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Strong coupling between electricity and gravitation and its application to human space flight

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Abstract

The finding of Prof.Biefeld and T.T.Brown, which is called Biefeld-Brown effect, suggests strong coupling between electricity and gravitation. However this phenomenon can not be predicted within the framework of the conventional physics. The author attempts to explain this phenomenon by introducing an asymmetrical gravitational field generated inside the atom by a high potential electric field and he also verifies the theoretical value compared with the experimental result.

Keywords

Biefeld-brown effect; Dielectric material; Gravity control; Weyl fields.

INTRODUCTION

It was discovered by Prof.Biefeld and T.T.Brown that high potential charged capacitor with dielectrics exhibited unidirectional thrust toward the positive plate when the atom was placed within the electric field of a capacitor. This phenomenon is called Biefeld-Brown effect (B-B effect) and it suggests the connection between electricity and gravitation.

Characteristics of the B-B effect can be summarized shown as follows[1]:

(1) The separation of the plates of the condenser-closer plates, greater effect
(2) The higher the specific inductive capacity of the dielectrics between the plates, the greater the effect
(3) The greater the area of the condenser plates, the greater the effect
(4) The greater the voltage difference between the plates, the greater the effect
(5) The greater the mass of the material between the plates, the greater the effect

However the coupling between electrostatic and gravitational fields can be predicted neither by general relativity, nor conventional field theory.

The author attempts to explain this phenomenon by introducing a new gravitational field generated inside the atom by high potential electric field.

THEORETICAL CONSIDERATIONS ON THE B-B EFFECT

Weak field approximation of Einstein's general relativity leads to the generalized formula of Lorenz force given by[2]

$$\mathbf{F} = q(\mathbf{E} + \mathbf{v} \times \mathbf{B}) + m(\mathbf{E}_g + \mathbf{v} \times \mathbf{B}_g) \quad (1)$$

where q is charge of the particle, m is mass of the particle, E is electric field, B is magnetic field, v is velocity of the particle, E_g is electrogravitic field and B_g is magnetogravitic field.

From this equation, it can be seen that there exists a gravitoelectromagnetic forces to generate electric and gravitoelectric coupling.

It was predicted by Schiff and Barnhill[3] that there exist net forces due to the interplay between gravity and elec-

trostatic forces inside a metallic shell, that has no currents, shown as[4]

$$qE + mE_g = 0 \quad (2)$$

in the nonrelativistic limit. From which, we can suppose that a new gravity like field can be generated inside a dielectric material, which has no current, in order to prevent drift of atomic nuclei due to an external electric field. Then there will be an electrically induced gravitational field generated at the center of the charged particle by an external electric field given by[5]

$$E_g = -(q / m)E \quad (3)$$

which induce the change of the electrogravitic potential around the atom shown as follows:

Comparing q/m values of an electron and a pion, E_g can be generated only by an electron rather than a pion, hence we can let $q \approx e$ and $m \approx m_e$, where e is a charge of an electron and m_e is its mass.

To estimate this gravitational effect, we introduce the following approximation of the electrogravitic potential given by

$$\Phi_g = -\frac{e}{m_e}E\{\delta^2 x/(\delta^2 + x^2)\} \quad (4)$$

which satisfies the following conditions:

$$\partial\Phi_g(0)/\partial x = -\frac{e}{m_e}E \quad (5.1)$$

$$\partial\Phi_g(\pm\infty)/\partial x = 0 \quad (5.2)$$

where δ is a length of the domain at which the new gravitational field is generated.

