On The Gravity, the "Delta-Integrator Model"

(the "Rainbow Particle" theory) v.10

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Abstract: This paper presents an unconventional view on the gravity force 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.

I. Introduction, Cumulative Energy Level Change

This paper assumes that the gravity is a force exhibited 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 transferred to the second particle, or is radiated out. But right before coming into the full contact with the second particle and getting or losing the 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" in the form of cumulative distribution function of the Gaussian distribution ($f_{ec}(x)=\Delta E/2*(1+erf(x/sqrt(2*\sigma^2)))$) 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=-2) of the first particle, and approaches ΔE at the position x_2 (e.g. x_2=2) 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.

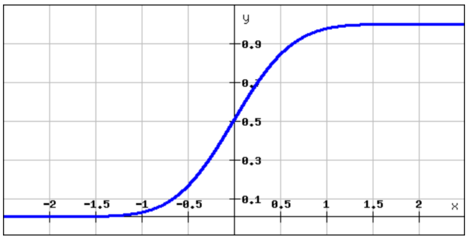

Figure 1: $y=f_{ec}(x)/\Delta E$, $\sigma=0.5$

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 in a manner similar to the first particle, in a step function manner, and the paragraphs above can be formulated as if the second particle is getting the energy from the first particle, or is losing it.

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 domain of the 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 Gaussian probability density function ($f_{ed}(x)=\Delta E*\exp(-x^2/(2*\sigma^2))$ / $\mathrm{sqrt}(\pi*2*\sigma^2)$) J/m (2), which is also called a "delta function", with $f_{ec}(x)=\int f_{ed}(x)dx$. If mapped over the Y axis, the function (2) shows the magnitude of the first particle's energy level change over the transient distance, 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: the function (2), without the ΔE multiplier, can be viewed as representing the spatial probability density function of a new particle. The 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.

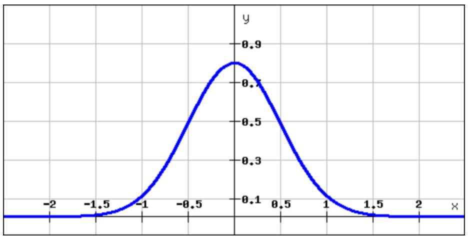

Figure 2: $y=f_{ed}(x)/\Delta E$, σ=0.5

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. 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 a free-standing formulation in 3-dimensional space, the "energy density function" of graviton is equal to:

$G_f(x, y, z)=\Delta E*W*\exp(-((x-x_0)^2/(2*\sigma_x^2) + (y-y_0)^2/(2*\sigma_y^2) + (z-z_0)^2/(2*\sigma_z^2)))$ 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); "W" – coefficient of energy proportionality; "$\sigma_x, \sigma_y, \sigma_z$" are coefficients of spatial proportionality, collectively they define the energy density symmetry, and may not be equal to each other, leading to an anisotropy and non-symmetry of the gravity force which can be hypothesized. In the simplest case, when the gravity force is isotropic, the "energy density function" of graviton is equal to:

$G(x, y, z)=\Delta E*W*\exp(-((x-x_0)^2 + (y-y_0)^2 + (z-z_0)^2)/B)$ J/m^3 (4). Where "B" is the coefficient of spatial proportionality.

Coefficients of spatial and energy proportionality may depend on ΔE, as demonstrated by X-ray continuum's shape dependence on energy in Bremsstrahlung, see below.

If required, the equation (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"). Other similar in sense step and delta function pairs can be used for better approximations.

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 in a particle accelerator a particle 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 the equation (1). The Fourier transform energy spectrum of (1) on the log scale falls by log(0.5)=~-0.6931 per doubling of the frequency (or “per octave”), fig.3, and is non-zero though not infinite on the linear energy spectrum scale, at zero frequency. A similar energy spectrum is demonstrated when Bremsstrahlung is 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.

