Annalen der Physik. 7. Folge, Band 35, Heft 2, 1978, S. 116–121 J. A. Barth, Leipzig

Theory of Gravitational-Inertial Field of Universe

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Abstract. In this paper the basic proposition is a generalization of the metric tensor by introduction of an inertial field tensor satisfying $\nabla_i g_{lm} \equiv g_{lm;i} \neq 0$. On the basis of variational equations a system of more general covariant equations of gravitational-inertial field is obtained. In Einstein's approximation these equations reduce to the field equations of Einstein. The solution of fundamental problems of generl taheory of relativity by means of the new equations give the same results as Einstein's equations. However application of these equations to the cosmologic problem leads to following results: 1. All Galaxies in the Universe (actually all bodies if gravitational attraction is not considered) "disperse" from each other according to Hubble's law. Thus contrary to Friedmann's theory (according to which the "expansion of Universe" began from the singular state with an infinite velocity) the velocity of "dispersion" of bodies begins from the zero value and in the limit tends to the velocity of light. 2. The "dispertion" of bodies represents a free motion in the inertial field and Hubble's law represents a law of motion of free bodies in the inertial field — the law of inertia.

All critical systems (with Schwarzschild radius) are specific because they exist in maximal inertial and gravitational potentials. The Universe represents a critical system, it exists under the Schwarzschild radius. In the high-potential inertial and gravitational fields the material mass in a static state or in the process of motion with decelleration is subject to an inertial and gravitational "annihilation". Under the maximal value of inertial and gravitational potentials ($= c^2$) the material mass is completely "evaporated" transforming into a radiation mass. The latter is concentrated in the "horizon" of the critical system.

All critical systems —"black holes"— represent geon systems, i.e., the local formations of gravitational-electromagnetic radiations, held together by their own gravitational and inertial fields. The Universe, being a critical system, is "wrapped" in a geon crown.

The Universe is in a state of dynamical equilibrium. Near the external part of its boundary surface a transformation of matter into electromagnetic-gravitational-neutrineal energy (geon mass) takes place. Inside the Universe, in the galaxies takes place the synthesis of matter from geon mass, penetrating from the external part of the world (from geon crown) by means of a tunneling mechanism.

The geon system may be considered as a natural entire cybernetic system.

Theorie des kosmischen Gravitations- und Trägheitsfeldes

Inhaltsübersicht. Ausgangspunkt der vorliegenden Arbeit ist die Verallgemeinerung des metrischen Tensors der realen Welt durch Einführung des Tensors des Inertial-Schwerefeldes mit der Eigenschaft $\nabla_i g_{lm} \equiv g_{lm;i} \neq 0$. Auf Grund von Variationsgleichungen ergibt sich das System von allgemeineren Kovarianzgleichungen des Inertial-Schwerefeldes. Die Gleichungen des Einsteinschen Feldes stellen einen Sonderfall der neuen Gleichungen dar.

Die Lösungen der neuen Feldgleichungen für das kosmologische Problem führen zu folgenden Ergebnissen: 1. Bei beliebigen Verteilungsdichten von Weltmassen, die von Null verschieden sind, wird der Raum ein Lobatschewskischer Raum sein; 2. Im Weltall „laufen" alle Galaxien genau nach dem Hubbleschen Gesetz „auseinander". Das Auseinanderlaufen von Körpern läßt sich als eine

freie Bewegung innerhalb des Inertialfeldes und die Hubblesche Gleichung als eine Bewegungsgleichung des freien Körpers im Inertialfeld (vom Galilei-Newtonschen Gesetz unterschiedlich) betrachten.

Alle kritischen Systeme (mit Schwarzschildschem Halbmesser) liegen in maximalen Inertial- und Schwerepotentialen. Das Weltall stellt ein kritisches System dar. Bei den genannten Maximalpotentialen wird die Stoffmasse einer inertialen und gravischen „Zerstrahlung" unterworfen. Die entstandene Strahlungsenergie konzentriert sich am „Horizont" des kritischen Systems in Form einer Geon-Korona.

