On The Gravity

(the "Rainbow Particle" theory) v.8

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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

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.

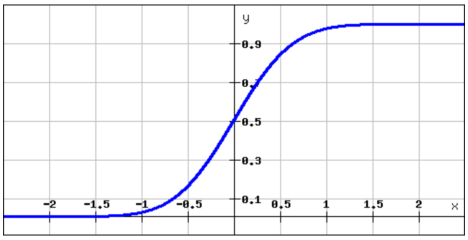

Figure 1: $y=f_{ec}(x)/\Delta E$, $\sigma=0.5$

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

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”. 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.

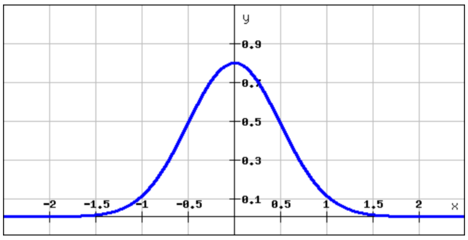

Figure 2: $y=f_{ed}(x)/\Delta E$, $\sigma=0.5$

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:

$E_{gf}(x, y, z)=\Delta E*A*\exp(-((x-x_0)^2/(2*\sigma_x^2) + (y-y_0)^2/(2*\sigma_y^2) + (z-z_0)^2/(2*\sigma_z^2)))$ 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); A – coefficient of energy proportionality; σ_x, σ_y, σ_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:

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

III

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.

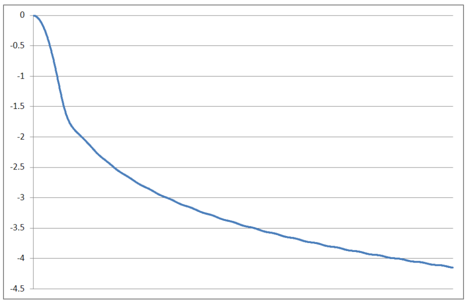

Figure 3: Normalized **log** cumulative energy spectrum of graviton near zero frequency (equals 0 at zero frequency). This figure shows an approximate slope on a linear frequency scale (horizontal axis).

However, if another 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 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, including the case of high-temperature plasma, ΔE_h is usually equal to zero due to statistically-based absorption.

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.

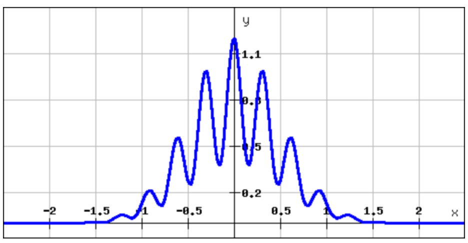

Figure 4: $y = f_{ed}(x)$, $\Delta E = 1 + \cos(x*20)*0.5$, $\sigma = 0.5$
A free-form example of graviton's "energy density function" in the case of X-ray Bremsstrahlung (real part).

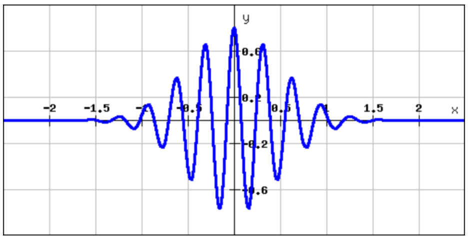

Figure 5: $y=f_{ed}(x)$, $\Delta E=\cos(x*20)$, $\sigma=0.5$
A free-form example of "energy density function" of a photon (real part), $\Delta E_l=0$.

Figure 3 shows graviton's <u>cumulative</u> 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.

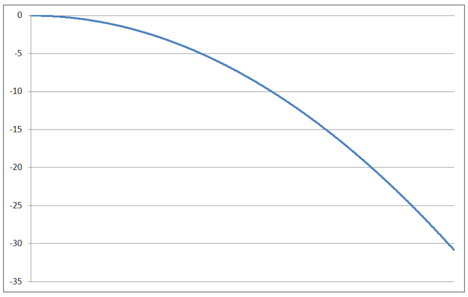

Figure 3b: Normalized **log** energy spectrum of the "energy density function" of graviton near zero frequency (equals 0 at zero frequency). This figure shows an approximate slope on a linear frequency scale (horizontal axis).

