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On the possibility of ZPF space propulsion systems

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Abstract

From the standpoint of the ZPF field, the author searches the possibility of the space propulsion system based on the interactions between the zero-point field of the quantum vacuum and high potential electric fields.

Keywords

Biefeld-Brown effect; Dielectric material; Gravity control; Zero point field.

INTRODUCTION

H.E.Puthoff proposed in his article[1] that gravity is a form of long-range van der Waals force associated with the Zitterbewegung of elementary particles in response to zero-point fluctuations (ZPF) of the vacuum. According to his theory, the inertia mass is arisen from the interaction of elementary particles with the vacuum electromagnetic zero-point field. Sakharov also suggested that gravity might actually be an induced effect brought about changes in the ZPF in the vacuum, due to the presence of matter. Based on the hypothesis introduced by Sakharov and Puthoff has explored a conceptually simple, classical model of a proposal by Sakharov; namely, that gravitation is not a fundamental interaction at all, but rather an induced effect brought about by changes in the quantum-fluctuation energy of the vacuum when matter is present.
Based on their approaches, the author proposes to consider the possibility of propulsion system by altering its inertial mass due to the zero-point fluctuations of the vacuum.

MASS SHIFT INDUCED BY THE EXTERNAL ELECTROMAGNETIC FIELD

According to quantum electrodynamics, the quantum vacuum is filled with the zero-point electromagnetic field as show in Figure 1. However this electromagnetic field is in the state of non-radiating mode and we can not recognize the influence of zero point fluctuation of quantum electromagnetic field. B.Haish, A.Rueda and H.E.Puthoff suggested that if one could somehow modify the vacuum medium then the mass of a particle or object in it would change according to the zero-point field theory[2,3]. Under an intense electromagnetic field, it has been theoretically predicted that electron experiences an increase of its rest mass.
Let H_A be the electrodynamic Hamiltonian of the particle under high electromagnetic field, the following formula was analogically discovered by Dr. P.Milonni[4] shown as

$$H_A = \frac{e^2}{2m_0c^2} < A^2 > \qquad (1)$$

where m_0 is the rest mass of the elementary particle, e is its charge, c is the light speed and A is the vector magnetic potential field. A similar equation by using terms of the ZPF field was also derived by Haish, Rueda and Puthoff[4] shown as

$$H'_A = \frac{e^2\hbar}{2\pi m_0 c^3}\omega_c^2 \tag{2}$$

where $\hbar$ is a Plank constant divided by 2π and ω_c is a cutoff frequency of ZPF spectrum in the vacuum. Under the intense electromagnetic field, it has been theoretical predicted that electron experiences an increase in its rest mass.

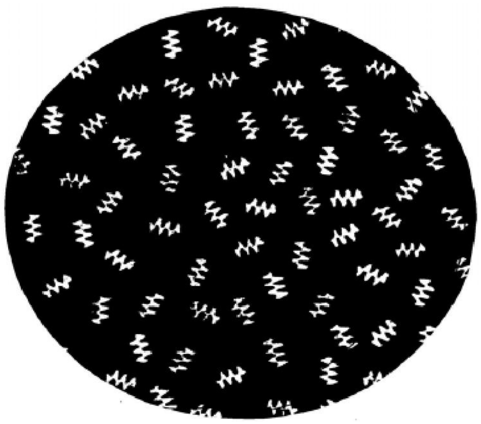

Figure 1 : ZPF field in the vacuum

Similar to this theoretical result, we assume that the cutoff frequency of the vacuum is shifted as $\omega_c = \omega_0 + \Delta\omega$ when the electromagnetic field is applied, where ω_0 is the Plank frequency given by $\omega_0 = \sqrt{c^5/\hbar G} \approx 3\times10^{43}$ Hz. Assuming that the electrodynamic Hamiltonian shown in Eqs.(1) and (2) shows the different aspect of quantum quantity, then it satisfies $\Delta H_A = \Delta H'_A$, when the electric field is applied as shown in Figure 2:

