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Wave Dynamics of Quantum Gravity-Space

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Abstract: Gravity-Space phenomenon is observed as unique, wavy, nonlinear and even a-temporal by its nature. A wave function describing the state of space encircling a gravitodynamic vortex is suggested. Linear vector gravity would be a realistic linear approximation. In the "strong field" limits, a quantization of orbits should be quite natural and fully observable. That phenomenon is named *gravitonium*. Quantum gravitomagnetic resonance with de Broglie's wave arises most naturally from this. It could possible be the mechanism of mass creation, but of gravitation as well. Questions of Lorentz symmetry, gravyphoton mass and "relativity limits" are considered in detail. The whole concept leads to change from 20th century field-geometry paradigm towards real wave-dynamic description of Universe.
Keywords: vector gravity, nonlinear wave gravitodynamics, gravitonium, quantum gravitomagnetic resonance, Planck scale, gravyphoton mass, Lorentz symmetry

Introduction

In the beginning of the new millennium, certain conceptual confusion and cacophony of working physical theories, models and ideas in general is noticeable: so-called Relativity Theories, Standard Model and Big Bang, opened the issues of quantum gravity, nature of space, time and mass, 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, the 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 arbitrarily, in most of the cases, by a kind of pre-existence of Planck's values (r_p, t_p, m_p). On indispensability of developing a *c-G-h physics* and about certain attempts towards it, it could be seen in [2]. In the matter of fact, we do not have it yet. Therefore, this work is intended to pave a possible, natural road to this objective. An inherently wave-dynamic view to gravity phenomenon would serve us as starting point. The gravitodynamic basis and a wider conceptual review of such theoretical picture was described by the present author in the previous works [3][4] listed in Ref. The text that follows includes its extracts and further explanation, especially in the context of recent considerations and findings.

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Wave nature of Gravity-Space

The $\vec{E}_g$ and $\vec{B}_g$ vectors are two part (say, gravitostatic/electric and gravitokinetic/magnetic, respectively) of a complete linear gravitodynamic interaction expressed through the Lorentz-like force

$$\vec{F}_g = \varepsilon\vec{E}_g + m\vec{v}\times\vec{B}_g \qquad (1)$$

where energy ε and momentum $\vec{p}$ are the "passive gravitodynamic charges" of a test particle with mass m and all of that out and before of any "relativity theory". Let us notice that the classical vector gravity proposal is $\vec{F}_g = m\vec{G} + m\vec{v}\times\vec{B}_g$, for details see in [3]. But, this author returns himself to his early considerations, where the gravitostatic part of gravitational interaction explicitly was as in Eq. (1). Hence, directly follows $\vec{B}_g = \vec{v}\times\vec{E}_g$. This could be considered as a part of the "gravitational induction". Therefore, classical gravitational vector (acceleration) $\vec{G}$ is a misleading approximation only, *i.e.* $\vec{G} = c_g{}^2\vec{E}_g$. The $\vec{E}_g$ explicitly is

$$\vec{E}_g = -H_{eg}\frac{M}{r^2}\vec{r}_0 \qquad (2)$$

where $H_{eg} = G/c_g{}^2$ is the basic gravitodynamic constant (to the honour of O. Heaviside, see Ref. in [3]); the most simplest and symmetrical is $c_g = c$; *c* is light speed. Moreover, even the *c* as "speed" this author see as a kinematical simpflication, i.e. strictly speaking, it should be $H_{eg} = G\varepsilon_0\mu_0$ (ε_0 and μ_0 are dielectric constant and magnetic permeability of vacuum, respectively), which draws a deep conection between one electrogravity and the space itself. Only our habit, or too easily accepted paradigm "gravitation as acceleration" hides from us the real physical meaning of H_{eg} (clearly saying, *G* and *c*, in this scope, are both only "parts" of H_{eg}). From the well-known values of the natural constants [4], follows

$$H_{eg} = 7.419\text{e-}28\ \text{kg}^{-1}\text{m} \qquad (3)$$

Let us notice that physical dimension of time plays no role in H_{eg}. If we look closely at Eqs. (1) and (2), obviously follows a qualitative conclusion: for passive gravitostatic charge has to be $\varepsilon = mc_g{}^2$ (or, following authors basic insights into the nature of gravity-space, $\varepsilon = m\varepsilon_0\mu_0$). One can say that the famous "relativistic" relation is caused by a real gravitodynamics. Also, it is obvious that $\vec{E}_g$ has physical dimensions of L^{-1}, which is sort of wave vector, *e.g.* $\vec{k} = 2\pi\vec{E}_g$. Far reaching consequences of these findings will be explored through the next lines of this work.

