On The Gravity: The “Delta-Integrator Model”. v.12

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Abstract: This paper presents an unconventional view on the gravity field and the way it manifests in particle interactions via a newly-introduced particle; introduces the “energy density function” of this particle and the way it affects the surrounding particles by its physical field; unites gravity interactions between mass-bearing and massless particles, proposes methods of gravity field measurement. This paper also proposes several inexpensive experiments that can be performed to check the presented hypotheses.

I. Introduction, Cumulative Energy Level Change

This paper assumes that the gravity field is a field produced by a particle called “graviton”. While not universally accepted and not strictly defined to date, the name “graviton” is quite easy to associate with the gravity. In the long run, the definition of “graviton” may change while the association of the name “graviton” with the gravity won’t probably change ever. This paper introduces a new understanding of what “graviton” is in several simple steps, describes its detectable electromagnetic energy spectrum and shows how graviton’s gravity field influences surrounding particles, as shown by a law of motion in differential equations.

In order to define what graviton is, it is necessary to make a certain axiomatic assumption: the energy level (in J) of a particle changes in an impulse manner, but not instantly. When the first given particle’s energy level increases, the energy is transferred to that particle from the second given particle. If the first particle’s energy level decreases, the energy is synchronously transferred to the second particle (or is partly radiated out). But right before coming into the full contact with the second particle and getting or losing the last bit of energy, the first particle is initially placed at a certain distance from the second particle, and thus the first particle has to travel this additional distance. This distance is called the “transient distance”.

In the simplest case, on a 2-dimensional plot, we can set the positions of these two given particles on the X axis symmetrically around x=0 (with x=0 position being in-between two particles), and put the cumulative energy level change of the first particle on the Y axis. We may use a suitable “step function”:

$$f_{ec}(x)=\Delta\mathrm{E}\left(0.5+\frac{\mathrm{ArcTan}[\frac{x}{\sigma}]}{\pi}\right)\ \mathbf{(J)}\ (1)$$

…to approximate the first particle’s energy level change over the transient distance: it approaches zero at the initial position x_1 (e.g. $x_1<-5$) of the first particle, and approaches ΔE at the position x_2 (e.g. $x_2>5$) of the second particle (“ΔE” is the total energy level change of the first particle, “σ” depends on the transient distance). The farther the first particle has travelled from its initial position towards the second particle along the transient distance, the larger the cumulative energy level change of the first particle is.

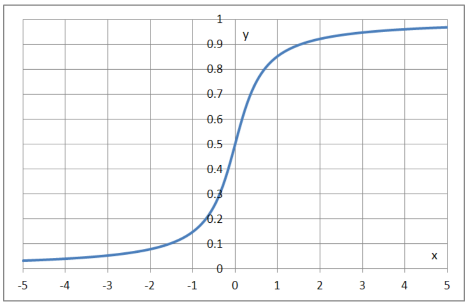

Figure 1: $y=f_{ec}(x)/\Delta E$, σ=0.5

The exact value of ΔE and the energy level change of the second particle depend on the states and interactions of and between the particles, and this is out of the scope of this paper. However, the energy level change of the second particle changes synchronously, but with an opposite sign, in a manner similar to the first particle, in a step function manner (however, part of the energy may be radiated out, or moved to a different domain).

The approach presented in this paper is similarly applicable to both kinetic and potential energies: ΔE can be either kinetic or potential energy level delta. However, as will be shown below, this paper promotes a view that a gravity field is not an abstract potential well making the use of potential energy redundant (still, the potential energy of a particle can be contained in another, non-spatial, domain and expressed as a state vector, or frequency as in the case of photon). The integration axis of function (1) can be generally chosen arbitrarily instead of the "meter" for spatial domain as used in this paper.

Such treatment of particle's energy level change is in many instances different to the one commonly used in physics now: commonly it is assumed that particle's energy level changes instantly and does not require introduction of any "transient distance" step function (e.g. commonly, a change of energy of an atom is treated as discontinuity). In reality, it is reasonable to assume that the energy is transferred to or from the particle during some span of distance or time, not instantly.

II. Delta Function and Graviton's Energy Density Function

The aforementioned step function (1) integrates the delta function (non-Dirac!), which is Cauchy distribution:

$$f_{ed}(x)=\frac{\Delta E}{\pi\sigma\left(1+\frac{x^2}{\sigma^2}\right)}\ \textbf{(J/m)}\ (2)$$

If mapped over the Y axis, function (2) shows the magnitude of the first particle's energy level change over the transient distance (and, synchronously, that of the second particle, but with an opposite sign), with such magnitude being maximal at x=0, right in-between the initial positions of two particles. Such "energy level change over the transient distance" is vital to introduction of a new particle: function (2) is used here over the spatial domain, and without the ΔE multiplier, it can be viewed as representing the "spatial probability density function" of a new particle, with $_{-inf}\int^{+inf} f_{ed}(x)/\Delta E\ dx=1$, for any positive "σ". Function (2) itself is equivalent to the "energy density function" of this particle, although this concept may be somewhat new. In the essence, this new particle represents the energy which the first particle loses or gains, with this energy spread over an area of space between two particles. In other terms, the "energy density function" is the spectral convolution of the spectral energy line by the spatial probability density function (which acts as a window function).

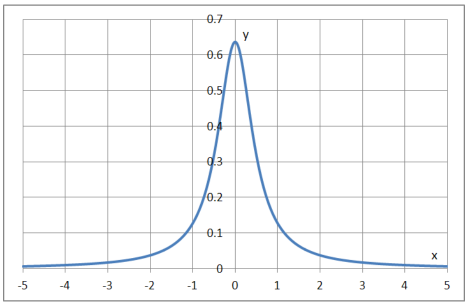

Figure 2: $y=f_{ed}(x)/\Delta E$, σ=0.5

This new particle with its inherent "energy density function" is what this paper presents as graviton. The graviton is a particle which may be detected directly: it may manifest itself as a real physical particle with its specific energy spectrum. The graviton makes it possible for any third particle to interfere with the process of interaction of two particles. In cases when the energy of this particle is fully contained within a certain particle interaction system, the graviton is treated as a virtual particle. In 3-dimensional space, the "energy density function" of graviton is equal to:

$$G_f(x, y, z)=\frac{\Delta E}{\pi^2\sigma^3(1+\frac{(x-x0)^2+(y-y0)^2+(z-z0)^2}{\sigma^2})^2}\ \mathbf{(J/m^3)}\ (3).$$

Where point (x_0, y_0, z_0) is the center of graviton in space; "ΔE" – graviton's energy (particle's gained or lost energy); "σ" – coefficient of spatial proportionality (in meters), a "central region", which in some cases may depend on ΔE.