IV

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 ($E_p'=E_p+\iiint E_g(x, y, z)*D_p(x, y, z)\,dxdydz*V_g(x, y, z)$) 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. $E_g(x, y, z)$ 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 $D_p(x, y, z)$ 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 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 $E_g(x, y, z)$ 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 over 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

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". It can be hypothesized that gravity field's strength of a large massive body at a given point is proportional to its "energy density function" divided by its mass: $Z=J/(kg*m^3)=m^{-1}s^{-2}$. This identity multiplied by a plane area (m^2) yields m/s^2 which is field's plane area acceleration at the given point. Equation (5), when transformed into a continuous-time kinetic vector-energy differential, is best expressed as integral of gravity field's "energy density function" E_g (proportional to Z*mass) over particle's <u>weighted</u> plane area (expressed as 2-dimensional probability density function perpendicular to particle's kinetic vector-energy) and integrated over distance, with the distance differential depending on particle's kinetic vector-energy integral minus field's kinetic vector-energy (see fig.11 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. The (average) plane area of a large massive body is proportional to its mass (A=mass/density/depth), but, specifically, it 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).

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. If two bodies of comparable masses are interacting, this system obviously requires two additional similar differential equations dP_f/dt and dE_f/dt to include the law of motion of another mass.

$dP/dt=vel(E_p-E_f,M_p)$
$dE_p/dt=(\iint E_g*D_p dA)*|dP/dt|*V_g$ (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, $\iint dA$ – 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.11), D_p is equal to 1 while E_g is represented as average integral value that depends only on the distance between field's center and a body.

The function E_g for the case of a large massive body can be expressed as $E_g(d)=Z_a*M/d^2$, where "Z_a" is the plane area acceleration constant of the body, "M" is the mass of the body, "d" is the distance from the center of the body. Comparative modeling demonstrated that Z_a is unique for each celestial body, and does not vary much with the altitude. For Earth, Z_a is approximately equal to $6.73085*10^{-7}m/s^2$, Z_a(Mars)=~$6.75619*10^{-7}m/s^2$, Z_a(Mercury)= ~$6.75630*10^{-7}m/s^2$, Z_a(Venus)=~$6.73245*10^{-7}m/s^2$. Z can be found from equation $Z=E_g(d)/M$. In the case of Earth, Z at the ground level equals to ~$1.65458*10^{-20}m^{-1}s^{-2}$,
Z at 500km altitude equals to ~$1.42276*10^{-20}m^{-1}s^{-2}$.

It can be hypothesized, that the identity $Z=m^{-1}s^{-2}$ itself 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 <u>on the macroscopic scale</u> 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 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. The value of Z is probably unique for each atomic element, and in such case it can be called as "specific gravity field strength of an atomic element".

The previously mentioned proportionality of E_g to Z*mass means that E_g is at the same time equivalent to some kind of pressure in Pa. In the case of Earth model, E_g is equal ~99kPa near its surface, which is accidentally very close to the standard atmospheric pressure.

VI

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, with each atom and body requiring a specific value of Z to be defined for them. 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

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 and plasmas 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 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 (note that the photon having its ΔE_l=0 has no kinetic energy in terms of this paper while its potential energy is "conserved" as its frequency, which may undergo a shift in the vicinity of such fast particle). The drag on microscopic (particle) scale may not necessarily appear to be along the kinetic vector of the faster particle, and so the kinetic vector of the slower particle (or photon) may be preserved. The “inertial drag effect” of a macroscopic-scale field may be vector-adjusted. Since photon has zero net gravity field, it cannot “drag” other particles, and thus it can be said that photon has no kinetic energy.

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 “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 field causes a particle to absorb the energy of gravitons, thus contributing to the “inertial drag effect”.

If required, the equation (1) can be expressed via the Heaviside step function and the equation (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.

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

VIII

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.6 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"-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.

IX

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. 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 vector relative to a macroscopic gravity field). Any particle interactions that lead to an increased ambient energy spectrum around zero frequency can be hypothesized to be interacting with or via gravitons.

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 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 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 at a known distance 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 photon frequency change (fig. 10). The plane area (weighted geometric cross section area) of photon should be known to calculate the gravity field's energy per cubic meter (and then per kg) 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 can be 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 and measure gravity field's gradient vector, and also to reduce systematic measurement errors. Eventually, such systems can be embedded into hand-held devices together with accelerometers and magnetometers.

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 6: 1-D “body-graviton” interaction simulation program in C programming language.

