Gravitational Radiation of the Relativistic Theory of Gravitation

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Abstract

The concept of gravitational radiation as a radiation of one level with the electromagnetic radiation is based on theoretically proved and experimentally confirmed fact of existence of electron’s stationary states in own gravitational field, characterized by gravitational constant $K=10^{42}G$ (G — Newtonian gravitational constant) and by irremovable space-time curvature. The received results strictly correspond to principles of the relativistic theory of gravitation and the quantum mechanics. In given article realization of the received results with reference to dense high-temperature plasma of multicharged ions and cosmological effects is considered also. The article is a systematic and full summary of the authors’ works published before [2,7,14].

Keywords: gravity, electron, spectrum, discharge, fusion, redshift, microwave radiation

Introduction

Last years’ astronomical observations have brought to general relativity based astrophysics and cosmology such notions as “inflation”, “dark matter”, and “dark energy” thus urging to elaboration of the major number of recent alternatives to GR. New theories offer interpretation of these experimental data not invoking those notions for they seem to be wrong or artificial to the authors of these theories. The basic concept implies that gravity must agree with GR at least within Solar System at present epoch but may be essentially different on galaxy scale or higher as well as in early Universe. However all experimental attempts to detect gravitational radiation (based both on GR views and on alternative theories) yield no results. In elaboration of the relativistic theory of gravitation (namely the relativistic theory of gravitation rather than its particular case such as GR) the authors have obtained a model of gravitational interaction at quantum level having no equivalents and making gravitational radiation spectrum computing possible. These results are particularized in the work [2]. Generalized summary of those results followed by their possible development is described in section 1 hereafter. In applied perspective, the most important consequence of the properties of the radiated gravitational field (as a field of the same level as electromagnetic one) is compression of the radiating system by it. This property is directly relevant to controlled thermonuclear fusion which is discussed in section 2 including layout of the approbated test unit for plasma compression by the radiated gravitational field [7]. The section 3 describes typical experimental data expressly or by implication confirming the advocated ideas about quantum character of gravitational radiation as a radiation of one level with electromagnetic radiation. The resonance of spectra of stationary states of the electromagnetic and gravitational interactions is of direct relevance to the shift of spectra of radiation of galaxies, too, which is discussed in the section 4. The existence of non-zero irremovable space-time curvature can be of direct relevance to the nature of the microwave background radiation. This assumption, considering the indisputable fact of existence of curvature of space-time distinct from zero, is far from being groundless [14]. Arguments in favor of such assumption are resulted in section 4.

Gravitational Radiation as a Radiation the Same Level as Electromagnetic

For a mathematical model of interest, which describes a banded spectrum of stationary states of electrons in the proper gravitational field, two aspects are of importance. First. In Einstein's field equations κ is a constant which relates the space-time geometrical properties with the distribution of physical matter, so that the origin of the equations is not connected with the numerical limitation of the κ value. Only the requirement of conformity with the Newtonian Classical Theory of Gravity leads to the small value $\kappa = 8\pi G/c^4$, where G, c are, respectively, the Newtonian gravitational constant and the velocity of light. Such requirement follows from the primary concept of the Einstein General Theory of Relativity (GR) as a relativistic generalization of the Newtonian Theory of Gravity. Second. The most general form of relativistic gravitation equations are equations with the Λ term. The limiting transition to weak fields leads to the equation

$$\Delta\Phi = - 4\pi\rho G + \Lambda c^2,$$

where Φ is the field scalar potential, ρ is the source density. This circumstance, eventually, is crucial for neglecting the Λ term, because only in this case the GR is a generalization of the Classical Theory of Gravity. Therefore, the numerical values of $\kappa = 8\pi G/c^4$ and $\Lambda = 0$ in the GR equations are not associated with the origin of the equations, but follow only from the conformity of the GR with the classical theory.

From the 70's onwards, it became obvious [1] 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 [2]:

“The gravitational field within the region of localization of an elementary particle having a mass m0 is characterized by the values of the gravity constant K and of the constant Λ 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”.

The most general approach in the Gravity Theory is the one which takes twisting into account and treats the gravitational field as a gage field, acting on equal terms with other fundamental fields ([3]). Such approach lacks in apriority gives no restrictions on the microscopic level. For an elementary spinor source with a mass m0, the set of equations describing its states in the proper gravitational field in accordance with the adopted assumption will have the form

$$\left\{ i\gamma^{\mu}\left(\nabla_{\mu} + \bar{\kappa}\Psi\gamma_{\mu}\gamma_{5}\Psi\gamma_{5}\right) - m_{0}c/\hbar \right\}\Psi = 0 \tag{1}$$

$$R_{\mu\nu} - \frac{1}{2}g_{\mu\nu}R = -\kappa\left\{ T_{\mu\nu}\left(E_n\right) - \mu g_{\mu\nu} + \left(g_{\mu\nu}S_{\alpha}S^{\alpha} - S_{\mu}S_{\nu} \right) \right\} \tag{2}$$

$$R\left(K, \Lambda, E_n, r_n\right) = R\left(G, E_n^{'}, r_n\right) \tag{3}$$

$$\left\{i\gamma^{\mu}\nabla_{\mu} - m_n c/\hbar\right\}\Psi' = 0 \qquad (4)$$

$$R_{\mu\nu} - \frac{1}{2} g_{\mu\nu} R = -\kappa' T_{\mu\nu}\left(E_n'\right) \qquad (5)$$

The following notations are used throughout the text of the paper: $\kappa = 8\pi K/c^4$, $\kappa' = 8\pi G/c^4$, E_n is the energy of stationary states in the proper gravitational field with the constant K, $\Lambda = \kappa\mu$, r_n is the value of the coordinate r satisfying the equilibrium n-state in the proper gravitational field, $\bar{\kappa} = \kappa_0\kappa$, κ_0 is the dimensionality constant, S_a = $\bar{\Psi}\gamma_a\gamma_5\Psi$, ∇_μ is the spinor-coupling covariant derivative independent of twisting, E'_n is the energy state of the particle having a mass m_n (either free of field or in the external field), described by the wave function ψ' in the proper gravitational field with the constant G. The rest of the notations are generally adopted in the gravitation theory.