Function (3), with $x_0=0$, $y_0=0$, $z_0=0$, integrated over "y" and "z" over the infinite range yields the following delta function, which is equal to function (2); it is 3-dimensional "energy density function" integrated over an infinitely thin and infinitely large plane area:

$$G_0(x)={}_{-\inf}\int^{+\inf}{}_{-\inf}\int^{+\inf}G_f(x,y,z)dydz=\frac{\Delta E}{\pi\sigma(1+\frac{x^2}{\sigma^2})}\ \mathbf{(J/m)}\ (4).$$

The argument "x" in function (4) can be also called the "radius" (to graviton's center) since function (4) stands any rotations of the coordinate system with position "x=0" assumed to be at graviton's center; when argument "x" is measured in thousands, the "1+" element can be omitted in this function. Note that function (4) assumes that the spatial size of graviton is much smaller than the mathematical integration plane area (which is infinite).

When the "energy density function" function (3) or (4) is being integrated, the result depends on the direction of integration: e.g. when function (4) is integrated in the direction from small "x" to large "x", the cumulative result is positive, when this function is integrated in the direction from large "x" to small "x", the cumulative result is negative.

Even though this paper will not refer functions (5), (5b) and (6) defined below, it is useful to understand how a function for finite-size integration plane area can be derived. The particle's or body's "infinitely thin" plane area can be defined via the form of function (3), with "x" and ΔE removed:

$$S(y,z)=\frac{1}{\sigma^2\pi(1+\frac{y^2+z^2}{\sigma^2})^2} \quad (5).$$

S(y,z) is 2-dimensional (planar) "spatial probability density function" of a particle, its full integral equals 1. Replacing "σ^2" with "a" (m^2) in (5) and multiplying by "a" yields:

$$A(y,z)=\frac{1}{\pi(1+\frac{y^2+z^2}{a})^2} \quad (5b).$$

A(y,z) is 2-dimensional "weighted plane area" function of a particle, its full integral equals "a" (m^2).

Function (3), with $x_0=0$, $y_0=0$, $z_0=0$, multiplied by (5b) and integrated over "y" and "z" over the infinite range yields the "energy density function" for a given integration plane area:

$$G_a(a, \sigma, x)={}_{-inf}\int^{+inf}{}_{-inf}\int^{+inf} G_f(x,y,z)A(y,z)\,dydz=$$
$$\frac{\Delta E*a\sigma(a^2-(x^2+\sigma^2)^2+2a(x^2+\sigma^2)\mathrm{Log}[\frac{x^2+\sigma^2}{a}])}{\pi^2(a-x^2-\sigma^2)^3(x^2+\sigma^2)} \ \mathbf{(J/m)} \ (6)$$

If required, function (1) can be expressed via the Heaviside step function and function (2) can be expressed via the Dirac delta function (with its "a" parameter controlling the "transient distance"), or via single-parameter Gaussian function. Other similar in sense step and delta function pairs can be used for better approximations, as long as they have a finite integral in the range "–infinity to infinity", over all dimensions.

III. Bremsstrahlung and Gravitons, Photon as a Case of Graviton

Various energy transfers between particles, their acceleration and deceleration included, can be mediated via gravitons. In most cases this will be redundant due to a high locality of energy transfers between particles, but in some cases such mediation is a requirement. It is known that a particle (e.g. electron) that quickly reduces its velocity in an electromagnetic (EM) field produces EM radiation known as Bremsstrahlung – a braking radiation. Bremsstrahlung is such case when a graviton is involved.

Since in the event of Bremsstrahlung an electron reduces its kinetic energy (changes its momentum), a rapid kinetic energy level shift in such event can be modeled with function (1). The Fourier transform energy spectrum of function (4), the y-z-integrated "energy density function" of graviton, is presented on figure 3, it is non-zero though not infinite on the linear energy spectrum scale, at zero frequency. This spectrum may be observed on the macroscopic level, as "ambient" energy spectrum, with the energy of the macroscopic numbers of gravitons unabsorbed at large. A very similar energy spectrum is demonstrated when measured in a high-temperature plasma which is characterized by a huge number of electron-ion Bremsstrahlung events per unit time, and hence due to spectral similarity, there must be a huge numbers of gravitons created in such plasma.

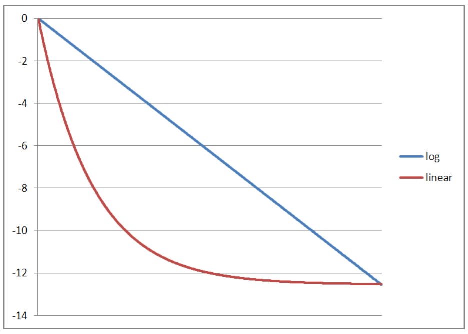

Figure 3: Normalized log and linear delta energy spectrums of graviton near zero frequency. This figure shows an approximate slope on a linear frequency scale (horizontal axis).

However, if another, isolated, case of Bremsstrahlung is considered: a major deceleration of a single electron in an electromagnetic field, not involving plasma, Bremsstrahlung's spectrum shifts to very high frequencies, to the range of wavelengths shorter than 0.1nm, and has a shape of a continuum. It can be hypothesized that even in such Bremsstrahlung event a graviton with its zero frequency spectrum is created, but its energy is counter-balanced by the high-frequency X-ray energy continuum. It can be reasoned that such counter-balancing happens so that near zero frequency energy is not too large, and the "energy density function" of graviton stays moderate in magnitude. This X-ray energy continuum is almost absent if only a very small kinetic energy change happened. To sum this up, the lower part of graviton's energy spectrum in the event of Bremsstrahlung stays in a "leverage ratio" to the higher part. Hence, in the general case ΔE can be represented as $\Delta E = \Delta E_b + \Delta E_o$, where ΔE_b is the lower (base) part and ΔE_o is the higher (oscillatory) part (e.g. the X-ray continuum) of graviton's energy spectrum (magnitudes of both ΔE_b and ΔE_o in a general case should be calculated in spectral domain since they can be defined in complex number form). The "leverage ratio" $|\Delta E_o|/|\Delta E_b|$ can be the function of ΔE.

