Gravimagnetism

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Abstract: Numerous deductions are made from the application of a well founded assumption that an isomorphism exists between the description of gravity and electromagnetism. Some outcomes include the existence of negative gravitational mirror matter and an explanation of the galaxy rotation problem.

Keywords: Electromagnetic field, gravity, mirror matter, dark energy, dark matter

OBJECTIVE

The objective here is to assume a formal isomorphism between the descriptions of electromagnetism and gravity exists, and to explore some consequences of such an assumption. The application of formal systems, logic and mathematical formalisms, such as symmetry, to scientific theory has a long and rich history. This is but a very small incremental step in the historical use of analogies between electromagnetism and gravity.

BUILDING THE GRAVIMAGNETIC ISOMORPHISM

The similarity of the Coulomb force laws and the laws of gravity have long been noted, and magnetic type gravity induced effects have long been anticipated, and even applied.[1,2,3] Jefimenko, in his book *The Magnetic Field and Relativity*[4], shows that causality and retardation, the delayed effect of the Coulomb force carrier, accounts for much of special relativity and fully for the magnetic field, and thus for the laws of electromagnetism (EM). In *Causality, Electromagnetic Induction and Gravitation*[5] , he similarly shows that causality implies the existence of a "gravikinetic" (GK) field. Jefimenko delineated numerous analogous laws between EM and GK fields, but did not fully establish an isomorphism between the mathematics describing gravity and electromagnetism. An isomorphism is a 1-1 correspondence of every element of one set to those of another set, which preserves all operations and relations. Whatever is known about the first set is then rigorously known about the second set. Let us suppose such an isomorphism exists between our formal descriptions of electromagnetism and gravity, that a full quantum description of gravity exists corresponding exactly on a 1-1 basis to such a description for electromagnetism. *All that follows within this article is within the framework of this assumption.* We can now deduce some characteristics such an isomorphism must have, and deduce the correspondences required to define it. The consequences of this single assumption are far reaching, though quantitative,

precise, and testable.

GRAVITY NOT AN ELECTROMAGNETIC FORCE

Suppose for a moment, a straw man assumption, that the force of gravity is electromagnetic in origin. It is thus carried either by photons or virtual photons.

There is good evidence black holes exist and the effects of their large mass is detectable.[6] Given black holes exist, photons are out of the question as the gravity messenger, because they can not escape black holes. If photons carried the gravitational force then black holes would be utterly undetectable and have no external gravitational effects, because, by definition of a black hole, the photons could not escape to cause gravitational effects. Further, within the assumptions, gravity can not be due to a shadowing of repellant force from an ambient flux of messenger particles, because the Coulomb force does not follow this model, and thus a 1-1 correspondence would be denied. This then leaves the second part of the straw man assumption: virtual photons carry the gravitational force.

Virtual photons can not be influenced by gravitational entities and also be the carrier of the gravitational force. This is saying that virtual photons can not be the carrier of the gravitational analog of electric charge, *mass charge, i.e. gravitational mass charge,* i.e. have weight. If they could, then black holes could not exist, by the same logic applied to the photon: black holes would be utterly undetectable and have no external gravitational effects. Conversely then, within the straw man assumptions, and by conservation of momentum, virtual photons can therefore not indirectly and gravitationally affect other bodies, i.e. third bodies with which they do not effect their final EM momentum exchange. If they can not affect, they can not be affected in an equal yet opposite manner.

Virtual photons effecting an actual, and thus final, electromagnetic force exchange upon absorption do so in a polarized, i.e. charge sign specific, manner. The field of gravitational force carried by virtual photons from a neutral body and acting on a neutral body must be dipolar in origin, and from many dipoles at that. Normal matter is made principally of leptons and quarks, all of which carry charge. Dipole fields are $1/r^3$ in nature, and forces between dipoles are well known to be $1/r^4$ in nature. Therefore, gravity between neutral bodies can also not be the result of the *direct* virtual photon force exchange. It is thus deduced, under the straw man assumptions, that EM fields, virtual photons, are not affected by gravity, and they

have no gravitational mass. They can not directly produce a $1/r^2$ gravitational force from a large neutral body. We thus are left with no possibility that the photon or virtual photon carries the force of gravity. Gravity is therefore not an electromagnetic effect if the isomorphism exists.

THE GRAVITON ASSUMPTION

Because gravity is not an electromagnetic effect, we are fully justified in inventing a separate messenger particle for gravity, the *graviton*. We are further justified in that it is also required to develop the presupposed isomorphism. The graviton is the analog of the virtual photon. Coulomb charge is the source or sink of the virtual photon. We are thus further justified in inventing the concept of *mass charge*, the source or sink for the graviton, and the analog of the Coulomb charge. If the sought isomorphism exists, then gravitational mass charge exists. Inasmuch as inertial mass is proportional to gravitational mass in normal circumstances, it is necessary that the mass charge of ordinary matter be proportional to its inertial mass, in normal circumstances.

VIRTUAL PARTICLES CARRY NO GRAVITATIONAL CHARGE

Under the straw man hypothesis virtual photons could carry no gravitational mass charge. There is powerful evidence virtual photons can carry no mass charge even without the straw man hypothesis. Virtual photons having no mass charge solves the "infinite mass density of the zero point field" [7] problem, because virtual photons, having no gravitational mass, can thus not create any mass density for the field carried. Also convenient, and in fact required, is that gravitons, under the isomorphism, are then not required by symmetry to carry Coulomb charge. Since ordinary charged particles have mass, and thus carry mass charge as well, the isomorphism therefore requires gravitationally charged particles to carry a corresponding though small amount of Coulomb charge, to at least weakly couple the gravitational mass charge to the EM force. Gravitons carrying Coulomb charge would lead yet again to their inability to escape black holes, because that Coulomb charge must have an associated gravitational mass. The only logical conclusion, if the desired isomorphism exists, is that virtual photons have no mass charge, i.e. exhibit no gravitational mass. Virtual photons have no gravitational mass because they carry no energy, they are created and abasorbed without energetic considerations. Similarly then, it is deduced virtual particles carry no mass charge.

EM FIELDS HAVE NO GRAVITATIONAL MASS

Given that virtual photons carry no gravitational mass charge, electromagnetic (EM) fields can have no gravitational mass. EM fields carry momentum, and energy, yet have no gravitational mass. EM fields not having gravitational mass implies the *direct* connection between gravitational mass and energy is broken. Some other indirect means of carrying photon gravitational mass therefore exists, and that something is bound with or binds the EM fields of the photon to form the discrete energy packet the photon is. The link of the field energy of the photon to its gravitational mass then is at this point not defined, nor is it necessary to define. It is merely necessary that any process that creates a photon also imparts an appropriate amount of mass charge as well. The source of the proportional correspondence of nonzero rest mass particle inertial mass to gravitational mass is not defined at this point either, nor is it necessary because it is experimentally well verified.

EXISTENCE OF THE GRAVIPHOTON

We have deduced the existence of gravitons and gravitational mass charge corresponding to their analogs: virtual photons, and Coulomb charge. The isomorphism must also accommodate a gravitational equivalent to the photon. Call it the *graviphoton.*

PHOTONS AND GRAVIPHOTONS CARRY CHARGE

The photon carries gravitational mass because its path is bent in the presence of a gravitational field. Photons then, being affected by gravity, and therefore also effecting third body gravitational forces, carry a small mass charge, and emit/absorb gravitons, analogous to the manner in which Coulomb charge emits/absorbs virtual photons. To fully sustain the isomorphism, yet without any existing physical evidence, a surprising implication is now made: graviphotons must carry a very small Coulomb charge, weakly coupled to the EM force.

Having determined the necessity of and some characteristics of gravitational mass charge, gravitons, and graviphotons, we can now can address the problems of

resolving isomorphic analogs of EM forces, field constants, and direction signs, and consider further implied particle types.

CAUSALITY AND JEFIMENKO'S GRAVITY

In establishing his correspondence between gravity and the electromagnetic field, based primarily on causality and the effects of retardation, Jefimenko[8] , in *Causality Electromagnetic Induction and Gravity*, choses the equivalencies:

$$\varepsilon_{0_g} = -1/(4 \pi G)$$

$$G = -1/(4 \pi \varepsilon_{0_g})$$

and:

$$\mu_{0_g} = - 4 \pi G / c_g^2$$

$$G = -\mu_{0_g} c_g^2 / (4 \pi).$$

The term ε_{0_g} is defined here as the gravitational equivalent to the electrostatic permittivity of the vacuum ε_0, μ_{0_g} as the gravitational equivalent to the magnetic permeability of the vacuum μ_0, and c_g as the speed of gravity. Note that the usage here of ε_{0_g}, μ_{0_g} and c_g is not conventional notation.

