Theoretical explanation of the Biefeld-Brown Effect

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INTRODUCTION

The finding of Prof.Biefeld and T.T.Brown, which is called Biefeld-Brown effect, suggests the coupling between electricity and gravitation. However this phenomenon can not be explained within the framework of the conventional physics. The author attempts to explain this phenomenon by introducing a new gravitational field generated by high potential electric field inside the atom. Some experimental results conducted to check the theoretical explanation are also presented.

THEORETICAL CONSIDERRATION ON THE B-B EFFECT

To explain the B-B effect, the author proposed two hypothesis, Hypothesis(1) and Hypothesis(2), shown as follows:

Hypothesis(1) : Charged particle under strong electric field generates a new gravitational field Φ_A around itself.

Hypothesis(2) : Additional equivalent mass due to the electric field is canceled by negative mass generated by the new gravitational field.

From Hypothesis(1), the new gravitational field satisfies

$$g^{ij}\frac{\partial}{\partial x^j}\Phi_A = -\frac{q}{m}F^{i0}, \tag{1}$$

which is derived from the relativistic equation of a moving charged particle[2], where $F^{i0} = (0,-E_1,-E_2,-E_3)$ (E_i: component of the electric field), q is charge of the particle , m is its mass and g^{ij} is a metric tensor of space. Then the new gravitational field generated at the center of the charged particle becomes

$$\frac{\partial}{\partial x}\Phi_A \approx -\frac{q}{m}E\ , \tag{2}$$

where E is intensity of the electric field. Comparing q/m values of an electron and a pion, Φ_A is generated by an electron rather than a pion. When we let $q \approx e$ and $m \approx m_e$ (e : charge of the electron, m_e: mass of the electron) and δ be a length of the domain where the new gravitational field is generated , the acceleration of the atom induced by electric field can be shown as [3]

$$\alpha = -\delta^2\frac{e}{m_e}\left[\frac{1}{(a_0+\lambda)^2}+\frac{1}{(a_0-\lambda)^2}\right]E\ , \tag{3}$$

where λ is a displacement of charge with applied electric field and a_0 is an orbital radius of the electron around the nucleus which can be replaced by Bohr' s radius. From Hypothesis(2), we obtain $\delta = 8.12\times10^{-21}$ m, which is much smaller than the size of the nucleus[3]. Then acceleration of a pion induced by the new gravitational field due to electrons around the nucleus becomes

$$\alpha \approx -1.2\times10^{-29}\left[\frac{1}{(a_0+\lambda)^2}+\frac{1}{(a_0-\lambda)^2}\right]E \quad , \tag{4.1}$$

$$\lambda = \frac{(\kappa-1)\varepsilon_0 E}{\rho} \quad , \tag{4.2}$$

where κ is specific inductive capacity of the dielectric material, ε_0 is permittivity of free space and ρ is charge density inside the dielectric material. From which the plot of the induced acceleration vs. impressed electric field is shown in Fig.1. From which it is seen that induced acceleration by a high potential electric field exhibits a non-liner characteristics when the electric field exceeds 10^{11} v/m. Satisfying that $a_0 >> \lambda$, the acceleration of the dielectric material induced high potential electric field can be approximated as

$$\alpha \approx -\frac{\delta^2 e}{m_e {a_0}^2}E = -0.42\times10^{-8}E \quad (\mathrm{m/s^2}) , \tag{5}$$

which shows the weight reduction of a capacitor is proportional to the impressed electric field.

EXPERIMENTAL RESULTS

To confirm the theoretical explanation, the author and his co-workers conducted experiments described as follows [4-7]:

Experiment (1)

The capacitor used for the experiment shown in Fig.2 was a plastic disk with thin copper films on both sides , the size of which was t=0.2mm, d=65mm, weight=4.2kg and κ = 2.3 .

The experiment was conducted by applying high voltage 0 ~1200 volt to the capacitor placed inside the plastic casing to reduce the influence of electric wind as shown in Fig.3. Weight reduction of the capacitor measured by the electric balance with the precision of 0.1mg is shown in Table.1.