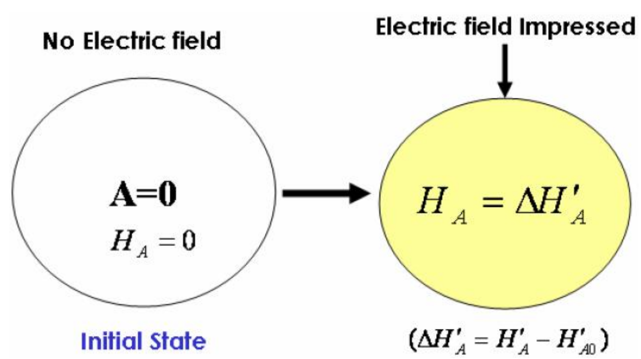

Figure 2 : Electro-dynamic Hamiltonian with and without electric field

From which, we obtain the formula given by

$$\Delta\omega \approx \frac{\pi c}{2\hbar\omega_0} < A^2 > \tag{3}$$

According to the gravitational theory by Haish, Rueda and Puthoff[4], the mass of the elementary particle induced by electromagnetic zero-point fluctuations of the vacuum can be given by

$$m = \frac{\Gamma\hbar\omega_c^2}{2\pi c^2} \tag{4}$$

where Γ is the radiation reaction damping constant which defines the interaction of charged elementary particles (point-mass sub-particles called partons) with electromagnetic radiation field.

$$\Delta m = \frac{\Gamma\hbar\omega_c}{\pi c^2}\Delta\omega_c \tag{5}$$

From Eqs.(4) and (5), we have

$$\Delta m / m = \frac{\pi c}{\hbar\omega_0^2} < A^2 > \tag{6}$$

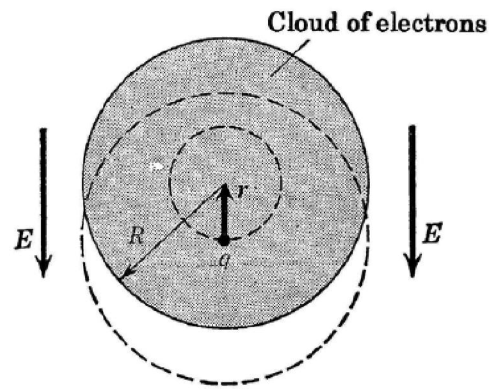

Figure 3 : Dipole field generated by the electric field

As shown in Figure 3, the vector potential field for the dipole field generated by the variance of electric charge becomes[5]

$$A = \frac{1}{4\pi\varepsilon_0 c^2}\frac{\dot{p}(t-r/c)}{r} = \frac{1}{4\pi\varepsilon_0 c^2}\frac{\omega Ne\cdot d(t)}{r} \tag{7}$$

where N is a number density of electric charge and d(t) is a displacement of the charge given by

$$d(t) = \frac{Ne}{m}\frac{E}{\omega_e^2-\omega^2}\cos\omega(t-r/c) \tag{8}$$

In Eq.(8), ω_e is a resonant angular frequency given by $\omega_e = \sqrt{Ze^2/\alpha_e m}$ (α_e: electron polarizability), which becomes about $10^{15} \sim 10^{16}$ Hz[6].

From above equations, we have

$$\Delta M(\omega)/M = \frac{\pi G}{c^4}\int < A^2 > dv$$

$$= -\frac{N^2e^4GR}{4\varepsilon_0^2 m^2 c^8}\frac{\omega^2}{(\omega_e^2-\omega^2)^2+\eta^2\omega^4}E^2 \tag{9}$$

where R is a radius of the electron cloud and η is the damping factor.

GENERATED FORCE FOR THE CAPACITOR BY THE IMPRESSED ELECTRIC FIELD

Case for the alternate electric field

From the approximation given by

$$\frac{\omega^2}{(\omega_e^2-\omega^2)^2+\eta\omega^4}\approx\frac{\omega^2}{\omega_e^4} \tag{10}$$

Eq.(9) becomes

$$\Delta M(\omega)\approx\gamma\ N^2R\frac{\omega^2}{\omega_e^4}E^2M \tag{11}$$

where $\gamma = e^4G/(4\varepsilon_0 m^2c^8)$.

According to the formula of momentum, we have

$$F=\frac{dP}{dt}=\frac{d(Mv)}{dt}=v\frac{dM}{dt}+M\frac{dv}{dt} \tag{12}$$

For the oscillating body given by $x = X_0\sin(\omega_0 t)$, the generated force can be given by

$$F\approx v\frac{d}{dt}M(t)=\gamma\cdot\dot{x}N^2R\frac{\omega^2}{\omega_e^4}\frac{M}{d^2}\frac{d}{dt}\psi(t)^2 \tag{13}$$

when we assume $M\alpha = 0$.