Jefimenko's version of EM fully accounts for and utilizes causality, i.e. the fact that a cause at a distance d can not precede the effect by time delta t which is less than d/c (or d/c_g in the case of gravity). Jefimenko shows that causality justifies invention of the "co-gravitational" field K, analogous to B. The fields B and K are thus merely computational and conceptual conveniences, like energy. The existence of field K is necessary, though not sufficient, to make a full gravitational-electromagnetic field isomorphism possible. Jefimenko demonstrates that B, and thus K, are merely computed quantities, secondary quantities that necessarily follow from the only true causes, the delayed interaction of charge upon charge or mass upon mass. This provides strong evidence for the "real" existence of K, as "real" as B. That is to say that an (apparent) K can be observed experimentally to the same extent B can, and with the same qualities, though it is much more difficult to observe in the laboratory

due to the extreme orders of magnitude difference in the forces involved. In other words, if causal electromagnetism is correct, then causal gravity is also necessarily correct. Provided all other correspondences necessary for an isomorphism can be established, and gravity and electromagnetism are both causal, the isomorphism holds *by necessity* because the laws for EM have already been experimentally extensively verified. However, if it turns out that causal electromagnetism is incorrect, and B exists in a real sense, then it does not follow that K can (any longer) be assumed to isomorphically exist on the basis that it is merely a computed quantity, like energy. An independent physical verification of the characteristics of K, or some other logical justification for K, is required to prove the isomorphism reflects reality.

The magnitude of B and E observed from a given source vary when the velocity of the observer is taken into account. This magnitude dependence on observer velocity is fully accounted for by causality treatment, because the relative velocity of the observer merely changes the apparent retardation through time. This dual field aspect even more fully justifies and fully corresponds to Jefimenko's treatment of B as an artifact of charge motion.

Suppose we chose ε_{0_g} and μ_{0_g} to be positive, like their electromagnetic counterparts. We would then have the correspondences shown in Table 1, the Initial Gravity-electromagnetism Isomorphism Correspondence Table.

Electric	Gravitational
virtual photon	graviton
photon	graviphoton
q	m (mass charge in kg)
E	g
B	K
c	c_g
ε_0	$\varepsilon_{0_g} = 1/(4 \pi G)$
μ_0	$\mu_{0_g} = 4 \pi G/(c_g^2)$
$k=1/(4 \pi \varepsilon_0)$	G
$F_e = k q_1 q_2 / r^2$	$F_g = G m_1 m_2 / r^2$

Table 1: Initial Gravity-electromagnetism Isomorphism

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Correspondence Table

This choice is not adequate. We have a problem with signs. Gravity is attractive for like charges. The problem lies in the fact that, to maintain the convention that a positive force is repelling, we end up with sign problems when corresponding the force equations:

$$F_g = G\ m_1\ m_2 / r^2$$

for gravity with:

$$F_e = k\ q_1\ q_2 / r^2 = (1/(4\ \pi\ \varepsilon_0))(q_1\ q_2 / r^2)$$

for the Coulomb force. Both are positive for like charges. Gravity is attractive for like charges, thus the force F_g must be computed as negative. One remedy is to make ε_{0_g} and μ_{0_g} both negative, as did Jefimenko. This, in effect provides the gravitational equivalent to Coulomb's law:

$$F_g = G\ m_1\ m_2 / r^2 = (1/(4\ \pi\ \varepsilon_{0_g}))\ \ (m_1\ m_2 / r^2)$$

Gravitational permittivity and co-gravitational permeability thus must both be negative in order to preserve the correct sign on force F_g, and also satisfy equations like:

$$c_g = (\mu_{0_g}\ \varepsilon_{0_g})^{-1/2}$$

This eventually causes problems. An example is the Poynting vector correspondence:

$$S = (1/\mu_0)\ E \times B$$

vs a prospective gravitational version:

$$P = (c^2/(4\ \pi\ G))\ K \times g = (1/\mu_{0_g})\ K \times g$$

The x above denotes a vector cross product. Note that K and G are reversed here instead of using an arbitrarily placed minus sign. Similar problems affect approaches applied in gravitomagnetism, where signs must be determined on an

equation by equation basis.[9]

There is a handy way out of this lack of true isomorphism. That solution is to specify the polarity of the mass charge in terms of $i = \sqrt{-1}$, the imaginary number i. Charge has polarity, so why not mass? This then appears to complete the isomorphism with respect to charge and constants. We now again have the positive EM analogous constants:

$$\varepsilon_{0_g} = 1/(4\pi G)$$

$$\mu_{0_g} = 4\pi G/(c_g^2)$$

and all gravitational formulae exactly correspond on a 1-1 basis. The disadvantage to this approach is that the imaginary number i must be carried throughout in all the gravitational field units, and in all gravitational mass charge units. Perhaps this is really an unexpected advantage though. Gravitational fields are imaginary, electromagnetic are real. There is then some hidden meaning to this? One is that the two worlds *are* for the most part disconnected. We have in fact an indication of field *dis-unification*. Additionally we have that anti-gravitational matter, the existence of which is implied by symmetry, must be described in negative imaginary units.

THE ISOMORPHISM IS NOT LIMITED TO CAUSAL FIELDS

Any complete theory of electromagnetism, including electromagnetism within the framework of special relativity, can be used to create an isomorphism between electromagnetism and gravity, provided B in the theory is not existentially real in the sense B is simply a byproduct of the other laws of the electromagnetic theory, and the electromagnetic vector potential function can be be derived from the (retarded) motion of charge. Jefimenko showed that the law of causality, if postulated, ensures that B meets this criteria. The constants for the subject isomorphism can be established by first measuring or establishing the rate of propagation of gravity, c_g. We then can compute the permeability of space to co-gravity:

$$\mu_{0_g} = 4\pi G / c_g^2$$

and the permittivity of space to gravity:

$$\varepsilon_{0_g} = 1/(4\,\pi\,G) = c_g^{\,2}/\mu_{0_g}$$

It is expected that $c_g = c$, and special relativity applies. However, the ratio c/c_g may change within close range to massive objects, due to the fact gravity and electromagnetism operate in separate spacial dimensions, and the speed of the force carriers may be affected by some factor like the charge density of material or flux through which it moves. A change in the ratio c/c_g manifests as an apparent change to time units for any clock dependent on mass, as does any change in the observed charge ratio q/q_g for particles used in a clock. The independence of dimensions for c and c_g opens the possibility of warping (actually the appearance of warping) of space or time in one set of dimensions independently from the others, though space warping here is not any more essential to describe gravity than it is to describe electromagnetics. The need for general relativity is thus eliminated.

THE ISOMORPHISM

We now establish the isomorphism by applying the following rules to every electromagnetic equation and relation in order to obtain the gravitational analogs.

Here the use of SI units where possible is assumed. In any EM formula or relation, subscript every term with "g" to denote the gravitational analog. For example, replace c, μ_0 and ε_0 with corresponding terms c_g, μ_{0_g}, and ε_{0_g}, where $c_g = c$, $\mu_{0_g} = 4\,\pi G/(c_g^{\,2})$, $\varepsilon_{0_g} = 1/(4\,\pi G)$. Co-gravity $B_g = K$ (with units i Hz) is defined as the gravitational analog to (corresponds under the isomorphism to) B, the magnetic field B, so H_g the Gravimagnetic Field Intensity (with units i kg/(m s)) corresponds to H, the magnetic field intensity. Gravity g (with units m/s^2) is defined as the gravitational equivalent of the electrostatic field E. Wherever charge is used, gravitational mass charge q_g (gravitational mass) is substituted (with units of i kg.) J_g is the mass current density vector (with units i $kg/(s\,m^2)$) corresponding to current density vector J. The gravitational force constant $G = 6.67259 \times 10^{-11} m^3/(kg\,s^2)$ corresponds to the Coulomb force constant k. Virtual photons correspond to gravitons, photons correspond to graviphotons, with the qualities already described. Virtual particles carry no gravitational mass. Other particles have Coulomb charge and mass charge values as empirically determined. We now have the correspondence shown in Table 2.

Electric	Gravitational
virtual photon	graviton
photon	graviphoton
g	i m/s^2
q	q_g = i m (mass charge in i kg)
E	E_g = g (gravitational field in m/s^2)
B	B_g = K (Gravimagnetic field in i Hz)
H	H_g (Gravimagnetic Field Intensity in i kg/(m s))
J	J_g (mass flow density vector in i kg/(s m^2))
c	$c_g = c = 2.99792458 \times 10^8$ m/s
ε_0	$\varepsilon_{0_g} = 1/(4\pi G)$ $= 1.192299(31) \times 10^9$ kg s^2/m^3
μ_0	$\mu_{0_g} = 4\pi G/(c_g^2)$ $= 9.33196(96) \times 10^{-27}$ m/kg
$k=1/(4\pi\varepsilon_0)$	$G = 6.67428(67) \times 10^{-11}$ $m^3/(kg\ s^2)$
$F_e = k\, q_1\, q_2 / r^2$	$F_g = G\, m_1\, m_2 / r^2$

Table 2: Gravity-electromagnetism Isomorphism Correspondence Table

NOTATION AND NOMENCLATURE RELATED TO GRAVITATION

The EM-GK isomorphism, here named the *gravimagnetic isomorphism*, provides analogs to a vast quantity of physical laws, formulae and terms. From the correspondences provided in Table 2, all gravitational formulas, relations, and constants can be derived from the EM analogs. This can cause much confusion in the process of attempting to assign names and symbols to the gravitational analog items.