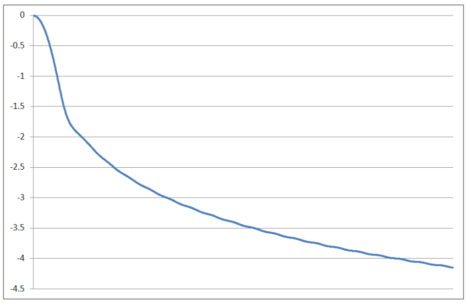

Figure 3: Normalized **log** cumulative energy spectrum of graviton near zero frequency (equals 0 at zero frequency). This figure shows an approximate slope on a linear frequency scale (horizontal axis).

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 area 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 $\Delta E=\Delta E_l+\Delta E_h$, where ΔE_l is the lower part and ΔE_h is the higher part (the X-ray frequencies) of graviton’s energy spectrum (the magnitude of ΔE_h is calculated in the spectral domain). The “leverage ratio” $\Delta E_h/\Delta E_l$ can be the function of ΔE.

Such $\Delta E_l+\Delta E_h$ sum representation of ΔE leads to a proposition that photons can be represented as gravitons without the ΔE_l (zero frequency) part. Then hypothetically, ΔE_h is oscillatory and equals to some sinusoidal function (or a sum of functions) on the complex plane; when ΔE_l is zero, equations (3) and (4) represent the “energy density function” of a photon, making it unable to directly affect kinetic energy of other particles in spatial domain, as will be shown below. On the macroscopic scale ΔE_h is usually equal to zero due to statistically-based absorption.

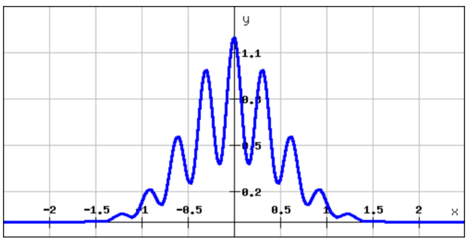

Figure 4: $y=f_{ed}(x)$, $\Delta E=1+\cos(x*20)*0.5$, $\sigma=0.5$
A free-form example of graviton’s “energy density function” in the case of X-ray Bremsstrahlung (real part).

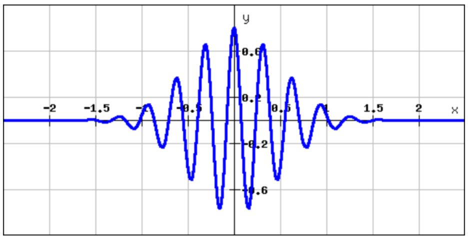

Figure 5: $y=f_{ed}(x)$, $\Delta E=\cos(x*20)$, $\sigma=0.5$
A free-form example of “energy density function” of a photon (real part), $\Delta E_l=0$.

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 a photon 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, it can be assumed that actually a whole continuum of photons is emitted in the event of Bremsstrahlung, which are then collectively blueshifted: if only a single photon instead of 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. 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.

Figure 3 shows graviton’s cumulative energy spectrum which manifests itself when graviton’s energy is cumulatively absorbed (e.g. by measurement equipment). Fourier transform of (2), the “energy density function” of graviton, has another, differential or delta, power spectrum, fig.3b. 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.

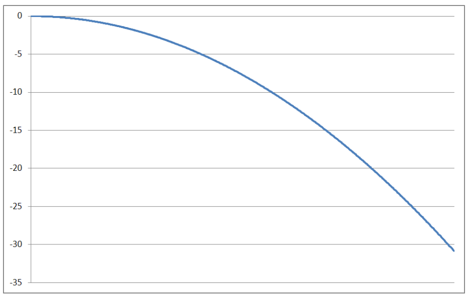

Figure 3b: Normalized **log** energy spectrum of the “energy density function” of graviton near zero frequency (equals 0 at zero frequency). This figure shows an approximate slope on a linear frequency scale (horizontal axis).

Graviton, having continuous cumulative and delta spectrums, and due to spectacular blueshift in the event of Bremsstrahlung, can be called the “rainbow particle”. This paper 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.

IV. Graviton's Field and The Energy Gain Equation

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 (1) 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 ($E_p' = E_p + \iiint G(x, y, z) * S_p(x, y, z) \mathit{dxdydz} * V_g(x, y, z)$) J (5) from this field, over particle's path (see below for continuous-time integral formulation); the triple integral's range includes the area surrounding the particle. G(x, y, z) is the equation (3) or (4), or similar in sense (e.g. a macroscopic variant that integrates individual gravitons of a large body). The scalar function $S_p(x, y, z)$ is proportional to particle's (or body's) spatial probability density function and bounds it in space. If the field moves relative to a particle, equation (5) is also applicable, and such situation must be seen as a part of the "inertial drag effect", see below.