From which, the amplitude of the generated force can be given by

$$F_0=2\gamma\omega_0X_0N^2R\frac{\omega^3}{\omega_e^4}M\frac{\psi_0^2}{d^2} \tag{14}$$

As the electric power is proportional to the square of the impressed voltage shown by $P\propto\psi_0^2$, then we have $F_0\propto X_0\omega^3P$, which is similar to the following formula given by Woodward from his experiment as[7]

$$F = 2.6\times10^{-13}\,\delta l_{PZT}\,f^3\,P_{cap} \tag{15}$$

where δl_{PZT} is the displacement of the piezoelectric device, f is its frequency and P_{cap} is the applied power.

Case for the impulsive electric field

If $\omega_2 - \omega_1$ is large compared to the width of the resonance frequency, we have[8]

$$\int_{\omega_1}^{\omega_2}\frac{\omega^2d\omega}{(\omega_e^2-\omega^2)^2+\eta^2\omega^4}\approx\frac{\pi}{2\eta\omega_e} \tag{16}$$

Then the charged particle experiences an alternation of its rest mass under the impulsive electromagnetic field given by

$$\Delta M/M=\frac{\kappa\pi}{2}\frac{N^2R}{\omega_e}E^2 \tag{17}$$

where $\kappa = \gamma/\eta$.

Form Eq.(12), generated force by alternating mass becomes

$$F=v\frac{dM}{dt}=\frac{\kappa\pi}{2}v\frac{N^2R}{\omega_ed^2}M\frac{d}{dt}\psi^2 \tag{18}$$

where d is a separation between electrodes.

From this equation, we have $F\propto N^2R\cdot P/d^2$, new factors to induce a weight loss of the capacitor are presented as follows:

- Increase the electric power impressed to the moving capacitor, the greater the force generated.
- Increase the charge density of electric current flowing through the capacitor, the greater the force generated

From which, it can be considered that the electric discharge between plates, which has a wide range spectrum, produces a great weight loss of the capacitor.

ARTIFICIAL GRAVITY PRODUCED BY THE ELECTROMAGNETIC FIELD

From $\eta = \Gamma = 2e^2/3mc^2$ which is the Abraham-Lorentz damping constant[4], we have

$$\kappa=\frac{3e^2G}{8\varepsilon_0^2mc^6}=5.36\times10^{-46} \tag{19}$$

Then the gravitational field generated for the moving body becomes

$$g=F/M\approx\frac{\kappa\pi}{2}v\frac{N^2R}{\omega_ed^2}\frac{d}{dt}\psi^2 \tag{20}$$

By introducing $\psi = \psi_0t/\Delta t$ $(0 < t < \Delta t)$, $\psi = \psi_0e^{-\alpha(t-\Delta t)}$ $(t\geq\Delta t)$, the acceleration induced for the moving body becomes

$$g\approx\kappa\pi v\frac{N^2R}{\omega_ed^2}\frac{\psi_0^2}{\Delta t^2}t,\ (0<t<\Delta t) \tag{21}$$

$$g\approx-\alpha\kappa\pi v\frac{N^2R}{\omega_ed^2}\psi_0^2\exp[-2\alpha(t-\Delta t)],\ (t\geq\Delta t) \tag{22}$$

This equation suggests that discharge of high voltage between two electrodes would produce an acceleration in the case satisfying $1/\alpha >> \Delta t$ for the disc structure with densely charged plasma cloud as shown in Figure 4. This is a system invented by T.T.Brown known as a electrogravitor. In his experiment, he observed that a large thrust was associated with a spark, which suggests that the surrounding medium was ionized and plasma was formed around the dielectric material[9]. Thus the key to the produced force might be due to a densely charged plasma cloud as predicted by Eq.(21).

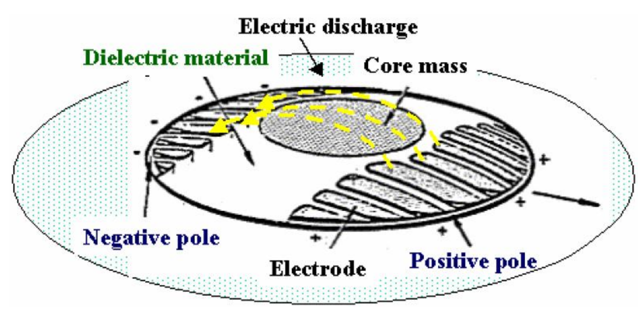

Figure 4 : Basic concept of the plasma propulsion

If we assume that $\omega_e = 6\times10^{13}$ and $N = 10^{18}/m^3$ for hot plasma from TABLE 1, then the maximum acceleration due to the mass shift becomes

$$g\approx2.8\times10^{-23}v\frac{R}{d^2}\frac{\psi_0^2}{\Delta t} \tag{23}$$

which is proportional to the square of applied voltage.