Es wird vermutet, das Weltall sei im Zustand des dynamischen Gleichgewichts. An seiner äußeren stofflichen Grenzfläche findet eine Umwandlung des Stoffes in ein strahliges Gebilde (in Geonmasse) statt. Innerhalb des Weltalls, in Galaxien, erfolgt eine Synthese des Stoffes aus der Geonmasse, die vom äußeren Weltteil (von der Geon-Korona) vermöge des Tunnelmechanismus' kommt.

Die Geon-Korona des Weltalls läßt sich als ein natürliches einheitliches kybernetisches System betrachten.

I. The basic idea of our theory is a generalization of the metric tensor g_{ik} of the real world in order to include the inevitably present (as we assume it) world tensor background $h_{ik}^{(I)}$ caused by cosmic mass. The tensor field $h_{ik}^{(I)}(\mathscr{P})$ is defined as an i n e r t i a l field. The metric tensor $g_{ik}(\mathscr{P})$ of the real world refers to a Riemannian space and represents the truely physical gravitationalinertial field that cannot be eliminated by the transformation of coordinates. On these grounds everywhere in the world

$$g_{ik,l} \equiv \frac{\partial g_{ik}}{\partial x_l} \neq 0, \quad \nabla_l g_{ik} \equiv g_{ik;l} \neq 0. \tag{1}$$

The space of affine connection $\overset{*}{\Gamma}{}^i_{kl}(\mathscr{P})$, as an abstract mathematical conception (introduced in tensor analysis) is related not to the metric tensor of the real field, but to an abstract tensor $\overset{*}{g}_{ik}$, i.e. $\overset{*}{\Gamma}{}^i_{kl} = \overset{*}{\Gamma}{}^i_{kl}(g_{ik})$, satisfying the following conditions: $\nabla_l \overset{*}{g}_{ik} = 0$, and *in the local geodetic reference frame* $\overset{*}{g}_{ik;l} = 0$.

The possibility of $\overset{*}{\Gamma}{}^i_{kl} = 0$ or $\overset{*}{\Gamma}{}^i_{kl} \neq 0$ depends on the choice of coordinate and reference frames. This means that there are various kinematic effects related to $\overset{*}{\Gamma}{}^i_{kl}(\mathscr{P})$ and hence to $\overset{*}{g}_{ik}$, namely the fictitious fields that originate in the noninertial frames of reference.

Condition (1) allows to obtain the field equations from the following expressions for the Lagrangian density of the gravitational field with or without matter

$$\Lambda_g = g_{lm;i} g^{lm}_{;k} g^{ik}, \quad \Lambda_m = f(g^{lm}, g^{lm}_{,i}) (\sqrt{-g})^{-1}. \tag{2}$$

Variation of the action integral results in covariant equations for the gravitational-inertial field:

$$g^{lp} g^{mn} \nabla_k(\sqrt{-g}\, g^{ik} g_{np;i}) - \nabla_i(\sqrt{-g}\, g^{ik} g^{lm}_{;k}) = (16\pi\varkappa/c^4) \sqrt{-g}\, T^{lm}. \tag{3}$$

Here $\varkappa$ is the gravitational constant, T^{lm} is the energy-momentum tensor.

In connection with the derivation of eq. (3) it should be noted that

1. as a result of variation of equation with Lagrangian Λ_g in (2) the following integrals are obtained

$$-k_1 \int [\nabla_i (\sqrt{-g}\, g^{ik} g^{lm}_{;k})\, \delta g_{lm} + \nabla_k(\sqrt{-g}\, g^{ik} g_{lm;i})\, \delta g^{lm}\, d^4\varkappa \tag{a}$$
$$+ k_1 \int g_{lm;i} g^{lm}_{;k}\, \delta(\sqrt{-g}\, g^{ik})\, d^4 x.$$

The second of these integrals can be neglected since, according to the basic propositions of present theory, in the locally geodetic coordinate system the derivatives $g_{lm;i} = g_{lm,i}$ are quantities of higher order of smallness than those in nonlocal conditions. Therefore in the locally-geodetic coordinate system the second term under integral in (a)

$$g_{lm;i} g^{lm}_{;k}\, \delta(\sqrt{-g}\, g^{ik}) \simeq 0 . \tag{b}$$

But since (b) is a scalar it will be approximately equal to zero also in all other coordinate systems.

