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ON THE GRAVITATIONAL OF THE MOVING BODIES

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Abstract

A parallel between the situations in physics that emerged at the turn of the 19-20th centuries and at the turn of 20-21st centuries is presented. Hundred years ago, the most fundamental theory was Maxwell's electrodynamics which predicted the existence of waves. This presumed the existence of the non-observable ether which confronted with the problem of negative result of Michelson-Morley experiment. Currently, the most fundamental theory is Einstein's general relativity which predicted the gravitational redshift but confronted with the problem of flat rotation curves of spiral galaxies (and some other problems). Usually, it is solved by introducing the non-unobservable dark matter. Hundred years ago they introduced a new model for the description of physical reality – space-time with a new type of geometry, which became the basis of special relativity and allowed to get rid of the ether, to cope with difficulties and to predict new phenomena. Eventually, the solution of the general relativity equations led to new cosmological ideas. Now it is proposed to introduce a new model for the description of physical reality – the phase space-time with a new type of geometry, which is the basis of anisotropic geometrodynamics (AGD). It eliminates the need for dark matter in the interpretation of the observed rotation curves, explains the Tully-Fisher law, the observed dynamics of globular clusters and some problems of gravitational lensing. In AGD, where the gravitational force depends on the velocity of gravitating bodies to a greater extent than in the known theories, a model of the formation of arms and bars in spiral galaxies is suggested. Besides, there is a possibility for the negative gravitational lenses existence, which allows a new interpretation of the SN1a observational data. The use of AGD also leads to new cosmological ideas that can be considered along with the known ones.

Key words: gravitation, anisotropy, phase space-time, interpretation of observations, spiral galaxies.

1 On the gravitation of the moving bodies

This paper has a methodological character and is based on the material of the book [1]. There is an attempt to draw a parallel between how the situation in physics developed at the turn of the 19th-20th centuries and at the turn of the 20th-21st centuries.

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In the late 19th century, the most fundamental theory was Maxwell's electrodynamics. Its main achievement was the prediction of electromagnetic waves that were subsequently discovered in experiment. This theory assumes the existence of an unobserved medium – the luminiferous ether, which could serve as the absolute reference frame. The crucial problem faced by this theory was the negative result of Michelson-Morley experiment. In the late 20th century, the most fundamental theory was Einstein's general relativity (GRT) (here we won't deal with quantum theory and its fundamental nature). Its main achievement was the prediction of the gravitational redshift, which was later discovered and measured in the experiment with high precision [2]. A significant problem faced by this theory was the observation of the flat rotation curves of spiral galaxies (and some other observations). Generally accepted solution to these problems now lies in the assumption that there exists an additional specific source of gravity which in principle cannot be observed in the electromagnetic range – (nonbaryonic) "dark matter" , whose mass is several times the mass of all other observable matter for which the GRT has been successful. This dark matter is also different from the (baryonic) dark matter, which was mentioned by F. Zwicky, whose observations led to the conclusion that the mass of the cluster galaxies is insufficient to hold the cluster as a whole.

Let us recall briefly, what are the observations that are not consistent with the classical general relativity, ie, with the unmodified one that ignores the existence of invisible bodies. Rotation curve is the dependence of the orbital velocity (usually, of the velocity squared) of stars and gas in the spiral galaxy on the distance from its center. Calculations based on the Schwarzschild-Einstein-Newton approach lead to the conclusion that this velocity should vanish at the periphery of the visible disk of the galaxy. Meanwhile, the measured velocity appears to approach a constant value of the order of 10^{2075} m/s for all spiral galaxies, and it approaches this constant either from the top or from the bottom depending on the parameters of the galaxy. There is also an empirical Tully-Fisher law, which is the fact that the luminosity of a spiral galaxy is proportional to the 4th power of the orbital velocity of stars in the periphery (one can pay attention to the fact that in this case the luminosity is due only to the visible matter, ie, this pattern does not involve dark matter). There are specific features in the behavior of the globular clusters of stars in our own (also spiral) galaxy: their orbits that are in the planes that are close to perpendicular to the galactic plane, do not have the paradoxical features characteristic of the rotation curves; besides, the clusters are mainly present near the center of the galaxy, rather than at the periphery as they should according to Kepler law. Besides, the observed effect of gravitational lensing is sometimes several times greater than the calculated one (and this is also interpreted as a manifestation of the dark matter influence).

