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Research Article

Experimental Evidence of Possible Gravity Modification based on an Einstein Unification Model: The GEM Effect

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Abstract

Two unified field theories, following the Einstein concept, and consistent with the "Plasma Universe" picture of a unified gravitic-electrodynamic universe, have proposed that the two long ranges forces of nature Gravitation and EM (Electro-Magnetism), can be unified separately from the short range nuclear forces. Both theories are based upon the connection of Gravitation to the Poynting vector of EM and suggest that gravity modification by EM fields may be possible. The basic theories are summarized as an introduction to the derivation of the VBE (Vacuum Bernoulli Equation) which makes quantitative predictions of the degree of gravity modification. Such effects may have been observed in the laboratory and a new experiment confirms these results and is described in detail, along with its results. The experiment, using a 170g coil from a miniature electric race car motor energized with Tesla 3-Phase power at frequencies in the range of 400Hz, hung by nylon filaments from a load cell, to avoid EM interference, apparently experienced changes in gravity force corresponding to a loss of approximately 0.15 grams when energized and relaxed back to normal weight when power was terminated. Null tests confirmed that no EM interference with weight measurement occurred.

"Chance favors the prepared mind"
Louis Pasteur

Introduction

The Plasma Universe concept and the Einstein Unification Problem

Based on evidence that the Cosmos began as a Planckian Vacuum with only one force field and one particle, and then became, in its first seconds, an expanding Primordial Plasma dominated by two forces, EM (Electro-Magnetism) and Gravitation, and two particles, electrons and protons, the GEM (Gravity-EM) or "Grandis Et Medianis" Unification theory was proposed [1,2]. The theory unifies the Great and the Middle scales, that is, the great Planck and Cosmic scales of energy distance and the middle, or "mesoscale" of subatomic particle's mass-energies and their sizes. This GEM Unification Theory, follows in the footsteps of Einstein's great "Unified Field Theory" effort in an attempt to explain, in the manner of a "Bohr Model," how the long range forces, EM and Gravitation, of the universe are related [3]. In addition, the GEM Unification theory also follows Einstein's reasoning in his "two particle paradigm": the deep significance of Einstein attached to the predominance of the early

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universe plasma by electrons and protons, the only two stable subatomic particles, which are both charged [3]. The GEM theory does this by positing that a physical connection exists between the "Vaccum Quantum Plasma" that arises because of the Heisenberg UncertaintyPrinciple, and the primordial hydrogen plasma and its dynamics, that still dominates the universe. In brief, because hydrogen exists, we exist.

GEM theory is notable in its success in deriving, by simple arguments, a quantum electrodynamic model of gravity fields and the value of the Newton Gravitation Constant to high accuracy, as well as the mass of the proton, from Planck scale considerations. In addition, and most significant in the purpose of this article, the GEM theory predicts that modification of gravity fields directly by EM fields is possible, and has been apparently seen in laboratory experiments.

Central to the GEM theory are existence and properties of a hidden 5th dimension. This is the Kaluza-Klein approach endorsed by Einstein [4,5]. In addition, we identify Poynting vector as the source of Gravity forces, consistent with the phenomenon of ExB drift seen in plasma physics. Together these models form the basis for the GEM theory. The Poynting vector plays a very similar role as well in the Sakharov-Puthoff approach to unifying Gravity and EM [6,7]. It is the goal of this article to show that the GEM theory may not only be useful, but that it is completely compatible with both Kaluza-Klien theory and Sakharov-Puthoff theories of Gravity-EM unification. Accordingly, we will briefly discuss the major basic results of the GEM theory and its key physical results. Once this is established as an intellectual foundation we can embark on the inquiry into gravity modification.

The Kaluza-Klein theory produces the coupled equations of Einstein's GR (General Relativity) of Gravitation and Maxwell's equations of EM and the Lorentz force by the introducing a quantized, constrained, or "hidden" 5th dimension to the Hilbert Action Principle [4,5,8].

The physical quantity associated with this quantized 5th dimension has been identified as a manifestation of subatomic electric charge [9]. As to why the Cosmos should require a seeming "extra" 5th dimension to function, the author says it is analogous the thumb on the human hand, which while shorter than the other four fingers, also "makes all things possible."

The success of (KK) Kaluza-Klein theory, was endorsed, and tentatively embraced by Einstein in his Unified Field effort [3]. It provides a mathematical connection between Gravitation and EM field theories and has inspired the entire "String Theory" effort to further unify the short range Strong and Weak Forces with the long-range forces of EM and gravity. The effort, however, has always been overshadowed by the mysterious physical nature of the multiple new dimensions that are the basis for the theoretical effort. However, we will set aside these theoretical problems for the purposes of this article and concentrate on merely a basic description of the GEM theory and the apparent confirmation of its major practical prediction, that modification of gravity fields by EM is possible and may have been seen in the laboratory.

The Basic Results of the GEM Theory

The GEM theory is based on two postulates: A. that gravity fields are equivalent to an array of ExB drifts familiar from plasma physics. B. That the cosmos began with a Planckian vacuum with one force field and one particle-anti particle species, of the Planck mass and then split apart in a Big Bang expansion , with the appearance and "inflationary" (faster than light) deployment of a hidden 5th dimension from the Planck length, into the coupled appearance of two long-range force fields Gravity and EM and two stable particles, electrons and protons of masses me and mp respectively [9]. Thus, we are assuming that the Cosmos began with a Planckian vacuum with only one particle and one force field, and became, after the appearance and deployment of the 5th dimension, a dense hydrogen plasma with two particles, electrons and protons and two force fields Gravitation and EM. These two particles now had the electric charges $\pm e$, whereas before they possessed the Planck charge.