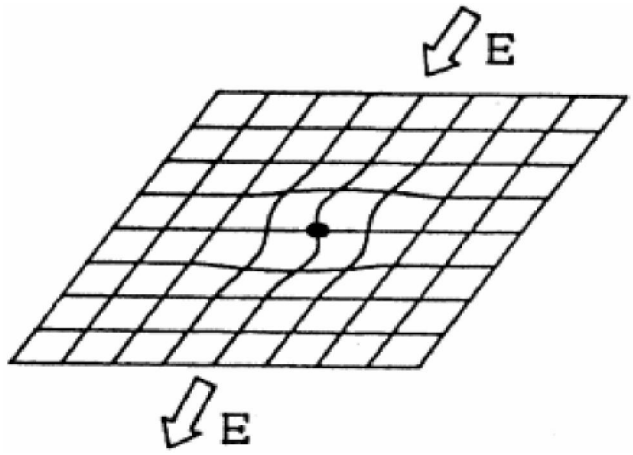

Figure 1 : New gravitational field generated by an external electric field

Figure 1 shows the deformation of the space generated at the center of the elementary particle and the shape of the electrogravitic potential. By the asymmetric electron orbit shown in Figure 2 generated by the external electric field, the electrogravitic potential at the center of the atomic nucleus becomes

$$\Phi_g = \Phi_g(r + \lambda) + \Phi_g(r - \lambda) \quad (6)$$

where λ is a displacement of charge by an applied electric field and r is an orbital radius of the electron around the nucleus.

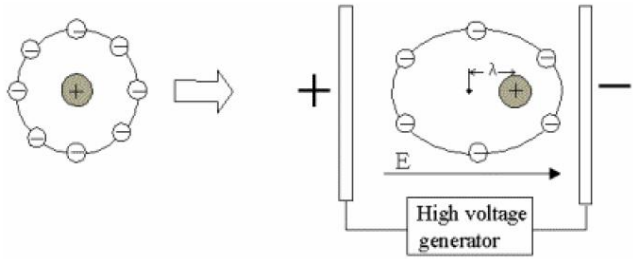

Figure 2 : Deformation of the atom in an external electric field

From which, the electrogravitic field generated by electrons circulating around the nucleus, the number of them equals the atomic number Z, is given by[6,7]

$$E_g = \frac{\partial}{\partial x}\Phi_g = \delta^2\frac{eE}{m_e}\sum_{i=1}^{Z}[(r_i + \lambda)^{-2} + (r_i - \lambda)^{-2}] \quad (7)$$

when satisfying $|r_i \pm \lambda| >> \delta$, where r_i is the orbital radius of each electron around the atomic nucleus.

For simplifying the problem, we set $r_i \approx r_0$, then Eq.(7) becomes

$$E_g \approx Z\delta^2\frac{eE}{m_e}[(r_0 + \lambda)^{-2} + (r_0 - \lambda)^{-2}] \quad (8)$$

For relative lower voltage, we can suppose that $r_0 >> \lambda$. Then Eq.(8) can be approximated as

$$E_g \approx -2\delta^2\frac{Ze}{m_e r_0^2}\{1 + 3\lambda^2/r_0^2 + \cdots\}E \quad (9)$$

If we suppose that additional equivalent mass in a space due to the electric field[8] is canceled by negative mass created by the new gravitational field (derivation of which is shown in Appendix), we have the following formula given by

$$\int_V 2\pi G\varepsilon E^2/c^2 dv - \int_V E_g^2/(2c^2)dv = 0 \quad (10)$$

where ε is permittivity, G is a gravitational constant and c is a light speed.

From which, we have

$$\delta \approx \sqrt[4]{\pi\varepsilon G m_e^2 r_0^4/e^2} \quad (11)$$

If r_0 is replaced by Bohr's radius and ε equals ε_0, which is the permittivity of free space, we obtain the length of a domain where the new gravitational field is generated to be $\delta \approx 8.3 \times 10^{-22}$(m), that is much smaller than the radius of electron, which is about 2.8×10^{-15}(m). Then E_g for the dielectric material induced by a high potential electric field can be approximated from Eq.(9) and (11) as

$$E_g \approx -Z\sqrt{4\pi\varepsilon_r\varepsilon_0 G}\cdot E = -8.62\times10^{-11}Z\sqrt{\varepsilon_r}\cdot E \quad (12)$$

where ε_r is specific inductive capacity of the dielectric material determined as $\varepsilon = \varepsilon_r\varepsilon_0$.

