On microscopic interpretation of phenomena predicted by the formalism of general relativity

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Abstract: The main macroscopic phenomena predicted by general relativity (the motion of Mercury's perihelion, the bending of light in the vicinity of the sun, and the gravitational red shift of spectral lines) are studied in the framework of the sub microscopic concept that has recently been developed by the author. The concept is based on the dynamic inerton field that is induced by an object in the surrounding space considered as a tessellation lattice of primary balls (superparticles) of Nature. Submicroscopic mechanics says that the gravitational interaction between objects must consist of two terms: (i) the radial inerton interaction between two masses M and m, which results in classical Newton's gravitational law $U = -GMm/r$ and (ii) the tangential inerton interaction between the masses, which is caused by the tangential component of the motion of the test mass m and which is characterized by the correction $-G(M\,m/r)(r^2\dot{\phi}^2)/c^2$. It is shown it is precisely this correction that is responsible for the three aforementioned macroscopic phenomena and the derived equations exactly coincide with those derived in the framework of the formalism of general relativity, which means that the latter must be reinterpreted as follow: the gravitational field of the resting central mass is flat, $-GM/r$, but the emergence of a test mass disturbs the field in such a way that its distribution exactly looks like the Schwarzschild metric prescribes.

Keywords: space, inertons, gravitation, Newton's gravitational law, tangential velocity, velocity of light.

1. Introduction

Although Poincaré (1905a) was the first to write the relativistic transformation The general theory of relativity formally predicted such phenomena as the motion of Mercury's perihelion, the bending of light by the gravitational field of the sun and the gravitational red shift of spectral lines (see, e.g. Refs. [1-3]). The predictions were verified experimentally and since then general relativity was widely recognized as the fundamental physical concept of the 20th century. Since general relativity has all attributes of an action-at-a-distance theory, some researchers try to understand its deeper sense coming back to the old idea of retarded potentials, or velocity-depended potentials, which would account for a nature of the motion of the front of the gravitational potential.

Soares [4] considering light as classical massive corpuscles calculated the deflection of a light beam under the Sun's gravitational force, which is described by the central force hyperbolic orbit; in the first approximation he obtained the so-called Newtonian deflection $\delta_{\rm N} = 2GM_{\rm Sun}/(c^2 R_{\rm Sun})$, though Einsteinian's is still $\delta_{\rm GR} = 2\delta_{\rm N}$ where $M_{\rm Sun}$ and $R_{\rm Sun}$ are the Sun's mass and radius.

Giné [5,6] reviewed tens of works dedicated to the study of the modified Newton's potential, among which there were such potentials as Weber's, Gerber's and others. Giné argues that Weber's potential, which is a velocity dependent potential $V = (1 - \dot{r}^2 / 2c^2) \cdot 1/r$, allows one to introduce an additional force component. Such a component is the tangential component of the speed of a test particle in the gravitational field of a central mass *M*, which significantly influences the eccentricity of the hyperbolic orbit of the particle. Thus taking into account the finite propagation speed – the velocity of light *c* – he [5] concludes that the anomalous precession of the Mercury's perihelion is associated with a second order delay of the retarded potential

$$V = -\frac{m}{r \cdot (t - \tau) - r \cdot (t - \tau) / c}.$$

As Giné [6] shows, at some fixed parameters the deflection of a light beam would reach that of derived by Einstein in 1916, i.e. $\delta_{\mathrm{GR}} = 4GM / (c^2 r_{\mathrm{p}})$ where r_{p} is the closest approach, i.e. perihelion of the beam.

So far the mentioned phenomena have not been described on the basis of a microscopic approach. Nevertheless, before applying such an approach to the study of the problem, one has to become familiar with major statements of the concept. However, let us initially consider general discrepancies between phenomenological and microscopic standpoints. General relativity, as a typical phenomenological theory, considers matter and space-time as two independent entities, which, however, can influence each other [7]: a matter curves space-time that is treated as a geometric entity resting on the statement of constancy of the speed of light *c*; photons are massless, they form the world line of light ray. Thus with such an approach the microscopic peculiarities of the real space remain beyond the study of the problem.

Indeed, since photons transfer momentum, they physically have mass. But what is mass? At a scale comparative with the de Broglie wavelength λ of the quantum system in question, a phenomenological description has to make way for a quantum mechanical one. However, conventional quantum mechanics is constructed in an abstract phase space and hence it cannot be used to investigate the behaviour of matter at a sub microscopic size: in line with the theory the less scale, the more indeterminism… Therefore, to account for the behaviour of matter at extremely small scales we have to rely on a theory developed in the real physical space, which is able to operate at any microscopic scale.