Table.1 Weight reduction observed at the experiment

Voltage	300V	600V	900V	1200V
Weight reduction of the capacitor (mg)	-1.0	-3.7	-7.8	-10.3
	-0.9	-3.2	-7.4	-10.0
	-0.6	-4.0	-8.3	-11.1
	-0.8	-3.1	-7.7	-12.0
		-3.5	-8.8	-11.1
			-8.2	
			-7.9	

Fig.4 shows the compared result between the experimental result and the theoretical value calculated by Eq.(6). From which, it is seen that the experiment coincide well with the theoretical calculation.

Experiment(2)

The successive experiment was conducted for a large size capacitor with thickness=2mm, diameter=10cm and weight=26g. Impressed voltage to the capacitor ranged 0 ~ 12000v. To estimate the influence of high voltage applied to the electric balance, the shift of the scale was measured in advance by suspending the capacitor not to contact the electric scale with supports as shown in Fig.5(A). We compared the shift of the scale with the successive measurement results as shown in Fig.5(B), it was seen that the influence of the high voltage electric field of the capacitor to the electric scale was negligible small. Weight reduction of the measurement results is plotted in the figure below. At the experiment, maximum weight reduction observed was about 200mg, which is 0.8% of its own weight of the capacitor.

Additional Experimental Result

An additional experiment was conducted under the circumstance by rejecting influence of ambient ion momentum transfer by the research group of HONDA R&D Institute to confirm the B-B effect [8]. For this purpose, the capacitor was set in the insulator oil inside the metal case, which was grounded(Fig.6). The capacitor used at the experiment was a circular plate made of glass with thickness=1mm, diameter=170mm, weight=62g and κ =10. They conducted experiments for two cases, DC 18kv and AC 8kv pulse with the frequency of 50Hz impressed to the capacitor. The experimental results measured by the HONDA research group is shown in Fig.7, which shows that the case of AC 8kv pulse exhibits higher reduction of weight than the case of DC 18kv. The order of obtained results for the static case agrees well with the calculated value by Eq.(5), which is about 0.5 g. Maximum weight reduction observed at the experiment is about 2g for AC pulse, which is about 3% of its own weight of the capacitor (These measurements were conducted nearly at noon between Feb.1st and March.1st. in 1996).

SOME CONSIDERRATIONS ON THE OBTAINED RESULTS

By these experimental results, it is considered that the Biefeld-Brown effect is real. However it was observed at the experiment by the HONDA research group that weight reduction was varied with time. This phenomena was also recognized at the experiments conducted by Naval Research Laboratory and it was suspected that the variance of the weight reduction was related to solar and lunar tides[1]. To verify this observation, the weight reduction and the moon phase at the time of experiment are compared as shown in Fig.8. From Eq.(1), acceleration of the dielectric material by the impressed electric field satisfying $a_0 >> \lambda$ is affected by the external gravitational field shown as

$$\alpha = -0.42 \times 10^{-8} E_i / g^{ii} \quad , \qquad (6)$$

where g^{ii} is a major diagonal of metric tensor of space. By substituting $g^{ii} \approx 1 + h^{ii}$ into Eq.(6), the weight variance Δw induced by an external gravitational field can be given by

$$\Delta w \approx 0.42\times10^{-8} mE_i h^{ii}\,, \qquad (7)$$

where m is a mass of the dielectric material and h^{ii} is the perturbations of space metric generated by an external gravitational field. From which, it is considered that experimental results have the correlation with the external gravitational field. From Eq.(7), It can be estimated that electric balance can detect the perturbations of space metric to have the order 10^{-2}. By the theory of relativity, perturbations of space metric induced by the movement of celestial bodies can be given by[9]

$$h^{ii} = \phi^{ii} + h/2\,, \qquad (8.1)$$

and

$$\phi^{ii} = \frac{4G}{c^4}\int \frac{\rho^2 v^i(x',y',z',t-r/c)^4}{r} dx'dy'dz'\,, \qquad (8.2)$$

where G is the gravitational constant, c is the light speed , ρ is a mass density and v^i is a velocity component of the moving bodies. From which the value of h^{ii} generated by the moon is estimated to have the order 10^{-14} at most. Hence it is concluded that the variance of weight of the capacitor observed at the experiment is not due to the external gravitational field generated by the moon but due to the unknown origin.