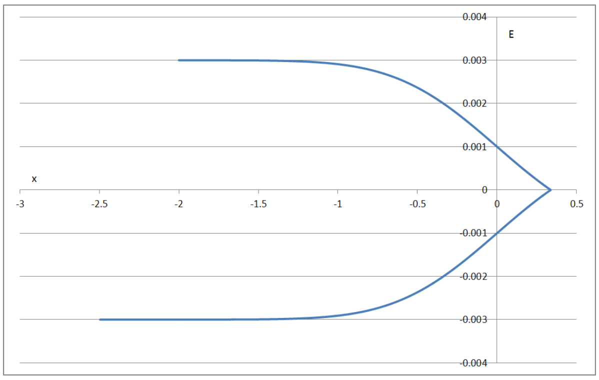

Figure 7: Integration of body's energy (E) and position (x) in the vicinity of graviton (x=0), see fig.6. The energy of graviton is not absorbed, because its change is higher (-0.004 J) than body's initial energy (0.003 J). The body "bounces back" and changes the sign of its velocity vector (represented as negative energy).

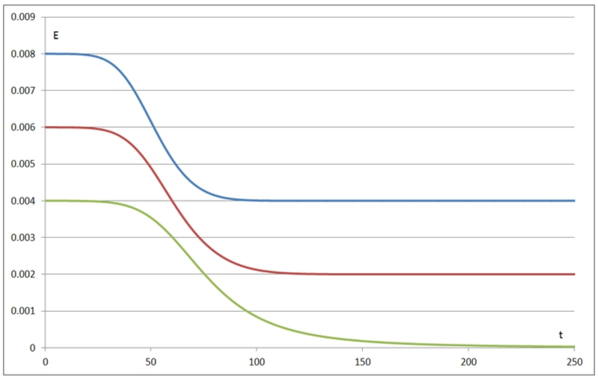

Figure 8: Integration of body's energy (E) over time (t) at various initial body energy settings (0.004 J, 0.006 J, 0.008 J), in the vicinity of graviton, see fig.6.

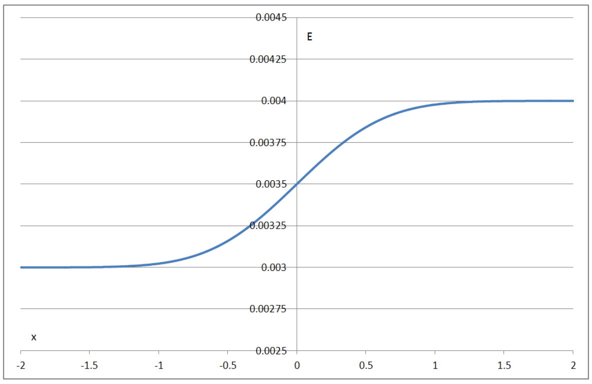

Figure 9: Integration of body's energy (E) and position (x) in the vicinity of graviton (x=0), with graviton's delta energy set to a positive value (0.001 J), see fig.6.

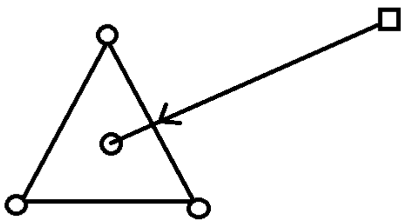

Figure 10: Scheme of absolute kinetic energy and gravity field's energy density detector. Circles are photon detectors, rectangle is a photon emitter. Line with an arrow on it – the normal vector and the direction of photon pulse emitting.

XI

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;

double fed( const double Fm, const double Fr, const double Za, const double y )
{
        // Macroscopic "Energy density function" for a field of a massive body,
        // J/(m^3) or kg/(m*s^2)
```

```
        //
        // Fm - mass of massive body,
        // Fr - radius of massive body,
        // Za - plane area acceleration 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 density = 19300.0; // Body's density, kg/(m^3)
        const double depth = 1.0; // Body's depth, m
        const double A = mass / density / depth; // Body's plane area, m^2
        const double Za = 6.73085e-7; // Earth's plane area acceleration, m/(s^2)
        const double Fm = 5.9736e24; // Earth's mass, kg
        const double Fr = 6378.1e3; // Earth's radius, m

        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 < 2.0 )
        {
                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, Za, Py ) * A * fabs( Vy ) * -1.0; // J/m*m/s
                        // Field's 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 11: The "Body in Earth's gravity field" simulation program in C programming language.