To be consistent, and to end terminology confusion, when discussing or expanding the isomorphism proposed here between the electromagnetic (EM) and gravikinetic (GK) fields, when referring to a gravitational feature the analogous term borrowed from the EM universe should be prefixed with "gravi" to indicate that that analogous feature is in the GK universe. If it is not appropriate to prefix a term with "gravi"

then it can be preceded with the adjective "gravitational". It is noteworthy that GK fields are also called by some “gravikinetic”. They are here named the *gravimagnetic* (GK) fields, and actually differ in that they are here considered to be imaginary entities as their units include a factor i.

Under the proposed EM-GK isomorphism every variable, every formula, every unit in EM now has a corresponding value, a gravitational analog. The formulas and variables from the EM world should be used faithfully, and simply subscripted where necessary with a “g” to designate the GK analog.

The exceptions to these rules are the variables g, and G, and co-gravitational field K, which is hereby now called the gravimagnetic field K, which are symbols that have been used by others, and now have the specific equivalencies:

$E_g = g$

$k_g = G$

$B_g = K$

Note, however, that here g and K are in imaginary units.

Based on the above nomenclature principles, Table 3, Sample Terminology Correspondences Under the EM-GK Isomorphism, demonstrates some typical terminology correspondences.

Electromagnetic	Gravimagnetics
electrostatic field E	gravitational field E_g = g
magnetic field B	gravimagnetic field B_g = K
magnetic field intensity H	gravimagnetic field intensity H_g
electromagnetic (EM)	gravimagnetic (or gravikinetic) (GK)
charge	gravicharge (an imaginary quantity in units of +i kg, or possibly –i kg, not to be confused with mass)
current	gravicurrent (an imaginary quantity in units of +i kg/s)
magnet	gravimagnet
monopole	gravimonopole
Poynting vector P	gravitational Poynting vector P_g
ohm (Ω)	graviohm (Ω_g)
permittivity (ε)	gravipermittivity (ε_g)
permeability (μ)	gravipermeability (μ_g)
lightspeed (c)	gravispeed (c_g)
impedance of the vacuum (η)	graviimpedence of the vacuum (η_g)
Maxwell's laws of electromagnetism	Maxwell's laws of gravimagnetism
Gauss' Law of electric flux	Gauss' Law of gravitational flux
Laplace's Law of Electrostatic pot.	Laplace's Law of Gravitational Potential

Table 3 - Sample Terminology Correspondences Under the EM-GK Isomorphism

Similar terminology should be used when applied to the laws of Lenz, Biot-Savart, Ampere, Ohm, etc. The theory itself, the EM-GK Isomorphic Theory, can simply be called a *theory of gravimagnetism,* or *gravimagnetic theory*.

This approach to nomenclature puts an end to the need for all kinds of special terms and variables. Also, when the meaning is clear, one can simply dispense with the "g" subscripts, and thus incur no notation overhead whatsoever. Note that this approach would not work if the isomorphism were not fully established, and thus if correspondences were not automatic and had to be made piecemeal and established individually.

DIMENSIONAL ANALYSIS IN GRAVIMAGNETISM

In a fully unified theory, physical quantities can no longer be defined over MLTQ dimensions. At the most fundamental level, reality must be defined, that is to say dimensional analysis must be defined, over the field of complex numbers, LT(a QM + b Q_g), where the value of real and b are determined by particle type(s) involved, and Q and the imaginary Q_g are units of Coulomb and gravitational mass charge. In

many calculations, however, quantities are strictly real or strictly imaginary, so complex arithmetic is not required and units look identical to typical MLTQ units with the possible exception of an "i" included in some units.

THE GRAVIMAGNETIC PLANK CONSTANT

We can now compute the gravimagnetic Planck Constant h_g. The Planck mass m_p is given by:

$$m_p = (\hbar\ c / G)^{1/2} = (h\ c / (2\ \pi\ G))^{1/2}$$

The Planck charge q_p is given by:

$$q_p = (4\ \pi\ \hbar\ c\ \varepsilon_0)^{1/2} = (2\ h\ c\ \varepsilon_0)^{1/2}$$

Applying the gravimagnetic isomorphism to the above, the Planck gravimagnetic charge q_{p_g} is given by:

$$q_{p_g} = (2\ h_g\ c\ \varepsilon_{0_g})^{1/2}$$

Where:

$$\varepsilon_{0_g} = 1/(4\ \pi\ G).$$

However, the Planck charge should also simply be i times the Planck mass

$$q_{p_g} = i\ m_p$$

where i is the imaginary number $i = \sqrt{-1}$. We thus have

$$q_{p_g} = i\ (h\ c / (2\ \pi\ G))^{1/2}$$

Setting the two values for q_{p_g} equal we have:

$$i\ (h\ c/(2\ \pi\ G))^{1/2} = (2\ h_g\ c\ \varepsilon_{0_g})^{1/2}$$

and solving for the gravimagnetic Planck constant h_g we have:

$$- (h\ c/(2\ \pi\ G)) = (2\ h_g\ c\ \varepsilon_{0g})$$

$$- (h\ c/(2\ \pi\ G)) = (\ h_g\ c/(2\ \pi\ G))$$

$$- h = h_g$$

Note that this relation must be altered if c is not equal to c_g. Planck's constant has a 2002 CODATA recommended value of $h = 6.626\ 0693 \times 10^{-34}$ J s with an uncertainty of $0.000\ 0011 \times 10^{-34}$ J s. Under the gravimagnetic isomorphism, the gravimagnetic Planck's constant h_g is similarly given by:

$$h_g = - h = -6.626\ 0693 \times 10^{-34}\ \text{J s}$$

Since both constants have the same units, this provides to some degree a unifying relation between gravimagnetism and electromagnetism at the quantum level. Graviphotons carry the same energy and momentum magnitude as photons at a given wavelength.

Given the gravimagnetic expression for graviphoton momentum,

$$p_g = h_g / \lambda$$

We see the momentum carried by the graviphoton is negative. This means impact with a graviphoton provides a thrust in the direction from which the graviphoton came. A graviphoton rocket would have to emit graviphotons in the direction in which it accelerates.

Given the gravimagnetic analog to Planck's equation

$$E_g = h_g \nu$$

the energy carried by a graviphoton is negative. This is a curious thing. Perhaps a mechanism exists to simultaneously emit photons in one direction and graviphotons in the other and thereby provide energy free propulsion.

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COMPUTATION OF THE EARTH'S GRAVIMAGNETIC FIELD

As an example of computation methods, we will now estimate the gravimagnetic field in the vicinity of the Earth, and values associated with some associated phenomena.

BASIC GRAVIMAGNETIC VARIABLES

See Table 2 for starting point gravimagnetic variables and constants .

The mass of the earth is $m_{t\_earth} = 5.985 \times 10^{24}$ kg. The radius r of earth is 6371 km. The rotation period $T_S = 86164$ sec. The moment of inertia for a sphere of radius r and mass M is (2/5) M r^2.

For estimating purposes, considering the iron core out to 3500 m, we might assume, by weighed value, the mass is located in a ring of radius 1780 km, rotating once every day, i.e. at $2*\pi*1780$ km/day = 129 m/s. The moment of inertia of the earth I is then $I = m\ r^2 = (5.985 \times 10^{24}\ \text{kg})(1780\ \text{km})^2$, so:

$$I = 1.90 \times 10^{37}\ \text{kg m}^2.$$

EARTH'S GRAVICURRENT

The gravicurrent is:

$$i_{g\_earth} = (5.985 \times 10^{24}\ i\ \text{kg})/\text{day}$$

$$i_{g\_earth} = 6.927 \times 10^{19}\ i\ \text{kg/s}.$$

Note that i in the units here is the imaginary number $i = \sqrt{-1}$. The i in i_{g_earth} represents gravicurrent, analogous to current i.

GRAVIMAGNETIC DIPOLE MOMENT OF EARTH

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The magnetic dipole moment for a current loop of area A is given by:

$$\mu = i_{amp}\ A$$

The gravimagnetic dipole moment μ_{g_earth} of the earth's gravicurrent is thus the gravicurrent times the area of the current loop, or (6.927E19 i kg/s)(π*(1780 km)^2), which gives:

$$\mu_{g\_earth} = 6.90 \times 10^{32}\ i\ kg\ m^2/s$$

EARTH GRAVIMAGNETIC FLUX (K) IN CENTER OF EARTH

The magnetic field in the center a conducting ring radius R and current i_{ring} is

$$B = \mu_0\ i_{ring} / (2\ R)$$

Using earth simulating ring radius 1780 km, and gravicurrent

$$i_{g\_earth} = 6.927 \times 10^{19}\ i\ kg/s$$

We have the field

$$K_{g\_earth} = (9.33 \times 10^{-27}\ m/kg)(6.927 \times 10^{19}\ i\ kg/s)/ (2 * 1780\ km)$$

$$= 1.815 \times 10^{-13}\ (i\ Hz)$$

GRAVIMAGNETIC INTENSITY (H_g) IN CENTER OF EARTH

The gravimagnetic intensity of the earth due to its own rotation is given by:

$$H_{g\_earth} = K_{g\_earth} / \mu_{0_g}$$

$$H_{g\_earth} = (1.815 \times 10^{-13}\ (i\ Hz))/(9.33 \times 10^{-27}\ m/kg)$$

$H_{g\_earth} = 1.945x10^{13}$ i kg/(m s)

The gravimagnetic intensity at orbital altitudes at the equator is within an order of magnitude of this value, but reduced.