Such $\Delta E_b + \Delta E_o$ sum representation of ΔE leads to a proposition that photons can be represented as gravitons without the ΔE_b (zero frequency) part. Then ΔE_o is oscillatory and equals to some sinusoidal function (or a sum of functions) on the complex plane (e.g. $\Delta E_o = e^{i(x * |\Delta Eo| / \hbar)}$); when ΔE_b is zero, functions (3) and (4) represent the "energy density function" of a photon. On the macroscopic scale ΔE_o is usually, but not always, equal to zero due to statistically-based absorption.

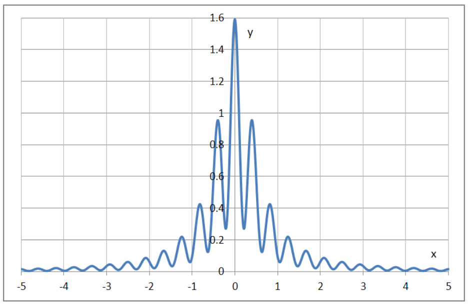

Figure 4: $y=f_{ed}(x)$, $\Delta E=1.5+\cos(x*15)$, $\sigma=0.5$

A free-form example of graviton's "energy density function" that includes the oscillatory part (real part).

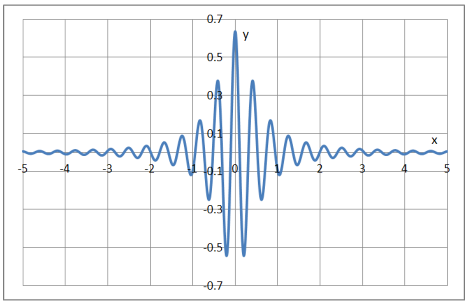

Figure 5: $y=f_{ed}(x)$, $\Delta E=\cos(x*15)$, $\sigma=0.5$

A free-form example of "energy density function" of a photon (real part), $\Delta E_b=0$.

The appearance of the X-ray continuum in the event of Bremsstrahlung, and the presence of the said "leverage ratio" can be considered causal, because photon continuum which is emitted in the event of Bremsstrahlung immediately absorbs a part of the energy of graviton, via blueshift, as will be shown below. By evidence, photons of this continuum are collectively blueshifted: otherwise, if only a single photon instead of a continuum was emitted during a high-energy event of Bremsstrahlung then its energy would probably be too high and disrupting.

In the event of a head-to-head ultra-high-energy particle collision a graviton is also created, but its energy is immediately absorbed by by-product particles.

Experiment 1: For a sustained graviton flux, dense but somewhat low-energy plasma is probably required so that electron-ion collisions are frequent, but have a low energy thus reducing the resultant "idle" X-ray flux. Such plasma can be efficiently contained in and controlled by a magnetic field of just a moderate intensity, and it can be bombarded with electrons to control its energy level. After mastering the creation of gravitons, the speed of graviton's "energy density" change propagation can be measured, thus solving the "mystery" of gravitational waves.

Graviton, having continuous delta spectrum, and due to spectacular blueshift in the event of Bremsstrahlung, can be called the "rainbow particle". This model draws a curious picture of the particle universe: the "energy differentials" (graviton, photon) are integrated by particles: this is a universe of energy deltas and their integrators, the "Delta-Integrator Model".

IV. Graviton's Field and The Energy Gain Function

A new important concept in relation to graviton and its energy at zero frequency is the induction of displacement in the surrounding particles. If we take some particle that oscillates around its parametric center in a sinusoidal manner, we can measure the frequency of such oscillation: it can be any value except zero. In the case of Fourier transform of function (4) the estimated energy spectrum reaches zero frequency. Presence of energy at zero frequency is what puts graviton into a special position among particles. The energy at zero frequency induces displacement in the surrounding particles, in a progressive, non-oscillatory manner.

In the essence, such displacement function of graviton creates a physical gravity field around it.

When some particle P with the given coordinates and the kinetic vector-energy E_p (relative to this field's kinetic vector-energy) is put into this field, it begins to gain energy ($E_p' = E_p + \iiint G(x, y, z) * A_p(x, y, z)\, dxdydz * V_g(x, y, z)$) J (7) from this field, over particle's path (this is only a general representation of the idea; see the "Macroscopic Gravity" topic below for practical continuous-time integral formulation); the triple integral's range includes the area surrounding the particle. G(x, y, z) is function (3) or (4), or similar in sense. The scalar unit-less function $A_p(x, y, z)$ is particle's (or body's) 3-dimensional "weighted volume" function, proportional to spatial probability density function, and bounds it in space, the full integral of this function converges into the volume value in m^3 (see function (5b) for 2-dimensional example). If the field moves relative to a particle, function (7) is also applicable: such situation must be seen as the "drag effect", and whether this particle gains energy or loses it depends on the direction of the moving field relative to the direction of a particle.

The field performs work by displacing this particle P. Since the gain of energy by the particle in this field is a persistent, cumulative process, the field accelerates or decelerates the particle. Of course, this synchronously affects the energy level of a body that created the field, but with an opposite sign, to fulfill the energy and momentum conservation constraints.

On the macroscopic scale, the vector function $V_g(x, y, z)$ is equal to the unit vector pointing from particle's position to the center of this field, but on the microscopic (particle) scale function $V_g(x, y, z)$ is equal to scalar value 1 and may be omitted. The reason $V_g()$ equals 1 on the microscopic (particle) scale, when a particle interacts with a <u>single</u> graviton, is because otherwise function (4) will be discontinuous with its integral approaching zero; also on the microscopic (particle) scale the sign of energy gain depends on the direction of integration. However, for a gravity field of a heavy atom the $V_g()$ function can be specified with some confidence to be similar to the macroscopic scale $V_g()$ function due to heavy atom's high number of mass-bearing subatomic particles.

The reason $V_g()$ on the macroscopic scale is the said vector function is due to empirical data: the fact that bodies fall down along perpendicular to the ground, but there are also statistical reasons for this available, associated with the existence of the "drag effect": subatomic particles and gravitons are in constant orbital and thermic motion causing the constant "drag effect".

If a macroscopic body has angular momentum then its gravity field also moves angularly, and such source of drag should be modeled as an additional gravity field that moves relative to the body at a certain angular velocity with the vector $V_g()$ pointing along the angular momentum vector, see fig.12 for example.