For the first time Bounias and the author [8-12] proposed a detailed theory of the constitution of the real physical space. In line with those researches, which are based on topology, set theory and fractal geometry, the real space emerges as a tessellation lattice of primary topological balls (primary entities of Nature, or 'superparticles') whose size can be estimated as the Planck's one, 10^{-35} m. It has been shown how mathematical characteristics, such as length, surface, volume and fractal geometry generate in this tessel-lattice the basic physical notions, such as mass, particle, electric charge, the particle's de Broglie wavelength, etc. and the corresponding fundamental laws. In particular, mass emerges from space as its local deformation, i.e. when a volumetric fractal deformation is created in the appropriate cell of the tessel-lattice. Hence matter is no longer separated from space, as it occurs in general relativity, but can reasonably appear at special conditions.

In the present paper we show in what way submicroscopic mechanics [13-19] developed in the real physical space [8-12] is capable of coping with the mentioned challenge, i.e. the (sub) microscopic description of three gravitational phenomena: the anomalous precession of Mercury's perihelion, the bending of light and the red shift of spectral lines. We will see below how this difficult problem becomes really trivial in the framework of the sub-microscopic consideration based on the constitution of real space. Namely, we will see this is the motion of matter, which generates deformations of space around the matter: one component of such motion is responsible for the Newton gravitational term, the other component introduces a correction to Newton's law, which we currently know as a curvature of space-time in general relativity.

2. Correction to Newton's gravitational law

Submicroscopic mechanics [13-19] studies the motion of a particle in the densely packed tessel-lattice, which means the induction of the interaction between a moving particle and the tessel-lattice. As a result, a cloud of deformations of the space tessel-lattice is accompanying the particle. These elementary excitations that migrate from cell to cell of the tessel-lattice represent a resistance of space, i.e. inertia, and, because of that, they have been called inertons. Thus, collision-like phenomena are produced: deformations of space (inertons) go from the particle to the surrounding space and then due to elastic properties of the tessel-lattice some come back to the particle. The Euler-Lagrange equations show the periodicity in the behaviour of the particle. Namely, the particle's velocity oscillates between the initial value υ and zero along each section λ of the particle path and this section emerges as the de Broglie wavelength of the particle [13,14]. The amplitude of the particle's cloud of inertons $\Lambda = \lambda c / \upsilon$ uncovers the physical meaning of the ψ-function: the latter, although determined in an abstract physical space, describes peculiarities of the range of space around the particle perturbed by the particle's inertons.

The next stage is that inertons transfer not only inertial, or quantum mechanical properties of particles, but also gravitational properties, because they transfer fragments of the deformation of space (i.e. mass) induced by the particle. The corresponding study [18,19] shows that inertons move like a typical standing spherical wave that is specified by the dependency $1/r$; it is this behaviour that allows the derivation of Newton's static gravitational law, $1/r$.

Thus inertons are carriers of both the inertial interaction (or, in other words, quantum mechanical's including the so-called Casimir forces) and the gravitational interaction. Experimental evidence of the existence of inertons was carried out in Refs. [20-25]. The experiments described there were performed in micro and mesoscopic ranges. The inerton radiation, i.e. a flow of free inertons, carriers of mass, can be measured by a device designed by Didkovsky and the author [26] and, moreover, the inerton field allows a number of practical applications: for instance medical applications (so-called Teslar watch, see Refs. [23,24]), the manufacture of biodiesel [27], etc.

Thus, having such conclusive results, we can now try to apply the description of the macroscopic phenomena starting from the same submicroscopic standpoint.

Inertons moving by the hopping mechanism pass a local deformation, i.e. a fragment of mass, from cell to cell of the tessel-lattice. These quasi-particles can be either bound with an object or free (if they are emitted from the object's inerton cloud). Any object, from a canonical particle to a star, is surrounded by its own inerton cloud. The inerton cloud oscillates in the vicinity of an object as a standing spherical wave and brings a tension to the surrounding space [17,18]; inerton waves of such central object are practically instant:

they reach a test body with a speed no less than the velocity of light and, hence, these spherical waves are perceived by an outstanding observer as the static (Newtonian) gravitational potential:

$$V = -GM\,/\,r\,. \qquad (1)$$

In the case of a classical motionless object, its massive particles (atoms, etc.) oscillate at their equilibrium positions and the particles' clouds of inertons overlap. If the object has a form close to spherical, the motion of the object's inertons will happen only along radial lines and the velocity of the inertons will be characterized by the radial component that is equal to the speed of light c (the tangential component of inerton motion averaged by all the particles and directions is reduced to zero).