POSSIBLE APPLICATIONS OF THE B-B EFFECT FOR SPACE PROPULSION SYSTEM

Under the assumption that the author's theory is right, validity of the B-B effect for the propulsion system was studied by Iwanaga [10]. In Table.2, the calculated thrust /power ratio of the B-B effect compared with the conventional propulsion systems is presented. From this table, it is seen that the thrust /power ratio for the BB effect is much better than the arc jet and the photon rocket and it is considered the BB effect is applicable for the propulsion system of small vehicles in a space.

Table.2 Thrust/power of the propulsion system

Propulsion System	**Thrust(N)**	**Thrust/Power(N/kW)**
Jet engine	2×10^5	4.0
Chemical fuel rocket	245×10^3	1.0
Arc jet	150×10^{-3}	0.136
Nuclear power	882×10^3	0.22
Photon rocket	3.3	3.3×10^{-6}
Biefeld-Brown System*	100	2.5

*calculated for the capacitor, M=100kg, diameter/height ratio=100, κ =5 and E=7×10^8 v/m [10]

CONCLUSION

The author attempts to explain this phenomenon by introducing a new gravitational field generated by a high potential electric field inside the atom. The experimental results coincide well with the theoretical values as predicted by the author's theory, so it is considered that the B-B effect might be caused by the new gravitational field generated at the microscopic level of material.

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*(J) means the report is written in Japanese

