Adaptive-dynamic gravitational field of the Solar System

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The correspondence to the Solar System of not the static Newtonian gravitational field, but the dynamic gravitational field, which is also formed by the motion of the planets and, therefore, adapts to changes in the location of the planets in it, is substantiated. The correspondence of the trajectories of the planets' motion to the laws of conservation of angular momentum and energies (the Newtonian of inert free rest energy and the Keplerian of ordinary rest energy of matter) is shown. Spatial distributions of potentials and strength of the adaptive-dynamic gravitational field along the elliptical trajectories of the planets' motion, which correspond both to the laws of conservation and to the results of astronomical observations, are obtained.

Keywords: Theory of Relativity, Newtonian, Keplerian, adaptive-dynamic gravitational field, Solar System.

I. INTRODUCTION

The formulations of the laws of classical physics are very simplified and too straightforward. After all, they, as a rule, do not take into account the presence of negative feedbacks between the physical parameters of matter. But it is precisely these negative feedbacks that ensure the stability of natural formations.

Such simplification was also not avoided in the formulation of the differential equations of the gravitational field of the General Relativity (GR). Therefore, these equations should be taken only as a basis and creatively reinterpreted and supplemented with additional dependencies. After all, the GR equations themselves do not directly take into account the conservation of angular momentum and the corresponding effects of the motion of matter on the gravitational field due to the presence of negative or positive feedbacks. Einstein himself compared the metric tensor of these equations with good-quality marble, and the energy-momentum tensor only with low-quality wood [1]. And indeed, as it turned out much later, the use of ordinary Lorentz transformations of increments of spatial coordinates and time (OLT) in these equations came into conflict with the relativistic and gravitational invariance of thermodynamic parameters and potentials of matter [2-4].

Thus, the equations of the GR did not ensure the absence of the influence of the external gravitational field and motion, both on the thermodynamic state of matter and on the rate of flow of its proper time. After all, the compensation of the change in the value of the gravitational parameter b (the Schwarzschild solution of the GR gravitational field equations [5]) by the motion of matter by inertia ($b_{cj} = b_i + {}^i v_j^2 c^{-2} = b_{0j} = \mathbf{const}(r,t)$) ensures the correspondence to reality of the analogous equations of relativistic gravithermodynamics (RGTD, which is only an improved version of the GR [2-4]). Only according to them, the strength of the gravitational field is directly equal at point i to the gravitational acceleration of the common velocity ${}^i v_j = d\,{}^i\hat{r}_j / dt$ of motion of all substances m, which may have unequal values of their hidden thermodynamic parameters ${}^m b_{0j} = {}^m b_{00}\, {}^m T_{00}^2 / {}^m T_j^2$ dependent on the absolute temperature T [2-4,6,7]:

$$ {}^i\hat{g}_j = -b_i c^2 \frac{d\ln b_i}{2d\hat{r}_i} = -c^2 \frac{d(b_{cj} - {}^i v_j^2 c^{-2})}{2d\hat{r}_i} = {}^i v_j \frac{d\,{}^i v_j}{d\hat{r}_i} = \frac{d\,{}^i v_j}{dt} $$

$$ {}^i\hat{\hat{g}}_j = -c^2 \frac{d(\ln b_{cj})_v}{2d\hat{r}_i} = -c^2 \frac{d[\ln(b_i + {}^i v_j^2)]_v}{2d\hat{r}_i} = $$

$$ = -c^2 \frac{d(b_{cj} - {}^i v_j^2 c^{-2})}{2b_{cj} d\hat{r}_i} = \frac{{}^i v_j}{b_{cj}} \frac{d\,{}^i v_j}{d\hat{r}_i} = \frac{G}{G_{00}} \frac{d\,{}^i v_j}{dt}, $$

where: ${}^i\hat{g}_j$ and ${}^i\hat{\hat{g}}_j$ are gravitational field strength at point i by the observer's clock and by a hypothetically stationary clock at point i, respectively, $G = G_{00} / b_{cj}$ and G_{00} are true and standard values of the gravitational constant, respectively.

Therefore, the gravitational field really determines only the velocity of motion and spatial gradients, and not at all the values of unequal hidden parameters ${}^m b_{0j}$ in different substances m, which were previously at rest at point j, and are now moving together at point i. And thus, each substance can have its own spatial distribution of the hidden gravithermodynamic parameter

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${}^{m}b={}^{m}v_l^2 c^{-2}$, which is equivalent not only to the absolute temperature *T*, but also to the limit velocity v_l of individual (separate) motion of a certain substance used in the RGTD (alternative to the coordinate pseudo-vacuum velocity of light of the GR [2-6]) [7].