From which, the force generated by high potential electric field becomes

$$F \approx 8.62\times10^{-11} Z\mu S\sqrt{\varepsilon_r}\cdot V/t \quad (13)$$

where μ is a total mass of the dielectric material per unit area, S is an area of the capacitor, t is a thickness of the capacitor and V is an impressed voltage.

This equation presented here satisfies characteristics 1) ~ 5) mentioned in the previous section and it also predicts another characteristic for the B-B effect shown as follows.

(1)' The greater the atomic number of the material between the plates, the greater the effect

RELATION WITH WEYL ELECTROVACUUM SOLUTIONS DERIVED BY IVANOV

Another theoretical foundation for Brown's electrogravitic effect was put forth by Boyko Ivanov of the Institute for Nuclear Research and Nuclear Energy, Sofia, Bulgaria. He used classical approaches to Einstein's equations known as the Weyl-Majumdar-Papapetrou field solutions, dating back to 1916, to derive what he called root gravity. In general relativity, EM fields do indeed alter the metric of space-time and induce a gravitational force through their energy-moment tensor given by

$$T^{\mu}_{\nu} = \frac{1}{4\pi}\left(F^{\mu\alpha}F_{\nu\alpha} - \frac{1}{4}\delta^{\mu}_{\nu}F^{\alpha\beta}F_{\alpha\beta}\right) \quad (14)$$

where $F_{\mu\nu} = \partial_{\mu}A_{\nu} - \partial_{\nu}A_{\mu}$ is the electromagnetic tensor and A_{μ} is the four potential. Ivanov had taken into account that $T^{\mu}_{\mu} = 0$ and he further assumed that the metric and E-M fields do not depend on time.

In this stationary case, the problem can be simplified by setting $A_{\mu} = (\bar{\phi},0,0,0)$, then there is just an electric field given by

$$E_{\mu} = F_{o\mu} = -\bar{\phi}_{\mu} \quad (15)$$

Let us further assume that the space-time is static, so that $f \equiv g_{00} = F(\phi)$ has the unique form $f = 1 + B\phi + \phi^2$, which was found by Weyl in 1917 in the axially-symmetric case, solutions of which are known as Weyl fields. Then the equation for the gravitational field induced by static electric field can be given by

$$g_i = c^2 f^{-1}\left(\frac{B'}{2}\sqrt{\frac{\kappa\varepsilon}{8\pi}}\bar{\phi}_i + \frac{\kappa\varepsilon}{8\pi}\bar{\phi}\bar{\phi}_i\right) \quad (16)$$

where $f \equiv g_{00}$, B′ is a constant and $\kappa = 8\pi G / c^4$.

From this, Ivanov derived the formula of gravitational force F_g shown here for a capacitor as[9]

$$F_g = \sqrt{G\varepsilon}\frac{M}{d}\bar{\psi}_2 = \sqrt{G\varepsilon}\mu S\bar{\psi}_2 \quad (17)$$

where M is the mass of the dielectric, μ is its mass density, ε is dielectric constant, d is the distance between the plates, ψ_2 is the potential of the second plate when $\psi_1 = 0$ and S is an area of the plate.

As mentioned in Ivanov's correspondence to the author, Invanov's and the author's formulas are equivalent when the dielectric atomic number Z equals unity. Both are inverse functions of the dielectric thickness and directly proportional to the voltage. The author incorporated modulo Z and the international system units (SI), instead Ivanov used the CGS (Gauss) system of units. From which, it is seen that the derived equation shows the validity of electrogravitic effect as claimed by T.T.Brown.

