms)}}{E_{(rms)}} \right) - 1 \right) \right] \tag{57}
\]

For \( V_{(rms)} = 26mV \) and \( d_A = 8mm \) we get \( E_{(rms)} = 3.250V / m \), and Eq. (57) yields

\[
\chi = -6.236
\]

For \( V_{(rms)} = 26mV \) and \( d_D = 16mm \) we get \( E_{(rms)} = 1.625V / m \) and \( \chi_d = -0.01 \).

Since \( \sigma_{iron} = 1.03 \times 10^7 \text{S/m} \) and \( \chi_{Fe} = -3.66 \), then the value of \( j_e \) is

\[
j_e = \sigma_{iron} \left( \frac{m_e}{e} \right) \chi_{Fe} \chi^9 \frac{M_{gs}}{r_0^2} = 5.29 \times 10^5 \text{A/m}^2
\]

and

\[
i_{source} = j_e S_A \approx 1.66A
\]

The resistance of the iron rod is given by

\[
R_{source} = \left( \frac{X_B}{\sigma_{iron} S_A} \right) = 3.1 \times 10^{-3} \Omega
\]

Thus, the dissipated power by the Iron rod is

\[
P_d = R_{source} i_{source}^2 = 0.9mW
\]

In the case of the miniaturized source, the iron rod has 2mm diameter and 10mm height, then we obtain the factor \( \gamma = 10mm / 2mm = 5 \) which gives \( N_m = 0.06 \) (See table V[12]). Therefore, we obtain \( \mu_r(\text{eff}) = 16.6 \).

Since \( V_s = V_{(rms)} = V_{D(rms)} = 26mV \) and the resistance of the resistor \( R_i \) is \( 21.6m\Omega / 31mW \) (See Fig.5), then the current from the first source is \( i = 1.24 \). Thus, we get \( B = \mu_r(\text{eff}) \mu_0 i / x_B = 2.5mT \).

Since the current through the second source is \( i_{source} = 1.66A \), and, if the voltage required by the charge, is \( V = 3.7V \) (usual lithium batteries’ voltage), then the source voltage is given by

\[
V_{source} = R_{source} i_{source} + V \approx 3.7V
\]

Consequently, the miniaturized source can provide the power:

\[
P = V_{source} i_{source} = (3.7V)(1.66A) \approx 6.1W
\]

This is the magnitude of the power of lithium batteries used in mobiles. Note that the miniaturized source of Gravitational EMF does not need to be recharged and it occupies a volume (8mm x 70mm x 80mm). See Fig.6) similar to the volume of the mobile batteries. In addition, note that the dimensions of this miniaturized source can be further reduced (possibly down to a few millimeters or less).
Fig. 5 – A Miniaturized Source of Gravitational EMF
High-power Source

\[ B = \frac{\mu_r \mu_0 i}{2r} = 2.5 \text{mT} \]
\[ i = 4 \text{A}; \ r = 5 \text{mm} \]
\[ \mu_r \approx 49.4 \]

Low-power Source

\[ B = \frac{\mu_r \mu_0 i}{2r} = 2.5 \text{mT} \]
\[ i = 1.2 \text{A}; \ r = 2 \text{mm} \]
\[ \mu_r \approx 16.6 \]

Fig. 6 – Schematic Diagram in 3D of the Gravitational EMF Sources
Appendix A: The “Geometrical Radii” of Electron and Proton

It is known that the frequency of oscillation of a simple spring oscillator is

\[ f = \frac{1}{2\pi} \sqrt{\frac{K}{m}} \quad (A1) \]

where \( m \) is the inertial mass attached to the spring and \( K \) is the spring constant (in N·m⁻¹). In this case, the restoring force exerted by the spring is linear and given by

\[ F = -Kx \quad (A2) \]

where \( x \) is the displacement from the equilibrium position.

Now, consider the gravitational force: For example, above the surface of the Earth, the force follows the familiar Newtonian function, i.e., \( F = -GM_{\oplus}m_{\oplus}/r^2 \), where \( M_{\oplus} \) is the mass of Earth, \( m_{\oplus} \) is the gravitational mass of a particle and \( r \) is the distance between the centers. Below Earth’s surface the force is linear and given by

\[ F = -\frac{GM_{\oplus}m_x}{R_{\oplus}^3} r \quad (A3) \]

where \( R_{\oplus} \) is the radius of Earth.

By comparing (A3) with (A2) we obtain

\[ \frac{K}{m_{\chi}} = \frac{GM_{\oplus}}{R_{\oplus}^3} \left( \frac{r}{x} \right) \quad (A4) \]

Making \( x = r = R_{\oplus} \), and substituting (A4) into (A1) gives

\[ f = \frac{1}{2\pi} \sqrt{\frac{GM_{\oplus}\chi}{R_{\oplus}^3}} \quad (A5) \]

In the case of an electron and a positron, we substitute \( M_{\oplus} \) by \( m_{e\oplus} \), \( \chi \) by \( \chi_e \) and \( R_{\oplus} \) by \( R_e \), where \( R_e \) is the radius of electron (or positron). Thus, Eq. (A5) becomes

\[ f = \frac{1}{2\pi} \sqrt{\frac{Gm_{e\oplus}\chi_e}{R_e^3}} \quad (A6) \]

The value of \( \chi_e \) varies with the density of energy [1]. When the electron and the positron are distant from each other and the local density of energy is small, the value of \( \chi_e \) becomes very close to 1. However, when the electron and the positron are penetrating one another, the energy densities in each particle become very strong due to the proximity of their electrical charges \( e \) and, consequently, the value of \( \chi_e \) strongly increases. In order to calculate the value of \( \chi_e \) under these conditions (\( x = r = R_e \)), we start from the expression of correlation between electric charge \( q \) and gravitational mass, obtained in a previous work [1]:

\[ q = \sqrt{4\pi e_0 G \ m_{e(\text{ imaginary})} i} \quad (A7) \]

where \( m_{e(\text{ imaginary})} \) is the imaginary gravitational mass, and \( i = \sqrt{-1} \).

