Gravitational radiation as radiation same level of electromagnetic and its generation in pulsed high-current discharge

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Abstract. The notion of gravitational radiation as a radiation of the same level as the electromagnetic radiation is based on theoretically proved and experimentally confirmed fact of existence of stationary states of an electron in its gravitational field characterized by the gravitational constant \( K = 10^{42} \text{G} \) (G is the Newtonian gravitational constant) and unrecoverable space-time curvature \( \Lambda \). This paper gives an overview of the authors' works [1, 2, 3, 4], which set out the relevant results. Additionally, data is provided on the broadening of the spectra characteristic radiation. The data show that this broadening can be explained only by the presence of excited states of electrons in their gravitational field. What is more, the interpretation of the new line of X-ray emission spectrum according to the results of observation of MOS-camera of XMM-Newton observatory is of interest. The given work contributes into further elaboration of the findings considering their application to dense high-temperature plasma of multiple-charge ions. This is due to quantitative character of electron gravitational radiation spectrum such that amplification of gravitational radiation may take place only in multiple-charge ion high-temperature plasma.

1. Introduction
Numerous attempts to detect experimentally gravitational radiation (as based on the notions of the general relativity theory and alternative theories) brought no result. Studying the development of the relativistic theory of gravitation (which is the relativistic theory of gravitation, and not any of its particular case, such as general relativity theory), the authors obtained a model of gravitational interaction at the quantum level, which has no analogues. [1,2,3,4].

2. Gravitational radiation of the relativistic theory of gravitation
From the 70's onwards, it became obvious [5] that in the quantum region the numerical value of G is not compatible with the principles of quantum mechanics. The essence of the problem of the generalization of relativistic equations on the quantum level was thus outlined: such generalization must match the numerical values of the gravity constants in the quantum and classical regions.

In the development of these results, as a micro-level approximation of Einstein's field equations, a model is proposed, based on the following assumption [1,2]:

“The gravitational field within the region of localization of an elementary particle having a mass \( m_0 \) is characterized by the values of the gravity constant \( K \) and of the constant \( \Lambda \) that lead to the
stationary states of the particle in its proper gravitational field, and the particle stationary states as such are the sources of the gravitational field with the Newtonian gravity constant G’.

Complexity of solving this problem compels us to employ a simpler approximation, namely: energy spectrum calculations in a relativistic fine-structure approximation. In this approximation the problem of the stationary states of an elementary source in the proper gravitational field will be reduced to solving the following equations:

\[
f^* + \left( \frac{v' - \lambda'}{2} + \frac{1}{r} \right) f' + e^{A} \left( K^2 - \frac{2}{n} e^{-V} - K^2 \frac{l(l+1)}{r^2} \right) f = 0
\]

(1)

\[
- e^{-A} \left( \frac{1}{r^2} - \frac{\lambda'}{r} \right) + 1 \frac{1}{r^2} + \Lambda = \beta(2l + 1) \left( e^{-A} K^2 + K_0^2 + \frac{l(l+1)}{r^2} + f'^2 e^{-A} \right)
\]

(2)

\[
- e^{-A} \left( \frac{1}{r^2} + \frac{v'}{r} \right) + 1 \frac{1}{r^2} + \Lambda = \beta(2l + 1) \left( K_0^2 - K_0^2 e^{-V} + \frac{l(l+1)}{r^2} - e^{A} f'^2 \right)
\]

(3)

\[
\left\{ - \frac{1}{2} (v'' + v'^2) - (v' + \lambda') \left( \frac{v'}{4} + \frac{1}{r} \right) + \frac{1}{r^2} (1 + e^A) \right\}_{r=r_n} = 0
\]

(4)

\[
f(\sqrt{\Lambda r^2}) = 0
\]

(5)

\[
f(r_n) = 0
\]

(6)

\[
\lambda(0) = \nu(0) = 0
\]

(7)

\[
\int_0^{r_n} r^2 dr = 1
\]

(8)

Equations (1)—(3) follow from equations (9)—(10)

\[
- g^\mu{}^\nu \frac{\partial}{\partial x^\mu} \frac{\partial}{\partial x^\nu} + g^\mu{}^\nu \Gamma^\sigma_{\mu\nu} \frac{\partial}{\partial x^\sigma} - K_0^2 \Psi = 0
\]

(9)

\[
R^\mu{}^\nu - \frac{1}{2} g^\mu{}^\nu R = -\kappa (T^\mu{}^\nu - \mu g^\mu{}^\nu),
\]

(10)

after the substitution of \( \Psi \) in the form of \( \Psi = f_{El}(r)Y_{lm}(\theta, \phi) \exp \left( -\frac{iEt}{\hbar} \right) \) into them and specific computations in the central-symmetry field metric with the interval defined by the expression [6]

\[
dS^2 = c^2 e^\nu dt^2 - r^2 (d\theta^2 + \sin^2 \theta d\phi^2) - e^A dr^2
\]

(11)

The following notation is used above: \( f_{El} \) is the radial wave function that describes the states with a definite energy E and the orbital moment \( l \) (hereafter the subscripts El are omitted), \( Y_{lm}(\theta, \phi) \) are spherical functions, \( K_n = E_n/hc \), \( K_0 = cm_0/h \), \( \beta = (\kappa/4\pi)(h/m_0) \).