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 [3], in the case of a spherical and rotating mass moving with uniform $\vec{v}$, follows

$$\vec{B}_g = H_{eg}\frac{\vec{J}}{r^3} \tag{4}$$

$\vec{J} = \vec{L} + \vec{S}$, $\vec{L} = \vec{r} \times M\vec{v}$, 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 (4) relation should be performed. The conclusion is

$$\left[\vec{B}_g\right] = T^{-1} \tag{5}$$

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. On Earth's surface for instance, and considering well-known planetary parameters should be $B_g \approx 10^{-14}$ Hz (recently Nduriri [6] calculates for Earths' poles exactlly $B_g = 1 \cdot 10^{-14}$ Hz).

In a way, this author accepted all this as a clear cosmic hint: The $\vec{E}_g$ and $\vec{B}_g$ vectors have physical dimensions of wave vector (L^{-1}) and frequency (T^{-1}), respectively. As a deeper level of understanding, the explained insight could be marked as a corner stone of one general wave stereodynamics. Let us express a basic mathematical shape of such a picture.

Nonlinear wave gravitodynamics

If we openly accept previously described insights, then the following mathematical step (wave function) should be fully justified

$$\psi(t,r) = A\cos 2\pi(B_g t - \vec{E}_g\vec{r} + \varphi_0) \tag{6}$$

or in a more general (complex) form [7]

$$\Psi_H = A\exp[2\pi i(\vec{E}_g\vec{r} - B_g t + \varphi_0)] \tag{7}$$

According to (2) and (4), an explicit form of a "disperse" wave function is

$$\Psi_H = \Psi_{Ho}\exp[2\pi i\frac{H_{eg}}{r^2}(M\vec{r}_0\vec{r} - \frac{Jt}{r})] \tag{8}$$

The phase velocity of inhere proposed, say, *H*-waves of gravity-space obviously is

$$v_\varphi = \lambda_H \nu_H = E_g^{-1} B_g = \frac{J}{Mr} \tag{9}$$

which could be a fundamental dynamic picture. Of course, *H*-waves must not be confused with transversal gravitodynamic waves 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 could be reached through the

energy density relation $w_g = -\frac{1}{8\pi G}(\vec{G}^2 + c^2 \vec{B}_g{}^2)$ [3] (physically, it would be a direct link between linear vector gravity and this *H*-wave picture). However, 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 be seen as physically real, which means it satisfies the scalar wave equation

$$\nabla^2 \psi_H - \partial^2 \psi_H / v_\varphi^2 \partial t^2 = 0 \tag{10}$$

or possibly more fundamental and general (nonlinear Klein-Gordon)

$$\nabla^2 \psi_H - \partial^2 \psi_H / c_g^2 \partial t^2 = k_g^2 \psi_H \tag{11}$$

Mentioned nonlinearity leads to the obvious mathematical difficulties (*e.g.*, the quantization is a complex issue because there is no exact superposition principle [9], which also could be in a contradiction with vector addition in the supposed picture) but on the other side, it clearly puts this entire picture in so natural and promising dynamic perspective. Or in words of S.N. Arteha [10]:

> "I believe that properties of the Universe are principally nonlinear and superposition is an approximate principle, but not precise one; electromagnetic and gravitational forces cannot act on infinite distance with the dependence $1/r^2$ - it is an approximate expression only."

Assuming $k_g \approx H_{eg} \frac{M}{r^2}$ and speaking more "quantum-mechanically", for time-independent case, Eq. (11) got an interesting exponential, but still nonlinear form [7][8]

$$\Delta \psi_H = k_g^2 \psi_H \tag{12}$$

Let us examine how possible solving of Eq. (12) depends on *r*-domain:

1. $r > r_g$; $r_g = H_{eg} M$.

