Gravitational Pair Creation

Horace Heffner November, 2009

BACKGROUND

The concepts of gravimagnetism were defined and explored in:

http://www.mtaonline.net/~hheffner/Gravimagnetism.pdf
http://www.mtaonline.net/~hheffner/CosmicSearch.pdf
http://mtaonline.net/~hheffner/PioneerAnom.pdf

The theory of gravimagnetics includes the specification that all gravitational fields and gravitational mass are purely imaginary, i.e. carry a factor of i = (-1)^(1/2). Particles can carry either ordinary gravitational charge, with a factor of +i, or negative gravitational charge -i. Gravitational repulsion occurs between particles having gravitational charge of opposed signs.

The gravimagnetic theory also encompasses the possibility of the existence of mirror matter, i.e. matter for which the left-handedness of electromagnetic laws is replaced with right-handedness. Such matter couples with ordinary matter only by gravitation, and a very weak electromagnetic coupling on the order of 5x10^-9 that of the Coulomb force.

Because mass with negative gravitational charge is proposed to exist, it is a necessary consequence that the extreme gravitational field intensity within a black hole can create from vacuum fluctuation energy pairs having opposed mass charge, retaining the particle of same gravitational charge type, and forcibly ejecting the particle of unlike type.

For example, if a black hole made of ordinary matter, having mass charge +i*M, and a pair of particles having mass -i * m and +*m, both created from the vacuum near the black hole, the force F between the -i * m charge and the black hole +i*M charge at separation r is given by:

F = G*(-i*m) (+iM)/r^2 = G* -(i)^2 m * M/r^2 = G*m*M/r^2

Since the sign of the force is positive, it is repulsive, and provided the field gradient is sufficient at radius r, the pair partner with mass -i*m is absorbed into the black hole singularity, and the remaining particle immediately has the enormous potential energy:

$U= G*m*M/r$

and is ejected from the black hole with that energy. Ejecta particles from a black hole thus will have a particle type and kinetic energy spectrum established according to the probability of specific pair creations at a given shell radius, integrated over all shell radii around the singularity. Each mass of black hole thus has a unique spectrum of kinetic energies by particle type. Given that antiparticle pairs recombine on their way out of a black hole, each mass of black hole thus also has a unique spectrum of x-ray energies by particle type.

If it is even assumed the Coulomb force can reach beyond the boundaries of a singularity, i.e. virtual photons can be exchanged between a charge within a singularity, and another charge arbitrarily close to the singularity, and we examine the force balance between the Coulomb force:

$Fc = K q^2 / r$

and gravitational force:

$Fg = G m_e M / r$

we see that the gravitational force matches the Coulomb force at all r when:

$M = K q^2 / (G m_e) = 3.7956x10^{12}$ kg

and given the mass of the sun is 1.9891x10^30 kg, any black hole with mass 1.91x10^-18 the mass of the sun can clearly produce pair separation if one pair member is absorbed by the singularity. If any significantly sized black hole center is a singularity then the volume of space around it within some critical radius R a function of mass will have sufficient field strength and field gradient to accomplish pair separation. As will be seen later, this kind of Coulomb force separating is not even essential, provided particles are created from the vacuum in quartets, where one pair has the opposite gravitational charge from the other pair. Even if Coulomb pair recombination occurs immediately, the resulting negative mass charge photon pair has extreme potential energy, is repelled from the black hole, and high energy x-ray emission occurs from the black hole, the spectrum of which is unique by hole mass.

An electron fully separated at a radius of 1 angstrom from a neutral singularity with the mass of 1000 suns will be ejected with an energy of 7.546x10^18 eV.

The purpose here is, within the scope of the gravimagnetic theory, to examine valid types of charged pair creation from the vacuum, to classify what kinds of particles are retained and what kinds are ejected from a given type of black hole.

