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WAVE GRAVITY

The Way towards Planck's Scale

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Abstract: Gravity phenomenon is observed as periodic and wavy by its nature. Wave function describing state of space encircling gravitodynamic vortex is being suggested. In the "strong field" area, a quantization of orbits should be quite natural and fully observable. That phenomenon is named as *gravitonium*. The so-called Resonance with de Broglie's wave arises as a natural. A direct consequence is the natural existence of Planck's values as the main quanta. Resonance observed there could be possible mechanism of mass creation. The whole concept leads to change of 20th century geometrization paradigm towards real wave-dynamic description of Universe.

Introduction

Theoretic physics of 20th century has opened many windows (quantum physics, theories of relativity, theories of field, etc.). In the beginning of the new millennium, certain conceptual confusion and cacophony of ideas is noticeable: Standard Model, Big Bang, opened issue of quantum gravity, nature of space and time, number and sense of higher space dimensions. Such list could easily be extended to almost all fields of modern physics. In all these theories, or in the alternative ones, main role is played by natural constants. Trying to associate gravity with quantum domain, it is always noticed [1] that three constants are in focus: light speed (c), Newton's gravity constant (G) and Planck's constant (h). But, these constants are, by rule, introduced arbitrary, in most of the cases, by a kind of pre-existence of Planck's values (r_p, t_p, m_p). This author has already commented [2] possible metaphysical background of analogous traditional insights. On indispensability of developing a *c-G-h physics* and about certain attempts towards it, it could be seen in [3]. As the matter of fact, we do not have it yet. Therefore, this work intents to pave a possible, natural road to this objective. Inherently wave-dynamic view to gravity phenomenon would serve us as starting point. The gravitodynamic basis of such view the author described in his work prior to this one [4]. The text to follow includes its extracts and further explanation.

1. Periodic nature of Gravity

The $\vec{B}_g$ (gravitomagnetic, co-gravitational, Coriolis- or gyro-like) vector is one of the main characteristics of every moving body (particle, flow, rotational system, vortex etc.), with an influence on a surrounding space. From the general theoretical assumptions explained elswhere [4,5,6], in case of spherical and rotating mass moving with uniform $\vec{v}$, follows

$$\vec{B}_g = H_{ae}\frac{\vec{J}}{r^3} \qquad (1.1)$$

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where $H_{ae} = G/c_g^{\,2}$ is the basic gravitodynamic constant (to the honor of O. Heaviside [6]); c_g is propagation-speed of gravitodynamic phenomena (the most simplest and symmetrical is $c_g = c$); $\vec{J} = \vec{L} + \vec{S}$, $\vec{L} = \vec{r} \times M\vec{v}$, M is source mass, $\vec{S}$ is spin angular momentum of the source, where is, *e.g.*, $r >> R$ and $\vec{r} \perp \vec{S}$. In order to understand better the nature of the field in question, a dimensional analysis of the (1.1) relation should be performed. The conclusion follows

$$\left[\vec{B}_g\right] = T^{-1} \tag{1.2}$$

The $\vec{B}_g$ - vector has dimensions of frequency. So, each space point around the motional mass is characterized by certain frequency. In a certain way, each point of the surrounding space vibrates. A simple description of that phenomenon of vibration could be given by the ordinary equation

$$\psi(t) = A\cos 2\pi(B_g t + \varphi_0) \tag{1.3}$$

The equation represents sort of harmonic oscillator and it is valid for the point around a source determined by the $\vec{r}$. Physically much more interesting could be the wave function

$$\psi(t, r) = A\cos 2\pi(B_g t - \vec{E}_g \vec{r} + \varphi_0) \tag{1.4}$$

or in mathematically more universal (complex) form [7]

$$\Psi_H = A\exp[2\pi i(\vec{E}_g \vec{r} - B_g t + \varphi_0)] \tag{1.5}$$

where $\vec{E}_g$ explicitly is

$$\vec{E}_g = -H_{ae} \frac{M}{r^2} \vec{r}_0 \tag{1.6}$$

The $\vec{E}_g$ vector is a "gravitostatic" part of a complete gravitodynamic interaction expressed trough the Lorentz-like force[i]

$$\vec{F}_g = \varepsilon \vec{E}_g + m\vec{v} \times \vec{B}_g \tag{1.7}$$

where passive gravitational charge ε must be some sort of energetic content[ii] of a test particle with mass *m*. Energy and momentum are the passiv gravitodynamic charges and all of that out of any "relativity theory"! Also, it is obviouse that $\vec{E}_g$ has physical dimensions of L^{-1}, which is sort of wave vector, *e.g.* $\vec{k} = 2\pi\vec{E}_g$. Considering (1.6) and last conclusion, an explicit form of a "disperse" wave function should be

$$\Psi_H = \Psi_{Ho} \exp[2\pi i \frac{H_{ae}}{r^2}(M\vec{r}_0 \vec{r} - \frac{Jt}{r})] \tag{1.8}$$