EARTH GRAVITATIONAL LORENTZ FORCE ON ORBITAL SPEED OBJECT

Given:

m = 1 kg

v = 8050 m/s (18,000 mi/hr)

Then:

$F_g = m (v \times K)$

$F_g = (1 \text{ kg i}) (8050 \text{ m/s}) \times (1.815x10^{-13} \text{ (i Hz)})$

$F_g = -1.461x10^{-9}$ N = $-1.49x10^{-10}$ kgf

So the lateral acceleration due to moving at orbital speed through Earth's gravimagnetic field is

$a_{earth} = 1.49x10^{-10}$ g,

or less depending on location. Note, however, the Earth's gravimagnetic field rotates with the earth. It thus has no influence on geosynchronous satellites, for example. The Earth's field rotation speed must be subtracted from satellite velocities going west to east, but added to satellite velocities going east to west.

The gravimagnetic force is not very observable. Only precise measurements or long term measurements can detect it.

In the center of earth, by the right hand rule, the gravimagnetic field is directed at the North Pole, and the lines of force exit the earth's surface in the Northern Hemisphere. However, the earth's gravimagnetic field is oriented southwards in

space above the equator, and due to the majority of mass being in the core, it is oriented that direction even just under the surface of the earth at the equator. Since normal mass has positive charge, but both the gravimagnetic field and gravimagnetic charge have a factor of i, the force has a negative sign. This means, at the equator, the direction of the earth caused Lorentz gravimagnetic force is away from the earth for an object traveling west-to-east, but toward the earth for an object traveling east-to-west.

The orbital speed, $V = (G\ m_{earth} / r)^{1/2}$, is reduced for a given altitude when the apparent gravity force is reduced by the earth's gravimagnetic Lorentz force. The apparent gravity force is reduced by the earth's gravimagnetic Lorentz force for the typical satellite which travels west-to-east. The orbital speed required for a given altitude r, $V = (G\ m_{earth} / r)^{1/2}$, is thus decreased by the earth's gravimagnetic field.

For the same altitude satellites (r fixed), the west-to-east satellite will move slower than the east-to-west satellite, because its apparent value of G m is decreased. This implies that for circular orbits, for the same speed satellites (V fixed), the earth orbit radius will be lower for a west-to-east satellite than for an east-to-west satellite.

Space tethers oriented radially in space above the equator will experience seemingly inexplicable stretching tidal forces, while those oriented east-west (or at least having a zero velocity cross product with earth's gravimagnetic field) will experience none.

Directly above the poles in polar orbit things are different. Space tethers experience a smaller tidal force when oriented vertically (radially), due principally to the vertical gravimagnetic field, than when oriented horizontally and thus broadside to the vertically directed gravimagnetic flux.

At the North Pole, the satellite is diverted to the left by the effect of the Earth's gravimagnetic field, as viewed feet down, i.e. in the direction of the earth's spin. At the South Pole it is diverted to the right, the opposite direction, by effects of the earth's gravimagnetic field. Between the poles the orientation of forces gradually shifts. This effect is similar to frame dragging.

It is noteworthy that the gravimagnetic field of any body may be influenced by its magnetic field. The spin of particles carries a gravimagnetic moment in addition to a magnetic moment, so statistical alignment of such particles in a magnetic field

will generate a corresponding gravimagnetic field. Magnetic pole changes of the sun and earth thus may affect the orbital mechanics of the earth-sun system.

OVERVIEW OF THE EM-GK ISOMORPHISM

An isomorphism between gravity and electromagnetism has been described here. In this theory of gravimagnetism the graviton is defined as the analog of the virtual photon. The graviphoton is defined as the analog of the photon. Gravitational mass charge, the analog of positive and negative Coulombic charge, is defined as positive when it is a positive imaginary quantity, and negative when it is a negative imaginary quantity. Imaginary here means a quantity containing the imaginary number i, the square root of minus one. A gravitational field g or gravimagnetic field K are imaginary analogs to the electromagnetic fields E and B.

An electrostatic attraction occurs when a virtual photon is exchanged between a positive and negative electrostatic charge. An electrostatic repulsion occurs when a virtual photon is exchanged between like electrostatic charges. Due to the effect of the i coefficient in gravitational fields, a gravitational repulsion occurs when a graviton is exchanged between a positive and negative mass charge. A gravitational attraction occurs when a graviton is exchanged between like mass charges.

By the fully defined isomorphism, every conceivable electromagnetic quantity, relationship, and law has a precisely defined gravimagnetic equivalent.

Table 4, Summary of Estimated Values, summarizes some readily derived estimates of various gravimagnetic values of importance right here on earth. Some values may be way off due to the fact particle spin produces a gravimagnetic field, thus magnetic bodies like the sun and earth will carry extra gravimagnetism.

Gravimagnetic Planck's Constant	$h_g = - h = -6.626\ 0693 \times 10^{-34}$ J s
Gravicurrent of earth	$i_{g\_earth} = 6.927 \times 10^{19}$ i kg/s
Gravimagnetic dipole moment of earth	$\mu_{g\_earth} = 6.90 \times 10^{32}$ i kg m^2/s
Gravimagnetic field ($K=B_g$) in Center of Earth due to its own rotation	$K_{g\_earth} = 1.815 \times 10^{-13}$ (i Hz)
Gravimagnetic Field Intensity (H_g) in Center of Earth due to its own rotation	$H_{g\_earth} = 1.945 \times 10^{13}$ i kg/(m s)
Lateral acceleration due to moving at orbital speed through earth's gravimagnetic field in a normal (perpendicular) direction	$a_{earth} = 1.49 \times 10^{-10}$ g
Gravimagnetic field from sun at Earth[10]	$K_{sun} = 9.526 \times 10^{-23}$ (i Hz)
Gravimagnetic field at earth from lunar rotation	$K_{moon} = 1.778 \times 10^{-30}$ (i Hz)
Gravimagnetic field at earth from lunar orbiting	$K_{orbit} = 3.78 \times 10^{-19}$ (i Hz)

Table 4 - Summary of Estimated Values

SOME IMMEDIATE IMPLICATIONS OF GRAVIMAGNETISM

The theory of gravimagnetism leads to many fully quantified and verifiable implications, some of which differ from those of general relativity. For example:

1. Gravity diminishes with distance due to propagation delays. A particle 14 billion light years from the origin of the big bang is 28 billion years behind in its graviphoton transactions with a particle 14 billion years on the other side of the big bang origin. Gravitons still in progress have not effected their force.

2. Gravimagnetic fields can cause errors in estimation of distant mass values.

3. Virtual paticles carry no gravitational mass charge. Virtual photons carry no gravitational mass charge, thus black holes can exhibit electromagnetic effects beyond and through the event horizon.

4. The missing mass density of the ZPF is explained.

5. A black hole above a very small threshold mass creates from vacuum fluctuations and then emits matter carrying gravitational mass charge of a type opposed to the mass charge of that black hole. The black hole retains mass charge of like kind and thus builds its own mass from the vacuum.

6. Parts of space, especially near super massive black holes, are filled with mass containing negative mass charge. This matter accounts in part for dark energy[11] and large apparent voids in space. Some cosmic rays consist of this matter.

7. Newton's f = m a contains no imaginary portions, thus inertia is primarily an electromagnetic effect.

8. The gravimagnetic analog to Planck's constant, $h_g = -h$, to some extent, unifies gravity and electromagnetism, and determines the momentum carried by graviphotons, etc. However, gravimagnetic theory also permanently ***dis-unifies*** gravity and electromagnetism in the sense that the forces exist in differing dimensions and have differing charges and charge carriers.

9. A gravitational zero point field (graviZPF) exists, an analog to the EM ZPF. A gravimagnetic Casimir force therefore exists.

10. Because virtual photons carry no gravitational mass charge, black holes can have magnetic fields. Such magnetic fields, along with the gravimagnetic field, forms matter emitted from high spin black holes into jets.

FIELD PANCAKING

It is well known[12] that special relativity predicts changes in the observed electromagnetic field of a charged particle due to the flattening of the field in the direction of motion. This flattening is due to application of the Lorentz contraction due to relative motion. This relativistic effect of flattening the apparent field is called the "pancaking" of the Coulombic field. Shadowitz provides the equation for relativistic (Coulombic) field pancaking as:

$$E = Q/(4 \pi e_0 r^2) \ (1 - (v^2/c^2))/(1 - (v^2/c^2) \sin^2 \theta)^{3/2}$$

Where v is speed and θ is the angle of the observer to the direction of particle travel.