Equations (1) through (5) describe the equilibrium states of particles (stationary states) in the proper gravitational field and define the localization region of the field characterized by the constant K that satisfies the equilibrium state. These stationary states are sources of the field with the constant G, and condition (3) provides matching the solution with the gravitational constants K and G. The proposed model in the physical aspect is compatible with the principles of quantum mechanics principles, and the gravitational field with the constants K and Λ at a certain, quite definite distance specified by the equilibrium state transforms into the filed having the constant G and satisfying, in the weak field limit, the Poisson equation.

The set of equations (1) through (5), first of all, is of interest for the problem of stationary states, i.e., the problem of energy spectrum calculations for an elementary source in the own gravitational field. In this sense it is reasonable to use an analogy with electrodynamics, in particular, with the problem of electron stationary states in the Coulomb field. Transition from the Schrödinger equation to the Klein-Gordon relativistic equations allows taking into account the fine structure of the electron energy spectrum in the Coulomb field, whereas transition to the Dirac equation allows taking into account the relativistic fine structure and the energy level splitting associated with spin-orbital interaction. Using this analogy and the form of equation (1), one can conclude that solution of this equation without the term $\bar{\kappa}\bar{\Psi}\gamma_\mu\gamma_5\Psi\gamma_5$ gives a spectrum similar to that of the fine structure (similar in the sense of relativism and removal of the principal quantum number degeneracy). Taking the term $\bar{\kappa}\bar{\Psi}\gamma_\mu\gamma_5\Psi\gamma_5$ into account, as is noted in [1], is similar to taking into account of the term $\bar{\Psi}\sigma^{\mu\nu}\Psi F_{\mu\nu}$ in the Pauli equation. The latter implies that the solution of the problem of stationary states with twisting taken into account will give a total energy-state spectrum with both the relativistic fine structure and energy state splitting caused by spin-twist interaction taken into account. This fact, being in complete accord with the requirements of the Gauge Theory of Gravity, allows us to believe that the above-stated assumptions concerning the properties of the gravitational field in the quantum region are relevant, in the general case, just to the gravitational field with twists.

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:

$$f''+\left(\frac{\nu'-\lambda'}{2}+\frac{2}{r}\right)f'+e^{\lambda}\left(K_n^2e^{-\nu}-K_0^2-\frac{l(l+1)}{r^2}\right)f=0 \qquad (6)$$

$$-e^{-\lambda}\left(\frac{1}{r^2}-\frac{\lambda'}{r}\right)+\frac{1}{r^2}+\Lambda=\beta(2l+1)\left\{f^2\left[e^{-\lambda}K_n^2+K_0^2+\frac{l(l+1)}{r^2}\right]+f'^2e^{-\lambda}\right\} \qquad (7)$$

$$-e^{-\lambda}\left(\frac{1}{r^2}+\frac{\nu'}{r}\right)+\frac{1}{r^2}+\Lambda=\beta(2l+1)\left\{f^2\left[K_0^2-K_n^2e^{-\nu}+\frac{l(l+1)}{r^2}\right]-e^{\lambda}f'^2\right\} \qquad (8)$$

$$\left\{-\frac{1}{2}\left(\nu''+\nu'^2\right)-\left(\nu'+\lambda'\right)\left(\frac{\nu'}{4}+\frac{1}{r}\right)+\frac{1}{r^2}\left(1+e^{\lambda}\right)\right\}_{r=r_n}=0 \qquad (9)$$

$$f(0)=const<<\infty \qquad (10)$$

$$f(r_n)=0 \qquad (11)$$

$$\lambda(0)=\nu(0)=0 \qquad (12)$$

$$\int_0^{r_n}f^2r^2dr=1 \qquad (13)$$

Equations (6) - (8) follow from equations (14) - (15)

$$\left\{-g^{\mu\nu}\frac{\partial}{\partial x_\mu}\frac{\partial}{\partial x_\nu}+g^{\mu\nu}\Gamma_{\mu\nu}^{\alpha}\frac{\partial}{\partial x_\alpha}-K_0^2\right\}\Psi=0 \qquad (14)$$

$$R_{\mu\nu}-\frac{1}{2}g_{\mu\nu}R=-\kappa\left(T_{\mu\nu}-\mu g_{\mu\nu}\right), \qquad (15)$$

after the substitution of Ψ 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 [4]

$$dS^2=c^2e^{\nu}dt^2-r^2\left(d\theta^2+\sin^2\theta d\phi^2\right)-e^{\lambda}dr^2 \qquad (16)$$

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), $Y_{lm}(\theta, \varphi)$ - are spherical functions, $K_n = E_n/\hbar c$, $K_0 = cm_0/\hbar$,$\beta = (\kappa/4\pi)(\hbar/m_0)$.