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 plus an energy-proportional perpendicular vector of angular momentum of the macroscopic field, but on the microscopic (particle) scale the 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 is because otherwise function (2) in many cases will be discontinuous with its integral approaching zero; also the phase (or angle) of zero frequency ΔE_l 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. 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, and the fact that geodetic effect was measured, but there can be also statistical reasons for this, and reasons associated with a possible existence of the "inertial drag effect", see below. In a more general but rare and complex case, the function $V_g()$ must be formulated as a vector field integral.

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 until all energy of the field was transferred to the particle.

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, hence photon has net zero gravity field, but has an oscillatory "energy density function".

It should be also 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 equation (5) 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 equation (5), as separate terms. The non-linear effects usually attributed to the gravity force like redshift and time dilation can be a result of the energy gain equation (5) and do not need any specific modeling.

V. Macroscopic Gravity

On the macroscopic scale, the "energy density functions" (3) and (4), and the energy gain equation (5) must include additional multiplier members to scale up to the macroscopic numbers of particles, which is usually "mass". Equation (5), when transformed into a continuous-time kinetic vector-energy differential, is best expressed as integral of gravity field's "energy density function" G() over particle's <u>weighted</u> plane area (expressed as 2-dimensional probability density function perpendicular to particle's kinetic vector-energy), integrated over distance, with the distance differential depending on particle's kinetic vector-energy integral minus field's kinetic vector-energy (see fig.12 for a macroscopic example with field's kinetic vector-energy equal to 0), and finally multiplied by the vector function $V_g()$ of this field. Specifically, the plane area of a large massive body is equal to the sum of integrals of weighted plane areas of all its subatomic particles (weighted plane area spatially "dissects" a particle in two halves by 2-dimensional probability density function). Proposed unit for the plane area calculus is m^2/kg. Since today no standard values of the plane areas of atomic elements and celestial bodies exist, the plane area of a body must be expressed via mass, as will be shown below.

The following system of 2 differential equations models a "body-gravity field" interaction considering gravity field is created by a much larger body like planet.

$dP/dt=vel(E_p-E_f,M_p)$
$dE_p/dt=(\iint G()*S_p()dA)*|dP/dt|*V_g()$ (6); where "dP" is body's position differential, 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, "∬dA" – body's plane area integral, centered at body's position "P" and rotated in a way to be perpendicular to body's kinetic vector-energy integral "E_p", "dt" – time differential. |dP/dt| means that the energy gain on the microscopic (particle) scale does not depend on body's (particle's) and field's kinetic vector directions, but only depends on the travelled distance (direction of integration of a single graviton's "energy density function" does not affect the result). On the macroscopic scale the sign of energy differential depends on the "$V_g()$" vector function of the field that depends on body's position.

In the simplest macroscopic case (demonstrated in fig.12), "$S_p()$" is equal to 1 while G() is represented as an average integral value that depends only on the distance between field's center and a body. Note that the area "A" cannot be calculated as "mass divided by density divided by depth", since it refers to the sum of weighted plane areas of subatomic particles, not the average area of a body.

The function G() for the case of a large massive body can be expressed as $G(d)=Z_a*M_f/d^2$ (7), where "M_f" is the mass of the massive body (kg), "d" is the distance from the center of the massive body (m), "Z_a" is the plane area acceleration constant (m/s^2).

Since the plane area "A" of a small body cannot be expressed today via a formula, it has to be modeled via the known variables like the standard atomic weight. See the part XII for the solution of both "Z_a" and "A".

Equation (7) in overall is a "workable model", similar to the well-known gravity equation and well understood. Of course, it has a problem of infinity at zero distance. In a better equation, due to a finite number of gravitons in the field, this value must converge much like the spectrum of (1) converges at zero frequency (fig.3).