This would be the case of week fields, *e.g.* planets, solar systems etc . Because $(r_g / r)^2 \approx 0$, Eq. (12) becomes well-known Laplace's equation

$$\Delta \psi_H = 0 \tag{13}$$

This domain is linear (superposition holds exactly) and it could be considered as classical vector gravity. According to Eqs. (6) and (7) it means that $\vec{E}_g \sim \nabla \psi_H / \psi_H$ and $\vec{B}_g \sim \partial \psi_H / \psi_H \partial t$ (let us note obvious similarity with Bohm's QM-potential considerations [9]). Equation of motion would be, considering Eq. (1), as follows

$$d\vec{p} / dt = \varepsilon \vec{E}_g + m\vec{v} \times \vec{B}_g \tag{14}$$

where momentum $\vec{p}$, besides its *v*-dependency, directly depends on G-potential as well, *i.e.* one χ-factor should play a crucial role (for details see the last chapter of this work, or in [3]). Harmonic functions ψ_H (scalar potentials in this scope), *i.e.* their solving from (13), strongly depend on boundary conditions. It is worthy to mention that Eq. (13) could be reached from (11), or even from (10), directly assuming $c_g \to \infty$. Constant [21] reached almost the same, but basis for his linear Klein-Gordon equation are physically different, *i.e.* he assumes $k_g = mc_g / \hbar$. Sort of a fundamental wave complementarity between these two pictures arises naturally. Also possible fundamental a-temporality of underlying space could be a consequence (recently, Sorlis [22] advocate similarly, but mostly as an assumption incorporated in the frame of GR's ether paradigm). Of course, this entire picture is basically different from classical force-field idea, that is, it is wavy and periodic by its nature. Therefore, we are expecting such phenomena even in this domain.

2. $r < r_g$

This domain is totally non-classical one (so-called a "black hole" inner-space). Highly nonlinear phenomena would be expected rightfully (*e.g.*, solitons as space-matter quantums). Coresponding nonlinear wave equation should be

$$\Delta \psi_H = (H_{eg} M / r^2)^2 \psi_H \qquad (15)$$

An interesting role of classical vector gravitomagnetism in this domain was investigated recently by Nduriri [6], especially the question of radiation through the *bipolar jets tunnels*. He concludes that due to the Lorentz gravitomagnetic force the matter escapes in space following a helicoidal trajectory. And

3. $r = r_g$

It seems that the proposed wave picture takes a more realistic meaning as we reach a "strong field" area, *e.g.*, when $r \to r_g$. In that case, from the de Broglie-like condition for circular orbits $2r\pi = n\lambda_H$, assuming $\lambda_H = E_g^{-1}$, follows

$$r = 2\pi r_g / n \qquad (16)$$

where $6 \geq n \geq 1$ if $r \geq r_g$. So-called "black hole" phenomenon must be fully reconsidered from this point of view. The present author rather uses term *gravitonium*. Corresponding wave equation would be

$$\Delta \psi_H = (H_{eg} M)^{-2} \psi_H \qquad (17)$$

with well-known general exponential solutions [7][8], *e.g.* for one-dimensional case $\psi_H(z)$

$$\psi_H(z) = \psi_1 \exp(-k_g z) + \psi_2 \exp(k_g z) \qquad (18)$$

where k_g in this case is $(H_{eg} M)^{-1}$. De Mess [23] reached recently very interesting findings for this domain, and all of that from the pure classical vector gravity perspective.

However, mathematical considerations aside, it seems that the main idea guides us in significant direction: *Gravitation is neither acceleration force nor geometry by its primeval nature*. 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. The Gravity-Space and its dynamics show itself behind phenomena. In a similar way, following its wave nature, we could expect a direct natural connection between two until now completely separate worlds – Quantum and Gravity.