We can explore the physical/mathematical models associated with each postulate. For the first postulate it is easy to see that all charged particles will assume the same drift velocity of magnitude Vd in the same direction in crossed E and B fields. The velocity magnitude will be in (cgs) for uniform crossed E and B fields, where we will assume the fields lie in the x and y directions, leading to motion in the z direction (in cgs units).

$$V_d = (cExB)/B^2 \qquad (1)$$

For constant B=Bo but varying E in the z direction we will have an acceleration affecting all charged particles identically (*1*). This is especially apparent in the limit of $E^2/B^2 \ll 1$ so that gyromotion of particles is small. Note that that numerator of Eq. 1 is proportional to the Poynting vector which carries EM radiation pressure.
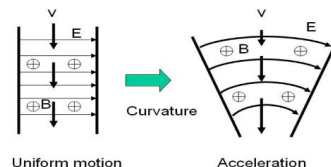
The ExB drift caused by crossed electric and magnetic fields affects all charged particles
Figure 1. The ExB drift model of Gravity.

Alternatively, we can keep B constant and vary E in time to produce an acceleration that effects all particles the same, regardless of charge or mass. It is this theoretical direct relationship between EM fields and gravity that will form the basis for our later discussions of the results of laboratory gravity modification experiments.

Returning to the case of spatial variation of E with B being constant, we consider the quantum model of the vacuum, where Heisenberg Uncertainty Principle requires a vacuum full of powerful ZPF (Zero Point Fluctuation) EM fields, a "Quantum Vacuum Plasma," Therefore, we can then attribute the EM fields required for the ExB drift model of Gravitation to function, to Quantum Mechanics.

We can find an expression for the Newtonian gravity potential from our model of ExB drift Gravitation.

$$a = V_d \frac{dV_d}{dz} = \frac{c^2}{2B_o^2} \frac{dE^2}{dz} \qquad (2)$$

Following the form of the relativistic metric g44 = (1+ 2 Ψ) where Ψ is the Newtonian gravity potential we obtain for g44

$$g_{44} = \left(1 + \frac{E^2}{B_o^2} \right) \qquad (3)$$

Similarly, the radiation pressure due to the Poynting vector, which is central to the Sakharov-Puthoff theory of Gravitation [5,6]. This pressure can be attributed to quantum ZPF, as in the Casimir effect. This theory can be understood by the simple model of two incandescent bodies placed in a dark

box in a gravity-free environment, that repel each other by mutual radiation pressure with a force following a $1/r^2$ distance dependence. In a similar way two dark objects placed in a box with incandescent walls will attract each other due to mutual shadowing, with a force that follows the same $1/r^2$ distance dependence, as seen in *Fig. 2*. So both the GEM and Sakharov-Puthoff theories of gravity can be understood using the Poynting vector as the source of gravity forces.
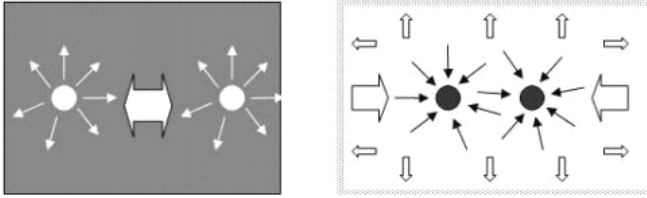
Figure 2. The Sahkarov-Puthoff theory of Gravity as Quantum EM Radiation Pressure

For E/B<<1, the ExB drift model of the GEM theory can be generalized to the relativistic form, where we assume a nearly flat space metric $\eta_{\mu\nu}$ results, in a form of the metric tensor where the ZPF fields will be seen to "self censor."

$$g_{\alpha\beta} = \frac{4(F^\gamma_\alpha F_{\gamma\beta})}{F^{\delta\varepsilon}F_{\delta\varepsilon)}} \cong \eta_{\alpha\beta} \qquad (4)$$

The metric of gravity is ultimately measured by the Geodesic equation, and so must be effectively an average over the space in which a particle moves. Since particles are ultimately quantum wave packets we must assume the metric is effectively a spacetime average. This means some local information is lost in the averaging process that must result in the metric tensor. Here we have defined the nearly flat space metric, $\eta_{\alpha\beta}$, which we will assume is entirely dominated by modes approaching the Planck Scale short wavelength modes, so that we have upon averaging nearly flat space metric over the spacetime accessed by quantum particles, including photons, which are by definition, are not localized. This form for the metric tensor of GR not only says that Gravity is a fundamentally EM phenomenon but also that very strong , high spatial frequency EM fields, $Fo^{\nu\mu}$,will "self censor" and not appear in the Maxwell stress tensor [2]. That is, the vacuum zero-point fields do not appear in the stress tensor. However weak, large scale-length fields $F1^{\nu\mu}$, coexisting with the strong , rapidly varying fields can appear in the stress tensor, these fields will appear in second order with the mixed zeroth and first order field terms averaging to zero.

The result, for $F^{\nu\mu} = Fo^{\nu\mu} + F1^{\nu\mu}$ is

$$\eta_{\alpha\beta} = <\frac{4F^\gamma_\alpha F_{\gamma\beta}}{F^{\delta\varepsilon}F_{\delta\varepsilon}}> = \frac{4F^\gamma_{o\alpha}F_{o\gamma\beta}}{F_o{}^{\delta\varepsilon}F_{o\delta\varepsilon}} \qquad (5)$$

However, the form of the metric tensor then requires that $Fo^{\nu\mu}$ $Fo^{\nu\mu} = Bo^2 - Eo^2 > 0$, that is, a vacuum- dominated by strong, small regions of magnetic field.

$$<F^\gamma_\alpha F_{\gamma\beta}> = <F^\gamma_{o\alpha}F_{o\gamma\beta}> + F^\gamma_{1\alpha}F_{1\gamma\beta} \qquad (6)$$

$$<F^{\delta\varepsilon}F_{\delta\varepsilon}> = <F^{\gamma\beta}_0 F_{0\gamma\beta}> + F^{\gamma\beta}_1 F_{1\gamma\beta} \qquad (7)$$