If ΔE in G(x, y, z) includes only an oscillatory member (photon case), the net displacement of the particle in such field will lean towards zero, photon is unable to directly affect kinetic energy of other particles in spatial domain, hence photon has net zero gravity field, but has an oscillatory "energy density function".

The phase (or angle) of zero frequency ΔE_b component in complex spectral domain should be statistically constant (presumably zero) or otherwise in the case of arbitrary phases the fields of unabsorbed gravitons would cancel-out on the macroscopic scale. This does not mean that the phase cannot be forced to an arbitrary value in a more artificial system.

It should be noted that the latest research of cosmic-scale redshift quantization concluded that such quantization does not exist. This fact is important, because the energy gain function (7) allows for non-quantized energy gains by particles.

It can be hypothesized that the calculation of dynamics of a particle under the influence of several overlapping gravity fields can be performed simply by summing kinetic vector-energy differentials of gravity fields at particle's position integrated over its path, as in function (7), as separate terms.

V. Graviton's Momentum and Spin

The momentum and spin of the graviton are debatable topics. While graviton's spin is most probably zero, the graviton may have an arbitrary "phase" encoded in its ΔE_b multiplier (if specified as a complex number). But such "phase" may not be related to spin.

The pseudo-mass required to define momentum of graviton can be calculated in 2 possible ways:

1. $m_g=|\Delta E/v^2|$ (8) (from $E=mv^2$)
2. $m_g=|\Delta E/c^2|$ (9) (from $E=mc^2$)

Here, "v" is graviton's velocity which is a combination of velocities of two interacting particles.

Variant 2 assumes graviton's velocity is equal to the speed of light. This corresponds to the "graviton as photon" case with ΔE_b=0 (see above). Variant 2 is interesting in that it can be used to derive a pseudo-mass of photon: $m_{ph}=hf/c^2$ (10), which can probably be used to find the "gravitational number" of photon, see below.

VI. Macroscopic Gravity

On the macroscopic scale, the "energy density functions" (3) and (4) must include an additional multiplier member to scale up to the macroscopic numbers of particles, which is usually "mass". However, once this was done, these functions require a very specific approach to their use as they cannot be integrated directly to obtain the energy gain like via function (7): function (7) should be formulated in a way so that the energy gain of a small body in a macroscopic gravity field depends on the mass of this small body.

Function (4) for a macroscopic gravity field can be formulated as (with "x" renamed to "r"; "σ" equals 1, and the "1+" element removed since "r" is assumed to be measured in at least thousand meters; note that "r^2" has unit of "meter"):

$$G(r)=\frac{mc^2}{\pi\sigma(1+\frac{r^2}{\sigma^2})}=\frac{mc^2}{\pi r^2}\ \textbf{(J/m)}\ (11).$$

Where "m" is the mass (kg) of the large body that produces the gravity field; "c" is the speed of light in vacuum (m/s). Note that the full integral of (11) converges and equals "mc^2", no singularity is present; this value tells how much energy is "held locked" in a gravity field.

Since function (11) implicitly represents the integral of function (3) over an infinitely-large y-z plane area, when function (11) is used in function (7), it absorbs the $\iint A_p()dydz$ part of the function. Instead of this area integral, the energy gain depends on the number of particles (mass) of the small body, assuming that each particle of this small body integrates a single graviton of the gravity field, over an infinitely-large y-z plane area.

The following system of 2 differential equations models a continuous-time "body-gravity field" interaction:

$dP/dt=vel(E_p-E_f,M_p)$
$dE_p/dt=G(r)*Z_a*M_p*|dP/dt|*V_g()$ (12); where "dP" is body's position differential, "r" is the distance from body to field's center, vel() – velocity vector of body's kinetic vector-energy integral "E_p" and mass "M_p", "E_f" – field's kinetic vector-energy, "dE_p" – body's kinetic vector-energy differential, "dt" – time differential. |dP/dt| means that the energy gain on the macroscopic scale in the case of downward gravitational pull does not depend on body's (particle's) and field's kinetic vector directions, but only depends on the travelled distance (note that in the case of angular "drag effect" modeling this element of equation also depends on body's angular velocity, see fig.12 for example). On the macroscopic scale the sign of energy differential depends on the "$V_g()$" vector function of the field that may be constant (e.g. -1 for downward gravitational pull) or may depend on body's velocity (for modeling of other energy influences like angular "drag effect"). In a general case, the element "$dP/dt*V_g()$" should be treated as a whole. "Z_a" is a coefficient of proportionality, equals to $2.330316*10^{-27}$ kg^{-1} as per comparative modeling. Note that the "Z_a*M_p" part is unit-less and it can be replaced by an expression or constant that represents a massless particle. This part can be also called the "gravitational number".

It should be noted that, classically, the gravity force is treated and calculated as a non-divisible combination of gravity forces of two bodies. The model presented in this paper strives to define the gravity force created by each body individually, not necessarily via mass. Such approach makes it possible to apply the gravity force in a uniform way to even the massless particles like photon, requiring only its "gravitational number" to be known, and makes it possible to calculate artificially-created gravity fields, not created by mass (e.g. by Bremsstrahlung). Of course, a body interacting with a gravity field affects the body that creates this gravity field: absorption of gravity field's energy even on its periphery synchronously changes the energy level of the body that creates this gravity field, but with an opposite sign. This is required by both the third Newton's law, and energy and momentum conservation constraints.

Function (12) can be also used to estimate energy losses or gains of a small static body of a given mass in a gravity field that moves relative to this body at a given velocity vector. However, this approach assumes (with a risk of being incorrect) that the energy gain along any direction within the macroscopic gravity field is equivalent to the energy gain in the direction towards gravity field's center (which the functions (4) and (11) assume), and depends only on the distance travelled by a small body within the gravity field.

The rotational drag effect of Earth at latitude of 0 degrees (equator) at 500km orbit can be estimated as 4211 J/(s*kg), along Earth's angular momentum, considering Earth's gravity field's rotational speed at this orbit is equal to 500.2 m/s. This is the additional amount of energy a static body of a given weight gains per second until its momentum becomes very close to Earth's angular momentum, effectively negating the rotational drag effect.