Condition (4) defines \( r_n \), whereas equations (10) through (7) are the boundary conditions and the normalization condition for the function \( f \), respectively. Condition (4) in the general case has the form \( R(K, r_n) = R(G, r_n) \). Neglecting the proper gravitational field with the constant G, we shall write down this condition as \( R(K, r_n) = 0 \), to which equality (4) actually corresponds.
In its simplest approximation (from the point of view of the original mathematical estimates) the problem on steady states in proper gravitational field (with constants K and \( \Lambda \)) is solved by [1]. The solution of this problem provides the following conclusions.

a) With the numeric values \( K \approx 5.1 \times 10^{31} \text{ Nm}^2 \text{kg}^{-2} \) and \( \Lambda = 4.4 \times 10^{29} \text{ m}^{-2} \) there is a spectrum of steady states of the electron in proper gravitational field (0.511 MeV ... 0.681 MeV). The basic state is the observed electron rest energy 0.511 MeV.

b) These steady states are the sources of the gravitational field with the G constant.

c) The transitions to stationary states of the electron in proper gravitational field cause gravitational emission, which is characterized by constant K, i.e. gravitational emission is an emission of the same level as electromagnetic (electric charge \( e \), gravitational charge \( m\sqrt{K} \)). In this respect there is no point in saying that gravitational effects in the quantum area are characterized by the G constant, as this constant belongs only to the macroscopic area and cannot be transferred to the quantum level (which is also evident from the negative results of registration of gravitational waves with the G constant, they do not exist).

Existence of such numerical value \( \Lambda \) denotes a phenomenon having a deep physical sense: introduction into density of the Lagrange function of a constant member independent on a state of the field. This means that the time-space has an inherent curving which is connected with neither the matter nor the gravitational waves. The distance at which the gravitational field with the constant K is localized is less than the Compton wavelength, and for the electron, for example, this value is of the order of its classical radius. At distances larger than this one, the gravitational field is characterized by the constant G, i.e., correct transition to Classical GR holds, (see Figure 1).

Figure 1. Electron in proper gravitational field in the ground stationary state.

- \( r_1 \) – radius of irremovable curvature,
- \( r_0 \) – “classical” electron radius being a radius of the ground stationary state of electron in proper gravitational field

3. Spectral lines widening of the radiation of multiple-charge ions

Figs 2 show characteristic parts of micropinch soft X-ray radiation spectrum as a mechanism of spectrum lines widening, a Doppler, radiation and impact widening were considered. Such adjustment according to said widening mechanisms does not lead to complete reproduction of the registered part of the micropinch radiation spectrum. This is the evidence (under the condition of independent conformation of the macroscopic parameters adjustment) of additional widening mechanism existence due to electron excited states and corresponding gravitational radiation spectrum part already not having clearly expressed lines because of energy transfer in the spectrum to the long-wave area.

That is to say that the additional mechanism of spectral lines widening of the characteristic electromagnetic radiation of multiple-charge ions (in the conditions of plasma compression by radiated gravitational field) is the only and unequivocal way of quenching electrons excited states at the radiating energy levels of ions and exciting these levels by gravitational radiation at resonance frequencies. Such increase in probability of ion transitions in other states results in additional spectral lines widening of the characteristic radiation. The reason for quick degradation of micropinches in various pulse high-currency discharges with multiple-charge ions is also clear. There is only partial thermolization of accelerated plasma with the power of gravitational radiation not sufficient for maintaining steady states [4].
4. Thermonuclear plasma steady states generation

The problem of controlled fusion realization is directly connected to obtaining steady state of dense high-temperature plasma.

It can also be unambiguously stated that the present state of the art does not solve the problem of dense high-temperature plasma retention for a time required for the reaction of nuclear fusion but only solving the problem of heating plasma to the state when these reactions can exist. In the offered method of forming dense-high temperature plasma steady states for nuclear fusion a new fundamental concept is used, namely retaining plasma by radiated gravitational field as radiation of the same kind as electromagnetic:

Forming and accelerating binary plasma with multivalent ions by accelerating magnetic field in a pulse high-current discharge, injection of binary plasma from the space of the accelerating magnetic field:

Exciting stationary states of an electron in its own gravitational field in the range of energy up to 171 keV with following radiation under the condition of quenching lower excited energy levels of ion electron shell of a heavy component (including quenching excited state of electrons directly in nuclei of small sequential number as carbon) when retarding plasma bunch ejected from the space of the accelerating magnetic field. Cascade transitions from the upper levels are realized in the process of gravitational radiation energy transit to long-wave range.

The sequence of the operations is carried out in a two-sectional chamber of MAGO installation (developed in Experimental Physics Research Institute, Sarov, [7]; the structure of the installation is most suitable for the claimed method of forming steady states of the dense high-temperature plasma) with magnetodynamic outflow of plasma and further conversion of the plasma bunch energy (in the process of quenching) in the plasma heat energy for securing both further plasma heating and exciting gravitational radiation and its transit into a long-wave part of the spectrum with consequent plasma compression in the condition of radiation blocking and increasing [4].

5. Characteristic radiation spectra of stars

Two groups of researchers, independently of each other [8,9] reported that in the X-ray spectra of galaxy clusters there is a new line of radiation with an energy of 3.57 keV. This radiation should go from hot intergalactic gas that fills the cluster of galaxies, but, unlike other identified emission lines, this cannot be explained by any atomic transition.
Above: MOS-camera spectrum in the range of 3 to 4 keV, XMM-Newton observatory. Separate dashes are the results of observation with errors; red curve is the best reproduction of the spectrum when only known emission lines of ions taken into account, blue curve is the result of addition of another previously unknown emission line. Bottom: deviation of observation data from the red and blue curves, [8].

The results of these measurements are shown in Figure 3. At the same time, the resonance spectra of stationary states of electrons in its gravitational field and the spectra of multiple-charge ions can produce not only the registered emission line, but also other lines of similar properties. We can expect the presence of such lines in detailed registration of the emission spectra of astrophysical objects in the energy range greater than 8 keV.

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