It should be noted that currently 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 "plane area" to be known, and makes it possible to calculate artificially-created gravity fields, not created by mass.

It can be hypothesized, that a curious identity $Z=m^{-1}s^{-2}$ (from Z_a/d^2) balances the perceived length of "meter" and duration of "second" inside a given point in the macroscopic gravity field relative to another point. For example, if gravity field's strength Z at the position A is equal to 4 ($m^{-1}s^{-2}$), and at the position B is equal to 1 ($m^{-1}s^{-2}$), equating "m" to 1 (meter) in both points, we get Ratio=sqrt(1/4)/sqrt(1/1)=0.5, which means 2 times faster time lapse on the macroscopic, statistical, scale at the position A for an observer at the position B. This can be 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, as will be described below.

In the case of Earth, $Z(d)=G(d)/M_f$ at the ground level equals to $\sim 1.69621*10^{-20}m^{-1}s^{-2}$,
Z at 500km altitude equals to $\sim 1.45857*10^{-20}m^{-1}s^{-2}$. This gives 7.84% slower statistical time lapse at 500km altitude in comparison to the ground, if the hypothesis is correct.

VI. Mass vs. Gravity Field

Note that 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), but it can be hypothesized that in a free-standing case the heavier atom may not have a gravity field proportional to its free-fall mass. It can be also hypothesized that gravity fields can be generated at will by electro-magnetic or plasma devices. Hence, the use of a known “mass” multiplier may be precise only in some cases as far as gravity fields are concerned. Unfortunately, today there may be no better alternative to “mass” since no publicly available and universally-accepted gravity field measurement method exists yet. It is a hope of the author that this paper gives an idea for such measurement method.

VII. Graviton’s Inertial Drag Effect, Photon’s Energy Gain

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 impulse trains 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 can be also 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 equation (5).

This hypothesis leads to a hypothesis of the “inertial drag effect” meaning that a particle with a considerably high kinetic energy drags a slower particle placed at a small distance from it by non-electromagnetic means. A slower particle may be dragged in the direction of the faster particle, but when a photon is dragged its velocity vector is preserved, as described further.

The photon having its ΔE_l=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 fast particle. The kinetic vector and position of the faster particle relative to photon’s vector specifies the sign of the energy gain of the “inertial drag effect” (blueshift or redshift). Alternatively, in a more general case, it can be hypothesized that in the case of <u>photon’s</u> energy gain, in equation (5) the <u>differential</u> 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 position and direction relative to a graviton (its gravity field). Hence, when photon is emitted along momentum, it gains energy, but when it approaches behind momentum, it loses energy; this makes the use of the $V_g()$ vector unnecessary in the case of photon, on both the microscopic and macroscopic scales.

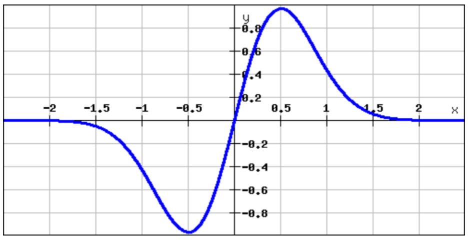

Figure 6: $y=f_{ed}(x)'/-\Delta E$, $\sigma=0.5$

If the "inertial drag effect" exists, several 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 equation (5). 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 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 "inertial drag effect".

VIII. Statistical Space-Time Curvature, Redefining Photon

This theory 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. A 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, only via particle's spatial probability density function 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 (see $Z=m^{-1}s^{-2}$ above) 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 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 theory, because "p" is momentum, a SI unit kg*m/s, which must be non-applicable to massless particles. Any situation when a deflection of photons by gravity field is hypothesized should be checked against a possibility of "gaseous matter" or "strong electromagnetic field" based deflection which may also change photon's frequency due to Doppler shifts. 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 contribute to black hole's huge gravity field).

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, this added and subtracted kinetic energy is not an abstract, formula-born, kinetic energy relative to some frame of reference, where it can be zero; this kinetic energy is absolute and relative only to the absolute speed of light. Hence, 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. The formula-born energy conservation balance of zero does not mean that the events of blueshifting and redshifting are not happening at all. Thus the method of measurement presented below should be realizable.

The formula 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.