However, the $F_1{}^{\nu\mu}$ scalar terms, are also near zero, in Eq. 7, when averaged over local spacetime on scales much larger than the quantum wavelength of particles , that is, $F_1{}^{\nu\mu} F_{1\nu\mu} = B_1^2 - E_1^2 \cong 0$ because the universe is predominately vacuum and EM fields are dominated by waves. Therefore, we have then

$$T_{\alpha\beta} \cong < F^\gamma_{o\alpha}F_{o\gamma\beta}> + F^\gamma_{1\alpha}F_{1\gamma\beta} - \frac{1}{4}(\frac{4F^\gamma_{o\alpha}F_{o\gamma\beta}}{F_o{}^{\delta\varepsilon}F_{o\delta\varepsilon}})(< F_o{}^{\delta\varepsilon}F_{o\delta\varepsilon}> + F_1{}^{\delta\varepsilon}F_{1\delta\varepsilon}) \qquad (8)$$

Taken together, we can make the approximation the that Maxwell stress tensor is predominately self-censoring with only weak long-wavelength fields predominating in an approximately flat space, where it is understood that powerful high frequency fields are self-censored and so only weak long wavelength, vacuum dominated fields appear explicitly.

Thus, we recover the standard expression for the Maxwell-Stress tensor in nearly flat space

$$T_{\alpha\beta} \cong F^\gamma_{1\alpha}F_{1\gamma\beta} - \frac{\eta_{\alpha\beta}}{4} F_1{}^{\delta\varepsilon}F_{1\delta\varepsilon} \qquad (9)$$

The second postulate is that a KK hidden dimension appears and in an inflationary manner and deploys to a constrained size, allowing separate EM and Gravity fields. The deployment occurs in a manner coupled to the separation of the electron and proton from the Planck masses, to form a new mass and charge scale as opposed to the Planck scale quantities of charge, mass , and length , respectively:

$$q_P^2 = \hbar c \qquad (10a)$$

$$M_P = \sqrt{q_P^2/G} \qquad (10b)$$

$$r_P = \sqrt{Gq_P^2/c^4} \qquad (10c)$$

Where we can define the ratio of the Planck charge to the newly appeared electronic charge, as the square root of the fine structure constant

$$\alpha^{1/2} = \sqrt{e^2/\hbar c} \qquad (11)$$

We now assume the inflationary deployment of the new KKE 5th dimension from the Planck scale, to a new scale, which we will call the mesoscale. This has the physical effect of producing a new charge-to-mass scale, e/mo, which is in contrast to $G^{1/2}$, which has units of charge-to-mass $G^{1/2} = q_P/M_P$.

We assume this new charge, mass, and length scale, e, ro and mo, appears as the KKE 5th dimension deploys in an inflationary manner, so that the "fine structure constant α goes from being unity to becoming approximately 1/137. We will call the final hidden dimension size r_o, the mesoscale length, where the new length scale represents new information in the cosmos being composed of new quantities e and mo, the mesoscale mass, which is $m_o = (m_p m_e)^{1/2}$ where m_p and m_e are the electrons and protons mass.

$$r_0 = e^2/(m_o c^2) \qquad (12)$$

We then posit an equation, defining the parameter $\sigma = (m_p / m_e)^{1/2} \cong 42.8503…$, the square root of the proton-electron mass ratio, so that the deployment of the mesoscale is coupled to the separate appearance of protons and electrons from the particle-antiparticle system of the Planck mass particles. Here we assume that both sides of the equation are approximately 1 at the turbulent Planck scale and both sides grow in a correlated way as the system expands from the Planck scale to everyday scales.

$$\ln(r_o/r_P) = \sigma \qquad (13)$$

The ratio of the mesoscale size and the Planck length, is not

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only a geometric ratio but also an important parameter of the relative strengths of quantum mediated forces of EM and gravity

$$\frac{r_o}{r_P} = \sqrt{\alpha e^2 / (G m_p m_e)} \qquad (14)$$

When Eq. 13 is inverted to find an expression for G, the gravitation constant we obtain the result for the everyday scale

$$G = \alpha \frac{e^2}{m_p m_e} \exp\left(-2\left(\frac{m_p}{m_e}\right)^{\frac{1}{2}}\right) \qquad (15)$$

This results, using recent CODATA values for all quantities on the right of the equation, if the predicted value for the Gravitation constant G_{gem}= 6.668 x 10^{-8} $cm^3/(g\ s^2)$. The derivation of this formula was first published in an IEEE journal in 1992 [2].

This a good estimate for G but can be improved. Recently, it was found that an additional correction term can be added physically to the formula in Eq. 13. Where this term is only important near the Planck scale but ensures that both sides of the equation go to zero under the Planck conditions of $\sigma =1$ and $r_o=r_P$

When this corrected equation $\ln(r_o/r_P) = \sigma - 1/\sigma^2$ is inverted it results in the improved formula for G

$$G = \alpha \frac{e^2}{m_p m_e} \exp\left(-2\left(\left(\frac{m_p}{m_e}\right)^{\frac{1}{2}} - \frac{m_e}{m_p}\right)\right) \qquad (17)$$

We can easily recover the MKS expression for G with the substitution $e^2 = e^2/(4\pi\varepsilon o)$. Using 2018 CODATA values for all physical constants this yields, in MKS, G_{gem}= 6.67539 x 10^{-11} $m^3/(kg\ s^2)$ and is within 0.015% of the presently accepted value of G_{CODATA} =6.67430 x 10^{-11} $m^3/(kg\ s^2)$

In the GEM theory we also have the mass formula for protons and electrons where q is the particle charge.

$$m = m_o \exp\left(\pm \frac{q}{e} \ln\sigma\right) \qquad (18)$$

Where the charge state of the particle determines its mass, producing protons for positive charge and electrons for negative charge. Where we have also for m_o

$$m_o = M_P \exp\left(\left(-\alpha^{-\frac{1}{2}} - \alpha - 1\right)\ln\sigma\right) \qquad (19)$$