Compare the attempts to overcome the difficulties encountered hundred years ago and now.

Table 1. Attempts to overcome difficulties in the late 19th century and at the turn of 20-21st century

Table 1:

$19-20^{th}$ **century: why Michelson-Morley experiment gives a negative result?**	$20-21^{st}$ **century: Why does the form of the observed rotation curves contradicts the theory?**
1. There is an "ether dragging" effect produced by a moving body (Hertz) But then there should be no aberration which is observed. 2. We should use the "ballistic theory of light" (Ritz), ie speed of light is constant relative to its source, rather than to its receiver. But then the images of binary stars can not produce the observed pattern.	1. The expression for the Hilbert-Einstein action is unsatisfactory: (a) $f(R)$-theory (De Witt); (b) additional scalar field (Brans-Dicke); (c) asymmetric metric corresponding to the 5th fundamental interaction (Moffat); (d) scalar built with the help of the Weyl tensor. These and similar efforts have not led to the satisfactory agreement with observations. 2. The empirical MOND theory (Milgrom) gives the required agreement with experiment. But it contains an additional fitting constant and an arbitrary function. Its covariant version (Bekenstein) reduces to the introduction of an additional field.
3. All the moving bodies consist of charged particles and, therefore, suffer the "electromagnetic compression" in the direction of motion (Lorentz, Fitzgerald, Larmor). This assumption is based on the hypothesis of the existence of ether. It consistently explains the experimental results using the same formulas as special relativity. Even in 1913, Lorentz believed his theory to be applicable and advantageous. However, the direct measurement of ether parameters could not be performed.	**3.** There is "dark matter" in an amount of 3- 4 times the amount of visible matter. It does not take part in electromagnetic interactions (ie, absorbs and emits no electromagnetic radiation) and provides the observed dynamics. This assumption is based on the hypothesis of the existence of dark matter. It is not free from serious contradictions, but explains the experimental results and is currently accepted by the physical community. However, the direct measurement of the dark matter parameters cannot be performed.
**) All the attempts were focused on the search for physical causes. Mathematics and computation play a secondary, supporting role.*	**) All the attempts were based on looking for the flaws in mathematical environment. Physics and observations had only a catalytic role, but finally the scientists were forced to introduce a new entity whose effect cannot be considered a small correction to the observed structure of the world picture.*

Table 2:

20^{th} **century**	21^{st} **century**
Postulate: The speed of light does not depend on the motion of the inertial reference system. Hint: the negative result of Michelson-Morley experiment.	Postulate: the gravitational force is not Newtonian. Hint: the form of the observed rotation curves which is not consistent with the theory.
The relation between mathematics, physics, and measurement: the existence and motion of the instantly interacting objects in absolute space and time violates the causality principle. We should pass to the consideration of processes.	The relation between mathematics, physics and measurement: the physical space-time cannot be empty (there is no absolute observer in physics), therefore, Lorentz transformations should be generalized with account to the measurement procedure used to register the straight uniform motion; physical space-time cannot be both empty and curved, (if the usual GRT assumption that mass causes curvature is preserved); physical space-time cannot be isotropic (the influence of mass currents cannot be neglected). The relations between the measurement results and ideal objects should be balanced and kept consistent.
Result: A new model of reality - the "space-time" (requiring a new geometry) - is suggested. It is suitable for describing the observed physical phenomena and involves a new math.	Question: Could there be a new model of reality (possibly requiring a new geometry), which is suitable to describe the observed physical phenomena?

If we agree that in both cases, the situation is not satisfactory, then it is instructive to present the subsequent events in the form of Table 2.

Table 2. Assumptions and consequences of new theories in the early 20th and early 21st centuries.