EXPERIMENTAL RESULTS AND THEIR ANALYSIS

From the 1st of Feb. till the 1st of March in 1996, the research group of the HONDA R&D Institute conducted experiments to verify the B-B effect with an improved experimental device[10,11] to reject the influence of corona discharges and electric wind around the capacitor. For the rejection of these effects, the capacitor was set in the insulator oil contained within a metallic vessel as shown in Figure 3.

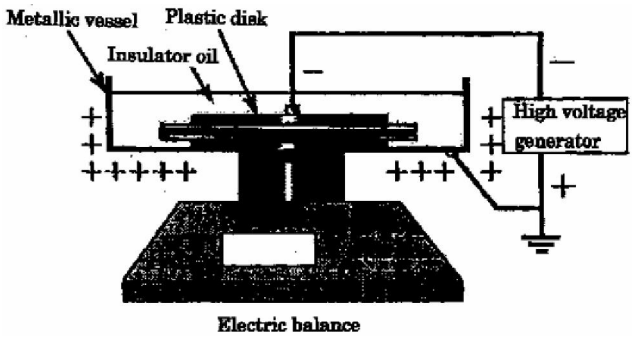

Figure 3 : Experimental set-up at t HONDA R&D institute

The capacitor used at the experiment was a circular plate made of glass with thickness = 1mm, diameter = 170mm and weight = 62g. The specific inductive capacity of the capacitor was about 10.

They conducted experiments for both cases, +DC 18kv and -DC 18kv applied to the capacitor.

The experimental results obtained by the HONDA research group is shown in Figure 4, where the horizontal line is for the number of the experiment which they conducted and the vertical line is for the weight loss of the capacitor.

By the experiment results, the coefficient κ as follows can be determined by

$$\kappa = E_g / E = (\Delta W / W)(t / V)g_0 \quad (18)$$

where ΔW is a weight loss of the capacitor under high potential electric field, W is a weight of the capacitor and g_0 is a gravitational acceleration on the Earth.

From which, histograms of the experiment was obtained

as shown in Figure 5, where the horizontal line shows the value K, which equals κ times 10^9, and the vertical line shows the number of observed results. Statistical analysis shows that the mean value of K obtained is 2.59 and its standard deviation is 1.46, then we have $\kappa \approx (2.59 \pm 1.46) \times 10^{-9}$.

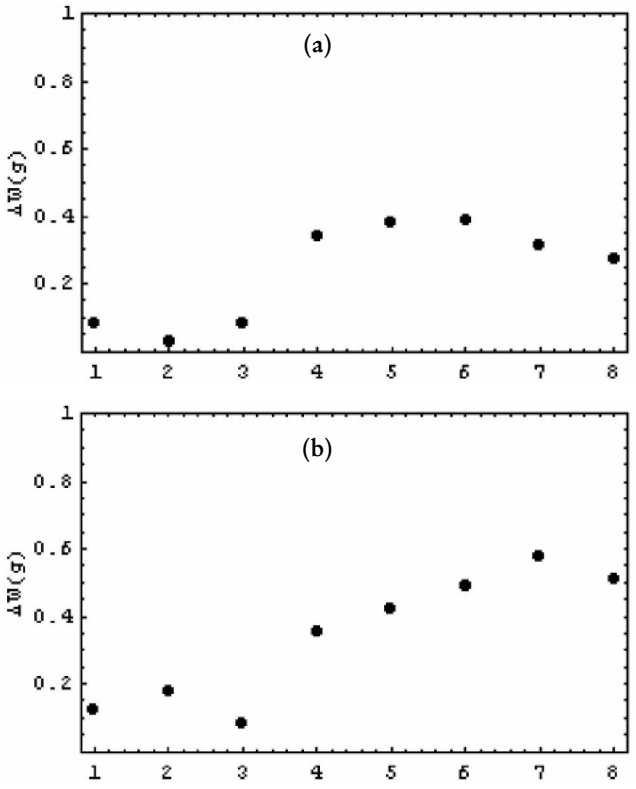

Figure 4 : Weight reduction observed at the experiment (Figure (a): +18kV, Figure (b): -18kV)