IX. Absolute Kinetic Energy and Gravity Field Sensor

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. Any particle interactions that lead to an increased ambient energy spectrum around zero frequency can be hypothesized to be interacting with or via gravitons. Photon's red- and blueshifts, corrected for the Doppler shifts, 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 kinetic energy 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, corrected for the Doppler shifts. 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 1 more detector in the center of this formation, tuned to a slightly different resonant frequency than the other 3 in order to detect frequency change (fig.11). The plane area (weighted geometric cross section area) of photon should be known to calculate the gravity field's energy per cubic meter from photon's frequency change and distance. It is a hypothesis of this paper to assume that such plane area can be found if photon's energy is expressed via the "energy density function" which bounds spatial size of photon: photon's spectral line which is infinitely thin is spectrally convolved by the spatial probability density function yielding a "thicker" spectral line.

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. Doppler shifts due to the ambient temperature noise 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.

X. 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 300 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.
        const double sigmasq2 = 2.0 * sigma * sigma;
        return( DE * exp( -( x * x ) / sigmasq2 ) / sqrt( M_PI * sigmasq2 ));
}

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 = -2.0; // 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 < 300.0 )
        {
                v = vel( E, mass ); // m/s

                printf( "%f\n", 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.

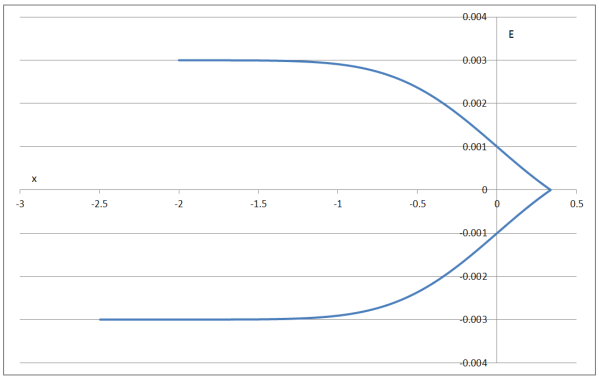

Figure 8: Integration of body's energy (E) and position (x) in the vicinity of graviton (x=0), see fig.7. The energy of graviton is not absorbed, because its change is higher (-0.004 J) than body's initial energy (0.003 J). The body "bounces back" and changes the sign of its velocity vector (represented as negative energy).

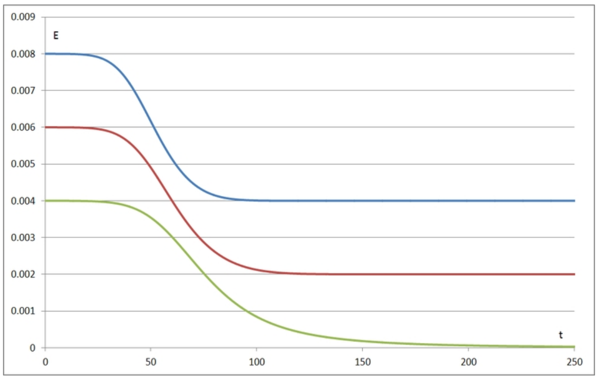

Figure 9: Integration of body's energy (E) over time (t) at various initial body energy settings (0.004 J, 0.006 J, 0.008 J), in the vicinity of graviton, see fig.7.

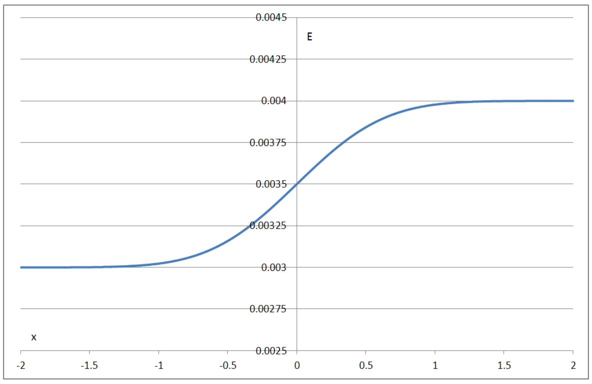

Figure 10: Integration of body's energy (E) and position (x) in the vicinity of graviton (x=0), with graviton's delta energy set to a positive value (0.001 J), see fig.7.