Based on the use of the identity of the gravitational mass $m_{gr} = m_{00}/\sqrt{b_c}$ of matter to the inertial mass $m_{inr} = m_{00}\sqrt{b_c}$ of matter only according to its intrinsic clock in the RGTD, a canonical differential equation of the dynamic gravitational field was obtained for a non-solid matter, which does not contain the spatial distribution of the mass density of the matter. Due to the definition of the spatial distribution of the local value of the gravitational radius by this equation, on the contrary, it allows to obtain the required spatial distribution of the mass density of the matter [8,9]:

$$S' = \frac{d[r/a(1-b_c)]}{dr} = \frac{1 - r_g' - \Lambda r^2}{(1-b_c)} +$$

$$+\frac{(r - r_g - \Lambda r^3/3)}{(1-b_c)^2} b' = -\frac{b_c S}{r(1-b_c)} + \frac{(1-\Lambda r^2)}{(1-b_c)^2},$$

$$S = \frac{r}{a_c(1 - v^2 c^{-2}/b_c)(1-b_c)} = \frac{r - r_g - \Lambda r^3/3}{1-b_c} =$$

$$= \frac{r}{a(1-b_c)} = \exp\int \frac{-b_c dr}{(1-b_c)r} \times \int \left[\frac{(1-\Lambda r^2)}{(1-b_c)^2} \exp\int \frac{b_c dr}{(1-b_c)r} \right] dr,$$

where the parameter *S* can be abstractly considered as the distance from the pseudo-horizon of the infinitely distant cosmological past and the parameters

$b_c = v_{lc}^2 c^{-2} = b + v^2 c^{-2} = b(1 + v^2 v_l^{-2}) \equiv b_0 = \mathbf{const}(t)$ and

$a_c = (d\hat{r}/dr)^2 = ab_c/b = a(b + v^2 c^{-2})/b = a/(1 - v^2 c^{-2}/b_0)$

are analogues of the parameters *b* and $a = 1/(1 - r_g/r - \Lambda r^2/3)$ of the Schwarzschild solution of the equations of the static gravitational field of the GR, *v* is the velocity of the hypothetical circular or real elliptical orbital motion of the planets of the Solar System, $r_g(r)$ is the radial value of the gravitational radius of the dynamic gravitational field of the Solar System, $\Lambda = 3H_E^2 c^{-2}$ is the cosmological constant, H_E is the Hubble constant, c is the constant of the velocity of light.

This is what allows us to form the proper spatial distribution of the parameter $b_c(r) = v_{lc}^2 c^{-2} = b + v^2 c^{-2}$ of the adaptive gravitational field along the elliptical orbits of the planets of the Solar System. That is, it allows us to obtain exactly such a distribution of this parameter that would correspond to the conservation of not only the Keplerian of ordinary rest energy of the planet, but also the conservation of the angular momentum of the planet in the process of its orbital motion. The parameter *a* of the gravitational field can be obtained by solving the canonical differential equation of the dynamic gravitational field based on the formed parameter b_c (similar to its obtaining for a flat galaxy [8,9]).

II. PARAMETERS OF THE MOTION OF PLANETS THAT ARE CONSISTENT WITH THE LAWS OF CONSERVATION OF ENERGY AND ANGULAR MOMENTUM

According to Kepler's laws, which are actually based on Newton's theory of gravity, it is not the Hamiltonians and the Lagrangians that are conserved (due to $v_{lc}^2 = v_l^2 + v^2 = \mathbf{const}(t,r)$) in the process of planetary motion, but the Newtonians of inert free rest energy:

$$\mathrm{N} = E_0 v_{lc}/c = m_{00} c v_{lc} = m_{00} c\sqrt{v_l^2 + v^2} \approx$$

$$\approx m_{00} c^2 \sqrt{1 - r_g/(r_1 + r_2)} = \mathbf{const}(t,r)$$

and the Keplerians of ordinary rest energy:

$$\mathrm{K} = W_0 c/v_{lc} = m_{00} c^3/v_{lc} = m_{00} c^3/\sqrt{v_l^2 + v^2} \approx$$

$$\approx m_{00} c^2/\sqrt{1 - r_g/(r_1 + r_2)} = \mathbf{const}(t,r)$$

of the planetary matter [8-12]. Here r_1 and r_2 are the radii of the planet's elliptical orbit at aphelion and perihelion, respectively, and r_g is the gravitational radius of the Solar System.

The values of the velocities v of orbital motion of independent objects of the Solar System at aphelions and perihelions are determined by the initial conditions of their inclusion inside the Solar System, or even by the conditions of their formation directly inside the Solar System.