In the case of electron, Eq. (A7) gives

\[ q_e = \sqrt{4\pi e_0 G \ m_{e(\text{ imaginary})} i} = \]
\[ = \sqrt{4\pi e_0 G \left( \chi_e m_{0e(\text{ imaginary})} i \right)} = \]
\[ = \sqrt{4\pi e_0 G \left( \chi_e \frac{2}{45} m_{0e(\text{ real})} \right)^2} = \]
\[ = \sqrt{4\pi e_0 G \left( \frac{2}{45} \chi_e m_{0e(\text{ real})} \right)^2} = -1.6 \times 10^{-19} \ C \quad (A8) \]

where we obtain

\[ \chi_e = -1.8 \times 10^{21} \quad (A9) \]

This is therefore, the value of \( \chi_e \) increased by the strong density of energy produced by the electrical charges \( e \) of the two particles, under previously mentioned conditions.
Given that \( m_{ge} = \chi_em_{\text{ radioactive}} \), Eq. (A6) yields
\[
f = \frac{1}{2\pi} \sqrt{\frac{G\chi_e^2 m_{\text{ radioactive}}}{R_e^3}} \quad (A10)
\]
From Quantum Mechanics, we know that
\[
hf = m_{\text{ radioactive}} c^2 \quad (A11)
\]
where \( h \) is the Planck’s constant. Thus, in the case of \( m_{\text{ radioactive}} = m_{\text{ electron}} \) we get
\[
f = \frac{m_{\text{ electron}} c^2}{h} \quad (A12)
\]
By comparing (A10) and (A12) we conclude that
\[
\frac{m_{\text{ electron}} c^2}{h} = \frac{1}{2\pi} \sqrt{\frac{G\chi_e^2 m_{\text{ electron}}}{R_e^3}} \quad (A13)
\]
Isolating the radius \( R_e \), we get:
\[
R_e = \left( \frac{G}{m_{\text{ electron}}} \right)^{\frac{1}{3}} \left( \frac{\chi_e h}{2\pi c^2} \right)^{\frac{2}{3}} = 6.87 \times 10^{-14} m \quad (A14)
\]
Thus, the result is
\[
R_p = \left( \frac{G}{m_{\text{ proton}}} \right)^{\frac{1}{3}} \left( \frac{\chi_p h}{2\pi c^2} \right)^{\frac{2}{3}} = 3.72 \times 10^{-17} m \quad (A17)
\]
Note that these radii, given by Equations (A14) and (A17), are the radii of free electrons and free protons (when the particle and antiparticle (in isolation) penetrate themselves mutually).

Inside the atoms (nuclei) the radius of protons is well-known. For example, protons, as the hydrogen nuclei, have a radius given by \( R_p \approx 1.2 \times 10^{-15} m \) [14, 15]. The strong increase in respect to the value given by Eq. (A17) is due to the interaction with the electron of the atom.

Compare this value with the Compton sized electron, which predicts \( R_e = 3.86 \times 10^{-13} m \) and also with standardized result recently obtained of \( R_e = 4 - 7 \times 10^{-13} m \) [13].

In the case of proton, we have
\[
q_p = \sqrt{4\pi\varepsilon_0 G m_{\text{ proton}}} \quad (A15)
\]
where we obtain
\[
\chi_p = -9.7 \times 10^{17} \quad (A16)
\]
Appendix B: An Experimental Setup for Testing a GCC with Air Nucleus

\[ V_{\text{max}} = 8 \text{kV @ 60Hz} \]

\[ \chi = 1 - 2 \left( \sqrt{1 + \frac{n_0^2 \sigma_{\text{air}}^2 S_a^4 \phi_m \sigma_{\text{air}} E_{(d)\text{rms}}^4}{16 \pi \mu_0 \rho_{\text{air}}^2 c^4 f^3}} - 1 \right) \]

For \( V_{(d)\text{rms}} = 8kV \) we obtain \( \chi = -6.814 \), \( M_g = \chi M_i \)

\[ P = M_g g = \chi M_i g \] (\( M_i \) is the inertial mass)
DETAILS OF PARTS

- 5 mm Metal
- 5 mm Metal
- 8 mm Metal
- 10 mm Acrylic
- 12 mm Metal
DETAILS OF THE BOX

**Acrylic**
- 3 plates 20mm x 26mm x 2mm
- 2 plates 20mm x 20mm x 2mm
- 2 plates 20mm x 20mm x 1mm (inner plates)
- 4 plates 20mm x 5mm x 2mm

**Aluminum**
- 2 plates 20mm x 10mm

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HV ends
References