If we let $\beta = v^2/c^2$ then we can interpret apparent charge Q' to be:

$$Q' = Q\,(1 - \beta)/(1 - \beta \sin^2 \theta)^{3/2}$$

which can be interpreted to mean apparent charge is reduced to observers in line (forward or back) with the charge's velocity vector and increased as the observing angle is increased toward the side.

Note - it is not standard physics to interpret pancaking as a change in apparent charge (standard relativity assumes charge is invariant with velocity) but rather a change in observed field strength, but we are able to interpret the pancaking equation for Q' either way.

By the isomorphism, field pancaking applies to gravitational fields as well, so we have:

$$\beta_g = v^2/c_g^{\,2}$$

$$Q_g' = Q_g\,(1 - \beta_g)/(1 - \beta_g \sin^2 \theta)^{3/2}$$

This effect then, in part accounts for dark energy. Due to the increased observed departing velocity of bodies with distance, the source of the Hubble red shift, there is also a corresponding reduction in gravitational field strength, due to the tendency for θ to be statistically close to a departing angle, i.e. $\sin^2 \theta = 0$. Note that even at high angles, e.g. $\sin^2 \theta = 0.99$, as light speed is approached, apparent gravitational mass charge disappears:

limit as β_g ---> 1, $\quad (1 - \beta_g)/(1 - 0.99\,\beta_g)^{3/2}$ ---> 0

DARK ENERGY

Gravity must necessarily be reduced by the effects of propagation delay, field pancaking, and graviton absorption by intermediary matter. These effects, however, are small compared to the effects of matter having negative mass charge, charge having negative imaginary value.

Through symmetry, gravimagnetics mandates the existence of such matter. Black holes above a critical mass must necessarily, spew forth mass manufactured from the vacuum having a gravitational mass charge opposed to that of the mass of such a gushing black hole. In the case of high angular momentum black holes or highly magnetic black holes, such an outward flow of matter will be channeled into polar jets.[13] The existence of such jets at the cores of massive galaxies provides evidence for the existence of this phenomenon, as does the spherical distribution of the dark mass halo about galaxies, as will be seen shortly.

The existence of negative mass charge necessitates the existence of both a repulsive gravitational force and matter containing negative gravitational mass charge . This matter has negative weight here on earth. Such matter will here simply be called *cosmic matter*, because the word cosmic is short, and recognizes the natural source of such matter.

Cosmic matter is born of black holes when the gravitational field is sufficient to separate particles of differing mass charge. We might expect both mass charge and Coulomb charge to be conserved by this process. Therefore, it might be expected a gravitationally separated light lepton pair must consist of either (1) a positron with negative gravitational mass and an electron with positive gravitational mass, or (2) a positron with positive gravitational mass and an electron with negative gravitational mass. We will see below that this is not correct.

THE GALAXY ROTATION PROBLEM

The Modified Newtonian Dynamics (MOND) theory is contrived to explain the galaxy rotation problem.[14] It shows that the problem is solved if gravitational acceleration $a_{grav}(r)$ obeys the law:

$$a_{grav}(r) = (a_0 G M)^{(1/2)} / r$$

where $a_0 = 1.2 \times 10^{-10}$ m/s^2. Suppose we want to preserve the inverse square gravitational law by assuming there is a distribution of mass about a galaxy that mimics the MOND formulation for local accelerations. We assume there is a large central mass M surrounded by a distribution of mass m(r). We then have:

$$(a_0 G M)^{(1/2)} / r = G M/r^2 + G m(r)/r^2$$

which yields a mass distribution m(r):

$$m(r) = k_1 r - k_2$$

for positive k_1 and k_2. This gives a mass density ρ(r) of the form:

$$\rho(r) = m(r)/v(r) = m(r)/(4/3\ \pi\ r^3) = 3k_1/(4\pi\ r^2) - 3k_2/(4\pi\ r^3)$$

Note the requirement that one component of the mass produce negative gravity. This mass density distribution problem is readily solved by positive gravitational mass charge matter in an approximately $1/r^2$ density planar configuration, and cosmic dark matter in a $1/r^3$ spherical configuration. Cosmic matter manufactured in the galactic plane, having negative gravitational mass charge, will leave the galactic plane to form a spherical halo. This $1/r^2$ distribution of positive matter and $1/r^3$ distribution of the cosmic matter halo solves the galaxy rotation problem as well as explaining the source and shape of the mass halo. The source of the spherical halo is principally the center of the galaxy.

REVERSE GRAVITATIONAL LENSING

Cosmic matter is not necessarily antimatter as it can be either matter or antimatter. In fact, again by symmetry, and conservation, a cosmic gamma, a gamma originating from cosmic matter and thus carrying negative gravitational mass charge, must decay into a cosmic electron and cosmic positron, or at least cosmic matter plus cosmic antimatter. All that distinguishes cosmic matter, as defined thus far, is that it gravitationally repels normal matter and attracts itself. However, we shall see the evidence overwhelmingly indicates that *cosmic matter and mirror matter are one and the same.*

Cosmic matter attracts itself, so in a locality consisting entirely of cosmic matter nothing appears different from our locality, at least to cosmic matter beings. Its spectra are normal, though photons emitted by such matter, *cosmic photons*, also carry negative mass charge, so exhibit *reverse gravitational lensing* in the presence of normal matter black holes. Similarly, ordinary light experiences reverse gravitational lensing near large cosmic matter masses.

Ordinary gravitational lensing, the bending of light around massive objects to create

Einstein rings, is a well known effect.[15] [16] Reverse gravitational lensing can similarly cause rings or crescents of light near a massive black hole, and centered on the black hole. A reverse gravitational lens (RGL) acts in some respects similar to a reflective glass ball. A large object, like a galaxy, behind an RGL, is distorted into a ring or partial ring around the RGL with an appearance similar to the Einstein ring produced by ordinary gravitational lensing. Because the mass forming the RGL repels the light, the view of the image immediately behind is highly darkened, thinned or obliterated in the vicinity of the center of the RGL. Light from the periphery is condensed into a brighter ring around the RGL center. Multiple paths from any light source located on the same radius to the rear and slightly to the side of the RGL simultaneously meat the eye, thus the bright ring from any large area light source. Detailed Hubble photos of at least eight Einstein rings are available.[17] Without knowing something about the background image being distorted, it can be difficult to tell if ordinary or reverse gravitational lensing is occurring, especially if the observer doesn't know the two possibilities exists. If an ordinary light source is clearly visible and to one side of the lens then an RGL is distinguished by the fact the reflection is on the same side as the light source, while the ordinary lens produces a bright spot on the side opposed to the source. A lens forming structure may consist of multiple black holes, so the lens may not be spherical and thus the reflection distorted.

MIRROR MATTER AND COSMIC MATTER ONE AND THE SAME

Physical evidence, like the invisibility of the Milky Way mass halo, makes it necessary that mirror matter and cosmic matter are one and the same. If they were not one and the same, then cosmic normal matter and cosmic mirror matter would be created in equal amounts from the vacuum by the black holes of our galaxy. This doesn't happen. Our mass halo consists of invisble matter. Therefore, all cosmic matter is invisible because it is *all mirror matter*. We interact only through gravity with mirror matter, except for a very weak EM force interaction, specifically a photon-mirror photon interaction equivalent to the interaction of charged particles with 5×10^{-9} the charge of an electron.[18] This accounts nicely then for the fact the spherical mass halo about visible galaxies, including ours, is invisible. It also means that RGLs should look like a bright spherical mass of matter with jets of high energy material spewing forth from its center. We can not see the cosmic-mirror matter galaxy from which the ordinary matter emanates. Its mirror matter black holes spew forth ordinary matter. A mirror matter galaxy with a real matter spherical halo would actually appear to us to be an elliptical galaxy, like M87.

Further, photon reflections are obscured by normal mass emissions of mirror galaxies.

Cosmic matter being mirror matter also explains why cosmic matter is so difficult to find on earth, even though our galaxy, the Milky Way, is surrounded by a sphere of mirror matter. It is invisible, and it blends with ordinary matter via a very weak EM interaction.

AN INTERACTION DEDUCED BY SYMMETRY

Table 5 - Selected Particle Interactions, summarizes the primary types of electromagnetic or gravitational force exchanges that occur between various types of particles, including various forms of cosmic matter.

Particle--->	Graviton	Gravi-photon	Virtual Photon	Photon	Cosmic Photon	Lepton	Hadron	Cosmic Lepton	Cosmic Hadron
Particle:									
Graviton	intf	null	null	g	-g	y,g	y,g	y,-g	y,-g
Graviphoton	null	intf	E	null	null	p	p	p	p
Virtual Photon	null	E	intf	null	null	z,E	z,E	z,E	z,E
Photon	g	null	null	intf	*	o	o	o	o
Cosmic Photon	-g	null	null	*	intf	o	o	o	o
Lepton	y,g	p	z,E	o	o	g,E	g,E	-g	-g
Hadron	y,g	p	z,E	o	o	g,E	g,E	-g	-g
Cosmic Lepton	y,-g	p	z,E	o	o	-g	-g	g,mE	g,mE
Cosmic Hadron	y,-g	p	z,E	o	o	-g	-g	g,mE	g,mE

Key:
g - ordinary (attracting) gravitational
-g - anti-gravitational
E - electromagnetic (+ or - depending on charges)
mE - mirror electromagnetic (+ or - depending on charges)
* - Weak EM with effective electric charge about 5×10^{-9} q
o - oscillating EM, momentum
p - oscillating GK, momentum
z - zero point EM
y - zero point GK
intf - superpositioning quantum waveforms interfere

Note: only largest interaction types specified

Table 5 - Selected Particle Interactions

Table 6 - the Particle Charge Table, summarizes the primary EM and GK interactions of selected particle types.