PARTICLE CLASSIFICATION

For purposes of this analysis charged particles can be classified using four binary characteristics:

T - Type: Matter or Antimatter (M or A)
C - Charge: positive or negative (+, -)
G - Gravitational charge type, (+i or -i)
H - Handedness: L (normal matter), R (mirror matter)

Neutral particles, some of which can periodically morph handedness and result in weak matter/mirror-matter coupling, will be ignored for the purposes of this analysis.

We can now see each particle type can be identified or classified by a 4-tuple of the form:

(T,C,G,H)

There are thus 16 particle types in this classification scheme.

If a tuple entry is designated T,C,G, or H, then a particle with the opposite characteristic can be designated correspondingly, T', C', G' or H'. A tuple with all characteristics opposite the characteristics of (T,C,G,H) is thus (T',C',G',H').

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ANTIPARTICLE PAIR CREATION CONSTRAINT ON HANDEDNESS

Let us assume charge and gravitational charge must be conserved for any pair creation from the vacuum. Further, since we observe an antiparticle creation for each charged particle creation, and mirror scientists must observe a similar phenomenon, we know that if one species of particle having handedness characteristic H is created, there must simultaneously be created an antiparticle also having characteristic H. This is because we always see pairs created from the vacuum, e.g. an electron with a positron. If handedness were assigned independently, we would not see half of each charged pair created.

We thus have the following possibilities for matter/antimatter pair creation, assuming charged particles can be created from the vacuum in pairs and genesis creation in quartets is not required:

(T,C=f(T),G,H), (T',C=f(T'),G',H)

Here f(T) is a function unique to each charged particle type, which matches charges to correspond with type, e.g. electron (-) with matter, positron (+) with antimatter, proton (+) with matter, antiproton (-) with antimatter, etc. Since the mapping of f always preserves a 1-1 correspondence between choices of T and C, we can therefore eliminate C from our tuple when considering possible classification cases. This leaves the 3-tuple:

(T,G,H)

THE EIGHT PAIR COMBINATIONS

To describe the feasible combinations of characteristics for particle creation. We now can describe valid pair creation as:

(T,G,H), (T',G',H)

This gives 8 possible classifications of pair creation

(M,+i,L), (A,-i,L)

(A,+i,L), (M,-i,L)
(M,-i,L), (A,+i,L) *
(A,-i,L), (M,+i,L) *

(M,+i,R), (A,-i,R)
(A,+i,R), (M,-i,R)
(M,-i,R), (A,+i,R) *
(A,-i,R), (M,+i,R) *

However, we can ignore pair order, so the duplicates, marked with an asterisk above can be eliminated, leaving the following four pair combinations:

(M,+i,L), (A,-i,L)
(A,+i,L), (M,-i,L)

(M,+i,R), (A,-i,R)
(A,+i,R), (M,-i,R)

This leaves all eight feasible possibilities for particle types:

(M,+i,L),
(A,-i,L),
(A,+i,L),
(M,-i,L),
(M,+i,R),
(A,-i,R),
(A,+i,R),
(M,-i,R)

Out of the above, assuming each tuple has equal probability of existence, ordinary matter (M,+i,L) constitutes only 1/8 of the matter in the Universe.

However, suppose this matter is being generated from the vacuum by a black hole that has -i gravitational charge. All the particles having -i gravitational charge will be absorbed into the black hole, increasing its mass. This leaves the following particle types being ejected at high velocity:

(M,+i,L),
(A,+i,L),
(M,+i,R),
(A,+i,R)

If the local universe consisted of one black hole then it would consist of about half the local universe's dark energy, as hidden in the black hole, consisting of the following particle types:

(A,-i,L),
(M,-i,L),
(A,-i,R),
(M,-i,R)

It is of interest here that, if the matter-antimatter pairs above mutually annihilated, the mass charges would remain in the black hole and the black hole would not lose mass.