2. In the process of variation of the equation with Lagrangian Λ_m in (2) the following tensor density is obtained:

$$\sqrt{-g}\, T_{lm} = \frac{\partial \Lambda_m \sqrt{-g}}{\partial g^{lm}} - \frac{\partial}{\partial x_i}\left(\frac{\partial \Lambda_m \sqrt{-g}}{\partial g^{lm}_{,i}}\right). \tag{c}$$

This expression (with inverse sign) may also be considered as the tensor density

$$\sqrt{-g}\, \overset{*}{T}_{lm} = \sqrt{-g}\left(T_{lm} - \frac{1}{2}\, g_{lm} T\right). \tag{d}$$

Therefore the tensors T_{lm} and $\overset{*}{T}_{lm}$ are mathematically equivalent. However, in Einstein's approximation, i.e. when $g_{ik} \simeq \overset{*}{g}_{ik}$, the eq. (3) reduce to

$$R^{lm} = \frac{8\pi\varkappa}{c^4}\, T^{lm},$$

where R^{lm} is the Ricci tensor. Therefore in order to keep the laws of continuity following from the Bianchi identities, one should proceed from tensor (d). Then the equations of the gravitational-inertial field will read as follows:

$$g^{lp} g^{mn} \nabla_k \left(\sqrt{-g}\, g^{ik} g_{np;i}\right) - \nabla_i\left(\sqrt{-g}\, g^{ik} g^{lm}_{;k}\right) = \frac{32\pi\varkappa}{c^4} \sqrt{-g}\, g^{mn}\left(T^l_n - \frac{1}{2}\, \delta^l_n T\right). \tag{3a}$$

Under the above mentioned limiting conditions ($g_{ik} \simeq \overset{*}{g}_{ik}$) the equations of the gravitational-inertial field (3a) reduce to the usual Einstein equations

$$R^{lm} = (8\pi\varkappa/c^4)\left(T^{lm} - \frac{1}{2}\, g^{lm} T\right).$$

It should be noted however that for all linear approximations and also for cosmologic problems eq. (3) and (3a) give completely identical results.

For eliminating fictitious fields it is assumed that everywhere $\overset{*}{g}_{ik,l} = 0$ ($\overset{*}{\Gamma}{}^i_{kl} = 0$). As a result we obtain interesting field equations without Christoffel symbols:

$$g^{lp} g^{mn} \frac{\partial}{\partial x_k}\left(\sqrt{-g}\, g^{ik} g_{np,i}\right) - \frac{\partial}{\partial x_i}\left(\sqrt{-g}\, g^{ik} g^{lm}_{,k}\right) = (32\pi\varkappa/c^4) \sqrt{-g}\, \overset{*}{T}{}^{lm}. \tag{4}$$

These equations are attractive in the sense that the solution of fundamental problems of General Theory of Relativity (including the Schwarzschild problem) by means of these equations gives the same results as the solution based on Einstein's equations. However, in contrast to the latter the solution of (4) for the cosmologic problem results in an equation of free motion in the inertial field agreeing precisely with Hubble's law.

II. Solution of the cosmologic problem by means of (4) is based as usually on the assumptions of isotropy and homogeneity of the mean distribution density ϱ_u of mass in the universe. Accordingly the expression for the space-time interval in spherical coordinates is as follows:

$$ds^2 = -a^2G^2(dr^2 + r^2\,d\vartheta^2 + r^2 \sin^2\vartheta\, d\varphi^2) + dx_4^2, \tag{5}$$

where

$$a = a(r),\ (r^2 = x_1^2 + x_2^2 + x_3^2), \qquad G = G(x_4); \qquad R = G\int_0^\infty a\,dr \tag{6}$$

is the "radius". Based on these assumptions (and in "accompanying" reference frame) the solution of (4) gives the following results.