	Carried Charge		Carried
	EM	GK	Force
Particle:			
Graviton	null	null	GK
Virtual Photon	null	null	EM
Graviphoton	w	null	
Photon	null	g	
Lepton	E	g	
Hadron	E	g	
Cosmic photon	null	-g	
Cosmic Lepton	mE	-g	
Cosmic Hadron	mE	-g	

Key:
g - ordinary (attracting) gravitational mass charge, positive imaginary value
-g - anti-gravitational, negative imaginary value
E - electromagnetic (+ or - depending on Coulomb charge +-q)
mE - mirror electromagnetic (+ or - depending on Coulomb charge +-q)
w - weak electromagnetic charge, about 5x10^-9 charge of electron
(apparent + or - depending on spin)

Table 6 - Particle Charge Table

Tables 5 and 6 contain an interesting symmetry. The photon carries a gravitational mass charge, but no Coulomb charge. By symmetry, then, the graviphoton carries a very small Coulomb charge, but no gravimagnetic charge. Graviphotons can be deflected, even focused, by a powerful electromagnetic field.

DARK MATTER AND MIRROR MATTER

Mirror matter has *only* gravitational mass charge[19] [20] to us in a normal matter world. Mirror photons, both virtual and real, have little effect on us. If mirror matter existed in both normal and cosmic form, then symmetry would demand that mirror matter exist in both positive and negative mass charge species. In that case, a black hole consisting of either mirror matter or normal matter, or a mixture of both types, when of sufficient size, would simultaneously spew forth *both* normal and mirror matter of the opposed gravitational mass charge, and in equal proportions. There is no evidence this happens, and much evidence to the contrary. The enormous spherical mass halos of galaxies are not made of visible matter.

So then, we are left with the problem of where large amounts of *dark* gravitational matter come from. First, it has already been shown the galaxy rotation problem is solved by negative gravitational mass charge matter, not positive gravitational mass charge dark matter, thus eliminating part of that problem. We will now see that black holes, both small ones generated by high energy large mass particle collisions, and massive ones, can account for a much larger dark matter mass than can be expected cosmologically.

Ordinary matter is created in particle-antiparticle pairs. This then is necessarily true of mirror matter pairs as well. Physicists in a mirror galaxy see particle-anti-particle pairs created from the vacuum. What physicists in neither ordinary nor mirror galaxies see is single charged particles created from the vacuum with an invisible partner. This means that mirror matter created in ordinary black holes is necessarily created in particle-antiparticle pairs. The gradient of the black hole gravitational field must therefore be large enough to tangentially separate charged pairs, thus a black hole must be of a very large size to emit much mirror matter. However, such a large gradient is not required to emit the annihilation photons which also have negative mass.

The vicinity near a sigularity is comprised of a quark and lepton soup. CP violation establishes the species that survives the quark soup to emerge from the event horizon of a black hole - matter from negative mass charge black holes, cosmic anti-matter from ordinary black holes. The imaginary charge of cosmic matter in some sense restores the symmetry lacking in the CKM matrix which includes only ordinary matter.

Statistically, we can expect that all that mirror matter generated from the vacuum by a black hole is matched, in terms of gravitational mass, by ordinary matter, or at least matched by the positive mass-energy that is added to normal matter black hole mass, i.e. to its singularity. Further, when a matter-antimatter pair is created from the vacuum there is reason to expect, for reasons of conservation of charge, that simultaneously there is created a mirror matter-mirror antimatter pair. Call such a foursome a *dual pair*. The pair having gravitational mass charge opposed to that of the black hole is expelled, the other pair is absorbed. Even given that pairs lose all their Coulomb charge identity in a singularity, or by annihilation, they retain mass charge, thus black holes will generate through time a much larger aggregate gravitational mass than could otherwise cosmologically be expected. Even very small black holes, created by high energy particle interactions, have a newly found ability to survive and grow despite their small size. A never ending exponential

expansion of black hole mass does not seem consistent with observations, yet an unbounded growth is a logical necessity. Only the limit of the ability of the vacuum to produce dual pairs limits the growth rate of black holes.

Note that *any* sized black hole with mass occupying a *point* has, for some finite radius, a volume in which the field strength is sufficient for pair creation to take place. As the mass of a black hole increases, the radius of this mass spawning sphere increases. For this reason, essentially *every* black hole spawns mass from the vacuum, and thus simultaneously builds its own mass.

NEGATIVE ENERGY AND OTHER ISSUES

Cosmic matter, reverse gravitational lensing, and negative energy are all concepts previously anticipated in various forms. Cosmic matter is anticipated by the "exotic" or "negative energy" matter discussed by Davis and Puthoff.[21] The possibility of negative energy virtual photons also relates to their work, which includes various suggested means of generating negative energy. They further anticipate "negative vacuum energy densities, which arise from *distortion of the electromagnetic zero point fluctuations* due to the interaction with a prescribed gravitational background, for providing a violation of the energy conditions." This is the kind of effect necessary for black holes to generate opposed gravitationally charged matter. Yet, interestingly, the work of Davis and Puthoff is based on general relativity theory, not graviton exchange.

There is a seeming problem with gravimagnetic theory at this point regarding the conservation of gravitational mass charge. Matter-antimatter pairs created from the vacuum carry the same mass charge. Mass charge thus appears to not be conserved. There is a convenient and highly unanticipated resolution to this problem. When a matter-antimatter pair is created from the vacuum there is always simultaneously created a mirror matter-mirror antimatter pair. Here such a foursome is called a *dual pair*. Further, having negative mass charge, the mirror matter-mirror antimatter pair represents negative energy. Thus is provided a significant new interpretation of the Dirac equation negative energy. Further, the net energy created from the vacuum dual pair formation is then exactly zero. Following dual pair creation, matter-anti-matter pairs can annihilate, but in so doing they create photons having a corresponding mass charge, thus the cosmic and ordinary mass-energies of the universe remain in balance.

UNDERLYING IMPLICATIONS

The isomorphism as defined here has utility in its own right. It has utility in putting solutions forward to the dark energy problem, galaxy rotation problem, and the Pioneer anomaly[22] , for example. It provides a simplistic but utilitarian overview of matter, though it also gives clues as to the underlying structure.

Gravitational mass charge, as defined by the isomorphism, is an *aspect* of a particle, something bound to the particle's location and other qualities, not a fermion in its own right. It can simply be viewed as a quality of a string or particle that interfaces with the imaginary universe. The imaginary universe is a quality of the vacuum characterized by ε_{0_g} and μ_{0_g}, which are the gravitational analogs to ε_0 and μ_0. The fact that c and c_g can differ in any particular volume of space, due to extreme field effects, i.e. a change in the index of refraction, accounts for the apparent space warping and time warping effects of GR.

In many circumstances, many applications, due to the small gravitational constant, it is adequate to treat gravitational quantities completely independently for computational purposes, and then consolidate with Coulomb force results if that is even necessary to the purpose. The exact same Coulomb based equations can be independently applied to the gravitational portion of the computation in order to derive the gravitational forces, energies, waveforms, etc. The gravitational formulations are completely independent of the electromagnetic formulations. They are isomorphic, so the same equations are used, though using the isomorphism substitutions as defined. The *results*, however, are not similar in handedness or magnitude, because, though the equations are all formally identical, there are imaginary values coming into play, and h_g = - h, G is used instead of the Coulomb constant, etc. Because the mass charge and EM charge are bound together, the forces can be summed to characterize a fermion, or to characterize a boson-fermion interaction as a whole.

When full relativistic effects are involved, or a correct formalism is required, then it is necessary to dispense with MLTQ units in favor of the full definition over the field of complex numbers, LT(a QM + b Q_g), where the value of real a and b are determined by particle type(s) involved, and Q and the imaginary Q_g are units of Coulomb and mass charge, M is inertial mass. This in effect provides a fully unified field theory, as unified as possible at this point that is.

Gravimagnetism

Horace Heffner July, 2007

The Dirac equation, the Dirac Hamiltonians for field interaction, etc., the Rarita-Schwinger equation used for spin 3/2 fermions, etc. , must be defined over the full imaginary field, not just real numbers with units.

It is noteworthy that the technique of normalization of units, commonly used in relativity, can not necessarily be used when applying gravimagnetic theory as unified over the imaginary field. It is not necessarily true that $c = c_g$, so it is not possible to set both $c = 1$ and $c_g = 1$. Q and Q_g exist in differing proportions in differing particles, and one of the values is imaginary.