Of the remaining matter not in the black hole, half is mirror matter, and thus dark matter with with attractive gravitational charge. A quarter is ordinary matter, and a quarter is antimatter. This scenario doesn't answer the question as to why antimatter is not around in a quantity equivalent to mirror matter, so is likely not consistent with an actual genesis of the universe. A more likely scenario is described in a following section

PAIR ANNIHILATION

Particles created by a negative mass black hole, namely (M,+i,L), (A,+i,L), (M,+i,R), and (A,+i,R), are half matter and half antimatter. We can thus expect them to annihilate at a high rate both inside and outside the black hole. We would expect these to be mostly in the form of positrons and electrons, because, being light, they can be created from the vacuum in greater frequency without violating Heisenberg during their initial fluctuation. However, their mass charge and handedness remain after their annihilation, requiring the creation of a properly handed photon from the annihilation. These photons come in equal amounts of left and right handed photons, thus, under this scenario, a black hole of any charge type is somewhat visible in both our right handed and left handed mirror universe. Astronomers in both universes should be able to determine that positrons and electrons are issuing forth from black holes, and should be able to determine that they have negative mass charge, i.e. are not-so-dark dark energy.

When annihilation of a pair with gravitational charge opposite that of the black hole occurs, the photons so created retain that gravitational charge, so continue the process of ejection from the black hole. The black hole is thus a “white hole” to photons of opposed gravitational charge. Such photons can continually recombine to make particles and vice versa throughout the volume of a black hole. In all cases, however, the energetic ejection of the opposed mass charges proceeds.

Note that true radiationless annihilation can only occur under this classification scheme when the following four pair types unite:

(M,+i,L), (A,-i,L)
(A,+i,L), (M,-i,L)
(M,+i,R), (A,-i,R)
(A,+i,R), (M,-i,R)

This kind of radiationless annihilation, genesis in reverse, should be comparatively rare, given that these pair types should be maintained separately in distant parts of the universe by their opposing gravitational charges. This property maintains the existence of the universe.

PROBLEM OF THE MISSING ANTIMATTER

There is an apparent imbalance of matter vs antimatter in the known universe. One solution to this problem of where the antimatter went is to assume antimatter has -i gravitational charge, and the initial genesis process did not come from a black hole, but rather from repellant -i and +i gravitational charges which were created in an essentially uniform manner. This answers both why the big bang was not a black hole, and where all the missing antimatter went - it went to the edge of the universe.

This then leaves only 4 types of matter:

(M,+i,L), ordinary matter
(A,-i,L), ordinary antimatter, dark energy, but isolated gravitationally
(M,+i,R), mirror matter (dark matter with ordinary gravity)
(A,-i,R), mirror antimatter, dark energy, but isolated gravitationally

If each has equal probability, then this leaves the universe as 1/4 ordinary matter, 1/4 dark matter around us, and 1/2 dark energy, the dark energy located mainly remotely, but also flowing from ordinary black holes, especially at the centers of galaxies.

CONSERVATION OF HANDEDNESS

Suppose handedness H must be conserved like the other characteristics, T and G, say to preserve angular momentum. We then have the necessity that, in a genesis transaction with the vacuum, given only the feasible particles (M,+i,L), (A,-i,L), (M,+i,R), and (A,-i,R), particles must be created in quartets of the form:

(M,+i,L), (A,-i,L), (M,+i,R), (A,-i,R)

In other words, when particles are created by a genesis process, equivalent mirror matter particles are simultaneously created.

This quartet production scheme then instantaneously preserves the balance of all 4 selected charged particle characteristics,

T - Type: Matter or Antimatter (M or A)
C - Charge: positive or negative (+, -)
G - Gravitational charge, (+i or -i)
H - Handedness: L (normal matter), R (mirror matter)

PAIR WISE ALTERNATIVE TO GENESIS QUARTET CREATION

The overall balance guaranteed by genesis quartet creation could be preserved by pair wise processes, provided they had equal probability, e.g.:

(M,+i,L), (A,-i,L)

and:

(M,+i,R), (A,-i,R)

MIRROR MATTER HAVING NEGATIVE GRAVITATIONAL MASS

A similar arrangement can be found by assuming that all mirror matter has negative gravitational mass, as was assumed in the original gravimagnetics paper:

http://mtaonline.net/~hheffner/FullGravimag.pdf

Negative gravitational mass (charge -i) mirror matter was there named "cosmic matter".