The model known as the 4-dimensional space-time proposed by Minkowski in 1908 in order to describe the physical reality was unusual for that time. Poincare who expressed similar ideas back in 1904 thought it artificial and pointed out that the complexity of translating all of physics into a new language is so great that the game is not worth it. But in the end, this model being the result of interpretation of Einstein results [3] by Minkowski allowed to naturally maintain the preceding fundamental theory, ie Maxwell's electrodynamics, and to avoid the use of unobservable ether. Later it was developed in the process of its generalization to the accelerated frames and to the involving of gravitation.

In [4] it was also proposed to modify the existing model that is used to describe the physical reality, and in [1] this is discussed in detail. The guiding considerations were the equivalence principle, understood in exact accordance with its literal meaning, and Maxwell identity. Namely, if there is no possibility in principle to distinguish between gravitational forces and inertial forces in experiment, and the inertial force may essentially depend on velocity (for example, the Coriolis force), the gravitational force should explicitly depend on velocity too. It is impossible to exclude such dependence, because of the absence of the absolute reference frame. Analysis has shown that the usual kinds of dependence of the gravitational force on velocity like that in the higher-order expansions in GRT, or in the theory of gravito-electromagnetism (GEM), or in the framework of concepts related to the Kerr metric, are not satisfactory. Simultaneously, the geometric Maxwell identities give a formal basis both to electrodynamics and gravitation and have the same structure; this was noted by the researchers from the very beginning. In particular, this means that one must take into account the interaction of the test particle and the mass currents. In GEM this approach was used inconsistently, that is by the direct analogy. It can be shown that moving bodies produce an unavoidable effect on the gravitational interaction. We conclude that the dependence of the gravitational force on velocity mentioned above demands the introduction of an anisotropic metric, which indicates at the anisotropy of the geometric space which should be used to model the physical reality.

For such a model, it was suggested to consider the phase space-time

$$(x^0, x^1, x^2, x^3) \Longrightarrow (x^0, x^1, x^2, x^3, y^0, y^1, y^2, y^3) \tag{1}$$

where y^i represents the derivative taken along the trajectory $x^i = x^i(s)$ of the test particle. In the "physical" variables, this set of coordinates takes the form

$$\begin{aligned} (x^0, x^1, x^2, x^3, y^0, y^1, y^2, y^3) &\Longleftrightarrow (ct, x, y, z, c/H, v_x/H, v_y/H, v_z/H) && (2) \\ [c] &= m/s; [H] = s^{-1} && (3) \end{aligned}$$

where c is the familiar fundamental constant with the dimension of velocity, and H is a new fundamental constant with the dimension of inverse time. It should be noted that one of the 8 coordinates in the introduced space is constant, and thus, all the events in the 8-dimensional phase space-time take place on a 7-dimensional surface. The introduction and use of additional dimensions now have clear physical meaning, resembling the situation with the common (6-dimensional) phase space. The metric in the simplest case can be taken in a linearized form

$$\begin{aligned} g_{ij}(x, y) &= \eta_{ij} + \varepsilon_{ij}(x, y); \\ \eta_{ij} &= diag\{1, -1, -1, -1\}; \\ \varepsilon_{ij}(x, y) &= \zeta \xi_{ij}(x, y); \zeta << 1 \end{aligned} \tag{4}$$

where η_{ij} is Minkowski metric; $\varepsilon_{ij}(x, y)$ is a small anisotropic perturbation. A more rigorous description of the anisotropic space and its metric is given in [4],[1]. Generalized geodesic has the form

$$\frac{dy^i}{ds} + (\Gamma^i_{jk} + \frac{1}{2}\eta^{ih}\frac{\partial \varepsilon_{jk}}{\partial x^l \partial y^h} y^l) y^j y^k = 0 \tag{5}$$

where $\Gamma^i_{jk} = \frac{1}{2}\eta^{ih}(\frac{\partial\varepsilon_{hj}}{\partial x^k} + \frac{\partial\varepsilon_{hk}}{\partial x^j} - \frac{\partial\varepsilon_{jk}}{\partial x^h})$ is the Christoffel symbol, depending on y. After transformations and simplifications, we obtain the equations of motion (dynamic equations) in the weak field limit in the anisotropic space