VII. Mass vs. Gravity Field

The term "mass" may not be an ideal term as far as gravity fields are concerned: an atom we call "massive" gains energy during a free fall in a gravity field faster than a lighter atom (accelerations of both atoms are equal while their masses are different), and as was shown above, such "massive" atom has a larger "gravitational number". But it can be also hypothesized that gravity fields can be generated artificially by electro-magnetic or plasma devices. In such cases the gravity field should be measured by means different to a known "mass" multiplier. Today there may be no better alternative to "mass" exist since no publicly available and universally-accepted mass-less gravity field measurement method exists yet. It is a hope of the author that this paper gives an idea for such measurement method.

VIII. Atom's Gravity Field

Given the overall description of the graviton above, it can be hypothesized that for an atom to have a stronger gravity field its subatomic particles have to travel in elliptical orbits, with the periods of deceleration and acceleration that lead to creation of gravitons. Thus, on subatomic level the gravity field may not be constant and may manifests itself as gravitational impulse train that also contribute to atomic decay (meaning fast-decaying atoms may have a greater gravity field). EM radiation of pulsars, the double-star systems, may be an example of such graviton Bremsstrahlung impulse trains on a cosmic scale.

It is unlikely that subatomic particles of an atom move at perfect circular or spherical orbits with a constant momentum: while the movement of subatomic particles inside an atom may be governed by electromagnetic, weak and strong forces, during the factual spatial accelerations and decelerations of these particles the gravitons are created, and they are either immediately reabsorbed locally, or absorbed at a distance thus contributing to atom's energy level change. However, since atom's internal (potential) energy level is stored as quantum states of its particles, and is more or less stable, the atom's energy level change via its gravity field absorption at a distance in almost all cases leads only to its momentum (kinetic energy) change, which is not quantized. Only if a lot of energy was absorbed at unit time the probabilities of the quantum states' change may increase.

IX. Graviton's Inertial Drag Effect

It can be hypothesized that a particle with kinetic energy is actually "carried forward" by a leading graviton placed at a certain distance from particle's center or at its center, along its kinetic energy vector, with graviton's delta energy equal to particle's kinetic energy. In free space, such "particle carried by a leading graviton" forms a dynamic kinetic system that exhibits no acceleration and no Bremsstrahlung radiation. In the essence, the kinetic energy of a particle can be represented as its additional local gravity field that may interact with other particles via functions (7), (11) and (12). The sign of ΔE of such gravity field is probably negative.

This hypothesis leads to a hypothesis of the "inertial drag effect" meaning that a particle with a considerably high kinetic energy (or an intense gravity field) drags another particle placed at a small distance from it.

The photon having its $\Delta E_b=0$ has zero net gravity field, it cannot "drag" other particles, and thus it can be said that photon has no kinetic energy, while its potential energy is "conserved" as its frequency. The frequency may undergo a shift in the vicinity of the aforementioned high-energy dragging particle. The kinetic vector and position of the dragging particle relative to photon's (or other particle's) vector specifies the sign of the energy gain of the "inertial drag effect" (blueshift or redshift).

Experiment 2: If the "inertial drag effect" exists, atoms that have a nearly equal kinetic vector-energies and that travel in space in an equidistant and unidirectional train formation, one after another along the same directional vector, will tend to group with each other over time due to mutual energy loss and gain like via function (7), driven by the ambient random thermic displacements. This may explain why repetitive oceanic waves in the deep ocean tend to form rogue waves, and why acoustic waves tend to form shock waves over time. It can be hypothesized that a similar "neutral charge atom train" ("^{1}H train" or "^{2}H train") method can be utilized to perform an energy-efficient, low-energy fusion, with the parameters such as frequency of atom firing and atom initial kinetic energy being chosen to be the most economically-efficient. During such mutual drag, the “principle of the least action” may guide atoms to fuse instead of infinitely increasing the pressure that may build up during such mutual drag.

During the time when graviton lives, the energy that this graviton has can be absorbed by any nearby particle. This is what a macroscopic gravity field demonstrates. This macroscopic gravity field is a sum of graviton fields of particles of a macroscopic body. Any particle that passes nearby this field absorbs the energy of gravitons of this macroscopic field. An opposite is also true: a moving gravity field causes a particle to absorb the energy of gravitons, thus contributing to the “drag effect”.

X. Photon’s Energy Gain

Alternatively, in a more general case, it can be hypothesized that in the case of photon’s energy gain, in function (7) the differential of the “energy density function” must be integrated (instead of the “energy density function” itself), and so, the sign of the energy gain by photon depends not only on the sign of the “energy density function”, but also on its velocity vector relative to graviton, which specifies the direction of integration. Hence, when photon is emitted along particle’s momentum, it gains energy, but when it approaches behind particle’s momentum, it loses energy: in the case of photon, this makes the $V_g()$ vector depend only on the direction of integration, on both the microscopic and macroscopic scales, and can probably be simply omitted if the integration step takes integration direction into account.

Moreover, this means that the “drag effect” due to body’s (and its gravity field’s) angular momentum will be zero in the case of photon, because “energy density function’s” differential along angular velocity vector is zero (“x” remains constant).

$$f_{ed}(x)' = -\frac{2*\Delta E*x}{\pi\sigma^3(1+\frac{x^2}{\sigma^2})^2} \ \mathbf{(J/m^2)} \ (13).$$

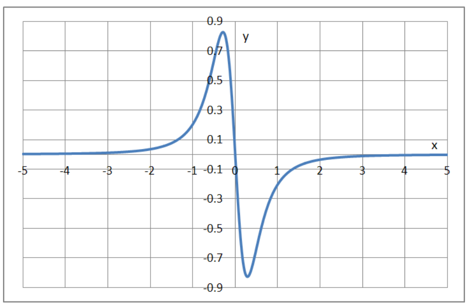

Figure 6: $y=f_{ed}(x)'/\Delta E$, σ=0.5

$$G_{ph}(r) = -\frac{2mc^2}{\pi r^3} \ \mathbf{(J/m^2)} \ (14).$$

Note that function (13) tells that photon’s energy gain has “inverse third power law” dependency, however if function (10) is correct, photon’s pseudo-mass and thus “gravitational number” increases as its frequency increases and thus the energy gain dependency may not look exactly as the “inverse third power law”. It can be also noted that if photon manages to fully “pass through” a graviton (or gravity field), the net energy gain of photon is zero.

To be mathematically correct, when functions (13) and (14) are used in functions (7), (11) and (12), they should be additionally multiplied by a value with the unit of “meter”, which can be a constant value, or some function that represents an additional degree of freedom (state) of photon.