Where $\alpha^{-1/2}$ is the Planck charge normalized to e, and α is a QED correction term , important near the Planck scale as is the $1/\sigma^2$ in the formula for G. This term must be included to give the proper limiting behavior near the Planck scale where we assume both σ and $\alpha \lozenge 1 + \varepsilon$, where we assume $\varepsilon \ll 1$ near the Planck scale so that the product of the ratios of masses and lengths will go to unity to second order in ε as the Planck scale is approached, making it a local extremum

$$\frac{M_P r_P}{r_o m_o} = \frac{1 - 3\varepsilon \ldots}{1 - 3\varepsilon \ldots} \rightarrow 1 \qquad (20)$$

This gives a formula for the mass of the proton

$$m_p = M_P \exp\left(\left(-\alpha^{-\frac{1}{2}} - \alpha\right)\ln\sigma\right) \qquad (21)$$

Using 2018 CODATA values for all physical constants this yields m_{pgem}= 1.6664 x10^{-27} kg and is within 0.37% of the presently accepted value of G_{CODATA} = m_p= 1.67262 x10^{-27} kg.

Therefore, the GEM theory, which posits that the ZPF or "Vacuum Quantum Plasma" underlies the connection between Gravitation and EM , and also connects the Planckian vaccum, and hydrogenic plasma, has been shown to have a solid physical basis.

The VBE (Vacuum Bernoulli Equation) from the GEM theory and Gravity Modification

How does the GEM theory predict that gravity modification by EM fields can occur? To begin this discussion we first we consider our ExB drift model of gravity fields, again in the limit of $E^2/B^2 \ll 1$ with B constant, where uo $\cong B^2/8\pi$

$$g = \frac{\partial E}{\partial t} xB \frac{c}{B^2} = \frac{4\pi}{B^2}\frac{\partial S}{\partial t} = \frac{1}{2u_o}\frac{\partial S}{\partial t} \qquad (22)$$

The formula for Newtonian gravity theory can be written with gravity vector field g, where G is Newton's gravity constant and ρ is a mass density:

$$\nabla \cdot g = -4\pi G\rho \qquad (23)$$

Assuming E = mc2 so an electro-magnetic energy density can form a mass density as a source for a gravity field, this density becomes, in cgs units: $\rho = u_o/c^2$, $u_o = (E^2 + B^2)/8\pi$

In MKS units the Poynting vector is given as S= (E x B)/μ_0 and energy density as

$$u_0 = 1/2(\ \varepsilon_0 E^2 + B^2/\mu_0\ ). \qquad (24)$$

Eq. 23 means when electro-magnetic energy flows into a spherical region from all sides, gravity vectors pointing into the region increase in time so that, for the case of a spherically symmetric region, we then have:

$$\nabla \cdot \frac{\partial g}{\partial t} = \frac{4\pi G}{c^2}\frac{\partial u_o}{\partial t} = \frac{4\pi G}{c^2}\nabla \cdot S \qquad (25)$$

Where both vectors can generate an additional vortex-like field F = $\nabla \times$ Q that include curls of a vector potential.

For the simplest case of no "curl fields" then:

$$\frac{1}{4\pi G}\frac{\partial g}{\partial t} = \frac{S}{c^2} \qquad (26)$$

We combine this result with Eq. 22 and obtain

$$\frac{1}{4\pi G}\frac{\partial g}{\partial t} \cdot g = \frac{1}{2u_o}\frac{\partial S}{\partial t} \cdot S \qquad (27)$$

Where, again, we assume the limit of $E^2/B^2 \ll 1$ uo=$(B^2+E^2)/8\pi$ is thus an approximately invariant magnetic field energy density.

Integrating both sides in time, we obtain the VBE (Vacuum Bernoulli Equation) [10]:

$$\frac{S^2}{u_o c^2} - \frac{g^2}{2\pi G} = \text{Constant} \qquad (28)$$

where again uo is the background EM field, g is the local gravity and S is the net Poynting vector. It can be shown that the Puthoff EM radiation pressure theory of Gravity-EM unification yields the same equation [9]. Since S $\propto$ ExB vanishes in the accelerated frame, so does g and this expression satisfies the Equivalence Principle. This expression also suggests that modification of Gravity fields can be accomplished by powerful EM fields, as is also suggested by Hal Puthoff [Private Communication].

The VBE equation suggests creating a powerful field of Poynting vector around an inductor, either oscillating or rotating, as in the cause of Telsa rotating EM fields used in "brushless" induction

motors, can change S in local gravity fields. This change in gravity is due to a reaction of the quantum ZPF fields underlying Gravitation to alter, creating a strengthening of gravity where the S fields are strongest and a corresponding weakening in the inductor itself, where E fields are suppressed. (3) This is similar to the reaction of static pressure to air flow kinetic energy density, seen in the aerodynamic Bernoulli Effect. Also, as in the case of the Bernoulli effect the static pressure field, in this case $g^2/(2\pi G)$, relaxes to its ambient value far away from the local disturbance. Since the inductor in a VBE experiment is the concentration of mass in the system, the local system should become measurably "lighter." However, the VBE expression includes contributions from the ZPF, whose fields are predicted to be very strong, yet not seen. Therefore, an important question is whether any technologically generated fields would have enough intensity to create useful effects.
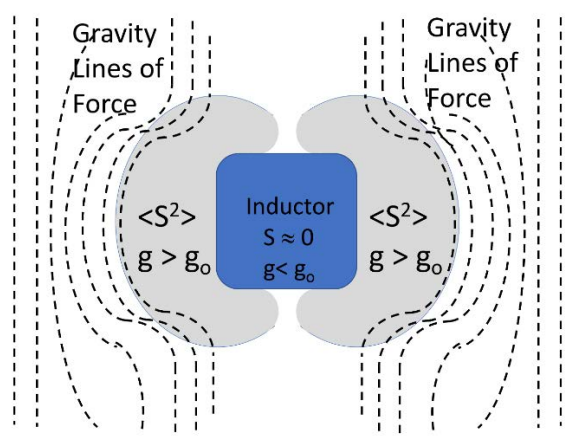

Figure 3. The GEM Effect of weakening of local gravity fields by Poynting Vector fields

We will term the Tesla polyphase rotating field configuration in the context of gravity modification as a TPV ("Tesla-Poynting Vortex") since its application is not to rotate a motor armature but instead to modify gravity. Thus, it can be argued mathematically from the GEM theory, that a TPV will modify gravity around the inductor creating it, and cause the inductor to feel less gravity force. However, is this "GEM Effect" based on the appearance of the Primordial Hydrogenic Plasma of the first seconds of the Cosmos, purely theoretical, or can it be seen in the present day laboratory? If so, it means that control of the "Vaccum Quantum Plasma" was technologically possible. The answer is yes, laboratory gravity modification is apparently possible.