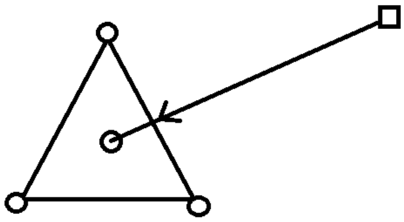

Figure 11: Scheme of absolute kinetic energy and gravity field's energy density sensor. Circles are photon detectors, rectangle is a photon emitter. Line with an arrow on it – the normal vector and the direction of photon pulse emitting.

XI. 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 Zr = 3.478557e-11; // Gravity field force constant, N/(m^2)
const double Za = 6.900223e-7; // Plane area acceleration constant, m/(s^2)

double fed( const double Fm, const double Fr, const double y )
{
        // Macroscopic "Energy density function" for a field of a massive body,
        // J/(m^3) or kg/(m*s^2)=Pa or N/(m^2)
        //
        // Fm - mass of massive body,
        // Fr - radius of massive body,
        // y - vertical position above the radius.
        const double d = Fr + y;
        return( Za * Fm / ( d * d ));
}

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 );
}

int main()
{
        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 = 100.0; // Initial body's Y position (above Earth's surface), m
        double Ex = 0.001; // Initial body's energy on X axis, J
        double Ey = 0.5; // Initial body's energy on Y axis, J
        const double mass = 1.0; // Body's mass, kg
        const double Fm = 5.9736e24; // Earth's mass, kg
        const double Fr = 6378.1e3; // Earth's radius, m
        const double A = mass * Zr / Za; // Body's plane area, m^2

        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;

        while( t < 10.0 )
        {
                double Vx; // m/s
                double Vy; // m/s
                vel( Ex, Ey, mass, Vx, Vy );
                printf( "%f\n", Py );

