The Gravitational Invisibility

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The possible obtention of *invisibility* by means of a gravitational method is shown in this work. This method is based on a gravity control process patented on 2008 (BR Patent Number: PI0805046-5). It goes far beyond the known methods of invisibility and camouflage, which use the principles of light refraction to allow light to pass right through an object (metamaterials).

Key words: Invisibility, Gravitational Invisibility, Real and Imaginary Universes.

1. Introduction

An object that cannot be seen by the human eyes is in called state of *invisibility*. At this state, the object neither reflects, nor absorbs light, i.e., the light passes freely through it. Under this condition, we can say that the object is 100% transparent. In the Nature, there is no material 100% transparent.

The concept of invisibility includes others ranges of the electromagnetic spectrum, such as radio, infrared, ultraviolet, etc., since the object can be detected by instruments operating in the ranges of radio, infrared, ultraviolet, etc. Thus, the invisibility depends on the eyes of the observer and/or the instruments used to detect the object.

At the state of *total invisibility*, an object cannot be detected by any real observer or instrument, even making use of detectors, which operate in real ranges of radio, infrared, ultraviolet, etc.

Here we will show a method to make a real body totally invisibly. This method is based on a gravity control process patented on 2008 (BR Patent Number: PI0805046-5, July 31, 2008[1]). It goes far beyond the known methods of invisibility and camouflage, which use the principles of light refraction to allow light to pass right through an object (metamaterials) [2, 3].

2. Theory

In a previous paper, I showed that gravitational mass, m_g, and *rest* inertial mass, m_{i0}, are correlated by means of the following expression [4]:

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

where m_{i0} is the *rest* inertial mass of the particle and Δp is the variation in the particle's *kinetic momentum*; c is the speed of light.

In general, the *momentum* variation Δp is expressed by $\Delta p = F\Delta t$ where F is the applied force during a time interval Δt. Note that there is no restriction concerning the *nature* of the force F, i.e., it can be mechanical, electromagnetic, etc.

For example, we can look on the *momentum* variation Δp as due to absorption or emission of *electromagnetic energy*. In this case, it was shown previously that the expression of χ can be expressed by means of the following expression [5]:

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

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

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

where U is *the electromagnetic energy absorbed or emitted by the particle;* n_r is the index of refraction of the particle; W is the density of energy on the particle $\left(J/m^3\right)$; ρ is the matter density $\left(kg/m^3\right)$ and c is the speed of light.

In the particular case of *heterogeneous* mixture of matter*, (powder, dust, clouds, air, smoke, *heterogeneous plasmas*†, etc), subjected to incident radiation or *stationary electromagnetic fields*, the expression of χ can be expressed by means of the following expression, which is derived from the above equation [5]:

$$\chi=\frac{m_g}{m_{i0}}=\left\{1-2\left[\sqrt{1+\left[\left(\frac{n_r n^3 S_\alpha S_m^2 \phi_m^2 E^2}{2\mu_0 \rho c^2 f^2}\right)\frac{1}{\left(c/n_r f\right)}\right]^2}-1\right]\right\}=$$

$$=\left\{1-2\left[\sqrt{1+\frac{n_r^4 n^6 S_\alpha^2 S_m^4 \phi_m^4 E^4}{4\mu_0^2 \rho^2 c^6 f^2}}-1\right]\right\} \qquad (3)$$

where S_α is the maximum area of cross-section of the body; ϕ_m is the average diameter of the molecules of the body; $S_m=\pi\phi_m^2/4$; E is the instantaneous electric field applied on the body; μ_0 is the magnetic permeability of the free space; f is the oscillating frequency of the electric field and n is the number of atoms per unit of volume in the body, which is given by

$$n=\frac{N_0\rho}{A} \qquad (4)$$

where $N_0=6.02\times10^{26}\,atoms/kmole$ is the Avogadro's number and A is the molar mass (*kg/kmole*).

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

$$\chi=\frac{m_g}{m_{i0}}=\left\{1-2\left[\sqrt{1+\frac{n_r^4 n^6 S_\alpha^2 S_m^4 \phi_m^4 E_{rms}^4}{4\mu_0^2 \rho^2 c^6 f^2}}-1\right]\right\} \quad (5)$$

Also, it was shown that our Real Universe is contained in an Imaginary Universe; in such way that the real spacetime of the Real Universe is contained in the imaginary spacetime of the Imaginary Universe‡ [4]. Thus, each action in the real spacetime corresponds to an equivalent action in the imaginary spacetime. This, means for example, that any *momentum*, $\vec{p}_r$, generated in the *real spacetime* produces simultaneously an equivalent *momentum*, $\vec{p}_{im}=\vec{p}_r$, in the *imaginary spacetime* and vice-versa.