For constant value of ϱ_u or $\varrho_u(\tau_0)$ (for given value of intrinsic time τ_0) and for $\varrho_u = \varrho_u(\tau)$ we get respectively

$$\frac{dR}{d\tau} = H_0R,\ H_0 = \sqrt{\frac{4}{3}\pi\varkappa\varrho_u}\,; \quad \frac{dR}{d\tau} = H(\tau)\,R,\ H(\tau) = -\frac{1}{2}\frac{1}{\varrho_u}\frac{d\varrho_u}{d\tau} \tag{7}$$

Condition $H(\tau) = H_0$ arises from the fact that $\frac{1}{\varrho_u}\frac{d\varrho_u}{d\tau} = h = \text{const.}$ or $\varrho_u = \varrho_c e^{h\tau} = \varrho_c + \varrho_m(\tau) \cong \varrho_c = \text{const.}$ Indeed on the basis of $H_0 = \sqrt{\frac{4}{3}\pi\varkappa\varrho_u}$, we get $\varrho_u = \sim 2\cdot 10^{-29}\,gr\cdot cm^{-3}$ while the experimentally measured value is

$$\varrho_m = \sim 3\cdot 10^{-31}\,gr\cdot cm^{-3}.$$

For the laboratory reference frame:

$$\frac{dR}{dt} = H_0(1 - v^2/c^2)\cdot R = \frac{H_0R}{\left(1 + \frac{H_0^2R^2}{c^2}\right)^{1/2}}, \tag{8}$$

$$H_0 = \text{const}, \quad v = \frac{dR}{dt}.$$

Eqs. (7) and (8) represent the well-known Hubble law. According to the results obtained, in the absence of local sources of gravitational and other fields each material point serves as a centre from which all bodies "disperse" with acceleration in hyperbolic trajectories, i.e. they freely "fall" in the inertial field. Violation of such free movement by outer forces gives rise to an inertial force — the „resistance". If the ratio v^2/c^2 is small the expressions (7) and (8) result in a formula similar to Newton's law but with the reverse sign: $d^2R/dt^2 = \varkappa u/R^2$. Thus for small values of velocities Galilei's law (of free fall) in the inertial field should have the same appearance as in a gravitational field. Hence follows the principle of equivalence.

Thus the present theory of equality of absolute values of gravitational and inertial fields in critical systems (with Schwarzschild radius) to some extent corresponds to a significant conclusion from Treder's tetrad theory of gravitation concerning absorption of gravitational field by a material medium.

III. The square of expression (8) represents the potential of the inertial field

$$\Phi_I = \left(\frac{dR}{dt}\right)^2 = \frac{H_0^2R^2}{1 + \frac{H_0^2R^2}{c^2}} \tag{9}$$

as well as the gravitational potential

$$\Phi_g = \left(\frac{dR}{dt}\right)^2 = \frac{2\varkappa M}{R}. \tag{10}$$

In both cases the maximal value of the potentials equals the square of the fundamental velocity c: $\Phi_{I,\max} = c^2(R \to R_{r_1} = \infty)$, $\Phi_{g,\max} = c^2$ ($R \to R_{r_1}$ = Schwarzschild radius). These maximal conditions will be further called the conditions of critical state. In this state complete "annihilation" of material mass into field mass takes place (we speak about the static state). This important statement originates from the equation

$$c^2\,d\tau^2 = ds^2 = g_{ik}\,dx_i\,dx_k\,. \tag{11}$$

from which it follows that $m_0^{*2}c_2 = g_{ik}p^ip^k$ where $m_0^* = m_0\,d\tau/dt$ is an inertial mass in a gravitational or inertial field, m_0 is the inertial mass at zero potentials and $p^i = m_0\,dx_i/dt$. On the basis of the Schwarzschild metric and the metric (5) of inertial field eq. (11) for gravitational and inertial fields respectively gives the following expressions for the inertial mass

$$\left.\begin{aligned} m_0^* &= \left(1 - \frac{2\varkappa M}{Rc^2}\right)^{\frac{1}{2}} m_0\,, \\ m_0^* &= \left[1 - \frac{(dR/dt)^2}{c^2}\right]^{\frac{1}{2}} m_0 = \left[1 - \frac{H_0^2R^2/(1 + H_0^2R^2/c^2)}{c^2}\right]^{\frac{1}{2}} m_0 \end{aligned}\right\} \tag{12}$$

According to these expressions m_0^* decreases with the increase of gravitational and inertial potentials. For the maximal potentials (when $(dR/dt)^2 = c^2$) or in critical state the m_0^* mass becomes zero, in other words it completely converts into the field mass. "Annihilation" processes are possible only when factors resisting the free motion of bodies, particularly galaxies (in the inertial field), are present. Such factors really exists.