When a test body falls within the inerton field of the central object, one can distinguish two components of the body's inerton cloud. The components are: radial $\dot{r}_{\text{rad}}$, which is parallel/antiparallel to the radial ray issued from the central object to the test body; and tangential $\dot{r}_{\text{tan}}$, which is transferral to the radial ray.

It is interesting to refer to Poincaré [28]: What exactly did he indicate as the main reasons for gravity a hundred of years ago? By Poincaré, the expression for the attraction should include two components: one is parallel to the vector that joins positions of both interacting objects and the second one is parallel to the velocity of the attracted object. Thus the velocity of an object must influence the value of its gravitational potential. Grand Poincaré was at the origin of topology, he understood how the generalized theory of space was important for physics. Now his ideas indeed have received further development in the studies of Bounias and the author [9-19].

Equating the radial component to the velocity of light c, i.e. $\dot{r}_{\text{rad}} = c$ [13-15], we obtain that the total velocity of the test body's inertons $\hat{c}$ in the frame of reference associated with the central object is defined from the geometric relationship (compare with Ref. [18])

$$\hat{c}^2 = c^2 + \dot{r}_{\tan}^2 \tag{2}$$

Hence around the test body in the region $r < \Lambda$ (Λ is the amplitude of the body's inerton cloud, which is huge for a macroscopic system [18]) inertons of the test body move with the velocity $\hat{c} > c$.

Besides, relationship (2) shows that a test body does not fall exactly to the centre of mass of the central object, as expression (1) prescribes, but to a point distant from the centre of mass at a section calculated on the basis of expression (2). In other words, this means that the true gravitational attraction between a central heavy motionless object (mass *M*) and a test moving body (mass *m*) should be different from the Newton's expression

$$U = -G\frac{Mm}{r}\ . \tag{3}$$

Based on expression (2) we can assume that the gravitational interaction between the motionless mass *M*, which generates the potential (1) (see Refs. 17 and 18 for detail), and the moving mass *m* should include also a function $\left(1 + \dot{r}_{\tan}^2 / \dot{r}_{\mathrm{rad}}^2\right) \equiv \left(1 + \dot{r}_{\tan}^2 / c^2\right)$. This function shows that the interaction between the two masses is realised through inertons whose total velocity at this interaction exceeds the velocity of light, i.e. $\hat{c} > c$. Thus, the correct expression for the potential energy of gravitational attraction of the moving mass *m* to the central motionless mass *M* should have the following form

$$U = -G\frac{Mm}{r}\cdot\left(1 + \frac{\dot{r}_{\tan}^2}{c^2}\right) \tag{4}$$

where $\dot{r}_{\tan}$ is the tangential velocity of the body with the mass *m*, i.e. the body's orbital velocity (because the projection of the velocity of body's inertons on the body's path has the value of the velocity of the body, though in perpendicular directions the velocity of inertons can be compared with the speed of light *c* – in these directions the spatial tessel-lattice itself is guiding inertons [14-18]). We can see that the correction in the parentheses is very close to Weber's for a velocity dependent potential (see Introduction) and such a correction indeed takes into account inner peculiarities of the system studied, which Weber and then Giné associated with the necessity to consider a short range action between interacting physical systems. In our case these are inertons that establish the direct interaction between distant masses M and m.

Corrected Newton's gravitational law (4) can be applied now to study the anomalous precession of the Mercury's perihelion, the bending of light and the red shift of spectral lines.

3. Motion of Mercury's perihelion

Classical mechanics yields the following equations describing the motion of a body with a mass *m* in the gravitational field induced by a large central mass *M* (see, e.g. Refs. 1-3)

$$I = m r^2 \dot{\phi}; \tag{5}$$

$$E_{\text{cl.}} = \tfrac{1}{2} m\dot{r}^2 + \tfrac{1}{2} m r^2 \dot{\phi}^2 - G\frac{Mm}{r}. \tag{6}$$

Eqs. (5) and (6) are the classical integrals of the movement of momentum and the energy, respectively. However, as follows from the consideration above, in Eq. (6) we have to change the potential gravitation energy (3) to the corrected expression (4). Then the energy conservation law (6) is corrected, such that two equations (5) and (6) are transformed to

$$I = mr^2\dot{\phi}; \tag{7}$$

$$E = \tfrac{1}{2} m\dot{r}^2 + \tfrac{1}{2} mr^2\dot{\phi}^2 - G\frac{Mm}{r}\cdot\left(1 + \frac{r^2\dot{\phi}^2}{c^2}\right). \tag{8}$$