In the case of a photon, the momentum p is related to its energy E by means of the following expression: $E=pc$, where c is the speed of light at the free space. Thus, when a photon is generated in the Real Universe with an energy $E_r=p_r c$ its correspondent photon in the imaginary spacetime will have energy $E_{im}=p_{im}c$. As $\vec{p}_{im}=\vec{p}_r$ we can conclude that $E_r=E_{im}$. Consequently, the photon generated in the imaginary spacetime will have *equal frequency*, and the same direction of the real photon (due to $\vec{p}_{im}=\vec{p}_r$). Consequently, when an object is illuminated with real photons, it is also being illuminated with imaginary photons. Since there is imaginary mass associated to the real mass [4]§, then, the imaginary photons interact with the imaginary mass associated to real mass of the object, and can be reflected, absorbed or transmitted, such as occurs with the real photons when they incide on the real matter. Real photons in turn do not interact with imaginary

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* From the macroscopic viewpoint, a *heterogeneous* mixture is a mixture that can be separated easily (sand, powder, dust, smoke, etc.). The opposite of a heterogeneous mixture is a *homogeneous* mixture (ferrite, concrete, rock, etc).

† *Heterogeneous plasma* is a mixture of *different ions*, while *Homogeneous plasma* is composed of a single ion specie.

‡ The terms *imaginary* and *real* are borrowed from Mathematics (real and imaginary numbers) [6].

§ These new concepts are widely detailed and explained in the ref [4]. It is essential to study the contents of this reference to get a complete understanding of the matter here developed.

matter. Consequently, they pass freely through the imaginary mass (See Fig.1 (a)). Note that the photons can be of any range of the electromagnetic spectrum, i.e., radio, infrared, light, ultraviolet, etc.

The *real* light photons are detected by the retina of our eyes, and thus we see the object. If the gravitational mass, m_g, of our body is reduced to a value between $-0.159 m_{i0}$ and $+ 0.159\ m_{i0}$, (m_{i0} is the rest inertial mass of the body), it becomes an *imaginary body* and realizes a transition to the *Imaginary Universe* [4], from where it still will can see objects, because its imaginary retina can to detect the *imaginary* light photons reflected from the imaginary mass associated to the real object (See Fig.1 (b)).

Imagine then an observer inside a spacecraft, seeing for an object out of the spacecraft, through a glass window of the spacecraft. If the spacecraft and the observer are turned into imaginary bodies, then, despite the real photons (reflected from the object) no more interact with the retina of the observer, he will still continue seeing the object out of the spacecraft by means of the imaginary photons (associated to the real photons) that are reflected from the object (See Fig.1 (b)). A second imaginary observer inside the spacecraft, seeing for the internal wall of the spacecraft does not see the real object out of the spacecraft, because the *imaginary photons* reflected from the body do not surpass the wall of the spacecraft (such as occurs in a real spacecraft with an real internal observer, i.e., the observer cannot see out of the spacecraft). On the other hand, a real observer out of the spacecraft does not see the spacecraft (See Fig.1 (b)); because the real photons pass through the spacecraft without interact with it, and the imaginary photons reflected from the surface of the spacecraft are not detected by the retina of the real observer (these photons pass freely through it). However, a third *imaginary* observer positioned out of the spacecraft will see the spacecraft, because the imaginary photons will sensitize its imaginary retina.