Based on the mutual equality of the values of all parameters at aphelion and perihelion of the planet (precisely values of the both Newtonians, values of the both Keplerians, and the values of the both Newtonian angular momenta ($m_{in} v_2 r_2 = m_{in} v_1 r_1$; $v_2 r_2 = v_1 r_1$ due to $m_{in} = \mathbf{const}(r,t)$):

$$b_c = v_{lc}^2 c^{-2} \approx (1 - r_g / r_2) + v_1^2 r_1^2 r_2^{-2} c^{-2} =$$
$$= (1 - r_g / r_2) + v_2^2 c^{-2} \approx (1 - r_g / r_1) + v_1^2 c^{-2}),$$

we can find the gravitational radius of the Solar System:

$$r_g \approx v_1^2 c^{-2} r_1 (1 + r_1 / r_2) = v_2^2 c^{-2} r_2 (1 + r_2 / r_1).$$

Table I shows exactly those known approximate values of the orbital parameters and velocities at aphelions of various planets that allowed us to obtain calculated values of the Solar System gravitational radius with the smallest deviation from its most probable actual value.

TABLE I. Parameters of the Solar System.

Planet	r_1 mln. km	r_2 mln. km	v_1 km/s	r_g km
Mercury	69.82	45.90	38.85	2.96
Venus	108.94	107.48	34.78	2.95
Earth	152.09	147.10	29.29	2.95
Mars	249.23	206.60	21.98	2.96
Jupiter	816.62	740.52	12.44	2.96
Saturn	1505.4	1353.6	9.10	2.93
Uranus	3006	2740	6.50	2.96
Neptune	4537	4456	5.39	2.96
Pluto	7375	4437	3.68	2.96

This table shows that the calculated values r_g of the Solar System gravitational radius are almost identical.

And this takes place despite the neglect (in the calculations) of the presence of both a slight evolutionary weakening (Λ-reduction) of centrifugal pseudo-forces of inertia, and the influence of planets on each other. And this confirms not only the correspondence of the Newtonians and the Keplerians to these planets, but also the absence of relativistic time dilation in them.

TABLE II. Theoretical parameters of planets.

Planet	v_1 km/s	v_2 km/s	η	$(1-b_c)$ **x10[10]**
Mercury	38.88	59.14	0.2067	255.9
Venus	34.83	35.30	0.0067	136.7
Earth	29.33	30.32	0.0167	98.92
Mars	22.00	26.54	0.0935	64.92
Jupiter	12.45	13.73	0.0489	19.00
Saturn	9.15	10.18	0.0531	10.35
Uranus	6.50	7.13	0.0463	5.15
Neptune	5.39	5.49	0.0091	3.29
Pluto	3.68	6.12	0.2487	2.51

Table II shows the calculated values of the planetary parameters for the orbital radii of the planets indicated in Table I and for the gravitational radius of the Solar System $r_g = 2.96$ km.

By clarifying both the value of the gravitational radius of the Sun and the values of the radii of the planets at aphelion and perihelion, it is possible to obtain corresponding to them more accurate values of the velocities of the planets.

Gravitational pseudo-forces are clearly compensated in the adaptive-dynamic gravitational field of the Solar System by centrifugal pseudo-forces of inertia [8,9]:

$$\mathbf{F}_{gr} = m_{0gr}\hat{g} = -\frac{m_{0in}c^2}{2}\frac{d\ln b}{d\hat{r}} = -\frac{m_{0in}c^2}{2b}\frac{d(b_c - v^2c^{-2})}{d\hat{r}} =$$
$$= -\frac{m_{0in}c^2}{2b}\frac{d(b_c - v_1^2c^{-2}r_1^2r^{-2})}{d\hat{r}} = \cdot$$
$$= -\frac{m_{0in}v_1^2r_1^2}{br^3} = -\frac{m_{0in}v^2}{br} = -\mathbf{F}_{in}$$

At the same time, since:

$$b_c = \frac{v_{lc}^2}{c^2} = b + \frac{v^2}{c^2} = 1 - \frac{r_{gad}}{r} + \frac{v^2}{c^2} =$$
$$= 1 - \frac{r_g}{r}\exp\left[\frac{r}{r_0} - \ln\left(\frac{r}{r_0}\right)\right] + \frac{v^2}{c^2} =$$
$$= 1 - \frac{r_g}{r} + \frac{v^2}{c^2} = 1 - \frac{r_g}{2r_0} = \mathbf{const}(t, r),$$

the squares of the true velocities of the planets:

$$v^2 = \frac{c^2br}{2}\exp\left[\ln\left(\frac{r}{r_0}\right) - \frac{r}{r_0}\right]\frac{d\ln b}{d\hat{r}} =$$
$$= \frac{c^2r}{2}\exp\left[\ln\left(\frac{r}{r_0}\right) - \frac{r}{r_0}\right]\times$$
$$\times\frac{d}{d\hat{r}}\left[1 - \frac{r_g}{r}\exp\left[\frac{r}{r_0} - \ln\left(\frac{r}{r_0}\right)\right]\right] = c^2r_g\left(\frac{1}{r} - \frac{1}{r_0}\right)$$