$$\mathbf{F}^{(g)} = \frac{mc^2}{2}\left\{-\nabla\varepsilon_{00} + [\mathbf{v}, \frac{\partial\varepsilon_{00}}{\partial\mathbf{v}}] + \nabla(\frac{\partial\varepsilon_{00}}{\partial\mathbf{v}}, \mathbf{v})\right\} \tag{6}$$

or in the simplest case

$$\mathbf{F}^{(g)} = -\frac{mc^2}{2}\nabla\left\{\varepsilon_{00} - \frac{8}{c^2}(\mathbf{u}, \mathbf{v})\right\} \tag{7}$$

$$\mathbf{u} \equiv \frac{c^2}{4}\frac{\partial\varepsilon_{00}}{\partial\mathbf{v}} \equiv [\Omega, \mathbf{r}] \tag{8}$$

With these and similar relations, one can get a number of theoretical results corresponding to the observations. Before giving a short list of them, we emphasize two points. First, the theory in question, which can be naturally called the anisotropic geometrodynamics (AGD) is directly reduced to GRT in the limit of small scales (star, planet system), ie small mass currents, and all the known results on these scales are preserved. Second, in the galactic scale, the old model of a source of gravity – the point or spherical object – is not suitable, because it does not take into account the effect of mass currents. New model of an elementary source is the "center plus current" system (CPC), that is a "charge, surrounded by a circular loop with current", it takes into account the corresponding term in the expression for the force. It is this model that should be used for the calculations associated with spiral galaxies. The main results are the following:

1. Now the theoretical rotation curves give two extreme values of the orbital velocity – zero and constant, which corresponds to a flat curve.
2. The process of evaluation of this constant value leads to the Tully-Fisher law.
3. The description of the globular clusters motion in orbits outside the galaxy plane does not require additional components because of the form of new terms in equations (5-6), and, therefore, remains Keplerian.
4. As shown by numerical calculation, the trajectory of a test body in the field of CPC allows its motion in the vicinity of the center at the same terms as at the periphery.
5. The choice of the speed of light as the fundamental constant, c and the Hubble constant as the fundamental constant, H leads to numerical estimates of the theoretical results corresponding to the observations. On the other hand, the well-known but unexplained closeness of the empirical constant in MOND theory to the product, cH of the fundamental parameters of the 8-dimensional phase space-time becomes nonrandom, because in AGD this value defines the range of applicability of the theory.
6. Light bending during the passage of CPC with the specified orientation greatly exceeds the bending produced by the corresponding spherical mass. This explains the quantitative differences arising with the direct observation of some gravitational lenses.

Thus, these results satisfactorily describe the observations mentioned in the beginning and do not require the introduction of dark matter, because they are based on a different model used to describe the physical reality. The mentioned approach also allows AGD to obtain some other interesting results:

7. For the gravitational lenses in the case of profile orientation relative to the source, a formula for the Khvolson-Einstein "radii" in the form

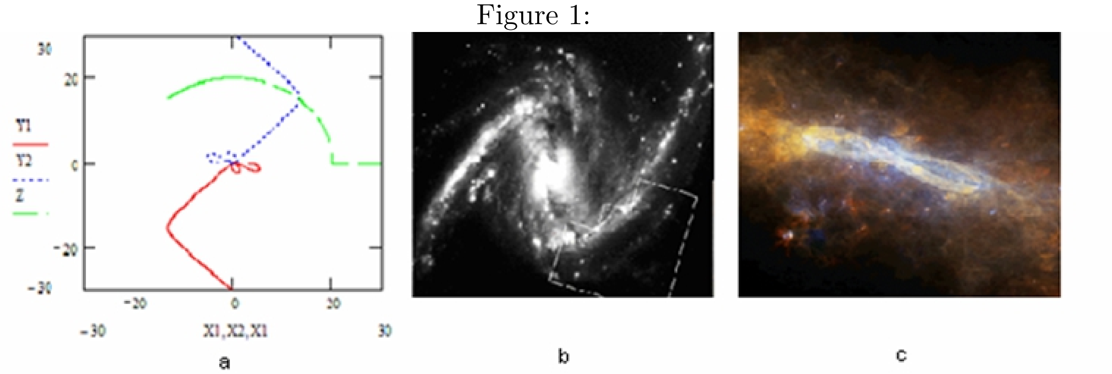
$$\xi_{1or2} = 4\xi_{Hv-E}\frac{\xi_{Hv-E}}{r_S}\frac{V_{eff}}{c}\left[\pm 1 + \sqrt{1 + \frac{c^2}{V_{eff}^2}\frac{r_S D_s}{32 D_{ds} D_d}}\right]$$

can be obtained. Applying it, for example, for such a known system, as Einstein Cross, we see that the result is consistent with observations [5].