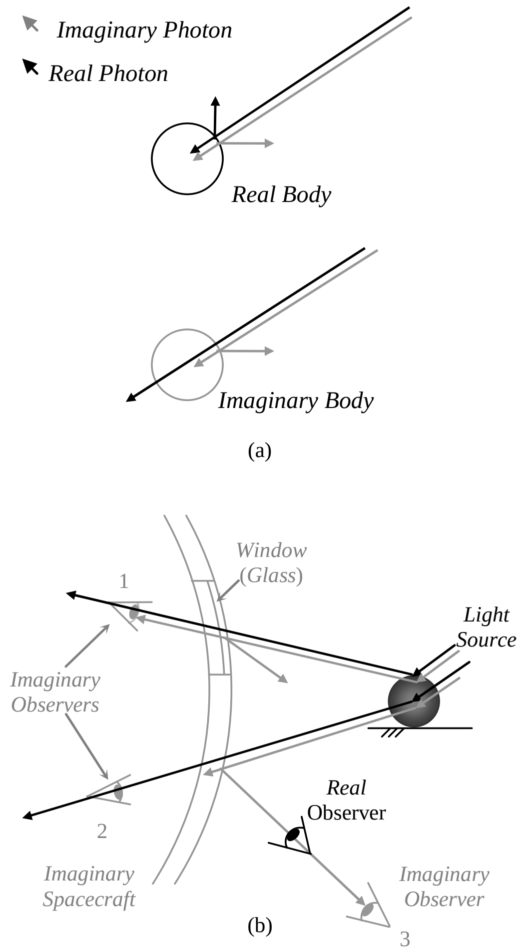
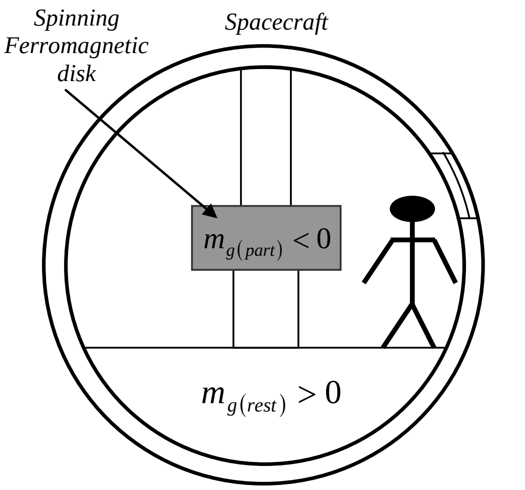


Fig.1 – *The real-imaginary pairs of photons interacting with real and imaginary matter, respectively.* (a) The imaginary photons interact with the imaginary mass associated to the real mass, and can be reflected, absorbed or transmitted, such as occurs when real photons incide on the real matter. Real photons in turn do not interact with imaginary matter. Consequently, they pass freely through the imaginary mass. (b) The *imaginary light* photons reflected from the ball sensitize the retina of the observer 1, and then he can see the ball through the window. The observer 2 cannot see the ball because the *real light* photons do not interact with his retina, and the imaginary photons reflected from the ball do not reach it. The real observer (out of the spacecraft) cannot see the spacecraft because the imaginary light photons reflected from the spacecraft do not sensitize its retina, i.e., they pass freely through the eyes of the real observer, but they will sensitize the retina of the observer 3 (imaginary observer), and consequently he can see the spacecraft. In addition, when a human body becomes imaginary, he becomes invisible to any real observer, but he can see real objects because its eyes can detect the imaginary light photons reflected from real objects.

There are two ways to transform a real body into an imaginary body. Reducing directly its gravitational mass, m_g, to a value between $-0.159m_{i0}$ and $+ 0.159\ m_{i0}$ or reducing the gravitational mass of *a part of the body* until it becomes negative, and the *total gravitational mass of the body* be reduced to a value inside the range above mentioned (See Fig.2).



$$m_{g(total)} = m_{(rest)} + m_{g(part)}$$

$$-0.159\, m_{i0} < m_{g(total)} < +0.159\, m_{i0}$$

Fig.2 – *Transforming a real spacecraft into an imaginary spacecraft*. It is possible to transform a real spacecraft into an imaginary spacecraft by reducing the gravitational mass of *a part of the spacecraft*, $m_{g(\text{part})}$, until it becomes negative, and the *total gravitational mass of the spacecraft* be reduced to a value between $-0.159m_{i0}$ and $+ 0.159\ m_{i0}$.

It was shown in a previous paper that the decreasing of the gravitational mass can become relevant in the particular case of spinning *ferromagnetic disks* subjected to electromagnetic fields with *extremely low frequencies* (ELF) [7]. This means that a *ferromagnetic disk*, subjected to appropriated ELF radiation, and spinning with sufficient angular velocity inside the spacecraft can make strongly *negative* its gravitational mass, $m_{g(part)}$, in such way that the *total* gravitational mass of the spacecraft can be reduced to a value between $-0.159m_{i0}$ and $+ 0.159\ m_{i0}$, transforming then the spacecraft into a *imaginary spacecraft*.

Note that this method is very efficient because there is no necessity of to alter directly the gravitational masses of the others parts of the spacecraft. Thus, the advantages of this method are evident. It also can be used in order to *transform real human bodies into imaginary human bodies*.