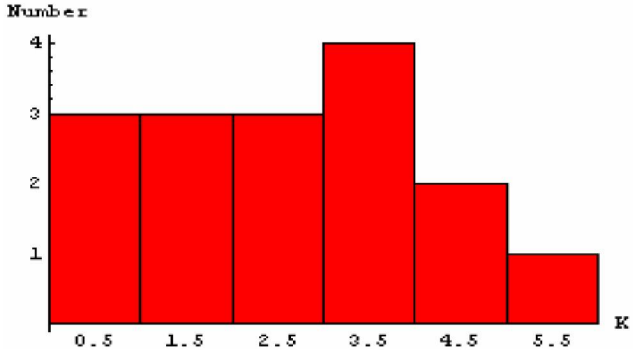

Figure 5 : Histogram of the experimental results

From Eq.(12), the absolute value of κ can be given by

$$|\kappa| = 8.62 \times 10^{-11} Z \sqrt{\varepsilon_r} \quad (19)$$

Most of ingredient of glass is S_iO_2, the mean value of Z per unit atom can be roughly estimated as $Z \approx (14 + 8 \times 2) / 3 = 10$, so we have $|\kappa| \approx 2.73 \times 10^{-9}$. From which, we have

$$(E_g)_{measured} / (E_g)_{theoretic} = 0.95 \pm 0.53 \quad (20)$$

Thus it is considered that the force generated due to the external electric field can be a new gravitational field generated in the micro level by strong coupling between electromagnetism and gravitation.

POSSIBLE APPLICATION TO HUMAN SPACE FLIGHT

By using the equation which the author derived, Iwanaga analyzed the effectiveness of the B-B effect as a propulsion system in his paper[12] and he estimated the thrust obtained by the B-B effect is much better than that of arc-jet propulsion system as shown in TABLE 1. He considered it would be profitable to apply this propulsion method to small space vehicles.

TABLE 1 : Thrust of the propulsion systems and B-B effect

Propulsion System	Thrust (N)
Jet engine	2×10^5
Chemical fuel rocket	2.45×10^5
Arc-jet	1.50×10^{-1}
Nuclear power	8.82×10^5
Photon rocket	3.3
B-B effect*	100

*Calculated for mass = 100Kg, diameter/height ratio = 100, $\varepsilon_r = 5$ and $E = 7 \times 10^8$ V/m[12]

CONCLUSIONS

The theoretical equation for the B-B effect, which satisfies the characteristics clarified T.T.Brown, is derived. As the experimental results agrees well with the theoretical calculation, it is considered that the force generated due to the external electric field can be due to a new gravitational field generated in the micro level induced by strong coupling between electromagnetism and gravitation.

APPENDIX

According to the book, "Causality Electromagnetic Induction and Gravitation", by O.D.Jefimenko[13], we have the equation;

$$\nabla \cdot \mathbf{E}_g = -4\pi G\rho + \frac{E_g^2}{2c^2} \quad (A.1)$$

where E_g is a gravitational field.

From the assumption that the mass density due to the electromagnetic field equals the negative mass density generated by the new gravitational field due to the external electric field. The mass density due to the external field becomes $\rho = \varepsilon E^2 / 2$, according to the electromagnetic theory. By introducing this formula into Eq. (A.1), we have

$$\nabla \cdot \mathbf{E}_g = -\frac{2\pi G\varepsilon}{c^2} E^2 + \frac{E_g^2}{2c^2} \quad (A.2)$$

From my assumption, the equivalent mass due to the electric field impressed to the dielectric material and the equivalent mass generated by the new gravitational field cancel each other, then we obtain

$$\int_V 2\pi G\varepsilon E^2 / c^2 dv - \int_V E_g^2 / (2c^2) dv = 0 \qquad \textbf{(A.3)}$$

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