Condition (9) defines r_n,, whereas equations (10) through (12) are the boundary conditions and the normalization condition for the function f, respectively. Condition (9) 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 (9) actually corresponds.

The right-hand sides of equations (7) - (8) are calculated basing on the general expression for the energy-momentum tensor of the complex scalar field:

$$T_{\mu\nu} = \Psi^{+}_{,\mu}\Psi_{,\nu} + \Psi^{+}_{,\nu}\Psi_{,\mu} - \left(\Psi^{+}_{,\mu}\Psi^{,\mu} - K_0^2\Psi^{+}\Psi\right) \quad (17)$$

The appropriate components $T_{\mu\nu}$ are obtained by summation over the index m with application of characteristic identities for spherical functions [5] after the substitution of $\Psi = f(r)Y_{lm}(\theta,\varphi)\exp\left(\frac{-iEt}{\hbar}\right)$ into (17).

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 Λ) is solved by [2]. The solution of this problem provides the following conclusions.

a) With the numeric values $K \approx 5.1\times10^{31}$ Nm^{2}kg^{-2} and $\Lambda = 4.4\times10^{29}$ 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 Λ 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.

There is certain analytic interest in β-decay processes with asymmetry of emitted electrons [6], due to (as it is supposed to be) parity violation in weak interactions. β - asymmetry in angular distribution of electrons was registered for the first time during experiments with polarized nucleuses $_{27}Co^{60}$, β-spectrum of which is characterized by energies of MeV. If in the process of β-decay exited electrons are born, then along with decay scheme

$$n \to p + e^{-} + \tilde{\nu} \quad (18)$$

there will be also decay scheme

$$n \to p + \left(e^*\right)^- + \tilde{\nu} \to e^- + \tilde{\gamma} + \tilde{\nu} \qquad (19)$$

where $\tilde{\gamma}$ is a graviton.

Decay (19) is energetically limited by energy values of 1 MeV order (in rough approximation), taking into consideration that the difference between lower excitation level of electron’s energy (in own gravitational field) and general <100 keV and the very character β-spectrum. Consequently, ${}_{27}Co^{60}$ nucleuses decay can proceed with equal probability as it is described in scheme (18) or in scheme (19). For the light nucleuses, such as ${}_{1}H^{3}$ β-decay can only proceed as it is described in scheme (18). At the same time, emission of graviton by electron in magnetic field can be exactly the reason for β-asymmetry in angular distribution of electrons. If so, then the phenomenon of β-asymmetry will not be observed in light β-radioactive nucleuses. This would mean that β-asymmetry in angular distribution of electrons, which is interpreted as parity violation, is the result of electron’s gravitational emission, which should be manifested in existence of lower border β-decay, as that’s where β-asymmetry appears to be.

Using Kerr-Newman metric for estimation of the numerical value of K one can obtain the formula [7]

$$K = \frac{r^2}{(mcr^2 / L - L / mc)(m / rc^2 - e^2 / r^2c^4)}; \qquad (20)$$

where *r, m, e, L* are classical electron radius, mass, charge, orbital momentum respectively, and *c* is the speed of light.

Despite the fact that we used external metric and orbital momentum in deriving the formula (20), its use is legitimate for the orbital momentum of a particle in internal metric equal to the electron spin by an order of magnitude. The estimation of K from the formula (20) using the numerical values of the abovementioned arguments agrees with the estimation that stands in correspondence with numerical values of electron energy spectrum in proper gravitational field. This may suggest that the physical nature of spin is possibly such that these are just values of the orbital momentum of a particle in proper gravitational field.

Gravitational Emission in Dense High-Temperature Plasma

A. Excitation of gravitational emission in plasma

For the above-indicated energies of transitions over stationary states in the own field and the energy level widths, the sole object in which gravitational emission can be realized as a mass phenomenon will be, as follows from the estimates given below, a dense high-temperature plasma.

Using the Born approximation for the bremsstrahlung cross-section, we can write down the expression for the electromagnetic bremsstrahlung per unit of volume per unit of time as

$$Q_e = \frac{32}{3} \quad \frac{z^2 r_0^{\,2}}{137} mc^2 \; n_e \, n_i \, \frac{\sqrt{2k}\, T_e}{\pi m} = 0.17 \times 10^{-39} z^2 n_e n_i \sqrt{T_e}, \qquad (21)$$

where T_e, k, n_i, n_e, m, z, r_o are the electron temperature, Boltzmann's constant, the concentration of the ionic and electronic components, the electron mass, the serial number of the ionic component, the classical electron radius, respectively.

Replacing r_o by $r_g = 2K\ m/c^2$ (which corresponds to replacing the electric charge e by the gravitational charge $m\sqrt{K}$), we can use for the gravitational bremsstrahlung the relation

$$Qg = 0.16Qe. \qquad (22)$$

From (36) it follows that in a dense high-temperature plasma with parameters $n_e = n_i = 10^{23}\ m^{-3}$, $T_e = 10^7$ K, the specific power of the electromagnetic bremsstrahlung is equal to $\approx 0.53\ 10^{10}\ J/m^3$ s, and the specific power of the gravitational bremsstrahlung is $0.86\ 10^9\ J/m^3$ s. These values of the plasma parameters, apparently, can be adopted as guide threshold values of an appreciable gravitational emission level, because the relative proportion of the electrons whose energy on the order of the energy of transitions in the own gravitational field, diminishes in accordance with the Maxwellian distribution exponent as T_e decreases. Certainly, application of the formula (21) is not quite correct, but admissible, whereas the question is only the orders of the estimated values.