Fig.3 – *Clothes for Gravitational Invisibility.*

For example, consider a person wearing a type of clothes similar to ninja clothes (See Fig.3). The tissue of these clothes is *similar* to *Metallic bubble wrap* (See Fig.4). It has 3 layers. Both the inner layer as the outer layer are metallic; between them there is a dielectric layer (bubble wrap). Inside the bubbles there is *ionized air*, which can be obtained by using

Fig.4 – *Aluminum bubble warp*.

an *air ionizer* [**]. The ionization of the air is necessary in order to increase its electrical conductivity up to $\sigma \cong 1\times10^{-6}\, S/m$ [††], which is an ideal value, as we shall see in the following.

From Electrodynamics we know that when an electromagnetic wave with frequency f and velocity c incides on a material with relative permittivity ε_r, relative magnetic permeability μ_r and electrical conductivity σ, its *velocity is reduced* to $v = c/n_r$ where n_r is the index of refraction of the material, given by [8]

$$n_r = \frac{c}{v} = \sqrt{\frac{\varepsilon_r \mu_r}{2}\left(\sqrt{1+(\sigma/\omega\varepsilon)^2}+1\right)} \qquad (6)$$

Let us now apply this equation to the ionized *air inside the bubbles in the metallic bubble wrap.* Since the electrical conductivity of the *ionized air* is $\sigma \cong 1\times10^{-6}\, S/m$. Then, if $f < 100Hz$, we have $\sigma >> \omega\varepsilon = 2\pi f \varepsilon_0$, ($\varepsilon_0 = 8.854\times10^{-12} F/m$ is the permittivity of the free space). In this case, Eq. (6) reduces to

$$n_{r(air)} = \sqrt{\frac{\mu_r \sigma}{4\pi\varepsilon_0 f}} \cong \frac{94.8}{\sqrt{f}} \qquad (7)$$

For *atmospheric air*, at 1atm, 25°C, we can assume $\rho \cong 1.2 kg/m^3$. The number of atoms of air (Nitrogen) per unit of volume, n_{air}, according to Eq.(4), is given by

$$n_{air} = \frac{N_0 \rho}{A_N} = 5.16\times10^{25} atoms/m^3 \qquad (8)$$

By substituting the values of $n_{r(air)}$, n_{air}, ρ and $\phi_m = 1.55\times10^{-10} m$ (Nitrogen), and $S_m = \pi\phi_m^2/4 = 1.88\times10^{-20} m^2$, into Eq. (5), we get

$$\chi_{air} = \left\{1 - 2\left[\sqrt{1+1.6\times10^4 \frac{S_\alpha^2 E_{rms}^4}{f^4}} - 1\right]\right\} \qquad (9)$$

where S_α is equal to the cross-section area of *one bubble* of the metallic bubble wrap, whose diameter is $\phi_b \cong 1cm$,i.e., $S_\alpha = \pi\phi_b^2/4 \cong 7.8\times10^{-5} m^2$ (See Fig. 5); E_{rms} is the oscillating electric field, with frequency f, through the ionized air inside the bubbles of the metallic bubble wrap.

Therefore, if the total gravitational mass of the human body with the ninja clothes for invisibility is M_g, then when a voltage V_{rms} is applied on the metallic layers of the tissue of the mentioned clothes, the mass M_g is reduced to

$$M_g = M_{g0} - |\chi_{air}| M_{i0(air)} = M_{i0} - |\chi_{air}| M_{i0(air)} = \left(1 - \frac{|\chi_{air}| M_{i0(air)}}{M_{i0}}\right) M_{i0} \qquad (10)$$

where $M_{i0(air)}$ is the *total* inertial mass of the *ionized air* and M_{i0} is the total inertial mass of the human body with the ninja clothes for invisibility.

Since we must have $-0.159 M_{i0} < M_g < 0.159 M_{i0}$ in order to the human body (with ninja clothes) to become imaginary, then from Eq. (10), it follows that

$$0.841\left(\frac{M_{i0}}{M_{i0(air)}}\right) < |\chi_{air}| < 1.159\left(\frac{M_{i0}}{M_{i0(air)}}\right) \qquad (11)$$

** For example, making the air passes through the plates of a capacitor subjected to a high voltage.

†† The electrical conductivity of atmospheric air at 1 atm, 25°C is $\sigma_{air} \cong 1\times10^{-14}\, S/m$ [9].

The total *volume* of the ionized air inside the bubbles can be obtained by multiplying the total external surface area, $S_c \cong 2m^2$, of the clothes for invisibility by the thickness of the bubbles, $h_b \cong 1mm$ (Fig.5). Thus, the total inertial mass of the ionized air, $M_{i0(air)}$, is given by $M_{i0(air)} \cong \rho\, S_c h_b \cong 2.4\times10^{-3}kg$.