8. If the lens is a spiral galaxy, and the light source belongs to it, AGD permits the existence of a concave gravitational lens, which is the result of two successive deflections in the field of CPC. This means that the observable distance to this source would be overestimated. If this source is used as standard candle (a type 1a supernova), then its redshift will contradict the linear Hubble law, although this will not prove the acceleration of the Universe expansion.

9. Calculation of the explosion of the central body in the CPC model, resulting in the release of two equal masses in opposite directions in the plane of the coil leads to trajectories that resemble well-known observations obtained with the aid of the telescope "Hubble" (see Fig. a) and b)), and those received recently by the space observatory 'Herschel' [5] by photographing the center of our galaxy (see Fig. a) and c)). This allows to suggest a new approach in the study of the origins of the arms and bars, characteristic to the majority of spiral galaxies.

Figure 1:



a) Numerical calculation (the exact view of central details depends on the step of calculation but they remain always present
b) Galaxy NGC-1365 (Hubble telescope, NASA/ESA)
c) Details discovered by Herschel orbital observatory in the center of Milky Way (to appear in ApJ)

10. There is a possibility of direct measurement of the space anisotropy due to the mass currents in our galaxy. It is related to the study of the effect of optic-metrical parametric resonance, which manifests itself in the appearance of a specific signal in the radiation of cosmic masers. It is due to the action of periodic gravitational radiation sources like close binary star systems on the cosmic maser radiation. The corresponding theory [7] and the first encouraging results [8] are also discussed in detail in [1].

Table 3:

The beginning of the 20^{th} century	**The beginning of the 21^{st} century**
The deep penetration of the mathematical ideas associated with the new model of intuitive notions of space and time, ie 4-dimensional space-time (Riemannian geometry, group theory, etc.) into physics.	The mathematical ideas associated with the new model of intuitive notions of space and time, ie with (7 +1)-dimensional phase space-time.
The emergence of the gravitation theory (GRT) and the emergence of "exact solutions"	AGD theory as a generalization of GRT
Cosmological consequences of the "exact solutions" of equations of GRT and the corresponding interpretation of observations: the existence of black holes, the existence of unobserved dark matter, non-stationary (expanding) Universe and the Big Bang, the Universe's expansion acceleration due to the dark energy associated with the interaction of repulsion.	Cosmological implications of the theory of AGD and corresponding interpretation of the observations: turbulent Universe consisting of baryonic matter and presenting interacting vortices of various scales.

Let us examine further the parallel related to the development of relevant theories in the early 20th and 21st centuries, see Table 3.

Table 3. Investigation of the theories that have emerged in the early 20th and 21st centuries.

Mathematical ideas associated with the emergence of special relativity and general relativity are well known. We list, therefore, only the relevant circumstances relating to the AGD. Note also that the presence in the theory of an additional fundamental parameter $l = c/H$ with the dimension of length and the existence of a coordinate that has a constant value, immediately brings to mind a set of associations with the well-developed sections of the GRT and related theories.

1. Riemann geometry is insufficient to describe the anisotropic space. One should consider using the geometries of Finsler, Lagrange and others. In particular, in the AGD the generalized Lagrange geometry was used.

2. The phase space-time can be naturally represented in the form of various sums of subspaces, previously studied. Thus, the subspace corresponding to the coordinates (x^0, x^1, x^2, x^3) is the *usual space-time* with the coordinates on the main manifold endowed with Riemann geometry. Subspace corresponding to the coordinates $(x^0, y^0, y^1, y^2, y^3)$ is used in the theory of high-energy particles, it is called the *relativistic velocity space* and is effectively described by hyperbolic Lobachavsky geometry. Subspace corresponding to the coordinates $(x^0, x^1, x^2, x^3, y^0)$, corresponds to the classical *de Sitter space* that contains the fundamental parameter with dimension of length. It is used when discussing cosmological problems, including recently acknowledged one that deals with the identifying of the relation between the constant radius of curvature with the cosmological constant and dark energy.