B. Amplification of gravitational emission in plasma

For the numerical values of the plasma parameters $T_e = T_i = (10^7\text{-}10^8)$K, $n_e = n_i = (10^{23}\text{-}10^{25})\ m^{-3}$ the electromagnetic bremsstrahlung spectrum will not change essentially with Compton scattering of electron emission, and the bremsstrahlung itself is a source of emission losses of a high-temperature plasma. The frequencies of this continuous spectrum are on the order of $(10^{18}—10^{20})\ s^{-1}$, while the plasma frequency for the above-cited plasma parameters is $(10^{13}—10^{14})\ s^{-1}$, or 0.1 eV of the energy of emitted quanta.

The fundamental distinction of the gravitational bremsstrahlung from the electromagnetic bremsstrahlung is the banded spectrum of the gravitational emission, corresponding to the spectrum of the electron stationary states in the own gravitational field.

The presence of cascade transitions from the upper excited levels to the lower ones will lead to that the electrons, becoming excited in the energy region above 100 keV, will be emitted, mainly, in the eV region, i.e., energy transfer along the spectrum to the low-frequency region will take place. Such energy transfer mechanism can take place only in quenching spontaneous emission from the lower electron energy levels in the own gravitational field, which rules out emission with quantum energy in the keV region. A detailed description of the mechanism of energy transfer along the spectrum will hereafter give its precise numerical characteristics. Nevertheless, undoubtedly, the very fact of its existence, conditioned by the banded character of the spectrum of the gravitational bremsstrahlung, can be asserted. The low-frequency character of the gravitational bremsstrahlung spectrum will lead to its amplification in plasma by virtue of the locking condition $\omega_g \leq 0.5\sqrt{10^3 n_e}$ being fulfilled.

From the standpoint of practical realization of the states of a high-temperature plasma compressed by the emitted gravitational field, two circumstances are of importance.

First. Plasma must comprise two components, with multiply charged ions added to hydrogen, these ions being necessary for quenching spontaneous emission of electrons from the ground energy levels in the own gravitational field. For this purpose it is necessary to have ions with the energy levels of electrons close to the energy levels of free excited electrons. Quenching of the lower excited states of the electrons will be particularly effective in the presence of a resonance between the energy of excited electron and the energy of electron excitation in the ion (in the limit, most favorable case — ionization energy). An increase of z increases also the specific power of the gravitational bremsstrahlung, so that on the condition

$\omega_g \le 0.5\sqrt{10^3 n_e}$ being fulfilled, the equality of the gas-kinetic pressure and the radiation pressure

$$k(n_e T_e + n_i T_i) = 0.16(0.17\ 10^{-39} z^2 n_e n_i \sqrt{T_e})\Delta t \qquad (23)$$

will take place at $\Delta t = (10^{-6} - 10^{-7})$ s for the permissible parameter values of compressed plasma $n_e = (1 + a)\, n_i = (10^{25} - 10^{26})\ m^{-3}$, $a > 2$, $T_e \approx T_e = 10^8$ K, $z > 10$.

Speaking of the two component composition of plasma we mean that along with a light component at plasma there can be multiply charged ions of various kinds, which we do not specificate so far.

Second. The necessity of plasma ejection from the region of the magnetic field with the tentative parameters $n_e = (10^{23} - 10^{24})\ m^{-3}$, $T_e = (10^7 - 10^8)$ K with subsequent energy pumping from the magnetic field region.

C. A series of actions required for obtaining steady states of dense-high temperature plasma

- Forming and accelerating binary plasma with multivalent ions by accelerating magnetic field in a pulse high-current discharge.
- Ejection 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 (Fig. 1) under the condition of quenching lower excited energy levels of ion electron shell of a heavy component (Fig. 2, including quenching excited state of electrons directly in nuclei of small sequential number as carbon, nitrogen, oxygen) when retarding plasma bunch ejected from the space of the accelerating magnetic field. Inverse Feynman diagrams are similar in appearance. 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 (Fig. 3); the structure of the installation is most suitable for the claimed method of forming steady states of the dense high-temperature plasma [8]) 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.

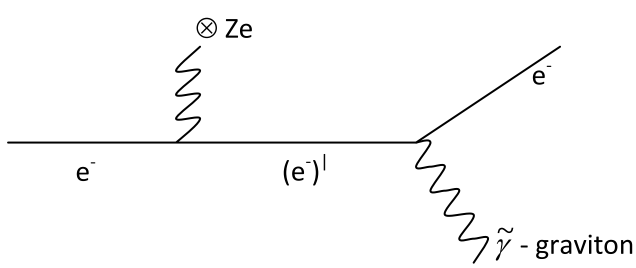


Fig. 1. Graviton emission when quenching an electron in a nucleus.