Photons, or bosons in general, are bound entities, having both an electromagnetic portion and a gravimagnetic portion. Photons have an electromagnetic potion and corresponding gravimagnetic charge. Graviphotons have a gravimagnetic portion and corresponding Coulomb charge. Virtual photons don't have a gravimagnetic portion and gravitons don't have an electromagnetic portion. Virtual particles do not have a gravitational mass charge. This then provides a description of gravity consistent with both Newton and special relativity. But is there more? Yes.

An interesting outcome of all this is that strong fields can change the apparent qualities of the vacuum. From the expected effect on the path of a photon in a gravitational field, Jefimenko provides[23] a description of the field interrelationship:

$$\varepsilon \mu \sim\sim 1 - (\varphi_g)/c^2$$

where φ_g is the potential function

$$\varphi_g = g\, ds$$

If the apparent $\varepsilon \mu$ changes then the speed of light

$$c_{new} = (\varepsilon \mu)^{(-1/2)}$$

changes as well, as does the refractive index of the vacuum:

$$n = c / c_{new}$$

It is interesting that the dual is true also. There is implied the existence of general relativistic (GR) effects (though they are not gravitational effects) on graviphotons due to powerful EM fields, because

$\varepsilon_g * \mu_g \sim\sim 1 - (\varphi)/c^2$

where φ is the potential function

$\varphi = E\, ds$

The independent treatment of the gravitational and electromagnetic fermion portions, using the appropriate gravitational or electromagnetic description portion of the boson messenger particle, produces the bending of light in accord with Jefimenko's derivation. Therefore, the independent Dirac treatment of the imaginary qualities of fermions and bosons, combined with an EM Dirac treatment, produces GR effects. There is no difference in effect between changing the velocities c and c_g and the bending of space, i.e. changing the apparent distances between objects.

BLACK HOLES RADIATE

Black holes consisting of mirror matter create dual pairs, as described above, and absorb the negative gravitational energy of the mirror pair. The ordinary matter pair is then ejected in one form or another, either as a matter pair, or as a pair of ordinary photons. Analogous effects occur from ordinary black holes. The smaller the black hole, the greater the proportion of energy ejected that is in the form of annihilation photons. Most of the mass-energy ejected is in the form of photons due to the high probability of (like gravitationally charged) pair annihilation. These gravitationally emitted photons will have energy levels that indicate the positive gravitational potential of the radius at which they were formed. Further, the radiant mass-energy of a mirror black hole which is not feeding on other bodies provides a direct indicator of the rate of mass increase of that black hole due to dual pair creation, because the two mass-energy flow rates are equal. This radiant energy is *not* Hawking radiation. Its origin is not the event horizon, but rather the interior of the black hole, and its spectrum provides information about conditions inside the black hole, including its mass and the dual pair formation flux at various radii r. Negative gravitational matter is utterly unaffected by an ordinary matter event horizon. Dual pair initiated radiation is comparatively invisible when coming from an ordinary matter black hole because that radiation is mostly mirror radiation. Some coupling of mirror and ordinary photons occurs on the order of 5×10^{-9} times the charge of an electron, so visible halo type effects on local light can be seen

from this.

TEST OF GRAVIMAGNETISM VS GR

Virtual photons can not carry gravimagnetic charge. Therefore, electric fields, i.e. near field effects, are readily transmitted from a black hole, and readily transmitted two ways across the event horizon. This means that black holes can exhibit Coulombic charge. This is not of any practical consequence except maybe when the size of the black hole is very small. Massive black holes will quickly neutralize any large net charge by creation of charge from the vacuum or by attraction of charged particles from space. What is really important here about the virtual photon's lack of gravitational mass charge is that black holes can exhibit very large magnetic fields even not in the presence of an accretion disk. This would be utterly impossible if either (a) GR effects are due to space warping or (2) virtual photons carried gravitational mass. This, then, provides a means of comparing gravimagnetic theory to that of GR. It should be possible, through spectral analysis, to see if polar jets from and near black holes are in a strong magnetic field, one too strong to be accounted for using accretion mass. Such a test should thus be made using a black hole with minimal accretion. It is notable that no polar jets should be present at all (under GR) if there is no accretion disk. The presence of polar jets without an accretion disk also eliminates GR as a viable theory, because there is no feasible source for the polar jet matter. Such an observation would exclude a GR explanation.

META-MATTER

Mirror photon and real photons very weak interact. Therefor real matter and should be expected to be capable of weakly bonding to ordinary matter, possibly magnetically, and vice versa. Call this bonded state *meta-matter*. If this happens, then accelerations of a meta-matter particle will produce simultaneously real photons and mirror photons. Real matter near a real black hole, being bathed in mirror photons, and some mirror particles, is thus slightly visible to the mirror world. Similarly, mirror matter near mirror black holes, being bathed in real photons, and some real particles, is thus faintly visible to the real world. Even without permanent bonding, a slight interaction of real matter or photons in the plasma of a mirror matter star should make it faintly visible in the mirror world if it is nearby a real matter radiating black hole.

BARRED SPIRAL GALAXIES

The galaxies[24] [25] in Figures 1 and 2 could be interpreted to consist of matter condensed from jets from a point source not having an accretion disc.

These galaxies match the profile expected from the jets of a great spinning mirror matter black hole or black holes, possibly in the core of an invisible mirror matter galaxy. Galaxies of this two lobe spiral shape are classified as barred spiral galaxies. About fifty percent of all galaxies are of this type.[26] The source of the bar is suggested here to be the result of polar jets of matter from a spinning mirror matter black hole. The jets subside as the black hole's spin diminishes. The stars formed from the jet coalesce into a bar and migrate into spiral arms, eventually to form a ring about the galactic center.

As viewed from the gravimagnetic north pole of a back hole, material within the equatorial plane which is falling inward directly toward the black hole will be acted upon by a gravitational Lorentz force to curve it into a clockwise rotating spiral, opposite to the direction of rotation of the black hole, assuming it is made of the same kind of matter. This will eventually diminish the black hole's angular momentum when the material enters the hole. Equatorial material moving in an outward direction is also forced into a clockwise rotation spiral, but as galaxies are classified, that spiral looks counterclockwise and is called counterclockwise, and if the matter is being repelled from a mirror matter black hole, then it rotates in the same direction as the mirror matter.

Material in a clockwise orbit, as seen from the north pole, experiences an outward Lorentz force, which reduces the apparent gravitational force and thus increases the orbital period for its orbital radius. This makes the mass of the black hole look smaller than it is. Similarly, material rotating in a counter clockwise direction as viewed from the north pole experiences an increase in apparent gravitational force, resulting in a reduced orbital period for its orbital radius. Black holes under the gravimagnetic influence of other black holes will precess if their gravimagnetic fields are not aligned. This precession can cause their polar gravimagnetic fields to align with and perturb the curvature of the galactic arms giving them a three dimensional curl.

MIRROR MATTER VIEWING

The EM power radiated by a charge q in oscillating motion over distance x with frequency w is given by:

$$Pe = q^2 w^4 x^2 / (12 \text{ Pi } e_0 c^3)$$

By the gravimagnetic isomorphism, the power radiated by mass charge (i m) in oscillating motion over distance x with frequency w is given by:

$$Pe = (i\ m)^2 w^4 x^2 / (12 \text{ Pi } e_{0_g} c^3)$$

where

$$\varepsilon_{0_g} = 1/(4\ \pi G)$$

We thus can see the ratio of powers is given by:

$$Pg/Pe = -4\ \pi\ G\ m^2\ \varepsilon_0 / q^2$$

which, for the electron is:

$$-2.400 \text{x} 10^{-43}$$

and the proton is:

$$-8.091 \text{x} 10^{-37}$$

It appears graviphoton emission is a highly unlikely event. Further, given that photon radiation is about 10^{36} times more powerful than gravimagnetic radiation from a proton acceleration, and photon rockets merely gain E/c inertia per photon, graviphoton propulsion appears to be difficult to achieve.

Graviphoton telescopes, on the other hand, appear to be a possibility, if viewing powerful x-ray sources. This would appear at first to be useless. However, it may be useful because it permits the observation of sources of mirror x-rays as well, and thus opens the astronomical world to direct mirror matter observation, and viewing

of otherwise invisible black holes.

COSMOLOGICAL CONSEQUENCES

The existence of cosmic matter has profound cosmological consequences. Ordinary black holes spew forth quantities of negative mass mirror matter, while gaining an equal quantity of mass themselves. Such matter repels out a local space for itself , forms stars, and eventually cosmic matter black holes. Cosmic matter black holes then repeat the process in reverse. The continual generation of pockets of repelling matter guarantees the continual expansion of the universe. Overall, the universe must expand indefinitely, yet in localized zones consists primarily of mature bodies all of one gravitational mass charge type or another. Local bodies have a local mutual attraction, while negative gravitational mass gas leaves galactic planes to initially float in spherical halos above galactic planes, eventually to escape and form new galaxies, or through local attractions and gravimagnetic fields, to form a ring around the galaxy of origin. A phoenix effect takes place through generations of alternating black hole types.