Particles in this scenario must be created in quartets of the form:

(M,+i,L), (A,+i,L), (M,-i,R), (A,-i,R)

or pair wise in equal probabilities as the pairs:

(M,+i,L), (A,+i,L)

or

(M,-i,R), (A,-i,R)

If truly dark large naked black holes exist, then the above are the only feasible scenarios consistent with gravimagnetics.

COMBINED PAIR WISE CREATION

Suppose the genesis quartet scenarios:

(M,+i,L), (A,-i,L), (M,+i,R), (A,-i,R)

(M,+i,L), (A,+i,L), (M,-i,R), (A,-i,R)

have equal probabilities. The genesis process could thus be imitated in the ongoing universe by the following pair creations having equal probabilities:

(M,+i,L), (A,-i,L)
(M,+i,R), (A,-i,R)

(M,+i,L), (A,+i,L)
(M,-i,R), (A,-i,R)

An alternative genesis scheme is an eight fold pair creation scenario, whereby all eight of the above pair types are created simultaneously, thus perfectly balancing all characteristics.

Note that this gives antimatter a 1/4 probability of having a positive gravitational charge, and matter only a 1/4 probability of having a negative gravitational charge. This then provides the opportunity for the universe to separate matter and antimatter gravitationally. That which is left behind in a gravitationally segregated volume can mutually annihilate leaving predominately matter with positive gravitational charge in positive gravitational areas, and antimatter far removed, isolated gravitationally.

Note also that left handed matter initially has a 1/4 probability of being negative gravitational matter, and right handed matter has a 1/4 probability of being positive gravitationally charged matter.

Here is what happens when the charges separate:

Negative gravitational mass region populations:

25% (A,-i,L), 25% (A,-i,R), 25% (M,-i,R), 25% (A,-i,R)

Positive gravitational mass region:

25% (M,+i,L), 25% (M,+i,R), 25% (M,+i,L), 25%(A,+i,L)

However, we can expect most all of (M,-i,R) to be wiped out by annihilation in the negative gravitational mass region, leaving each of the identical (A,-i,R), (A,-i,R) populations reduced by about a half. This then results in the population distribution in the negative gravitational mass region of:

50% (A,-i,L), 50% (A,-i,R)

Similarly the resulting population distribution in the positive gravitational mass region approaches:

50% (M,+i,L), 50% (M,+i,R)

This means that about half of our local universe is mirror matter and half is not, and almost all of it has positive gravitational charge, except for the negative gravitational mass particles spewing forth from local black holes, which have the following distribution: 25% (M,-i,L), 25% (A,-i,L), 25% (M,-i,R), and 25% (A,-i,R).

ADDITIONAL PARTICLE CLASSIFICATION

Particles with no gravitational charge, can be classified by adding the value 0i to the G characteristic. Similarly, neutral particles can be classified by adding 0 to the C characteristic. Other particle characteristics, like spin, or the all the characteristics of the standard model according to its rules, can be added to the tuples to gain a full classification system that defines the limits of what kinds of vacuum transactions can occur.

MORE ON MASS/ENERGY VACUUM EXCHANGES

If particles are created in quartets then it is easy to see how black holes emit opposed mass charge matter as well as radiation. Each quartet has two pairs of particles, each pair with opposed mass charge. When a pair annihilates, it creates two photons having the same gravitational mass charge as the original pair.

However, the photons have no charge to hold them back from exiting the vicinity of the remaining pair. If the photons have the same gravitational charge as the black hole, they are absorbed into the singularity, increasing its gravitational charge. If the photons have opposed gravitational charge, then they ar ejected from the black hole with additional energy added.