significantly differ from their values in a static gravitational field:

$$v_s^2 = (c^2r\sqrt{ab}/2)d\ln b/d\hat{r} =$$
$$= (c^2/\sqrt{b})(r_{gs}/2r - \Lambda r^2/3) \approx c^2r_{gs}/2r,$$

where: $r_0 = (r_1 + r_2)/2$,

$$v^2 = r_g(1/r - 1/2r_0) = r_g[1/r - 1/(r_1 + r_2)],$$

$$r_{gad} = r_g\left[\frac{r}{r_0} - \ln\left(\frac{r}{r_0}\right)\right] = \frac{2r}{c^2}\exp\left[\ln\left(\frac{r}{r_0}\right) - \frac{r}{r_0}\right]\times$$
$$\times\int v^2\exp\left[\left(\frac{r}{r_0}\right) - \ln\left(\frac{r}{r_0}\right)\right]\frac{dr}{r}$$

is the instantaneous value of the gravitational radius of the adaptive-dynamic gravitational field.

III. CONCLUSION

1. The gravitational field is only a manifestation of the spatial inhomogeneity of the thermodynamic state of matter, and therefore, is not an independent form and a special type of matter. The emergence of the spatial inhomogeneity of the thermodynamic state of matter is not due to gravity, but due to the electromagnetic interaction of micro-objects of matter due to the non-conservation of momentum by quanta of electromagnetic radiation in the process of the origin of this inhomogeneity. Therefore, a hypothetical ideal gas is fundamentally unable to form a spatial inhomogeneity of its thermodynamic state, and, thus, is unable to have a gravitational field [2,3]. And therefore, the search for a special gravitational interaction of micro-objects of matter and attempts to combine it with other types of interactions is as naive as the search for "dark energy" and "non-baryonic dark matter" [9].

2. The gravitational field initiates only the desire of matter to achieve a more stable spatially inhomogeneous thermodynamic state of its own. After all, it only stimulates the motion of matter, without changing its thermodynamic state in the process of the motion. And therefore, the gravitational field determines only the velocities of motion and spatial gradients, and not at all the values of the hidden thermodynamic parameters that are different in different substances [2,3,6]. And this may be associated with the spiral-wave nature of both matter and the Universe as a whole [13-15].

3. But the parameters of the motion of any matter itself, and therefore the planets of the Solar System, are not determined by the gravitational field at all. They are determined by the laws of conservation of the thermodynamic state of matter and the stability of the main parameters of its motion. Namely, they are determined by the laws of conservation of the Newtonian of inert free energy and the Keplerian of ordinary rest energy of matter and the Newtonian angular momentum of matter, respectively.

4. The gravitational field of the Solar System is not stable. After all, it is forced to adapt to changes in the spatial arrangement of the planets, thereby guaranteeing the flawless operation of the conservation laws. And therefore, as the planets approach the Sun, its strength increases. And thus, it is the motion of the planets that forms the adaptive-dynamic gravitational field they need, which is actually a consequence of not only the spatially inhomogeneous thermodynamic state of the entire gravithermodynamically bound matter of the Solar System, but also the motion of the planets (and not at all the cause of both the spatial inhomogeneity of the thermodynamic state of the matter of the Solar System and the motions of its planets) [2,3].

5. An elliptical orbit, not a circular one, is more resistant to external influences. Even the Moon rotates in an elliptical orbit due to the influence on it not only of the Earth's gravitational field, but also of the Sun's gravitational field.

6. Due to the absence of the influence of both the external gravitational field and the motion on the thermodynamic state of matter, along with the conservation (not related to the absorption of solar radiation) of the thermodynamic state of matter, the rate of flow of the planets' proper time is also conserved. And this is due to the conservation of the Newtonian and Keplerian respectively (instead of the Hamiltonian and Lagrangian), in the process of their inertial motion in the gravitational field [8-12].

7. The forces of evolutionary self-contraction of matter in the frame of reference of spatial coordinates and time comoving with the expanding Universe, which are determined mainly by the cosmological constant Λ, are negligibly small in the Solar System. The hypothesis regarding the compensation of two pseudo-forces (namely of the gravitational pseudo-force and additionally of the almost equivalent pseudo-force of evolutionary self-contraction of another origin) by the centrifugal pseudo-force of inertia has not found reliable substantiated confirmation [8-12]. Therefore, the gravitational field of the Solar System should actually be considered not just dynamic, but adaptive-dynamic.

CONFLICTS OF INTEREST

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