                double dEx = 0.0 * A * fabs( Vx ); // J/m * m/s
                double dEy = fed( Fm, Fr, Py ) * A * fabs( Vy ) * -1.0; // J/m * m/s
                        // The field vector Vg points down, hence multiply by -1.0.
                const double dPx = Vx; // m/s
                const double dPy = Vy; // m/s
                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;
                t += h;
                p2dEx = p1dEx; p1dEx = dEx;
                p2dEy = p1dEy; p1dEy = dEy;
                p2dPx = p1dPx; p1dPx = dPx;
                p2dPy = p1dPy; p1dPx = dPy;
        }
}
```

Figure 12: The "Body in Earth's gravity field" simulation program in C programming language.

XII. Solving "Z_a" and "A"

Equation (7) can be expressed via a form of force (N), as $G(d)=Z_f/d^2$ (10), where $Z_f=Z_a*M_f$. Such expression has an advantage, because we can assume that both "Z_a" and "M_f" are unknowns, and only their product is known.

It is also known that the approximate acceleration of 1-kg body, regardless of the number of atoms in it, on any given planet equals to $-6.67*10^{-11}*M_f/d^2$, where "d" is the distance from planet's center. This law of gravitational acceleration can be used as a comparative model.

The position differentials and energy (velocity) differentials of 1 kg body on a given planet at a given altitude should be ultimately equal between the comparative and this paper's models. The position differential equality condition can be excluded if in both models the position differential is expressed via the same energy-mass velocity function. Then only the energy differential equality is required ($dE_1=dE_2$).

$dE_1/dt=C_p*K_p*sqrt(2*|E_1|/M_p)*Z_f/d^2*-1$ (11)

$dE_2/dt=2*sqrt(|E_2|*M_p/2)*-6.67e-11*M_f/d^2$ (12)

The energy differential equality can be optimized this way, considering the initial energy of the body in both models is same; d^2 is also optimized out:

$C_p*K_p*sqrt(2)*sqrt(|E_0|/M_p)*Z_f*-1 = 2*sqrt(1/2)*sqrt(|E_0|*M_p)*-6.67e-11*M_f$

With M_p=1 kg (the mass of a small body):

$C_p*K_p*sqrt(2)*sqrt(|E_0|)*Z_f*-1 = 2*sqrt(1/2)*sqrt(|E_0|)*-6.67e-11*M_f$

Optimizing the parts, and balancing the minus sign, we get (note that Z_f/M_f should <u>not</u> be optimized out, because they are independent variables):

$C_p*K_p*Z_f = 6.67e-11*M_f$

Moving the known C_p (the number of atoms in a small body per kg) to the right part:

$K_p*Z_f = 6.67e-11*M_f/C_p$

This gives an equation with two unknowns. To solve it, it is necessary to form a system of equations, like this:

$K(Iron)*Z_f(Earth) = 6.67e-11*M_f(Earth)/C(Iron)$
$K(Silver)*Z_f(Earth) = 6.67e-11*M_f(Earth)/C(Silver)$
$K(Iron)*Z_f(Mars) = 6.67e-11*M_f(Mars)/C(Iron)$
$K(Silver)*Z_f(Mars) = 6.67e-11*M_f(Mars)/C(Silver)$

E.g. we can take a small Iron body with the mass 1 kg, that has $C(Iron)=1/(1.660538921*10^{-27}*55.845)=1.0783671*10^{25}$ atoms in it, as measured on Earth. This value is fixed, and is proportional to body's plane area, on all planets of the solar system. We can also take 1-kg Silver body, $C(Silver)=5.5828699*10^{24}$.

If each K() value is expressed as a ratio like K(Silver)=R(Silver)*K(Iron), and K(Iron) set to a constant value; and each $Z_f()$ value is expressed as a ratio like $Z_f(Mars)=R(Mars)*Z_f(Earth)$, and $Z_f(Earth)$ set to a constant value, this system of equations has a trivial solution:

The ratio between standard atomic weights of the elements is equivalent to the ratio between K values of the elements. So, knowing K value of one element, the K values of all other elements can be expressed.

Quite the same applies to the Z_f values: the ratio between masses of planets is equivalent to the ratio between Z_f values of the planets.

Then the formula for the "plane area" is as follows:

$A=C_p*K_p=X_a*M_p/(u*W_p)*(K_0*W_p/W_0)=X_a*M_p$, where "$W_p$" – relative atomic weight of the mass "M_p", "W_0" – relative atomic weight whose "K_0" is "known", "u" – unified atomic mass unit, "X_a" – coefficient of proportionality. "X_a" includes the "known" "K_0" and absorbs both "u" and "W_0" coefficients, and has the unit of m^2/kg. The value of "A" has an advantage in that it can be expressed via a direct measurement, not knowing the mass of a particle.

In a similar way the value of Z_f can be expressed:

$Z_f=Z_a*Z_{f0}M_f/M_0=Z_a*M_f$, where M_0 is the mass of planet whose "$Z_f=Z_{f0}$" is "known". "Z_a" includes the "known" "Z_{f0}" and absorbs the "M_0" coefficient, and has the unit of m/s^2. This equation is only applicable to particles that have mass.

As modeling and equation (11) show, the values of A ($=C_p*K_p$) and Z_f are multiplied, hence "X_a" and "Z_a" may have any magnitudes, but the ratio $Z_r=Z_a/X_a$ should be fixed to produce a correct result, this ratio is equal to $3.478557*10^{-11}$ $kg*m^{-1}s^{-2}$ or Pa, or $N*m^{-2}$. This value can be called as "the ratio between the plane area acceleration and the plane area per kg", or "the force applied by the gravity field to body's plane area". In a very general case, "Z_a" and "X_a" may not be tied to each other, and may depend on the atomic element, local- and cosmic-scale conditions.

In order to remain within "reasonable" range of values, the proposed value of Z_a is $6.900223*10^{-7}$ m/s^2. This value, when used in equation (7), gives the result of 101.3kPa, the standard atmospheric pressure at Earth's surface. Then the value of X_a is equal to $3.478557*10^{-11}/6.900223*10^{-7}=5.041224*10^{-5}$ m^2/kg. This gives the radius of the gravitational "plane area" of Platinum atom of about $2.28*10^{-15}$ (femto)meters.

The values of Z_a and X_a can be found precisely by measuring photon's energy gain in the gravity field over known distance and postulating photon's average plane area.