Note that here the dot over r and ϕ means the differentiation by the proper time t of the body, i.e. t is the natural parameter that is proportional to the body path [14-17]. The system of equations (7) and (8) **are identical to** the equations of motion of a body in the Schwarzschild field obtained in the framework of the general theory of relativity (see, e.g. Refs. [1-3]). The solution to Eqs. (7) and (8) is available in literature (see, e.g. Refs. [1-3]) and it shows that it is the last term in Eq. (8), which displaces the perihelion of the planetary orbit by amount

$$\Delta\phi = 6\pi\frac{GM}{Lc^2} \tag{9}$$

where L is the focal parameter.

4. Bending of a light ray

The energy E of a photon in the gravitational field induced by a large mass M can easily be written by recognizing that the photon is characterized by mass m [29,10]. However, the photon is not a canonical particle, but a quasi-particle, a local excitation of the tessel-lattice, which migrates in space by hopping from cell to cell. This means the photon does not possess its inerton cloud at all; it is itself similar to an inerton (also an elementary excitation of the tessel-lattice), though in addition to the inerton it has an electrically polarized surface [30].

Therefore, since a photon does not disturb the ambient space with a cloud of inertons, it cannot experience the radial component of the gravitational field of a heavy object (no overlapping with the inerton cloud of the heavy object). Hence, the radial component $-GMm/r$ is absent in the interaction between the heavy object and the photon (recall that this Newton's component emerges owing to the overlapping of inerton clouds of two interacting objects, the central object and the test body). Nevertheless, the tangential component $-GMmr\dot{\phi}^2/c^2$ associated with the true motion of the photon must still be preserved. That is why the behaviour of the photon in the gravitational field of mass M has to be defined by the following pair of equations

$$I = m r^2 \dot{\phi}\,; \tag{10}$$

$$E = \tfrac{1}{2} m \dot{r}^2 + \tfrac{1}{2} m r^2 \dot{\phi}^2 - G\,\frac{M m r \dot{\phi}^2}{c^2} \tag{11}$$

where the time t is treated as the natural parameter proportional to the photon path, which is very important for the invariance of the theory [14].

Again, Eqs. (10) and (11) **are exactly the same** input equations for the study of the bending of a light ray in the Schwarzschild field, which are obtained in the framework of the formalism of general relativity. As is well known (see, e.g. Ref. [1-3]) the solution to Eqs. (10) and (11) yields the following angle deviation of the ray from the direct line

$$\Delta\varphi = 4\frac{GM}{c^2 r}\,. \tag{12}$$

5. Red Shift of Spectral Lines

Let us consider a simple task. Let *l* and *m* be, respectively, length and mass of a mathematical pendulum and let φ be the angle of the deviation of the pendulum from the equilibrium. The pendulum is found on the surface of a planet with the radius *r*. In this case the kinetic energy of the massive point is

$$K = \tfrac{1}{2} m\, l^2 \dot{\phi}^2 \tag{13}$$

and the potential energy is

$$U = -G \frac{Mm}{r + l \cdot (1 - \cos\phi)} \cdot \left(1 + \frac{l^2 \dot{\phi}^2}{c^2} \right) \tag{14}$$

(to write the expression, we have used corrected Newton's law (4)). Because of the small variable φ one can write the energy $E = K + U$ of the massive point as follows

$$E \cong \tfrac{1}{2} m l^2 \dot{\phi}^2 - G \frac{Mm}{r} - G \frac{Mm}{r} \cdot \left(-\frac{l\phi^2}{2r} + \frac{l^2 \dot{\phi}^2}{c^2} \right). \tag{15}$$

In the case of the potential depending on the velocity the equation of motion is determined by the Euler-Lagrange equation [31]

$$\frac{d}{dt}\frac{\partial K}{\partial \dot{q}} - \frac{d}{dt}\frac{\partial U}{\partial \dot{q}} - \frac{\partial K}{\partial q} + \frac{\partial U}{\partial q} = 0$$

where in our case $q \equiv \phi$ and t is the proper time of the oscillating massive point. In the explicit form it yields

$$\left(l^2 + 2G \frac{M}{r} \frac{l^2}{c^2} \right) \ddot{\phi} + G \frac{M}{r} l\phi = 0\,. \tag{16}$$