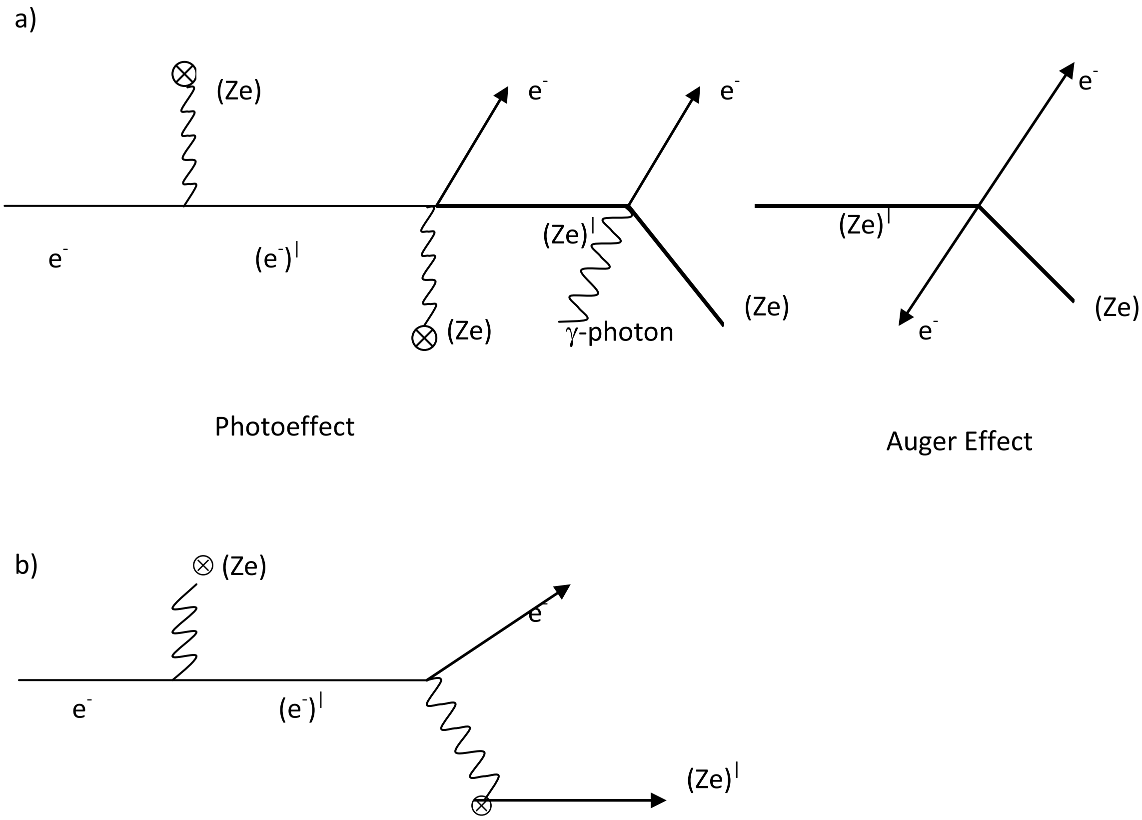


Fig. 2. Quenching lower excited states of electron by: a) many-electron ions (photoelectric effect with release of one electron or autoionization (Auger effect) with release of two electrons depending on the ion number and quenching energy); b) nuclei without electron shells when an excited electron returns to normal state transferring excess energy directly to the nucleus with higher probability for the lover energy levels of excited electrons.

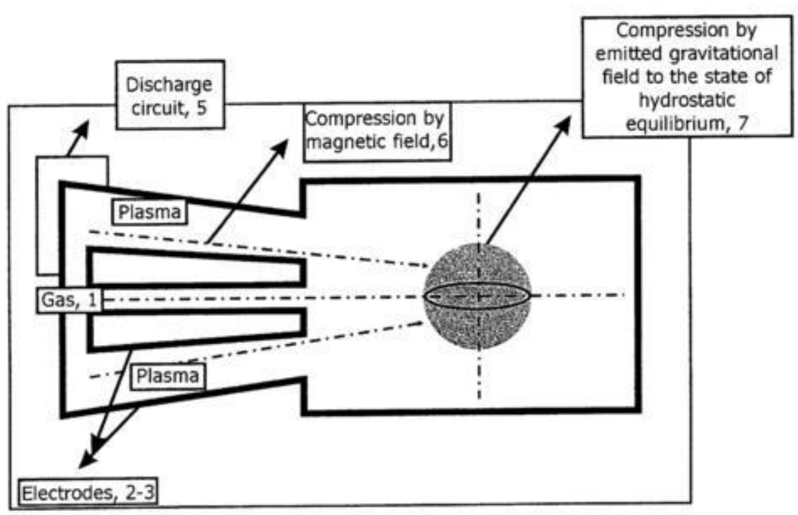


Fig. 3. Forming of stable states of dense high-temperature plasma: the scheme

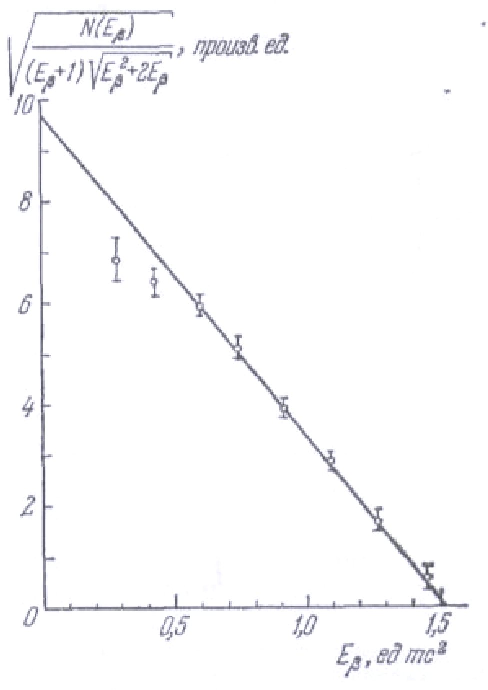
Of interest there are two modes of the installation operations depending on the work gas composition:

- a composition with hydrogen and xenon (as a generic representative of a strongly emitting multielectronic gas) providing only for achieving steady states of plasma with consequent realization of thermonuclear reactions for compositions of (d+t) + multi-charge atoms type;
- a composition with hydrogen and carbon (nitrogen, oxygen) providing thermonuclear reactions of carbon cycle in plasma steady state mode, including energy pick-up in the form of electromagnetic radiation energy.