Quantum-gravitomagnetic resonance and mass

Knowing from the above general assumption that the masses motion causes in principle new physical 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 [11]. That aspect was already formulated clearly in main relations for frequency

$$\nu = \frac{E}{h} \tag{19}$$

and for wavelength

$$\lambda = \frac{h}{p} \tag{20}$$

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 could be postulated rightfully:

$$\nu = \nu_H \tag{21}$$

($\nu_H \equiv B_g$), which means a direct natural connection between the quantum and gravitation characteristics of the substance. As a note, we use herein 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 $m_0 c^2 = \hbar\omega$ [11] (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 $w = v$ [12]. If a substitution from the (4) and (19) relations into (21) one is made, then it is

$$\frac{mc^2}{h} = H_{eg}\frac{\vec{r}\times M\vec{v} + \vec{S}}{r^3} \tag{22}$$

For simplification $S = 0$ and $\vec{r} \perp \vec{v}$, when settled by the m, "resonance" gives

$$m = \frac{GhMv}{c^4 r^2} \tag{23}$$

where m now is the "mass of resonance" (H_{eg} is expressed explicitly only from convenience; just passing away, let us note also combination of constants c^4/G or better stated c^2/H_{eg}, which is, in this author view, a very interesting fact but out of the scope of this work). This resonance has, in author's view, a clear physical meaning, *i.e.* every moving body produces a B_g-frequency in surrounding space, and then that space is able to vibrate under the same (but now quantum) frequency. A fundamental consequence of such a mutual influence would be natural appearance of mass. Therefore, mass is an expression of gravity-space dynamics.

It seems obvious that Eq. (23) becomes most realistic when a strong field domain is reached. According to the known value ranges of the three fundamental constants, and in "strong field" limits $r=r_g$ and $v=c$, it becomes

$$m \approx \frac{ch}{GM} \tag{24}$$

As an example, 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 (24), follows to

$$M_e \approx \frac{ch}{Gm_e} \tag{25}$$

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

$$r_g = \lambda_e = \frac{h}{m_e c} \tag{26}$$

Following same direction, it is possible to conclude that the smallest mass, which can generate some other mass, is Planck's mass $m_p = (c\hbar/G)^{1/2}$, *i.e.* from (25), if $M=m_P$, follows $m \approx m_P$. Or in reverse, if both masses are of Planck's values, then from resonance (23) follows $r=r_P$, where r_P is known Planck's length, *i.e.* $r_p = (G\hbar/c^3)^{1/2}$.

So, to comprehend conditions and circumstances referring to the resonance (21) means to be able to understand the appearance of the mass (on mass problem see, *e.g.*, conceptual reviews [14][15]). Furthermore, along the same line of conclusions should be seen so-called gravitational mechanism as well.

Wave gravity, Lorentz symmetry and gravyphoton mass

It seems that Nature guides us in significant direction: the resonance phenomenon (21) is profoundly associated with mass generation. A 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. Or in the words of Ellis and Uzan [16]:

> "The historical path was from electrodynamics to the demonstration that the speed of light was constant (Michelson-Morley experiments) to the Lorentz transformation and the group structure of spacetime. Then it was realized from the study of relativistic dynamics that any particle with vanishing mass will propagate with the speed of light. But clearly, the speed of light c_em agrees with the universal speed, c_st, only to *within the experimental precision of Michelson-Morley type experiments (or put differently, the photon has zero mass only within some accuracy)* and the causal cone need not coincide with the light cone. If one were to prove experimentally *that the photon is massive then the standard derivation of relativity from electromagnetism would have to be abandoned*." (italics by this author).

Such an interesting attempt of "derivation of relativity from electromagnetism" (but out of photon's mass considerations and in the dynamical frame of the relativistic Newton's second law) seems to be shown recently by Hamdan [17]. Also an interesting and pretty general reconsideration of relativity paradigm (or much better, of mechanical relative motion) is made by Rybczyk [24], and in one semi-classical manner mostly. The state in the field (relativity-antirelativity debate) is very interesting one with a wide diapason of theoretical and heuristical approaches. Using the words of W. Babin, for example:

> "The logical contradictions evident in the kinematics of Special Relativity have been independently identified by a number of individuals since the original publication of the paper. Despite this, the theory remains operative through a perceived correspondence with experiments that pre-date, or were subsequent to its publication." [25], or "Since its publication, special relativity has survived countless attacks by critics who proved beyond doubt that it contained irreconcilable contradictions. To this date, no experiment either conceived or executed can be cited as definite proof of the theory. Only those experiments whose results were sufficiently vague and subject to wider interpretation have been adopted" 0

However, considering very important actual question of real existence of non-zero gravyphoton mass (the term itself is intriguing one and its main purpose is to show clearly a deep connection between space, gravity and light) and seeing a possible influence on the rest of physics, different authors [18][19][20] from very different reasons came to the possible limit for it, *i.e.* $m_{ph} \approx$ e-68 kg.