If we designate $(2\pi\nu_0)^2 = 2GM/(rl)$, we can write instead of Eq. (16)

$$\ddot{\phi} + \frac{(2\pi\nu_0)^2}{1+2GM/(c^2 r)}\phi = 0. \tag{17}$$

In Eq. (17) assuming the inequality $r_0 = 2GM/c^2 << r$, we acquire the renormalized frequency of the pendulum

$$\nu \approx \left(1 - \frac{GM}{c^2 r}\right)\cdot \nu_0. \tag{18}$$

The scheme described above may easily be applied to vibrating atoms (ions) located on the surface of a star. This means that expression (18) determines the so-called gravitational red shift of spectral lines

$$\delta\nu \cong -\frac{GM}{c^2 r}\nu_0. \tag{19}$$

The result (19) is **in complete agreement** with that derived in the framework of general relativity (see, e.g. Refs. 1 and 2).

5. Discussion

To derive the equations of motion of the perihelion, Eqs. (7) and (8), the motion of light ray, Eqs. (10) and (11), and the shift of spectral lines, Eq. (17), we have started from very transparent ideas of classical physics and the sub-microscopic deterministic physical concept developed in works [8-27,29,30]. General relativity derives the same equations of motion, Eqs. (7), (8), (10) and (11), starting from the equations of motion in the form of a geodesic line (written in polar coordinates $\xi^{4(i)}$)

$$\frac{d^2\xi^4}{dt^2}+\Gamma^{\mu}_{\rho\sigma}\frac{d\xi^{\rho}}{dt}\frac{d\xi^{\sigma}}{dt}=0 \qquad (20)$$

for the investigation of the motion of the perihelion of a planet, and in addition takes into account the geodesic line for a light ray

$$g_{\rho\sigma}\frac{d\xi^{\rho}}{ds}\frac{d\xi^{\sigma}}{ds}=0\,. \qquad (21)$$

Here, the components of the metric tensor have the form

$$g_{11}=-\frac{1}{1-2GM/(c^2 r)}; \qquad (22)$$

$$g_{22}=-r^2; \qquad (23)$$

$$g_{33}=-r^2\cos^2\vartheta; \qquad (24)$$

$$g_{44}=1-2GM/(c^2 r)\,. \qquad (25)$$

General relativity achieves the result (18), (19) from the relationship connecting the coordinate frequency ν of oscillating atoms and their proper frequency ν_0,

$$\nu=\sqrt{g_{44}}\,\nu_0 \qquad (26)$$

where the time component of the metric tensor g_{44} is determined in expression (25).

It is believed that the Schwarzschild metric (22)-(25) describes the space-time around a spherically symmetric object, such as a point mass, a planet, a star (and a “black hole”).

In contrast, the submicroscopic concept deriving Newton’s gravitational law (3) [18,19] does not reveal the reasons for the emergence of the term $2GM/(c^2 r)$ in the metric of real space around a resting spherical object with mass *M*. From the sub microscopic viewpoint the metric of a resting mass object must be linear

$$g_{\rho\sigma} = \begin{pmatrix} -1 & 0 & 0 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & -1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix} \tag{27}$$

The sub microscopic theory argues that an additional gravitational term appears in the equations of motion of a test body, Eqs. (8) and (11), owing to its interaction with the Newtonian gravitational field of the central mass *M*. In other words, it is the test body that perturbs the flat-space metric (27) of the resting object *M* in the place of the body's motion. The perturbation introduces a correction to the Newtonian gravitation (see expression (4)), such that through the tangential velocity $\dot{r}_{\tan}$ of the test body, the additional term $2GM/c^2$ is added to the Newtonian one.

Thus, if the submicroscopic approach is correct, a lack of correspondence should be available in the interpretation of the Schwarzschild's solution. Let us recall how the result (22)-(25) is obtained in general relativity (see, e.g. Ref. 1, sect. 58 and Ref. 2, chap. 13). The coordinate system is treated as undetermined identically. At the transformation that contains an arbitrary function $f(r)$ (for instance, the turn of spatial coordinates ξ^i round the axis that goes through the origin)

$$\xi'^i = \xi^i f(r)/r \tag{28}$$

where

$$r = \sqrt{(\xi^1)^2 + (\xi^2)^2 + (\xi^3)^2}, \qquad r' = \sqrt{(\xi'^1)^2 + (\xi'^2)^2 + (\xi'^2)^2} = f(r), \tag{29}$$