XI. Statistical Space-Time Curvature

The model this paper presents assumes that only statistical, non-physical, space-time curvature exists and that gravity is not propagated as waves of change of this space-time curvature. The “gravitational radiation” must be reformulated to be just the lower part of the EM radiation spectrum near zero frequency, again not involving any physical space-time curvature. Statistical curvature is observable when a statistically large number of particles, expressed via mass, interact with the gravity field. When a particle’s interaction with the gravity field is expressed in a way that does not involve mass, like in the case of photon, interactions with the field become linear in time and space (“dx” will be constant all the time in fig.7 while dE affects photon’s frequency only). Due to this the time scale change on the microscopic (particle) scale may be much less apparent than on the macroscopic scale. The practical effects of the statistical time scale change are probably best studied involving macroscopic biological entities and mechanical devices: it is at this level the effects of aging associated with the time scale change may be apparent.

This statistical time scale change can be also explained by the fact that bodies and particles gain kinetic energy in the vicinity of a stronger gravity field faster, hence their accelerations and velocities in a stronger field are higher than if they were in a weaker gravity field. Thus the ambient pressure in a large open thermodynamic system like the atmosphere, in a stronger gravity field is also stronger than in a weaker gravity field. The larger the spatial scale is, the more predictable the time scale change is, the time scale change may not be so much evident on the microscopic (particle) scale; the time scale change will be more visible with mechanical clocks than with atomic clocks, due to photon’s fixed speed regardless of the gravity field strength.

Eventually, knowing the exact time scale change within a gravity field, it should be possible to define a “Z field function” which models the time scale gradient and tells how much time is statistically “compressed” depending on the distance from the center of a gravity field.

XII. Redefining Photon

This paper strongly suggests that a photon cannot be deflected by a gravity field due to photon’s lack of mass and kinetic energy, only the frequency of photon may change in a gravity field. The known equation between photon’s “momentum” and its energy $E=|p|c$ stays in a physically uncertain relation to the equation $E=hv$: when photon’s measured frequency changes, two explanations are possible: photon was deflected and simultaneously changed its frequency, or photon was not deflected, but changed its frequency. This poses an unresolvable problem which leads to mostly random operations over physical measurement data. $E=|p|c$ is unlikely to be a usable equation, at least in the terms of this model, because "p" is momentum, a SI unit kg*m/s, which must be non-applicable to massless particles. Another reason the momentum is non-applicable to photon is because if we take a system of two photons, their combined energy when expressed via the $E=|p|c$ equation does not depend on their velocity vectors, so when using the $E=|p|c$ equation it is possible to perform <u>any</u> photon vector rotations, which is a questionable physical freedom, because momentums equal by magnitude but opposite in the vector should sum up to zero.

Any situation when a deflection of photons by gravity field is hypothesized should be checked against a possibility of "gaseous matter" based reflection which may also change photon's frequency due to Doppler shifts (which are reflective, not deflective). The lensing and deflection effects can also appear when a "gaseous matter" is affected by a strong gravity field, yet the photon radiation of this matter may not be lensed or deflected, and only undergo a blue- or redshift (which may, for example, shift photon's energy down to zero as in the case of a black hole and feed back to black hole's energy).

Another understanding this paper would like to promote is that photon's <u>speed and energy</u> has no dependence on any frame of reference, they are absolute, but in a specific way. When photon is emitted, the kinetic energy of emitter is <u>always</u> added to the photon, when photon is absorbed, the kinetic energy of absorber is <u>always</u> subtracted from the photon (here, emitter and absorber have equal velocity vectors and photon emitting is done along this vector). Such addition and subtraction can be described via the "inertial drag effect" above. In this case, the net energy change of photon is zero. However, even if the net energy change is zero, it does not mean that the events of blueshifting and redshifting are not happening at all. This added and subtracted energy is absolute and relative only to the absolute speed of light. When both emitter and absorber travel in space along the same vector at velocity c/2, the measured speed of light between them will be c/2, but it does not mean that the speed of light was reduced or in any way changed, it means that the frame of reference moves at the <u>absolute</u> velocity of c/2, and the energy of photon is heavily blueshifted during emitting and then heavily redshifted during absorption. Thus the method of measurement presented below should be realizable.

The equation for kinetic energy "near the speed of light" can probably be expressed with a corrective law, being a simple hypothesis in itself, not tied to any theories. Then the classical kinetic energy equation can be formulated as: $E=1/2*m*v^2c^2/(c^2-v^2)$, with "$c^2/(c^2-v^2)$" being a unit-less value expressing the natural law of velocity limitation, "v" is the absolute velocity.

XIII. Absolute Velocity and Gravity Field Sensor

Experiment 3: It can be hypothesized that in order to detect gravity field changes it is necessary to precisely measure ambient EM energy spectrum around zero frequency, which requires electromagnetic equipment of a high precision; of course, the intensity of the measured energy level is only correlative to the full energy density (J/m^3) that creates the gravity field at the point of measurement. Any particle interactions that lead to an increased ambient energy spectrum around zero frequency can be hypothesized to be interacting with or via gravitons.

Experiment 4: Photon’s red- and blueshifts can be also used as a measure of the gravity field and its gradient (the direction of frequency shift depends on photon’s direction relative to gravity field’s gradient).

For precise modeling of body motions it may be useful to find the absolute velocity of a particle or body, free of any frames of reference, by measuring the average arrival time and angle of billions of short-time visible light photon pulses in the current frame of reference. The summary gravity field can be additionally measured by evaluating the average change of the frequency of these pulses. This will require 3 fast-acting photon detectors placed in equiangular triangle formation in front of a photon emitter along the normal vector to this formation, plus 2 more detectors in the center of this formation, tuned to a slightly different resonant frequencies than the other 3 in order to detect frequency change (fig.11). The “gravitational number” of photon should be known to calculate the gravity field’s integral “energy per meter” from photon’s frequency change and distance. It should be also decided whether or not functions (13) and (14) are applicable to modeling of photon’s energy gain.

Additionally, such measurement system can be rotated along its axes to increase precision, measure velocity vector and gravity field’s gradient vector, and also to reduce systematic measurement errors. Alternatively, such measurement system may include several arrays of the aforementioned detectors, with each array placed at a unique fixed angle: this way no mechanical wear will happen. Doppler shifts due to the ambient temperature noise and movements of the system will cancel out automatically in the measurements given the system is small enough. Eventually, such systems can be embedded into hand-held devices together with magnetometers.