3. Experimental Data

A. Registration of electron gravitational radiation lines and energy spectrum in their own gravitational field:

It is known that the form of free neutron decay β-spectrum satisfactorily corroborates theoretical dependence for allowed transitions except soft parts of β-spectrum. Corresponding theoretical and experimental spectra are shown in Figs. 4, 5. The soft part of the spectrum is clearly linear exactly corresponding (taking into account kinetic energy of an outgoing electron) to the spectrum of electron steady states in its own gravitational field in then range of the steady state energies up to 171 keV.



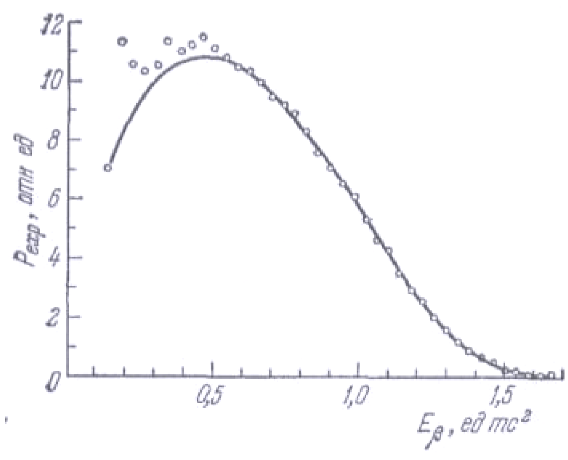


Fig 4. Beta-spectrum of free neutron decay obtained by Robson, see [2].

The strait line is Fermi graph, the experimental data points according to Robson,see [2]

Fig. 5. Beta-spectrum of free neutron decay obtained by Christensen et al. [9].

The curve corresponds to a theoretical spectrum corrected for spectrometer energy resolution.

In independent experiments (see [2]) when at the same time electron energy distribution after electron beam passing through a foil was registered, clearly line energy spectrum was observed: Fig. 6(a). The line radiation spectrum is also clearly seen: Fig. 6(b) which can not be explained only by the presence of accelerated electron groups. The quantitative identification of the spectrum requires more precise and broad measurements including identification algorithm of energy spectrum quantitative values relating directly to steady states of electrons. Nevertheless, registered the line type of electron energy spectrum and corresponding line electron radiation spectrum preliminary corroborate as a rough approximation the very fact of electron steady states in their own gravitational field exactly in the energy range up to 171 keV.