the square of linear element

$$\begin{aligned} ds^2 = A(r)\, d\xi^{4\,2} \;+\; & 2B(r)\chi_q d\xi^4 d\xi^q \\ & - C(r)\,\delta_{qp}\, d\xi^q d\xi^p \;+\; D(r)\chi_q \chi_p d\xi^q d\xi^p \end{aligned} \tag{30}$$

has to preserve its form. A suitable transformation of the coordinates, a kind of normalization, allows one to reduce the number of unknown functions *A*, *B*, *C* and *D*, such that the problem still remains spherical and static. Coordinates change as follows

$$\xi'^4 = \xi^4 + f(r), \qquad \xi'^i = \xi^i \tag{31}$$

It was convenient to consider the metric in the form

$$g_{44} = A, \quad g_{4q} = 0, \quad g_{qp} = -C\delta_{qp} + D\chi_q \chi_p. \tag{32}$$

The metric tensor components g_{4q} are transformed in line with equations

$$g'_{4q} = g_{44} \frac{\partial \xi^4}{\partial \xi'^q} \;+\; g_{4q}, \qquad g'_{qp} = \frac{\partial \xi^i}{\partial \xi'^q} \frac{\partial \xi^k}{\partial \xi'^p} g_{ik}. \tag{33}$$

The further transformations reduced the number of unknown functions to two, *A* and *D*. The choice (32) and the rules of transformations (33) generate a special form of Christoffel symbols Γ^i_{qp} in which a term proportional to $1/r$ appears. The time component of metric tensor becomes $g_{44} = 1 - \alpha / r$, which after comparison with Newton's law allows one to write $g_{44} = 1 - 2GM/(c^2 r)$.

It is generally recognized that the transformations (22)-(25) and (28)-(33) are completely correct, because they are performed in line with the similar transformations conventional in the special theory of relativity in which the interval $s^2 = c^2t^2 + x^2 + y^2 + z^2$ is treated as invariant with respect to the Lorentz transformations. However, Lorentz's transformations are associated with the introduction of a (relative) velocity υ to the system studied, which reduces the system parameters in accordance with the Lorentz factor $\sqrt{1-\upsilon^2/c^2}$. Note the velocity υ is a foreign parameter for the system, which is imposed on the system from outside.

That is why if one wishes to search for invariance of the interval ds^2 (30), the one constructs the element ds'^2 introducing some foreign parameters in it looking for the conditions when the equality $ds^2 = ds'^2$ is held. Such foreign parameters are available on the right hand side of expression (30) somewhere among functions A, B, C and D and also among coefficients χ_i. Moreover, owing to the structure of these coefficients, $\chi_i = \xi^i / r$, i.e. their inverse dependency on distance r, we can recognize them as possible sources of the outside gravitational field. Carrying out transformations (31)-(33) and so on until we reach the metric (22)-(25) (see, e.g. Refs. 1 and 2), we gradually add a perturbation to Newton's gravitational potential of the central mass M on the side of a test mass. That is the crucial point! Therefore, a point mass at rest possesses the conventional Minkowski flat-space metric (27), but this metric disturbed by inerton waves of a smaller mass changes to the metric (22)-(25) in the place of the smaller mass location.

6. Conclusion

In the present work we have shown how the sub microscopic views allow us to solve the problems of the motion of Mercury's perihelion, the bending of a light ray by the sun and the gravitational red shift of spectral lines. The solutions are exactly as those derived from the formalism of general relativity. This means that the Schwarzschild metric (22)-(25) is correct, however, the interpretation of the final result is different; namely, the Schwarzschild metric does not represent properties of the geometry of space-time of a point mass M at rest, but the geometry of space-time around this mass disturbed by a test smaller mass m.

The misunderstanding could not be resolved so far, because a sub microscopic theory of the real space was absent. The availability of such theory [8-27,29,30] has allowed us to look at many problems of gravitational physics from a very new point of view. In particular, it is finally clear now that the idea of black holes is fiction, as the parameter $r_0 = 2GM / c^2$ does not have the meaning of a critical radius at all (that was already accurately demonstrated by many researchers by means of using general relativity; especially see remarkable works by Loinger [32,33] and also recent studies by Grothers [34]). There are not also gravitational waves, because on the microscopic scale the role of carriers of the gravitational interaction plays inertons [21,18,19] (see also Refs. 32 to 34). The presence of inertons allows us to talk about such discipline as inerton astronomy [26]. However, all this is only a first step of the sub microscopic deterministic concept of physics. The other steps promise to be even more exciting.

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