It is obvious that the proposed wave picture takes a more realistic meaning as we rich a "strong field" area, *e.g.*, when $r \to r_g = GM/c^2$. In that case, from the de Broglie-like condition for circular orbits $2r\pi = n\lambda_H$, assuming $\lambda_H = E_g^{-1}$, follows $r = 2\pi r_g / n$, where $6 \geq n \geq 1$ if $r \geq r_g$. So, classical "black hole" phenomenon must be fully reconsidered from this point of view. This author rather uses term *gravitonium*. The phase velocity of inhere proposed, say, *H*-waves obviously is

$$v_\varphi = \lambda_H \nu_H = E_g^{-1} B_g = \frac{J}{Mr} \tag{1.9}$$

which could be very interesting dynamic picture[iii]. On this way we must confront ourselves with an open question: The existence and real meaning of the waves in question. The *H*-wave could been seen as physically real, which means it satisfies the scalar wave equation

$$\nabla^2\psi_H - \partial^2\psi_H / v_\varphi^2 \partial t^2 = 0 \qquad (1.10)$$

or possibly more fundamental and general (Klein-Gordon)

$$\nabla^2\psi_H - \partial^2\psi_H / c_g^2 \partial t^2 = k_g^2\psi_H \qquad (1.11)$$

However, it seems that all of this guides to significant direction: *Gravitation is neither acceleration force nor geometry by its primeval nature*[iv]. Even the Faraday-Maxwell's field picture is on the surface of gravity phenomena only. Moreover, the physical field as a concept is fictional, very similar to XIX century's concepts of mechanical ether or phlogiston, for example. As a deeper level of understanding, the explained concept could be marked as a corner stone of one *wave gravitodynamics*. In a similar way, following harmonic oscillator equation (1.3) and wave function (1.4,5 or 8), we could expect a direct natural connection between two until now completely separate worlds – Quantum and Gravity.

2. The Resonance behind Planck's values

Knowing from the above general assumption that the masses motion causes in principle new qualities, the result is that the qualities have its own wave (periodical) characteristics – frequency and wavelength. The situation is to some extent analogue to de Broglie's postulate of the wave aspect of the substance [7,8]. That aspect was already formulated clearly in main relations for frequency

$$\nu = \frac{E}{h} \qquad (2.1)$$

and for wavelength

$$\lambda = \frac{h}{p} \qquad (2.2)$$

where *h* – Planck's constant . The frequency naturally appeared in the area of quantum and gravitation. This fact seems to be quite fundamental. A sort of resonance[v] could be postulated rightfully:

$$\nu = \nu_H\,, \qquad (2.3)$$

($\nu_H \equiv B_g$), which means a direct natural connection between the quantum and gravitation characteristics of the substance. If a substitution from the (1.1) and (2.1) relations into (2.3) one is made, than it is (in general case of two different particles)

$$\frac{mc^2}{h} = H_{ae}\frac{\vec{r}\times M\vec{v} + \vec{S}}{r^3} \qquad (2.4)$$

If $S = 0$ and $\vec{r} \perp \vec{v}$, when settled by the *r*, it follows

$$r = \left(\frac{GhMv}{c^4 m}\right)^{1/2} \qquad (2.5)$$

where negative root is skipped. The distance *r* is realistic and maximal when $v \approx c$ and $M >> m$. That case is just interesting for us and it means the greatest distance from the center of the mass *M* , where de Broglie's frequency of a test particle can not be differed from the extern B_g any more. Obviously, it is impossible for any smaller distances. If $S \neq 0$ and $v = 0$ then (in a simplified scalar form)

$$r = \left(\frac{GhS}{c^4 m} \right)^{1/3} \tag{2.6}$$

So the places of the "total resonance" of the particles are determined by the (2.5 and 6) relations. It is obvious that it leads to the strong G - area. Very important special case of (2.5) is $v = c$ and $M = m$. Within the "special relativity", this is the case of photon or generally all particles without rest mass. Nevertheless, from (2.5) directly follows fundamental length

$$r = \left(\frac{Gh}{c^3} \right)^{1/2} \tag{2.7}$$

which makes sense of deep quantum level of reality. First of all, r (2.7) is Planck's length r_P, if we use reduced $\hbar$ instead of h. Thus, in a certain way, this length is represented as basic length quantum.