TABLE 1 : Plasma sources and their plasma density

Plasma sources	Plasma density	Operation circumstance
Plate electrodes	10^{15} / m^3 ~10^{16} / m^3	Sputter deposition
Inductive coupled plasma	10^{17} / m^3 ~10^{18} / m^3	Atmospheric pressure
Helicon	10^{17} / m^3 ~10^{8} / m^3	Lower gas densities
Electron cyclotron resonance	10^{18} / m^3 ~10^{19} / m^3	Lower gas densities

From this equation, the acceleration induced by the external electric field has the characteristics given by

- Increase the electric field to the moving body, nonlinear increase of acceleration is generated.
- Increase the radius of plasma cloud, the greater acceleration is generated
- Increase the plasma density of electron cloud, the grater acceleration is generated.

From which, the following space propulsion system for the spacecraft can be proposed.

If we suppose that electromagnetic field generated by the plasma cloud surrounding the spacecraft can influence its mass according to Eq.(22), it can attain the higher capability of acceleration by coronal discharges generated by the high-voltage (HV) pulse generator on board as shown in Figure 5. This spacecraft is powered by the HV pulse generator for the production of negative ion clouds around the body. The high-voltage power is applied to the cone of the craft and the exhaust nozzle to produce greater potential difference between the cone and the exhaust nozzle.

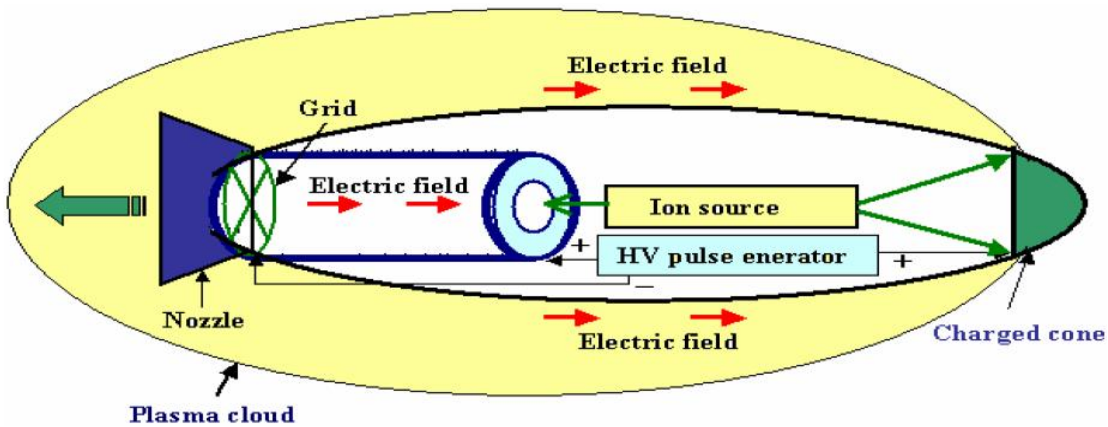

Figure 5 : Proposed propulsion system for the spacecraft

Hence this ZPF propulsion system generates high intensity electric field along its body to produce a locally acceleration, which is coupled with the mass shift generated by the coronal discharge that causes a greater forward directed gravitic-force for the spacecraft. Figure 6 shows the schematic diagram of the ZPF propulsion craft surrounded by negative ion plasma cloud.

Supposing that R = d = 10(m), $\Delta t = d / c$, ν = 1.0Ma, the generated acceleration can be shown as the following figure.