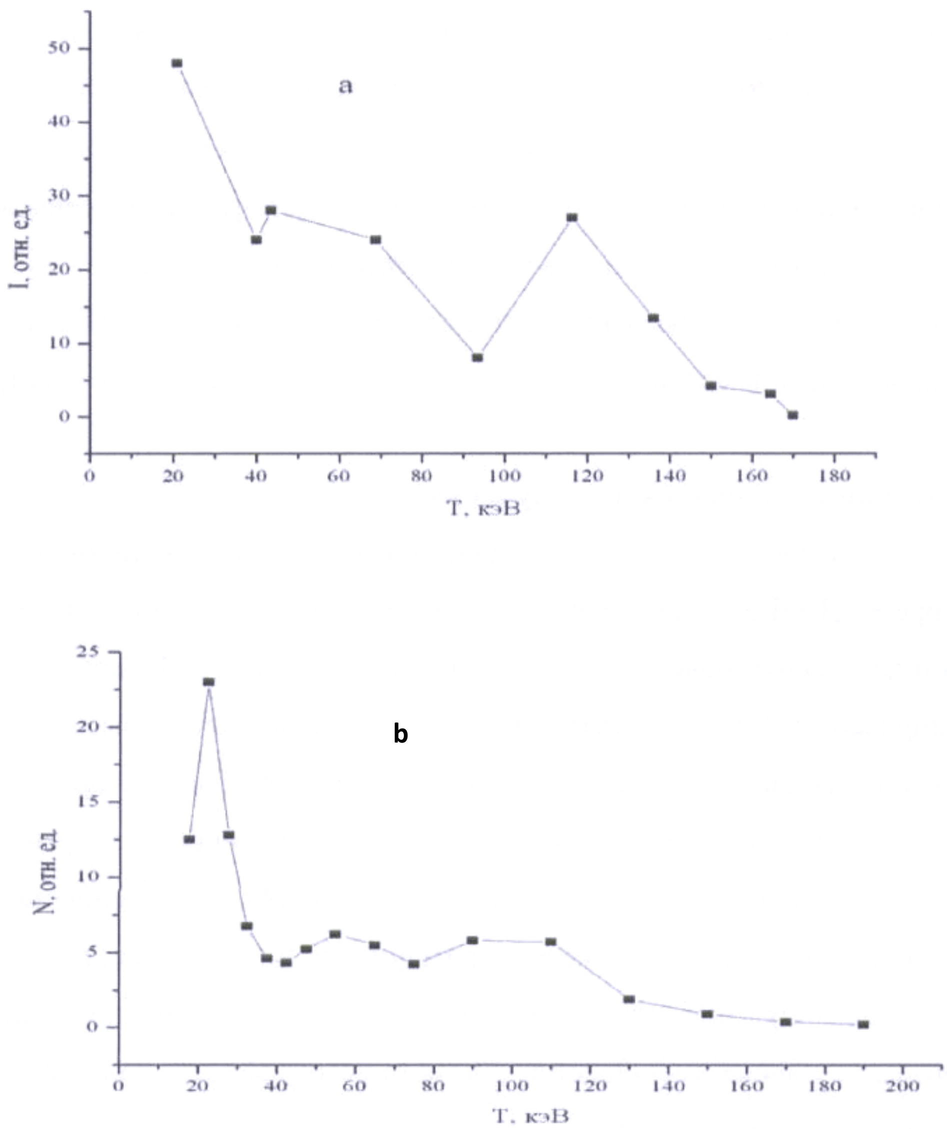


Fig.6. Energy distribution of (a) electrons and (b) X-ray quanta (see [2])

It is obvious that these data need to be supplemented with direct experimental identification both regarding both electron gravitational radiation spectrum lines and electron steady state energy spectrum in its own gravitational field. Fig. 7 shows electron beam energy spectra in a pulse accelerator measured by a semicircular magnetic spectrometer. Two peaks of the energy spectra are connected to the feature of the pulse accelerator operations, the secondary pulse is due to lower voltage. This leads to the second (low-energy) maximum of the energy spectrum distribution.

A telemetry error in the middle and soft parts of the spectrum is not more than ± 2%. The magnetic spectrometer was used for measuring the energy spectrum of electrons after passing through the accelerator anode grid and also spectra of electrons after passing though a foil arranged behind the accelerator mesh anode. These data (and the calculated spectrum) are presented in Fig. 7. Similar measurements were carried out for Ti foil (foil thickness 50 µm) and Ta (foil thickness 10 µm). In case of Ti the measurements were limited from the top by energy of 0.148 MeV, and in case of TA by energy of 0.168 MeV. Above these values the measurement errors increase substantially (for this type of the accelerator). The difference between the normalized spectral densities of theoretical and experimental electron spectra after passing through Ti, Ta and Al foils is shown on Fig.9. The data indicate that there is a spectrum of electron energy states in their own gravitational field when the electrons are excited when passing through a foil. The obtained data are not sufficient for numerical spectrum identification but the very fact of the spectrum presence according to the data is doubtless.