Previous Laboratory Results

In 1989, after the author had presented the GEM theory at scientific meetings, an article was published by two Japanese researchers, Hideo Hayasaka and Sakae Takeuchi where they reported that a gyroscope rotor spun using Tesla 3 Phase EM fields would apparently lose weight when spun in the "spin down" or "right rotation" direction but would not lose not weight when spun in the "spin up" direction [1,11]. (4 and 5) The weight was measured using a mechanical chemical balance, and was observed for both aluminum and brass gyroscope rotors. The weight loss persisted even after the Tesla fields were turned off and the rotor "spun down", suggesting that spinning fields were retained in the metal rotors. Because of the GEM theory and the association of the weight loss with electrodynamics, the author was intrigued. The author, by chance, mentioned this article to a coworker who was a student

of obscure literature. Upon hearing of the Japanese results he reported that a Russian scientist had reported the identical phenomena in 1968, again using Tesla EM field to drive the rotors of the gyroscopes [12]. Shortly thereafter, however, an article in the same journal was published claiming that the Japanese results could not be reproduced and were therefore refuted [13]. However, in the refutation article the rotor of the gyroscope was spun, not with EM fields, but with compressed air. Armed by these two reports of the weight reduction that was spin dependent and driven by EM fields, and the GEM theory, as well as the null result obtained without EM fields, the author was motivated to find support to reproduce the Japanese-Russian experiments in detail. When this was accomplished, the phenomena was observed as it was reported in the Japanese and Russian experiments (6) These positive results were reported at a NASA "Breakthrough Propulsion" meeting [10]. What was also reported was the discovery by the author, trying to do a "null effect test" by removing the gyroscope rotor, that removal of the metal rotor increased the weight loss effect and that without the metal rotor the spin direction dependence disappeared. (7) This effect was seen to have an approximate dependence on the voltage to the 4th power at fixed frequency of 400Hz.
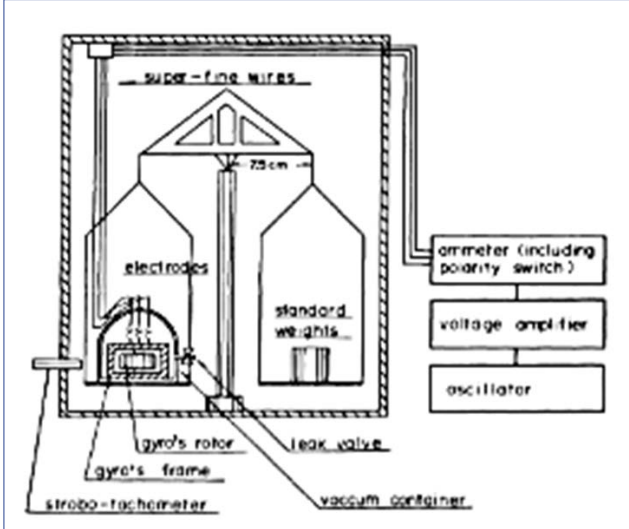

Figure 4. A diagram of the Hayasaka and Takeuchi experimental apparatus where weight loss was observed.
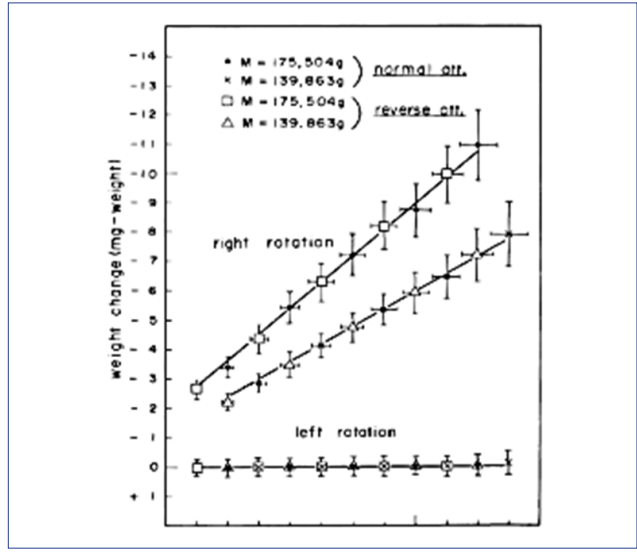

Figure 5. The data from the Hayasaka and Takeuchi experiment.

Kozyrev attributed the dependence on spin direction of the force to the influence of the Earth's rotation [12]. In more contemporary terms this would be described as "inertial frame dragging". He also reported that that at a spin vector 90 degrees to vertical, the weight changes in the gyroscope were ½ of those observed with spin vector down.