3. As indicated in Table 2, Lorentz transformations should be generalized in such a way as to move from the imaginary motions to the measured ones, ie to eliminate the uncertainty associated with the state of motion of the observer. As shown in [9], the generalized Lorentz transformation, which preserves the observed constant motion, must contain some fundamental length, ie just one new parameter, which originated in the AGD.

4. It should be noted that the most general group of transformations [10] also contains a fundamental constant with the dimension of length, and it is the de Sitter group corresponding to the transformation $x'^{\mu} = \frac{L^{\mu}_{\nu} x^{\nu} + a_{\mu} x^{\nu}}{1 + l^{-1} b_{\mu} x^{\mu}}$(where a_{μ} and b_{μ} are dimensionless). Note also that the corresponding homogeneous group does $x'^{\mu} = \frac{L^{\mu}_{\nu} x^{\nu}}{1 + l^{-1} b_{\mu} x^{\mu}}$not preserve Minkowski space interval.

Thus, in the approach used in AGD, all these motives are naturally connected with each other due to the use of (generalized Lagrange) geometry of the 8-dimensional phase space-time. This, in particular, means that when considering the situations and problems in the spaces of lower dimension, ie within only a projection of an 8-dimensional phase space-time, there may be additional problems and difficulties, and we see that this is just the case we have. It is also known the requirement for the general approach in classical dynamics, which stresses [11] the need to move from the configuration space to the phase space. In the first of them, the initial and current particle positions are regarded, while the points of the second are the *states* of the particles that are given by pairs {position, velocity}. AGD corresponds to a relativistic generalization of this approach.

Let us point out the causes that led to the inconsistencies between the classical solutions of the GRT equations and the observations on the galactic scale. They are related to the overestimation of the role of exact solutions of mathematical problems and to the underestimation of the physical setting of the latter. A more detailed discussion of these issues is given in [5] and in [1], here we only note that the solutions of the field equations were carried out in isolation from the equation of a geodesic. Namely: an analysis of the possibility of verifying the boundary conditions used was not performed; no attention was paid to the existence of two kinds of problems – external and inner ones; no analysis of their applicability to various physical situations was done and, consequently, the lacing problem for their solutions was not discussed; and more recently – in connection with an interest in the cosmological constant – there are misleading speculation on the evaluation of the approach made by Einstein, who used it first. It is sometimes argued that Einstein spoke of it as of "the greatest mistake of his life" in connection with the observations of the Hubble interpreted as confirmation of the theory of non-stationary Friedmann Universe. However, Einstein pointed out simply the instability of the corresponding solutions of the field equations with cosmological constant.

It should be noted that A.Einstein himself, and V.Fock, paying tribute to the beauty of the mathematical results, preferred approximate but physically more grounded solutions to the corresponding equations. In AGD we also consider a linear approximation, and it is important to emphasize that in this approximation, the form of field equations is the same as in GRT [12], and only the Christoffel symbols begin to depend on yi.

Finally, we discuss the cosmological consequences that follow from the GRT and from the AGD. Of concepts that arose on the basis of general relativity and that were accompanied by the appropriate interpretation of some observations (see Table 3), the Big Bang is most difficult to deal without, it is an essential element of the hypotheses that in the earliest stages the matter constituting the Universe was in a state of thermal equilibrium. The latter is confirmed by the COBE satellite with amazing accuracy. All the rest effects mentioned in Table 3, despite their avowed character, have internal contradictions and alternatives. When using the internal Schwarzschild problem for the modeling of massive homogeneous spherically symmetric objects, the appearance of black holes may not be possible [1],[5],[13]. The hypothesis of dark matter turns out to be unnecessary in the AGD. Linear Hubble law can correspond both to the uniform expansion of the Universe (Doppler effect) and to the gravitational red shift due to the tangential motion of the remote parts of the Universe as it follows from AGD. Deviation from linearity in the Hubble law in the observations of SN1a may correspond to the acceleration of the Universe expansion, but may be also due to the scatter of the tangential velocities of remote parts of the Universe containing these sources, or to the incorrect determination of the distances to them associated with the effect of concave gravitational lenses present in the AGD.