XIV. 1-D Graviton Simulation

The following 1-dimensional graviton simulation program in C programming language demonstrates that the energy in the “body-graviton” system is conserved, supporting a hypothesis that such system follows the “principle of least action”, essential for physical systems.

This simulation uses the Adams–Bashforth three-step explicit method of integration, which is strongly stable. Simulation is run for 1030 seconds.

```
#include <stdio.h>
#include <math.h>
const double M_PI = 3.14159265358979324;

double fed( const double x, const double DE, const double sigma )
{
	// Energy density function (2). DE - graviton's energy delta.
```

```
        return( DE / ( M_PI * sigma * ( 1.0 + x * x / ( sigma * sigma ))));
}

double vel( const double E, const double mass )
{
        // Velocity of a body with kinetic energy E and mass.
        return( sqrt( 2.0 * fabs( E ) / mass ) * ( E >= 0 ? 1.0 : -1.0 ));
}

int main()
{
        const double h = 0.02; // Integration step, s
        double t = 0.0; // Initial time, s
        double x = -10.0; // Initial body's position, m
        double E = 0.003; // Initial body's energy, J
        const double mass = 10.0; // Body's mass, kg
        const double sigma = 0.5; // Graviton's sigma. Center is at x=0
        double DE = -0.004; // Graviton's delta energy, J. Graviton's velocity equals 0.

        double v = vel( E, mass );
        double dE = fed( x, DE, sigma ) * fabs( v );
        double dx = v;
        double p2dE = 0.0;
        double p2dx = 0.0;
        double p1dE = 11.0 * dE / 12.0;
        double p1dx = 11.0 * dx / 12.0;

        while( t < 1030.0 )
        {
                v = vel( E, mass ); // m/s

                printf( "%f\t%f\n", x, E );

                dE = fed( x, DE, sigma ) * fabs( v ); // J/m * m/s
                dx = v; // m/s
                E += h * ( 23.0 * dE - 16.0 * p1dE + 5.0 * p2dE ) / 12.0;
                x += h * ( 23.0 * dx - 16.0 * p1dx + 5.0 * p2dx ) / 12.0;
                t += h;
                p2dE = p1dE; p1dE = dE;
                p2dx = p1dx; p1dx = dx;
        }
}
```

Figure 7: 1-D "body-graviton" interaction simulation program in C programming language.

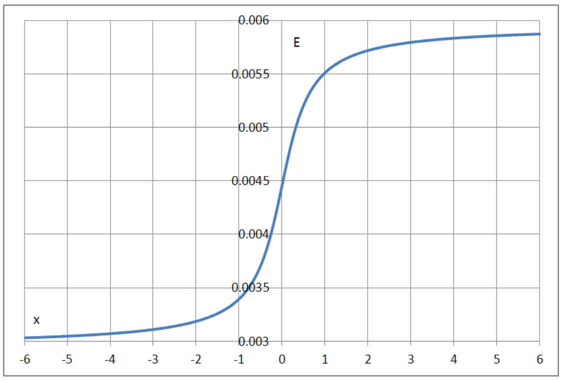

Figure 8: Integration of body's energy (E) and position (x) in the vicinity of graviton (@ x=0), with graviton's delta energy set to a positive value (0.003 J), see fig.7.

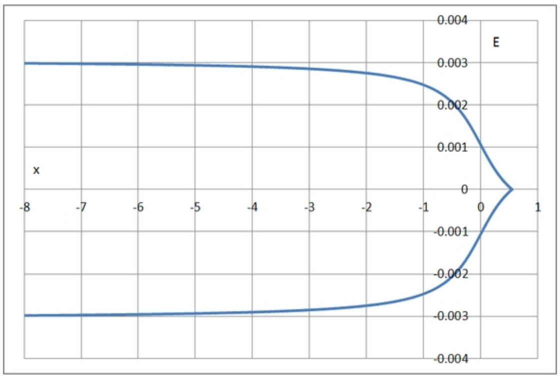

Figure 9: Integration of body's energy (E) and position (x) in the vicinity of graviton (@ x=0), see fig.7. The energy of graviton is not absorbed, because its change is higher (-0.004 J) than body's initial energy (0.003 J). The body "bounces back" and changes the sign of its velocity vector (represented as negative energy).

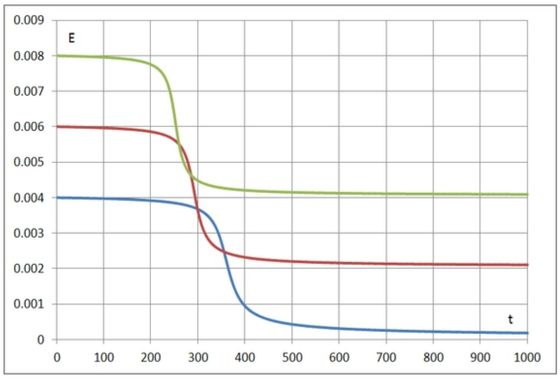

Figure 10: Integration of body's energy (E) over time (t) at various initial body energy settings (0.004 J, 0.006 J, 0.008 J), in the vicinity of graviton with delta energy equal to -0.004 J, see fig.7.

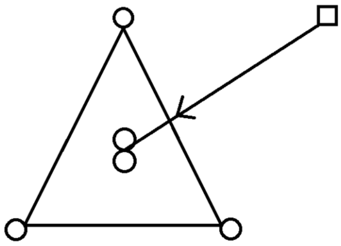

Figure 11: Scheme of absolute kinetic energy and gravity field's energy density sensor. Circles are photon detectors, rectangle is a photon emitter. Line with an arrow on it – the normal vector and the direction of photon pulse emitting.