This effect can be understood in the limit of small gravity changes of the VBE as a coupling between a rotational component of the Poynting field due to the Earth's gravity, and the spinning Tesla fields imposed in the laboratory [10]. This can be written generally as

$$\frac{dg \cdot g}{2\pi G} = \frac{dS \cdot S}{u_o c^2} \qquad (30)$$

Where we assume two rotating Poynting field components rotating with the metal rotor, at frequency ω in the horizontal (x, y) plane. There exists that due to the Earth of magnitude SE

$$S = S_E(\hat{x}Sin\,\omega t + \hat{y}Cos\,\omega t) \qquad (31)$$

And that due to the applied field Sa with a spin axis at an angle θ with the horizontial y axis

$$dS = S_a(\hat{x}Sin\,\omega t + Cos\theta\,\hat{y}Cos\,\omega t) \qquad (32)$$

We have then for an average coupling over a rotation cycle

$$<S \cdot dS> = S_E S_a\left(\frac{1}{2} + \frac{1}{2}Cos\theta\right) \qquad (32)$$

Which becomes the "half angle formula " familiar from spinor analysis.

$$<S \cdot dS> = S_E S_a\left(Cos^2\theta/2\right) \qquad (33)$$

Based on the experimental data reported in the Japanese experiment and assuming a power of approximately 100W for the gyroscope, we arrive at, for approxiamtely 100W, a phenomenological estimate of

$$\frac{dg}{g} \approx 5x10^{-6} \quad \text{per thousand rpm} \qquad (34)$$
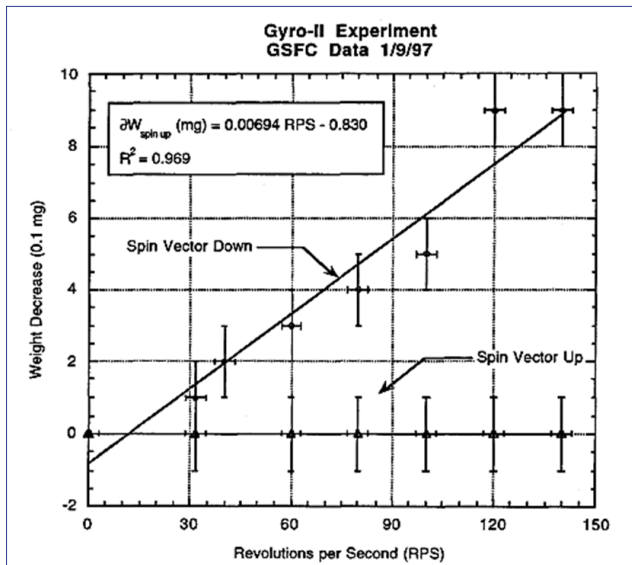
Figure 6. Weight loss measured on a Meitler scale at Goddard Space Flight Center, as a function of rotation frequency of a gyroscope driven by three phase power. Sensitivity of the scale was 0.1mg.

Rotor mass in the replication experiments was 289.6 g and gave a weight loss of approximately 1mg at 9 thousand rpm,

yielding an experimental result of

$$\frac{dg}{g} \approx 3x10^{-7} \quad \text{per thousand rpm} \qquad (35)$$

This is approximately 1/10 the Japanese rate of weight loss. Despite this difference, the results of the author's experiment appeared to confirm the existence of the Russian-Japanese reported effect. This meant that in the context of the GEM theory, it was possible to manipulate the properties of the ZPF underlying gravity fields.
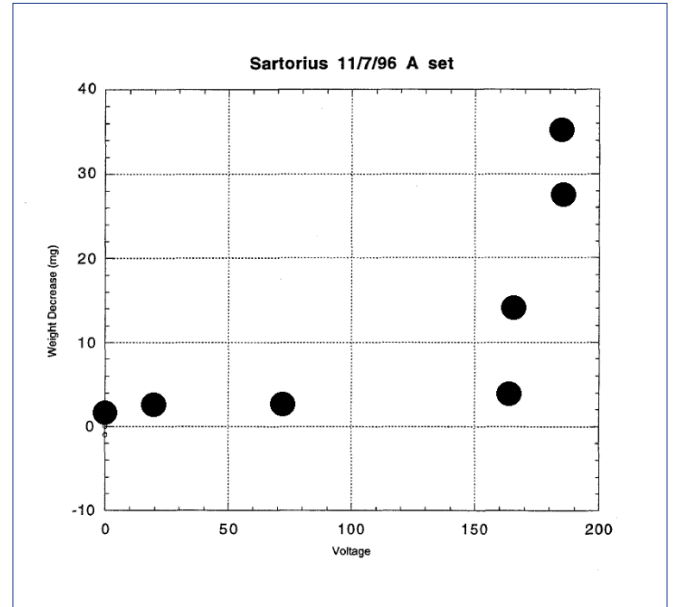
Figure 7. The GEM Effect observed in rotor-less three phase power experiments as a function of applied voltage.

Coil mass in the rotor-less experiments was approximately 150 g. As can be seen the rotor-less results gave a much stronger effect, approximately, 35 mg and appeared to give a weight loss at 400Hz of the following approximate rate, where V is voltage in Volts

$$\frac{dg}{g} \approx 1.5x10^{-5} \; x(V/100)^4 \qquad (36)$$

These last results were unexpected and puzzling even in the context of the GEM theory. Whereas previous experimental results had yielded linear relationships between weight losses and applied field strengths , consistent with applied fields being a perturbation on the ZPF underlying gravity fields, these new results suggested a quadratic coupling between applied Poynting fields (the applied Poynting field scaling as V2).

This provoked the author and colleagues to undertake several subsequent experimental efforts to explore the phenomenology of the "GEM Effect" and find sources of error, such as Lorentz forces on current feeds or electronic interference with weight measuring devices. However, the absence of moving parts in the rotorless experiments and their stong signal made them inherently simpler to repeat and the effect was found to persist when liquid metal contacts, using non-toxic Gallinstan liquid metal, were used for current feeds instead of fine copper wires. The effect was also detected when purely mechanical weight measurement devices were used. Therefore, the author decided

to publish the results of recent experiments confirming the weight loss effect and which make use of considerable advances in technology since the initial publication in 1998.

Recent Experimental Confirmation of the GEM Effect

Using newly available, cost effective technologies the GEM Effect experiments were repeated and earlier published results have been confirmed. Brushless motors, used in model racing cars and aircraft contain field coils, made of laminated iron and using copper windings, can create an intense TPV when energized with three phase power (*8*).