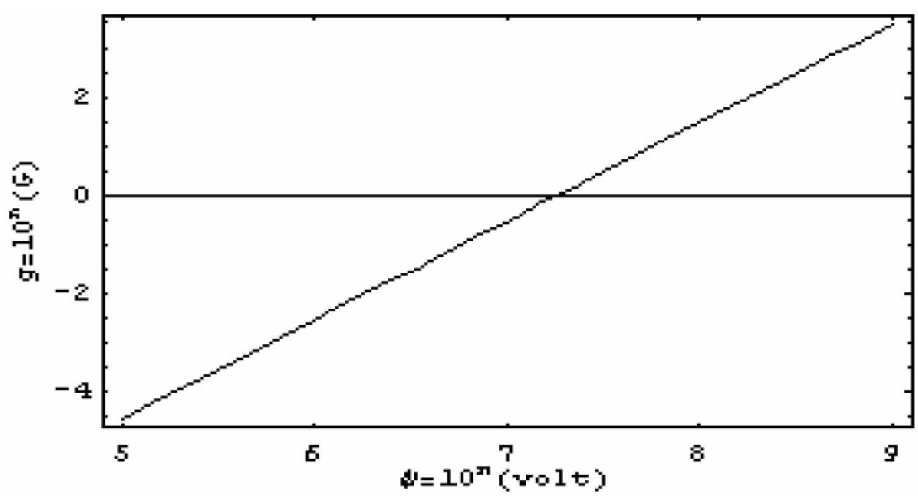

Figure 6 : Acceleration (G) induced by an applied voltage

From which, plasma cloud surrounding the spacecraft may influence its mass and it can attain the high capability of acceleration, that enables us to fly to the space station above the Earth with a little fuel compared with the conventional rocket system as shown in Figure 7.

Frank Wilczek, Nobel laureate in physics, also proposed a concept similar to the one proposed by Puthoff that space consists of the "Grid" which is made up of spontaneous activity that occurs between magnetic and electric fields[10]. He claimed that space grids can produce an exothermic reaction, releasing more energy than is initially put in. Thus space is filled up with such entities, we can utilize them for the space propulsion system.

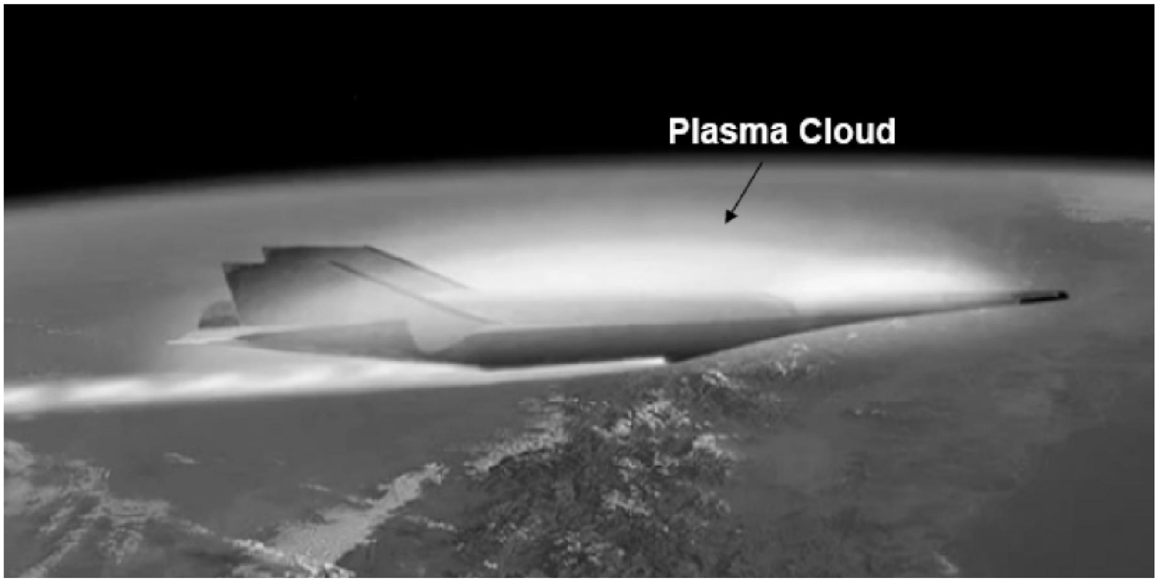

Figure 7 : Artist's view of the ZPF propelled spacecraft

CONCLUSION

From the theoretical analysis by the zero-point field theory, it is considered that the interaction of zero-point vacuum fluctuations with pulsed high potential electric field can induce a higher acceleration to the moving body. This result suggests that the pulsed plasma field applied to the spacecraft may produce artificial gravity sufficient for practical application to the space propulsion technology.

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