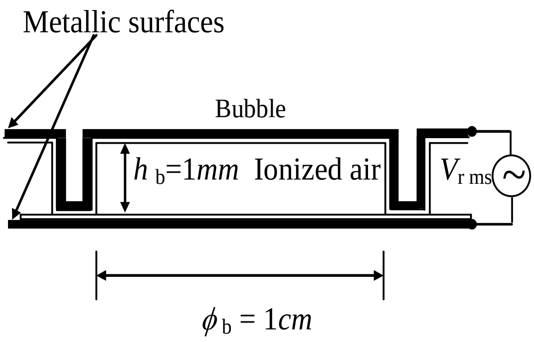


Fig.5 – Dimensions of the bubbles

If $M_{i0} \cong 100kg$, then Eq.(11) tells us that we must have

$$3.5\times10^4 < \left|\chi_{air}\right| < 4.8\times10^4 \qquad (12)$$

In order to obtain $\left|\chi_{air}\right| = 4\times10^4$, for example, Eq. (9) tells us that we must have

$$\frac{S_\alpha E_{rms}^2}{f^2} = 158.1 \qquad (13)$$

Since *one bubble* of the metallic bubble wrap has diameter $\phi_b \cong 1cm$, and therefore $S_\alpha = \pi\phi_b^2/4 \cong 7.8\times10^{-5}m^2$. Then, for $f = 1Hz$, Eq. (13) gives

$$E_{rms} = 1.4\times10^3 V/m \qquad (14)$$

This intensity of electric field can be obtained through the ionized air when a voltage V_{rms}, given by

$$V_{rms} = E_{rms}h_b \cong 1.4V \qquad (15)$$

is applied on the metallic surfaces of the metallic bubbles wrap.

It is important to note that the bubble with ionized air, such as described in this paper, it can also work as a Gravity Control Cell (GCC). A device widely mentioned in some of my previous works [10, 11, 12, 13, 14].

References

[1] De Aquino, F. (2008) *Process and Device for Controlling the Locally the Gravitational Mass and the Gravity Acceleration*, BR Patent Number: PI0805046-5, July 31, 2008.

[2] J. B. Pendry, J.B., et al., (1996).*Phys. Rev. Lett. 76, 4773*.

[3] J. B. Pendry, J.B., et al., (1999). *IEEE Trans. Micr. Theory Techniques* 47, 2075.

[4] De Aquino, F. (2010) Mathematical Foundations of the Relativistic Theory of Quantum Gravity, Pacific Journal of Science and Technology, **11** (1), pp. 173-232.

[5] De Aquino, F. (2011) *Ultrafast Conversion of Graphite to Diamond in Gravitational Pressure Apparatus*, http://vixra.org/abs/1208.0007, p. 4.

[6] De Aquino, F., (2012) *Beyond the Material Universe*, Journal for Interdisciplinary Research on Religion and Science, No. 10, pp.83-128.

[7] De Aquino, F., (2013) *New Gravitational Effects from Rotating Masses*. Avaiable at; https://hal.archives-ouvertes.fr/hal-01078046 and http://vixra.org/abs/1307.0108 , version 2.

[8] Quevedo, C. P. (1977) *Eletromagnetismo*, McGraw-Hill, p. 270.

[9] Chalmers, J.A., (1967) *Atmospheric Electricity*, Pergamon press, Oxford, London; Kamsali, N. et al., (2011) *Advanced Air Pollution*, chapter 20, DOI: 10.5772/17163, edited by Farhad Nejadkoorki, Publisher InTech.

[10] De Aquino, F. (2010) *Gravity Control by means of Electromagnetic Field through Gas at Ultra-Low Pressure*, Pacific Journal of Science and Technology, **11**(2) November 2010, pp.178-247, Physics/0701091. Also available at: http://vixra.org/abs/1401.0119

[11] De Aquino, F. (2014) *Quantum Gravitational Shielding*, https://hal.archives-ouvertes.fr/hal-01074607v3

[12] De Aquino, (2015). *Improvements in the Design of the Gravitational Motor*. Available at: https://hal.archives-ouvertes.fr/hal-01188315v1 http://vixra.org/abs/1508.0293

[13] De Aquino, F., (2015) *Method for Obtaining Quantum Vacuum*. Available at: https://hal.archives-ouvertes.fr/hal-01199704 http://vixra.org/abs/1509.0134

[14] De Aquino, F., (2015). *A System to convert Gravitational Energy directly into Electrical Energy*. Available at: http://vixra.org/abs/1205.0119