Whole picture of resonance (2.3) might be seen from the viewpoint of a single body (particle). In that case, a particle does not need to relatively move ($v = 0$) at all, but to rotate only ($S > 0$). For radius, it is identical as (2.6), just S and m are now "eigenvalues". According to the author's understanding of the quantum objects world, Planck's constant has clear physical meaning of angular momentum. In other words and in accordance with Kanarev's view [14,15], h (*i.e.* $\hbar$) could be regarded as a pseudo-vector, *i.e.* as a source of B_g field. From (2.4) or (2.6) then follows:

$$r = \left(\frac{Gh^2}{2\pi c^4 m} \right)^{1/3} \tag{2.8}$$

Determining r in this way, it represents the position of a particle's resonance with its B_g vortex. For instance, electron (the smallest known mass) has $r \approx 10^{-28}$ m. If we rise a question for which mass the resonance radius is equal to Planck's length, then directly follows

$$m_P = \left(\frac{c\hbar}{G} \right)^{1/2} \tag{2.9}$$

which is Planck's mass. For all masses over the m_P, resonance would be produced in cases of radius being below r_P, so that it is legitimate to ask if it is certain distance limit. In the same line of reasoning, and within $\hbar$-angular momentum paradigm, basic gravitomagnetic frequency for r_P-level could be expressed as

$$\nu_P = \frac{G\hbar}{c^2 r_P^3} \tag{2.10}$$

Because of $\nu_P = t_P^{-1}$ it is obvious that

$$t_P = \left(\frac{G\hbar}{c^5} \right)^{1/2} \tag{2.11}$$

which is well-known Planck's time[vi]. Therefore, there is one more reason to regard herein-postulated gravity wave picture as deeply natural, opening the next theme of this paper.

3. Resonance and mass

The (2.4) relation is allowed by the above-mentioned explanation to be reinterpreted. To be clearer, it can be transformed into the following scalar form

$$m = \frac{Gh}{c^4 r^3} \left| \vec{r} \times M\vec{v} + \vec{S} \right| \tag{3.1}$$

where *m* now is the "mass of resonance". For simplification $S=0$, and because of crucial $m=m_o \exp(-r_g / r)$[vii] [4,16], follows

$$m = \frac{GhMv}{c^4 r^2}\exp(-r_g / r) \tag{3.2}$$

where $r_g = GM / c^2$. According to the known value ranges of the three fundamental constants, these relations are valid for $r=r_g$ and $v=c$ only. Hence,

$$m \approx \frac{ch}{GM} \tag{3.3}$$

The question could be, *e.g.*, what value must M be to generate, at a distance of its r_g, mass equal to an electron's mass. This, applied to (3.3), follows to

$$M_e \approx \frac{ch}{Gm_e} \tag{3.4}$$

where is, according to the value of the natural constants, $M_e \approx 3.27\times10^{15}$ kg. Also, it could be marked that the gravitational radius r_g of the M_e is identical to the electron's Compton-wavelength

$$r_g = \lambda_e = \frac{h}{m_e c} \tag{3.5}$$

Following same direction, it is possible to conclude that the smallest mass which can generate some other mass is Plank's mass, *i.e.* from (3.3), if $M=m_P$, follows $m_0 \approx m_P$. It is obvious that gravitational (or resonance) radius in this case must be Planck's length. Also, above results and conclusions gave us a possible connection between our *gravitonium* model and inner structure of elementary particles. The theme is fundamental one, but out of the scope of the article.

It seems that Nature guides to significant direction: the resonance phenomenon (2.3) is profoundly associated to mass generation. Very significant issue includes the existence of rest mass for "relativistic borderline" of $v=c$. It is generally accepted that such bodies (particles) do not have rest mass, being determined by Lorentz's γ - factor. According to the author's opinion, all of that is an ultimate simplification of the real world. All the restrictions of the "special relativity" are the consequence of limited scopes instead much wider dynamical one[viii]. This wider scope leads to the direction completely opposite to the established "general relativity" paradigm, *i.e.* opposite to any a priori *geometrization*.

So, to comprehend conditions and circumstances referring to the resonance (2.3), means to be able to understand the appearance of the mass (on mass problem see, *e.g.*, conceptual reviews [16,17]).