XV. Body in Earth's Gravity Field Simulation

The "body in Earth's gravity field" simulation program in C programming language.

```
#include <stdio.h>
#include <math.h>
const double M_PI = 3.14159265358979324;
const double Za = 2.330316e-27;

double fed( const double Fm, const double r )
{
        // Macroscopic "Energy density function" for a field of a massive body,
        // J/m
        //
        // Fm - mass of massive body,
        // r - radius from the center of massive body,
        return( Fm * 8.9875517873681764e16 / ( M_PI * r * r ));
}

void vel( const double Ex, const double Ey, const double mass,
        double& Vx, double& Vy )
{
        // Velocity of a body with kinetic energy E and mass.
        Vx = sqrt( 2.0 * fabs( Ex ) / mass ) * ( Ex < 0.0 ? -1.0 : 1.0 );
        Vy = sqrt( 2.0 * fabs( Ey ) / mass ) * ( Ey < 0.0 ? -1.0 : 1.0 );
}

void rotate( double& x, double& y, const double th )
{
        // Rotate the specified vector by "th" radians.
```

```
        const double nx = x * cos( th ) - y * sin( th );
        y = x * sin( th ) + y * cos( th );
        x = nx;
}

int main()
{
        const double Fm = 5.9736e24; // Earth's mass, kg
        const double Fr = 6378.1e3; // Earth's radius, m
        const double h = 0.001; // Integration step, s
        double t = 0.0; // Initial time, s
        double Px = 0.0; // Initial body's X position, m
        double Py = 500000.0 + Fr; // Initial body's Y position, m
        double Ex = 1000000000.0; // Initial body's energy on X (angular) axis, J
        double Ey = 400000000.0; // Initial body's energy on Y (perpendicular) axis, J
        const double mass = 10.0; // Body's mass, kg
        const double GN = Za * mass; // Body's gravitational number

        double p2dEx = 0.0;
        double p2dEy = 0.0;
        double p2dPx = 0.0;
        double p2dPy = 0.0;
        double p1dEx = 0.0;
        double p1dEy = 0.0;
        double p1dPx = 0.0;
        double p1dPy = 0.0;
        int i = 0;

        while( t < 10800.0 )
        {
                const double Pangle = atan2( Px, Py ); // Position vector angle, rad
                const double elev = sqrt( Px * Px + Py * Py ); // Body's elevation, m
                const double FVx = 2.0 * M_PI * elev / 24.0 / 60.0 / 60.0;
                        // Earth's angular velocity (at equator), m/s
                double Vx; // Body's angular velocity, m/s
                double Vy; // Body's perpendicular velocity, m/s
                vel( Ex, Ey, mass, Vx, Vy );

                if(( i % 1000 ) == 0 ) // Print position above surface every 1000 steps
                {
                        double x = 0.0;
                        double y = ( elev > Fr ? elev - Fr : 0.0 );
                        rotate( x, y, -Pangle );
                        printf( "%f\t%f\n", x, y );
                }
                i++;

                double ed = fed( Fm, elev ); // Energy density, J/m
                double AVx = ( Vx < 0.0 ? Vx + FVx : fabs( Vx - FVx ));
                        // Body's summary angular velocity, m/s
                double dEx = ed * GN * AVx; // J/m * m/s
                double dEy = ed * GN * fabs( Vy ) * -1.0; // J/m * m/s
                        // The field vector Vg points down, hence multiply by -1.0.
                double dPx = Vx; // m/s
                double dPy = Vy; // m/s
                rotate( dPx, dPy, -Pangle );
                Ex += h * ( 23.0 * dEx - 16.0 * p1dEx + 5.0 * p2dEx ) / 12.0;
                Ey += h * ( 23.0 * dEy - 16.0 * p1dEy + 5.0 * p2dEy ) / 12.0;
                Px += h * ( 23.0 * dPx - 16.0 * p1dPx + 5.0 * p2dPx ) / 12.0;
                Py += h * ( 23.0 * dPy - 16.0 * p1dPy + 5.0 * p2dPy ) / 12.0;
                p2dEx = p1dEx; p1dEx = dEx;
                p2dEy = p1dEy; p1dEy = dEy;
                p2dPx = p1dPx; p1dPx = dPx;
                p2dPy = p1dPy; p1dPy = dPy;
                t += h;
        }
}
```

Figure 12: The “Body in Earth’s gravity field” simulation program in C programming language.

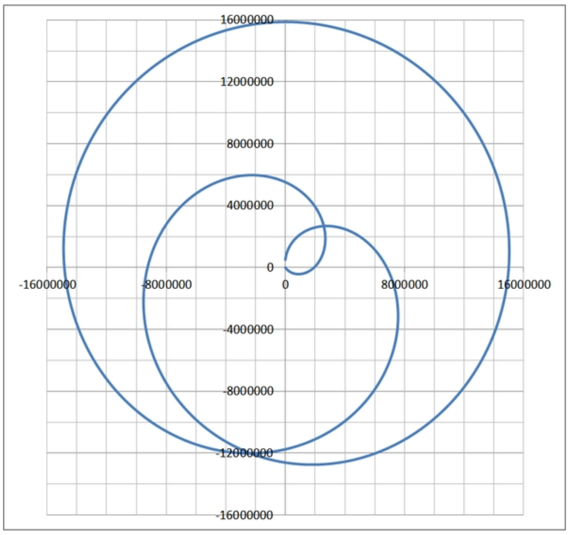

Figure 13: The "proof of concept" integration of body's position (meters) above ground in Earth's gravity field, see fig.12. Body's mass=10kg, starting elevation=500km, angular velocity=14142m/s, perpendicular velocity=8944m/s. Perpendicular velocity is below the escape speed, hence the body eventually falls down.

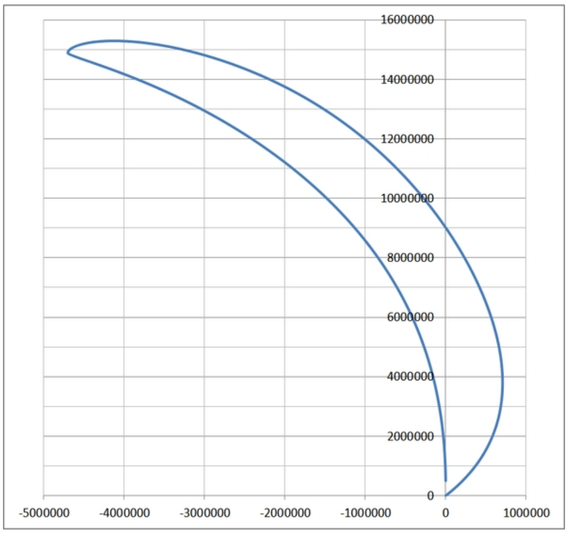

Figure 14: A curious "crescent"-like shape produced by integration of body's position (meters) above ground in Earth's gravity field. Same initial conditions as on fig.13, but the initial angular velocity=-557m/s.