Metagalaxy as a whole stays in a critical state with the infinitely large Schwarzschild radius R_k in the laboratory reference frame (this follows from (9)) or with a finite Schwarzschild radius in the local frame of reference,

$$R_k = \frac{c}{H_0} = \left(\frac{c^2}{4/3\pi\varkappa\varrho_u}\right)^{\frac{1}{2}} = \frac{2\varkappa M}{c^2}\ (= \sim 10^{28}\ cm)\,.$$

At this R_k, potentials of gravitational and inertial field are equal to each other

$$\frac{4}{3}\,\pi\varkappa\varrho_4R_k^2 = \frac{2\varkappa M}{R_k} = (dR/d\tau)^2_{\max} = c^2\,.$$

Such a Universe should necessarily be surrounded by a field mass — the geon[1]) crown. The latter to some extent should penetrate diffusively inside the Universe and together with gravitational field behave as a "viscous" medium. As a result, the motion of galaxies close to the velocity of light stabilizes. Thus the outer domain of metagalaxy is a critical zone, where the matter "burnes out". Such zones of "burn" and "synthesis" of matter represent the critical systems — "black holes" inside metagalaxy.

IV. The obtained cosmological results give us reason to suppose that our Universe with its outer geon crown is in a state of dynamic equilibrium. In the outer reactive (critical) zone takes place the conversion of material mass into geon mass. Inside the Universe (inside the nuclei of galaxies, for instance) the reverse process proceeds—conversion of geon (gravitational-electromagnetic) mass into material mass.

Due to the leak of geon radiation because of tunneling effect and due to the local inhomogeneity of galactic mass distribution in the Universe the geon mass in certain places finds its way to penetrate inside the Universe. Then this focussed flux of geon mass meeting a galaxy on its way gets involved in a "trap" of the galaxy's critical system, where conditions exist for conversion of geon mass into material mass.

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[1]) This term is due to J. A. WHEELER.

On the basis of all theoretical results obtained we come to the following important conclusions.

The density of material mass in the Universe makes about 1.5% of its total mass ($\varrho_u = \sim 2 \cdot 10^{-29}$ gr $\cdot$ cm^{-3}). The main part of the Universe mass consists of electromagnetic-gravitational (possibly neutrino) formations (in the form of geon system).

The so-called "relict" radiation should be a part background radiation[2]) from the geon crown of the Universe. Galactical critical systems, where a permanent synthesis of matter from geon mass takes place (the latter feeding from the outer reactive zone of Universe) may be considered as pre-star bodies.

The geon system of Universe as a combination of electromagnetic and gravitational radiations simultaneously represents a source of infinite information. It is fed by all kinds of radiation from all over the Universe, carrying information about the processes inside it. Moreover this information on the basis of "resonance" finds "response" of similar radiations, present in the geon crown. Thus, the geon crown, that receives, stores, and transforms (increases or decreases) the information from all the world, actually represents a cybernetic system with an infinite memory and hence with an infinite intellect.

In conclusion the author expresses his gratitude to Professor Dr. Dr. e.h. H. J. TREDER for helpful discussion and important remarks. He expresses his gratitude also to Prof. Dr. G. RICHTER for organizing a very competent and fruitful discussion of this paper and its publication.

Bei der Redaktion eingegangen am 15. März 1977.

Revidiertes Manuskript eingegangen am 14. 8. 1977.

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2) Energy leak from the geon crown of metagalaxy (Universe) in the cosmic space without strongly focussing masses (like galaxy nuclei) will be perceived as an isotropic cosmic background radiation.