From author's earlier considerations (see 2nd chapter of [3]), the Lorentz-Fitzgerald's γ-factor is special case of, say, χ-factor, *i.e.* $1/\sqrt{\exp(2r_g/r)-\beta^2}$; $\beta = v/c$. Obviously, when $r_g/r \to 0$ then $\chi \to \gamma$. Behind χ-factor should be one general Electrogravito-Dynamics, or as more fundamental, the unified wave picture of micro- and macrocosms. In one previous article of this author (see for details in *Addendum* of [3], also independently Vankov, e.g. [14]) a fundamental exp-factor, $m = m_o \exp(-r_g/r)$, is derived from the relativistic dynamics, *i.e.* from energy-mass equivalence $E = mc^2$ and classical gravity energy. But in this scope it is a clear wave factor. Using the old phrasing, this entire wave gravity-space concept is not Lorentz invariant at all. 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 $\beta^2 \geq 1$, i.e. $v \geq c$. The conclusion follows: *Speed of light is not any kind of barrier at all*. So, all the restrictions of the "special relativity" are the consequence of limited, or even deeply erroneus kinematical/geometrical scope instead much wider dynamical one. This wider scope leads to the direction completely opposite to the established "relativity" paradigm, *i.e.* opposite to any a priori *geometrization*. Along the same line of conclusions is next one: *The*

gravyphoton could possess some rest/proper mass as a consequence not as an assumption. A mechanism of its creation nearby some known mass M, would be as is already described (through the "gravitomagnetic resonance"). As for the purpose of illustration, let us calculate such "mass gaining" nearby Earth's surface. As is already mentioned, on Earth's poles would be $B_g = 1 \cdot 10^{-14}$ Hz. Following the resonance from Eq. (21), the gravity-space arround poles vibrates with same frequency, or explicitly

$$m_{gph} = hB_g / c^2 \qquad (27)$$

where m_{gph} is a pure quatnum-gravitomagnetic value, say "gravyphoton mass", in this case $m_{gph} \approx 7.37$ e-65 kg (compare it with above mass limit e-68 kg; also, it could be interesting for the reader to calculate the "resonance mass" for Sun, Sun-Earth, Earth-Moon, galaxy etc.). The same picture, according to this author, exists universally, so as on the totally oposite cosmic scale, *i.e.* for elementary particles as well. In case of an electron, using the adequate values [4] (although its radius is an open conceptual question and spin is in range of $\hbar$) we get for its "poles" $B_g \approx 10^{-16}$ Hz and for corresponding quantum-gravity mass $m_{ph} \approx$ e-68 kg! Let us state, one more cosmic hint.

To complete this entire wave-gravitodynamic picture, let it be mentioned that the above "mass-space resonance" has to be accomplished with the above mass G-potential dependence $m = m_o \exp(-r_g / r)$. That would be sort of "mass loosing". Therefore, considering the photon as a particle with the changeable mass, its semi-classical equation of motion also should be something like Eq. (14). An in depth analysis of it should, and hopefully will, be performed in a separate work.

Conclusions

Full acceptance and dimensional analyses of both gravitostatic ($\vec{E}_g$) and gravitomagnetic ($\vec{B}_g$) vectors show that they have physical dimensions of wave vector (L^{-1}) and frequency (T^{-1}), respectively. Its generality (all moving bodies, rotating systems, vortexes, etc.) leads directly to the original sort of waves (*H*-wave). Proposed nonlinear wave picture takes a more realistic meaning in the "strong field" area , *e.g.*, when $r \to r_g$. In that case, from the de Broglie-like condition for circular orbits $2r\pi = n\lambda_H$, 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*). Linear vector gravity would be a realistic linear approximation. 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, m_p). Within given principles, it is possible to consider origin and genesis of mass but so-called gravitational mechanism as well. In a wider perspective, all of this leads to foundation of one general cosmic wave picture, which, apparently, has been fully hidden so far. Or in other words, it leads to change of 20th century field-geometry paradigm towards real wave-dynamic and deeply holistic description of Universe.