Figure 8. The induction stator coil of a brushless motor driven by three-phase power with the cylindrical rotor removed, that normally rotates outside of the coil.

The model purchased and utilized in this experiment is the GOOLRC 3650 4300KV Waterproof Brushless Motor for 1/10 RC Car 94123. For this experiment the rotor was removed and the case resealed. This was purchased with its standard 3-phase power supply (*9*).


Figure 9. The GOOLRC brushless induction and power supply which were used in the GEM Effect experiment.

The coil was mounted on wooden plate and hung on two nylon fibers from a Plexiglas structure crowned with a electronically read load cell. The 3 phase electrical connections to the coil were made via thin copper electrodes immersed in Galinstan liquid metal filled cup electrodes below where the coil was suspended (*10*).
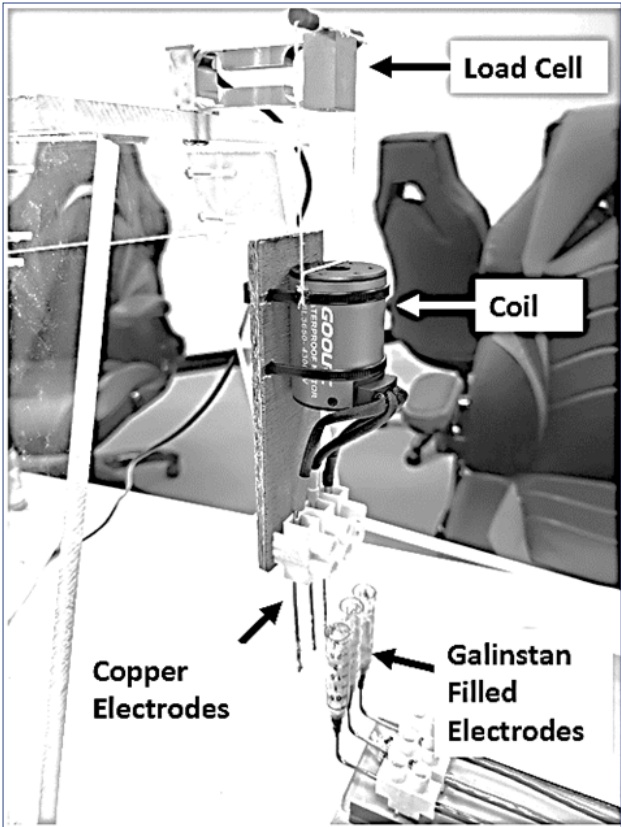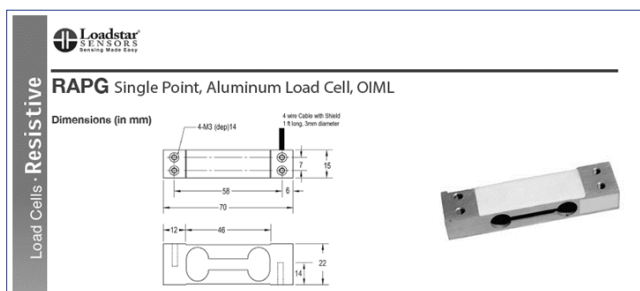

Figure 10. The GEM Effect experimental apparatus mounted on a structure of clear Plexiglas. During experiments the copper electrodes were suspended inside the Galinstan filled cup electrodes to power the 3-phase coil.

Looked at from directly in front of the coil assembly, the fibers on which the coil assembly was hung from the load cell can be seen to connect mechanically to a plastic "T" mounted on the end of the load cell. The load cell readout leads were kept well separated from the coil and its connection to the 3-phase power supply to prevent any electrical "crosstalk" between the circuits (*11*).
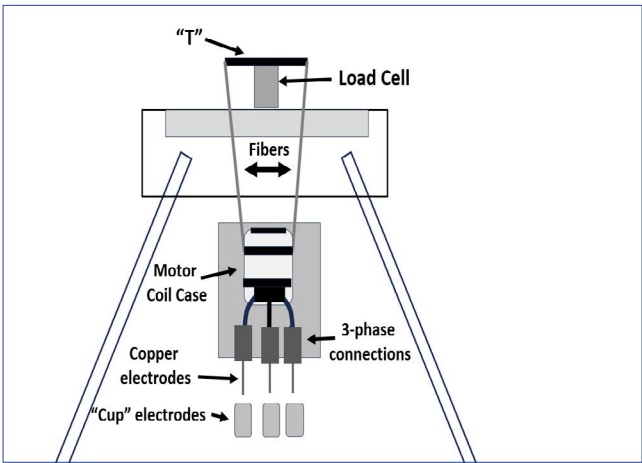
Figure 11. The GEM Effect apparatus of Fig. 10 viewed from directly in front. During experiments the copper electrodes were suspended inside the Galinstan filled cup electrodes to power the 3-phase coil.

Changes in gravity force on the coil could be detected via the load cell readout. The load cell used was Loadstar Sensor Part Number RAPG-300G-A with 300gram capacity (*12*).


Figure 12. The Loadstar 300g capacity load cell used in the GEM Effect experiments.

The data readout for the load cell was obtained from another Loadstar product, the AI-1000 Single Channel Signal Converter (*13*).

Figure 13. The Loadstar load cell signal analyzer used in the GEM Effect experiments.

The coil and the load cell structure it was suspended from was put under a Plexiglas dome to prevent interference from air currents. The air in the room was kept still before the experiments and no-one entered the room where the apparatus was located during experimental runs (*14*).
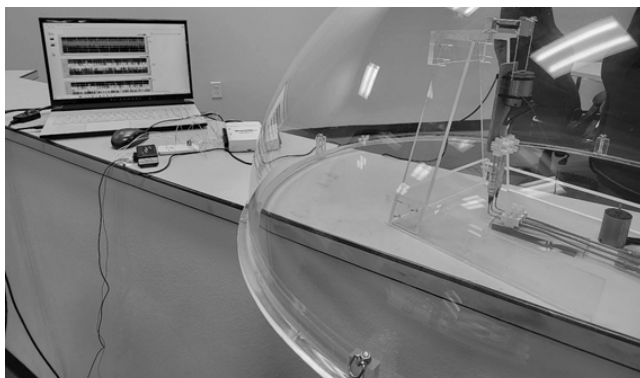
Figure 14. The Plexiglas dome used in the GEM Effect experiments to isolate the apparatus from air movements.