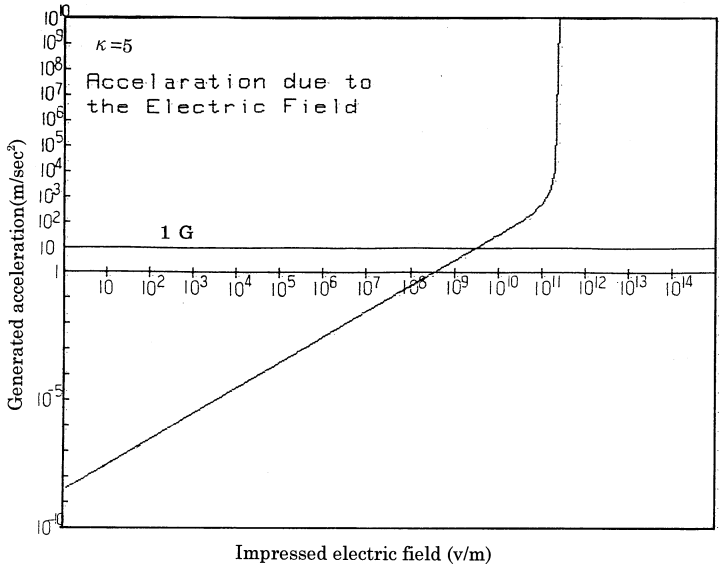

Fig.1 Acceleration generated by high potential electric field

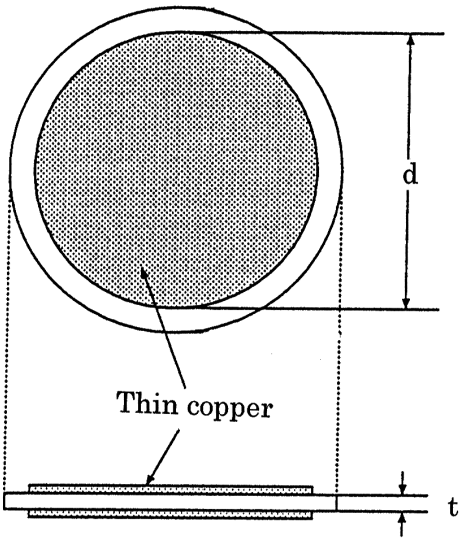

Fig.2 Capacitor used for the experiment

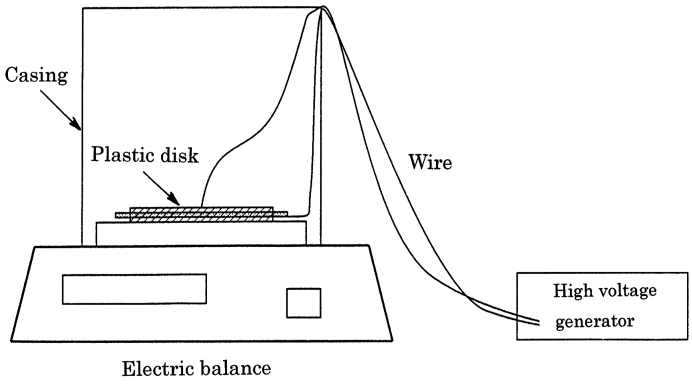

Fig.3 Experimental setup at the Experiment(1)