The specific feature of the cosmological picture that follows from the AGD, is that on a scale of stars and planetary systems all the conclusions and predictions of GRT are preserved, but on the scale of galaxies and beyond the main role is played by the tangential motion of matter. When considering the anisotropic space in gravitational interaction the features associated with inertia are beginning to be traceable, which leads to "repulsive forces" that does not have the character of the fifth fundamental force. These inertial forces cannot be excluded from the observations or be separated from the classical gravitational forces which is in full accordance with the equivalence principle. The Universe resembles a medium with developed turbulence and interacting vortices of various scales. This sheds new light on existing ideas about the distribution of energy between the luminous bodies (classical gravity) and their motion in the Universe. In general, this picture is more efficient, and it provides the satisfactory descriptions of the observations that can not be handled by the classical GRT, besides, it requires no involvement of new concepts, but uses a different model for the description of physical reality – the phase-space-time.

References

[1] Siparov, S., *Introduction to the Anisotropic Geometrodynamics*, New Jersey-London-Singapore, World Scientific, 2011.

[2] Müller, H., Peters, A. and Chu, S., *A precision measurement of the gravitational redshift by the interference of matter waves*, Nature **463** (2010), p926.

[3] Einstein, A., *On the Electrodynamics of Moving Bodies*, Ann. Phys. **17** (1905) p. 891.

[4] Siparov, S., *The gravitation law and the source model in the anisotropic geometrodynamics*, HNGP **12**, (2009), p144; Siparov, S. *Anisotropic Geometrodynamics: Observations and Cosmological Consequences*, Proc.4-th Int. Gamow Conf., Odessa-2009. Eds. S.K.Chakrabarti, G.S.Bisnovatyi-Kogan, AIZhuk, AIP Conf. Proc., Melville,

New York, V.1206, p152; Siparov, S., *Anisotropic metric for the gravitation theory - new ways to interpret the classical GRT tests*, Proc. Int. Conf. DGDS - 2009, BSG Proc. V.17. Eds. K. Udriste, V. Balan. Geom.Balkan Press 2010 p.190; Siparov, S., *Anisotropic geometrodynamics in cosmological problems*, Proc. Int. Conf. "Math. and Astron.", Madrid - 2009. Eds. M. de Leon, D.M. de Diego, R. M. Ros, AIP Conf. Proc., Melville, New York, 2010, V.1283, p222.

[5] Siparov, S. HNGP **15** (2011), (in press)

[6] Molinari S. et al .. *A 100-parsec Elliptical and Twisted Ring of Cold and Dense Molecular Clouds Revealed by HERSCHEL around the Galactic Center*, arxiv: 1105.54684v1 [astro-ph.GA] May **27** 2011.

[7] Siparov, S. *A two-level atom in the field of a gravitational wave - on the possibility of parametric resonance* A & A **416** (2004), p815.

[8] Siparov, S. and Samodurov, V.A., *Specific component of the cosmic maser emission, which arises because of gravitational-wave effects*, Comp. opt. **33** (2009), p79.

[9] Kerner, E. H., *An extension of the concept of inertial frame and of Lorentz Transformation*, Proc. Natl. Acad. Sci. USA **73** (1976), p1418.

[10] Bacry H., and Levy-Leblond, J.-M., *Possible Kinematics*, J. Math. Phys. **9** (1968), p1605.

[11] Mornev, O.A. *Newtonian dynamics on manifolds* All-Russian Congress of theor. and Appl. Mech.. Perm', (2001) VIII.

[12] Voicu, N., *New Considerations on Einstein Equations in Pseudo-Finsler Spaces* AIP Conf. Proc. 1283 (Melville, New York) (2010), p249.

[13] Hobson, M.P., Efstathion, G. and Lasenby, A.N., *General Relativity*, Cambridge, 2009.