Figure 3 provides a possible example of a fairly aged galaxy[27] having normal matter black holes which produce mirror matter. The effects of the mirror matter are (1) the repulsion of the inner portions of the galatic arms into a ring, and (2) the repulsion of some ordinary matter to the periphery of the spherical shaped mass of mirror matter which surrounds the galaxy, thus making the spherical shell visible.

SUMMARY

A gravimagnetic isomorphism, a correspondence between the formal descriptions of electromagnetism and gravity, has been defined. Many consequences are logically, quantitatively and very specifically implied. The most important implication is the necessity of ordinary matter black holes generating negative gravitational matter from the vacuum while increasing mass at the same time. This negative gravitational matter, being mirror matter, forms mass halos about galaxies like the Milky Way, thus accounting for the galaxy rotation problem as well as dark energy.

Much work remains in adjusting, validating, expanding, and hopefully making practical use of this gravimagnetic isomorphism. Gravimagnetics as portrayed here may or may not provide an accurate description of reality. It does provide a large

number of quantitative predictions for comparison to other theories, as well as the possibility of extension or adaption of the isomorphism to various EM theories in order to describe gravity.

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FIGURES

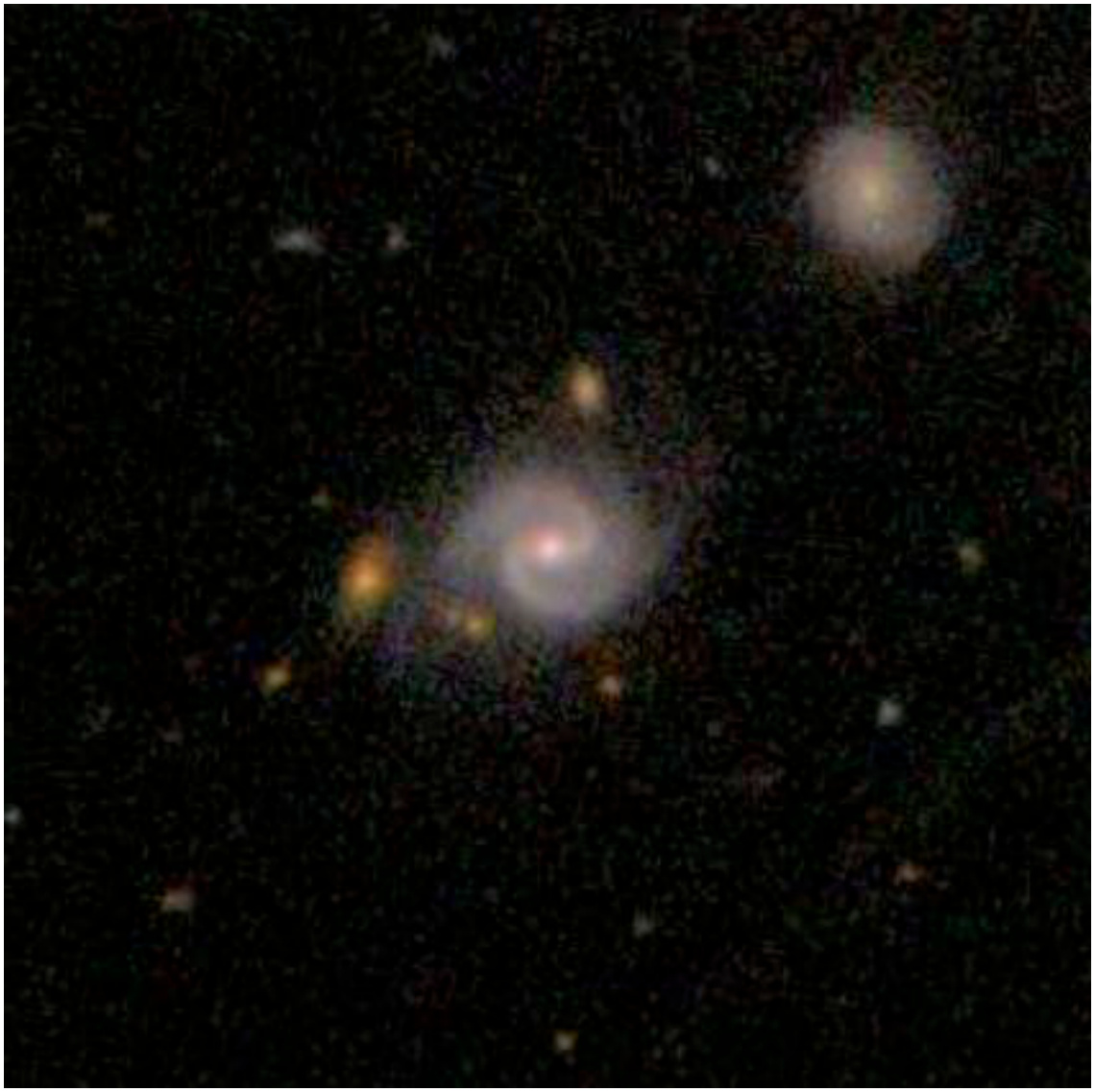

Figure 1 - Galaxy 587731868022800502

Figure 2 - Galaxy 587733195161272422

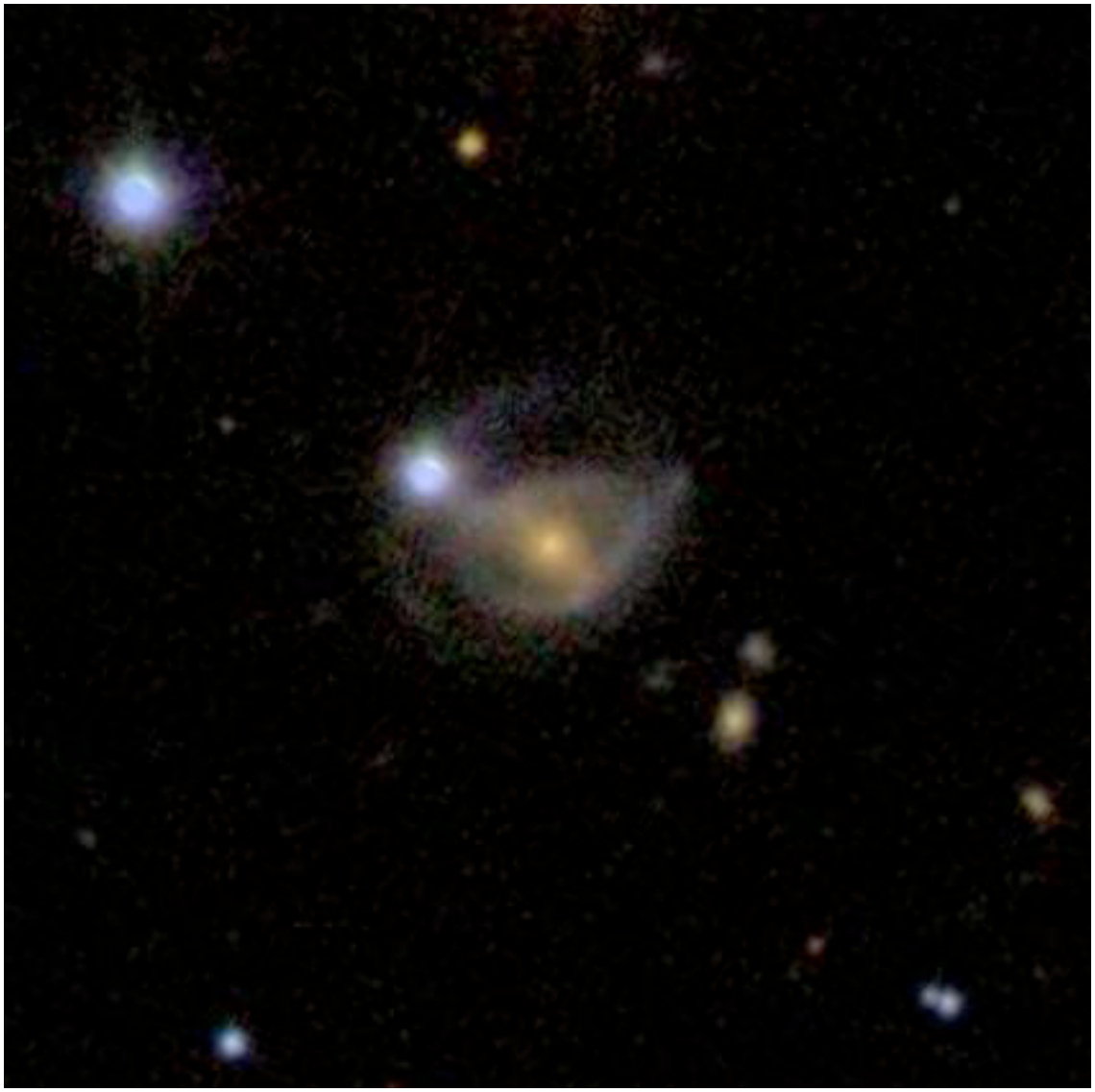

Figure 3 - Galaxy 587742782068817961

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