Experiment Results
The experiments confirmed the weight loss seen in earlier GEM Effect experiments but most clearly after certain sources of procedural and interpretation errors were eliminated.

It was discovered that the flow of power through the 3-phase

liquid metal connectors, in which copper electrodes were emersed became hot on long pulse shots. Galinstan expands when it is heated even more than Mercury, hence its use in thermometers, and this lessens the buoyancy forces on the copper electrodes making the force on the load cell greater, and thus giving a false signal of a small mass increase for the coil assembly after the test. This effect was much less than the sought-after GEM effect weight loss signal but resulted in long pulses not returning to their start weight when power was shut off. For this reason pulses were kept to under ten seconds. Shorter pulses also created minor problems.

The factory power supply for the brushless motor did not supply full power instantaneously to the coil, but being optimized running rotors connected to gear boxes, required a time of several seconds to reach full power. This is fully in keeping with the hardware's role in model vehicle propulsion. In such an application, buffering of the delivered power to avoid wheel slippage and high torques which could damage the model vehicles drive trains was the goal, not gravity modification. However, this power buffering feature created a lag time effect not seen in previous GEM Effect experiments. Therefore, it is advised that those seeking to repeat these experiments utilize an oscilloscope to monitor the actual waveforms of applied power to the coil. Thus, too long of pulses create thermal effects which can create spurious features in the weight data, but short pulses can create false interpretations of the phenomenology, because of the seconds long buffered rise time of the actual power being applied to the coil.

Recognizing both problems in the data sets, we here simply present results for multiple seconds-long pulses where neither the thermal effects or power supply buffering effects where significant. (*15*)
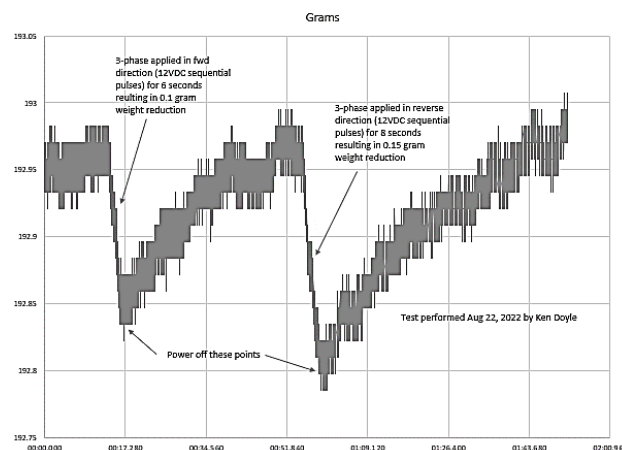
Figure 15. The data from the GEM Effect experiments using intermediate length pulses.

In order to detect any interference from the coil fields on the load cell sensor, the coil assembly was supported partially and energized to the same values of power as in the previous figure. No signal was seen from the load cell of any weight change during this null test (*16*). Therefore, the GEM Effect, despite being at odds with the predictions of Standard Model Physics, appears real and should be investigated further.

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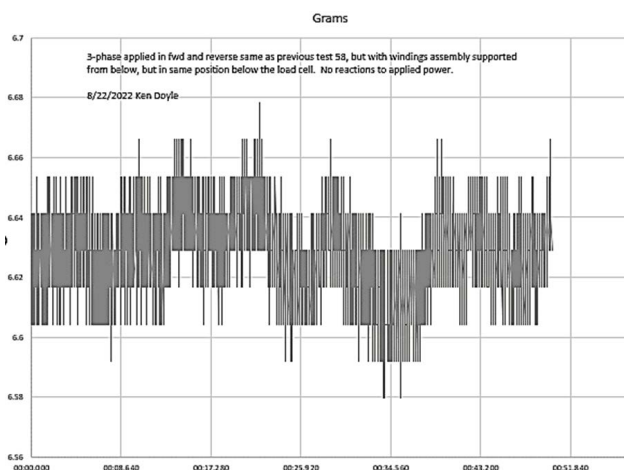
Figure. 16 The data from the GEM Effect experiments with the coil partly supported and using intermediate length pulses to test for EM interference from the coil with the load cell measurements. No interference was seen.

Summary and Conclusions

It is a scientific consensus that the cosmos began with a Planckian Vacuum and a second later was an expanding hot, hydrogen plasma and that the dynamics of the cosmos have been dominated ever since by two charged particles- electrons and protons, and two long range force fields, Gravitation and EM. This consensus has not changed in a century, and was fully apparent to Albert Einstein at the peak of his career. Here, he began the great scientific quest that was to last until the end of his life: to unify the two long range forces of the Cosmos, Gravitation and EM. However, despite being an attending physician at the birth of quantum mechanics, he rejected its model of reality as "rolling dice". One wonders what the ultimate motive for Einsten was in this journey. Was it pure scientific understanding or hopes of controlling gravity fields with EM. In any case, it seems his final lonely quest ended without reaching its goal.

Now comes the GEM unification theory. It is not a "Theory Of Everything, " just a theory of what is basically observed in the night sky. Recognizng that dice is apparently played widely in the Cosmos, the GEM theory includes quantum mechanics. The theory explains gravity fields in terms of a "Quantum Vacuum Plasma," and gives accurate formulas for G and m_p. It also predicts one can manipulate gravity fields with EM fields, opening the way to gravity modification technologies.

Such effects can now, apparently, be seen clearly in the laboratory, using now common-place technologies. Therefore, let those who can, investigate this effect.

The existence of such technologies has now been apparently confirmed by the White House OSTP office [14]

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