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Above all: “In the beginning was the Word, and the Word was with God, and the Word was God.” John, 1.1

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References

[1] Duff J.M., Okun B.L., Veneziano G., Trialogue on the number of fundamental constants, JHEP03 023, (2002) physics/0110060
[2] Gorelik G., First Steps of Quantum Gravity and the Planck Values, Studies in the history of general relativity. [Einstein Studies. Vol.3]. Eds. Jean Eisenstaedt, A.J. Kox., Boston, (1992) p.364-379
[3] Turanyanin D., On Interaction of Motional Masses, Journal of Theoretics, Extensive Papers Section, (2004) www.journaloftheoretics.com
[4] Turanyanin D., Wave Gravity – the way towards Planck scale, General Science Journal, Papers section, (2005) gsjournal.net
[5] CODATA Values of the Fundamental Physical Constants, (2005) physics.nist.gov/constants
[6] Nduriri J.W., Unified field approach (Gravitomagnetism), General Science Journal, Papers section, (2006) gsjournal.net
[7] Crawford F., Waves, Mc Grow-Hill Book Co, (1968)
[8] Polyanin A. D., editor in chief, Linear and Nonlinear Wave Equations, EqWorld: The World of Mathematical Equations, (2004) eqworld.ipmnet.ru
[9] Bohm D., Causality and Chance in Modern Physics, foreword by L.V. de Broglie, London, Routledge & Kegan, in Serbian, Nolit, Belgrade (1972)
[10] Arteha S.N., Private communication (via e-mails) (2005/6) www.antidogma.ru
[11] Broglie L.V. de, Radiation — Waves and Quanta, Comptes rendus, Vol. 177, pp. 507-510) (1923) www.davis-inc.com
[12] Wesley P. J., Classical Quantum Theory, Apeiron, Vol.2 Nr. 2, (1995) redshift.vif.com
[13] Boscovich J.R., Theoria Philosophiae Naturalis, in Latin and Serbo-Croatian, Liber, Zagreb (1974)
[14] Vankov A. On Mass Problem in Relativistic Mechanics and Gravitational physics, (2003) philsci-archive.pitt.edu
[15] Okun. L.B., Photons, Clocks, Gravity and the Concept of Mass, arXiv.org, (2001) physics/0111134v1
[16] Ellis G.F.R., Uzan J-Ph., ‘c’ is the speed of light, isn’t it?, arXiv.org, (2003) gr-qc/0305099

[17] Hamdan N., A Dynamic Approach to De Broglie's Theory, Apeiron 12, p. 274-290, (2005) redshift.vif.com
[18] Vigier J.P., Relativistic Interpretation (with Non-Zero Photon Mass) of the Small Ether Drift Velocity Detected by Michelson, Morley and Miller, Apeiron Vol.4 Nr. 2-3, Apr.-July (1997)
[19] Tajmar M, de Matos C.J., Local Photon And Graviton Mass And Its Consequences, arXiv.org, (2006) gr-qc/0603032
[20] Sidharth B.G., Are We Observing Violations Of Lorentz Symmetry?, arXiv.org, (2006) physics/0602132
[21] Constant J., Einstein's Equivalence Postulate And Spacelike Waves, (2000) gravitation.coolissues.com/gwaves.htm
[22] Sorli A., Sorli I., A-Temporal Gravity, Electronic Journal of Theoretical Physics, No. 2:1-3, (2004) www.ejtp.com
[23] De Mees T., The Kerr-metric, Mass and Light-Horizons, and Black Holes' Radii, General Science Journal, Papers section, (2006) gsjournal.net
[24] Rybczyk J.A., Millennium Relativity, Different articles, also Private communication (via e-mails), (2006) www.mrelativity.net
[25] Babin W., A Theoretical Analysis of Sub-Atomic Particle Interactions, GSJ, (2000) gsjournal.net
[26] Babin W., Relativity Redux: The World Year of Physics, GSJ, (2006) gsjournal.net