Conclusions

Dimensional analyses of gravitostatic ($\vec{E}_g$) and gravitomagnetic ($\vec{B}_g$) vectors shows that they have physical dimensions of wave vector (L^{-1}) and frequency (T^{-1}), respectively. Generality of those fields (all moving bodies, rotating systems, vortexes, etc.) leads directly to the original sort of waves (*H*-wave). Proposed wave picture takes a more realistic meaning in the "strong field" area , *e.g.*, when $r \to r_g = GM / c^2$. In that case, from the de Broglie-like condition for circular orbits $2r\pi = n\lambda_H$, assuming $\lambda_H = E_g^{-1}$, follows $r = 2\pi r_g / n$, where $6 \geq n \geq 1$ if $r \geq r_g$. This should be a fully observable phenomenon (the proposed term for it is

gravitonium). As frequency appears in both quantum and gravitation picture of the substance, the so-called Resonance with de Broglie's wave arises as a natural. Analyses of conditions and consequences of those resonances clearly and naturally leads to Planck's values (r_p, t_p, m_p). In the same manner, within given principles, it is possible to consider origin and genesis of mass. Crucial role of angular momentum as general source of all fundamental interactions is anticipated, too (see Notes vi). In wide perspective, all of this leads to foundation of real *c-G-h physics* or a concept of one general wave picture, which, apparently, has been fully hidden so far.

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Notes

[i] Classical vector gravity proposal is $\vec{F}_g = m\vec{G} + m\vec{v}\times\vec{B}_g$ [4,5,6]. But, this author returns himself to his early work on this theme [4], where the gravitostatic part of gravitational interaction explicitly was as in (1.6). Hence, directly follows $\vec{B}_g = \vec{v}\times\vec{E}_g$. This could be considered as a part of the "gravitational induction".

[ii] Newton's gravitational vector (acceleration) $\vec{G}$ is a "classical" approximation only, *i.e.* $\vec{G} = c_g{}^2\vec{E}_g$. From (1.6 and 7) directly follows a qualitative conclusion $\varepsilon = mc_g{}^2$! One can say that a real (gravito)dynamics stays behind the "relativistic" relation.

[iii] The proposed picture is not so far from the ideas [10,11] about dynamic and wavy character of Nature itself. Of course, *H*-waves must not be confused with transversal gravitodynamic waves [4,5] represented, *e.g.*, through the vector potential $\nabla^2\vec{A}_g - \partial^2\vec{A}_g / c_g{}^2\partial t^2 = 0$. Dispersion relation of *H*-waves should be reached trough the energy density relation $w_g = -\frac{1}{8\pi G}(\vec{G}^2 + c^2\vec{B}_g{}^2)$ [4,5,6].

[iv] Considering (1.2 to 5) we can say that gravitation phenomenon has something vibrational and wavy by its deepest nature. Starting from the quantum mechanics, Plotnikov [12] came to the similar conclusion, but it seems that our proposal starts from a deeper level and goes much further. Always inspiriting are thoughts of R. Boscovich about his "Unique Force Law" [13], where that force also possesses something deeply changeable.

[v] We use the resonance as a simple model, although an interference picture could be applied equally (and perhaps in a more adequate fashion). For the purpose of simplicity, here is used de Broglie's condition $m_0c^2 = \hbar\omega$ [7,8] (where phace velocity is $w = c^2/v$), although there could be much more realistic, say, Wesley's wave $\vec{p}\cdot\vec{v} = \hbar\omega$ with $w = v$ [9].

[vi] Using h as a pseudo-vector of angular momentum, it could be said that Planck's values are special case of the most universal law. For example, $r_J = (GJ/2\pi c^3)^{1/2}$ is sort of a basic length for every rotational (spinning) system throughout the entire Universe. Spin (rotation, total rotational momentum measuring by $\vec{J}$) must be accepted as the universal charge. The theme is fundamental one, but out of the scope of this article.

[vii] In the previous article (see *Addendum* in [4]) the exp-factor is derived from the "relativistic mechanics", *i.e.* from energy-mass equivalence $\varepsilon = mc^2$. But on the contrary, the author is able to show [18] how above proposed wave concept stays behind both the exp-factor and energy-mass equivalence!. Furthermore, still unknown gravitation mechanism is hiding behind dynamics of the exp-factor!

[viii] In this author's opinion (see in [4]), the Lorentz-Fitzgerald's γ-factor is special case of , say, χ-factor, *i.e.* $1/\sqrt{\exp(2r_g/r) - \beta^2}$. Obviously, when $r_g/r \to 0$ then $\chi \to \gamma$. Behind χ -factor should be one general Electro-Gravitodynamics, or as more fundamental, the unified wave picture of micro- and macrocosms. We can see that so-called "special relativity" limitations are wrong *per se*.

For instance, because of $\exp(2r_g / r) \geq 1$, it is quite possible to be $\beta^2 \geq 1$. The conclusion follows: *Speed of light is not any kind of barrier at all.*

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