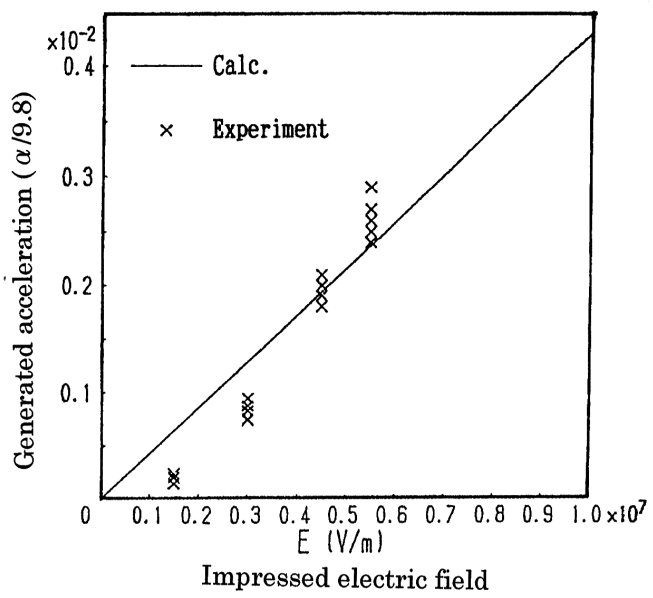

Fig.4 Experimental Result and the theoretical calculation

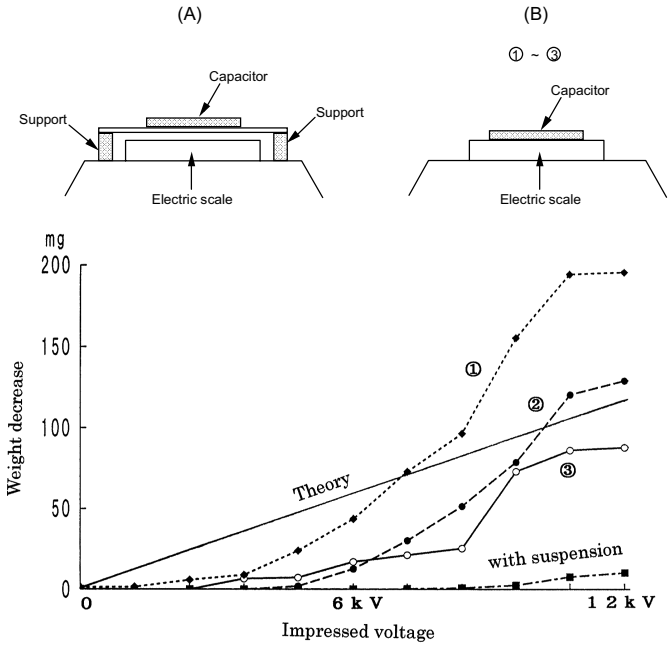

Fig.5 Measured result and theoretical calculation

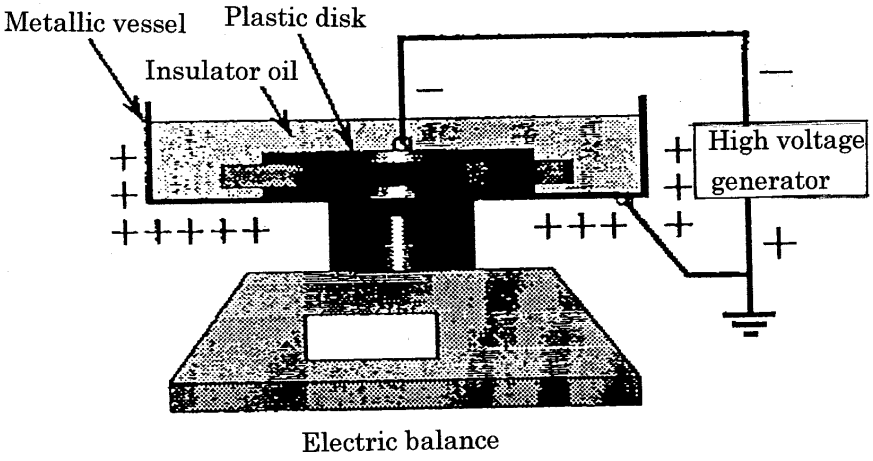

Fig.6 Experimental setup for the additional experiment

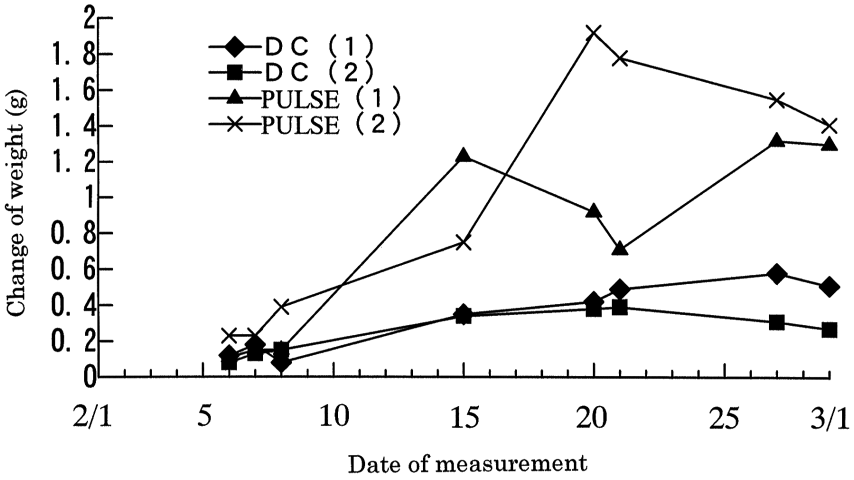

Fig. 7 Mass reduction observed at the experiment

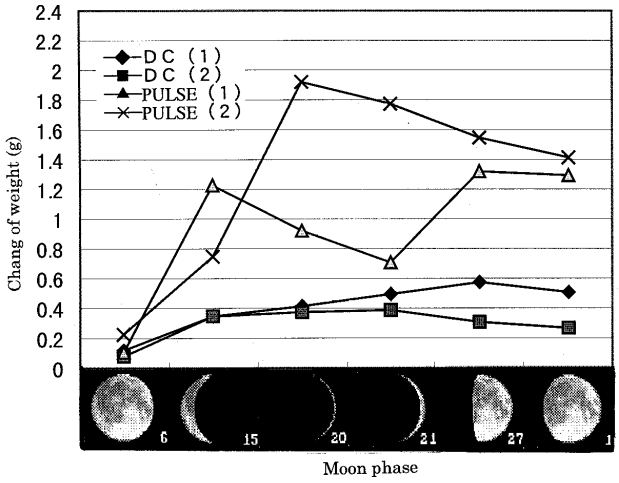

Fig.8 Mass reduction measured vs. moon phase