Suppose a quartet of electron-positron particles is created from the vacuum in the interior of a black hole, one pair having 2 *(+i)*(511 keV/c^2) gravitational charge, the other 2 *(-i)*(511 keV/c^2) gravitational charge. The black hole has mass +i*M. If one pair of the quartet, say the pair having 2 *(+i)*(511 keV/c^2) gravitational charge annihilates, then the two resulting 511 keV photons will be absorbed by the singularity. The remaining pair, if they annihilate, will create a pair of 511 keV photons which will be expelled at high energy from the black hole, otherwise, both particles will be expelled. If the quartet creation event occurs at radius r from the singularity, then the ejected mass/energy in either case will be

U= G*m*M/r = G*(2*511 keV/c^2)*M/r

If a quartet is created at a radius of 1 m from the singularity of a black hole of mass of 1000 suns then the energy created for each member of the ejected pair is:

U= G*m*M/r = G*(511 keV/c^2)*(1000)*(1.9891x10^30 kg)/(1 m)

U = 1.20904x10^-7 J = 7.54624 x 10^11 eV

The Schwarzschild radius of a black hole is given by:

R_s = 2*G*M/c^2

The kinetic energy of a pair particle, ejected at the Schwarzschild radius is:

U_s = G*m*M/(R_s) = G*m*M/(2*G*M/c^2) = (1/2)*m*c^2

which for an electron or positron is the kinetic energy:

U_s = (1/2)*(511 keV/c^2)*c^2 = (1/2) 511 keV = 255.5 keV

For a photon, we add that gravitational potential energy to its original 511 keV energy, to arrive at 766.5 keV as the lowest energy photons to be emitted from within the Schwarzschild radius of any black hole, and as seen at large distance. That is a frequency of 1.8533×10^{20} Hz, and wavelength of 1.6175×10^{-12} m. The relation of flux to energy is inverse cubic. That is because the volume from which a given energy is emitted is proportional to the cube of the radius at which the emission occurs, and vacuum fluctuation quantities per unit of time are proportional to the volume of vacuum involved. The largest flux of photons from within any black hole will thus be at about 767 keV. The cutoff energy is limited only by the shortest feasible radius at which quartet fluctuations can occur.

The luminosity of a black hole grows in proportion to its volume which means in proportion to its Schwarzschild radius cubed, and thus its mass cubed, i.e.:

$$\text{Luminosity} \sim (2 G M/c^2)^3 \sim M^3$$

Unfortunately, it is not certain this photon flux will be visible. The photons represent negative energy to the locality of the black hole if the mass of the black hole is of the same sign as the locality it is in. In other words, black holes emit photons and particles which have repelling gravitational characteristics. If an approaching black hole has ordinary gravity to us, we might not be able to see it except for the glow of any inward falling mass.

SUMMARY

An initial exploration was made of how the theory of gravimagnetism, as defined by this author, predicts pair production from the vacuum within a black hole. The types of charged matter that can be created were classified. This theory can be confirmed by finding a flux of electrons and positrons radiating radially from black holes, with both the flux and kinetic energy spectrum appropriate to the mass of the black holes. It can also be confirmed by a finding a halo having approximately electron-positron annihilation photon energy near naked black holes, the spectrum of which is appropriate to the size of the black hole and blue shifted according to the expected kinetic energy distribution of the pairs issuing forth. There should also be a gamma spectrum with a luminosity and spectrum appropriate to the black hole size.

Gravitational Pair Creation

Horace Heffner November, 2009

This theory can also be confirmed by finding meta-matter, ordinary matter bound to mirror matter, here on earth, consisting of both the positive and negative gravitational charge kinds, as described in “Searching for Cosmic Matter”:

http://www.mtaonline.net/~hheffner/CosmicSearch.pdf