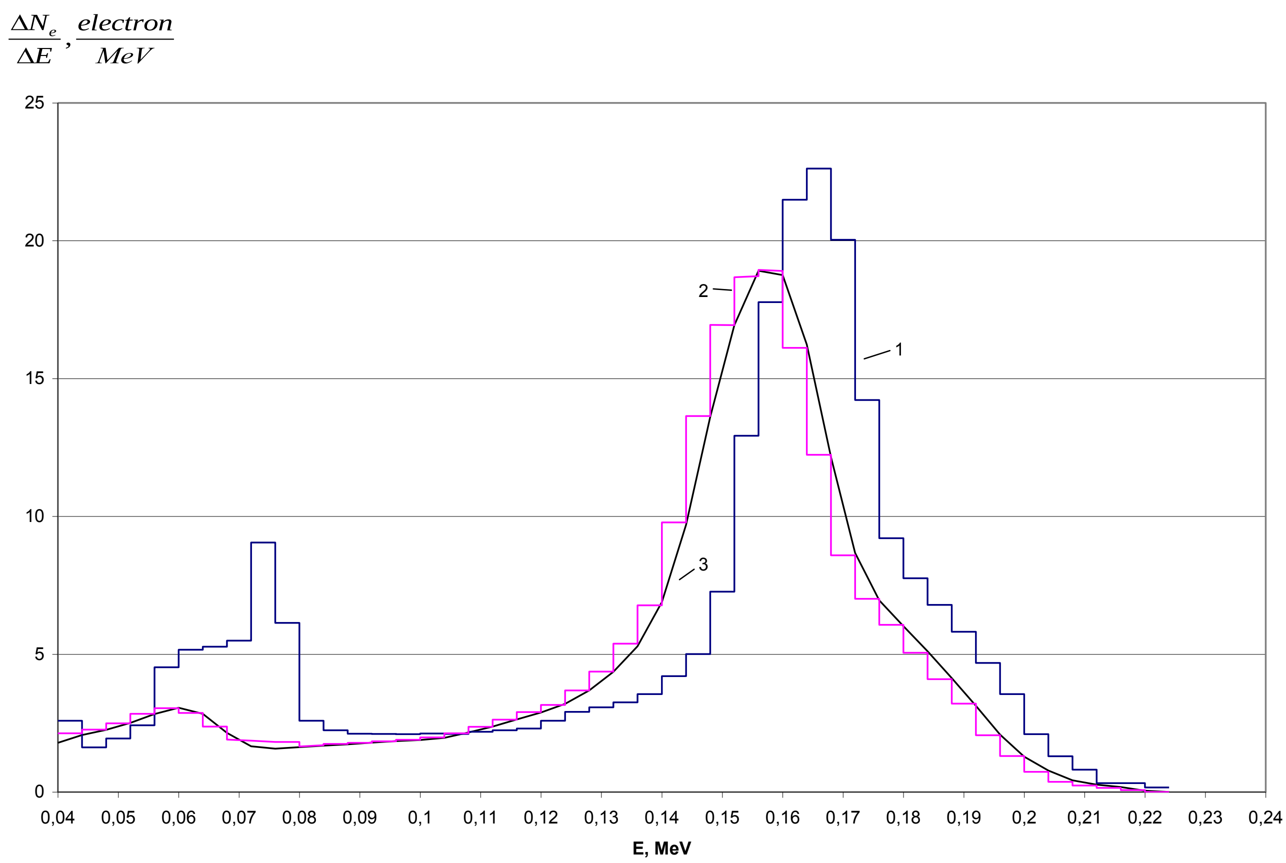


Fig. 7. Electron energy spectra: 1 – after passing the grid, 2 – after passing the Al foil 13 µm thick; 3 – spectrum calculation according to ELIZA program based on the database(see [2]) for each spectrum 1. The spectrum is normalized by the standard.

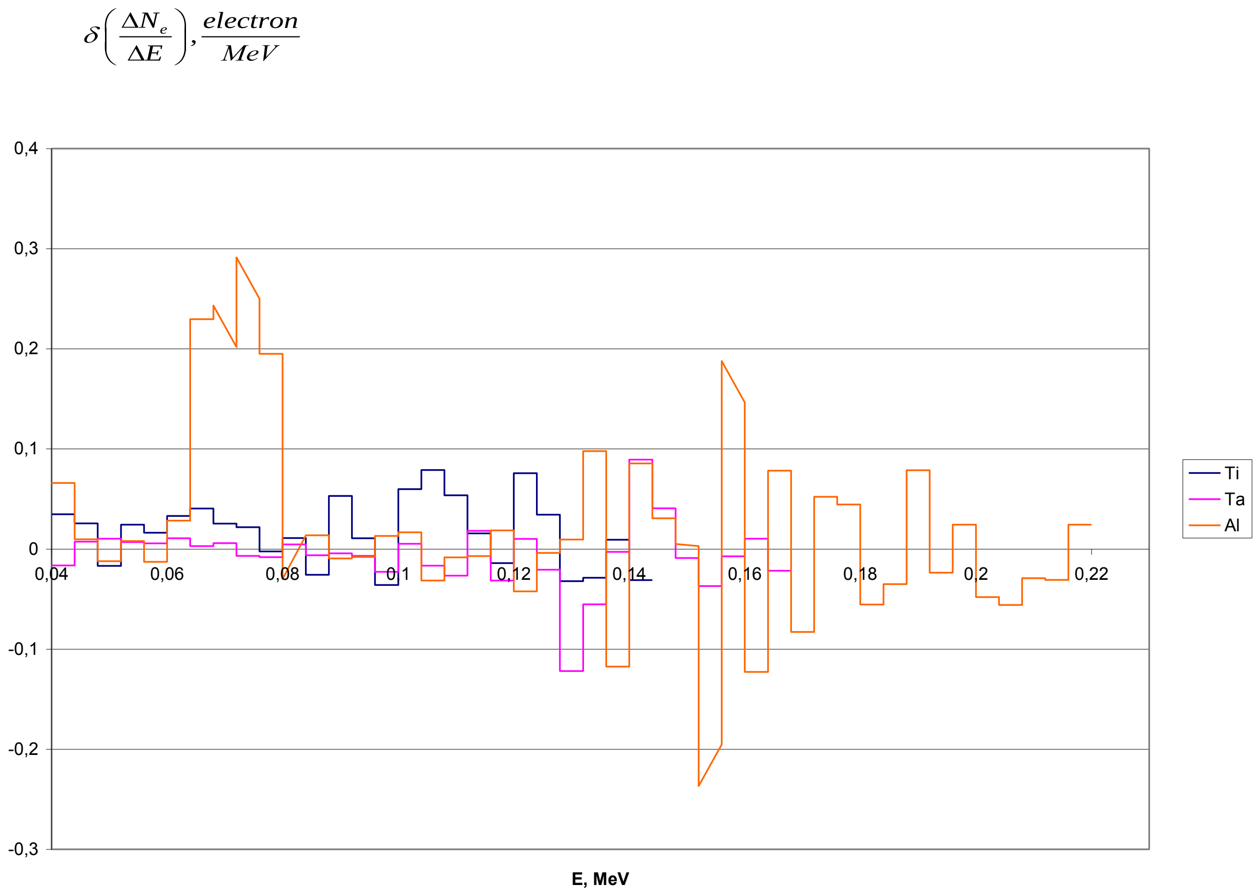


Fig. 8. Difference of spectral density for theoretical and experimental spectra of electrons passed through Ti, Ta and Al foils.

B. Micropinch plasma electron gravitational radiation in pulse high-current discharges

The concept of a thermonuclear reactor on the principle of compressing dense high-temperature plasma by emitted gravitational field is supported by the processes of micropinching multicharged ion plasma in pulse high-current diodes. Figs 9, 10 (a) show characteristic parts of micropinch soft X-ray radiation spectrum. Micropinch spectrum line widening does not correspond to existing electromagnetic conceptions but corresponds to such plasma thermodynamic states which can only be obtained with the help of compression by gravitational field, radiation flashes of which takes place during plasma thermalization in a discharge local space. Such statement is based on the comparison of experimental and expected parts of the spectrum shown in Fig. 10 (a, b). Adjustment of the expected spectrum portion to the experimental one (see[2]) was made by selecting average values of density ρ, electron temperature Te and velocity gradient U of the substance hydrodynamic motion.

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.

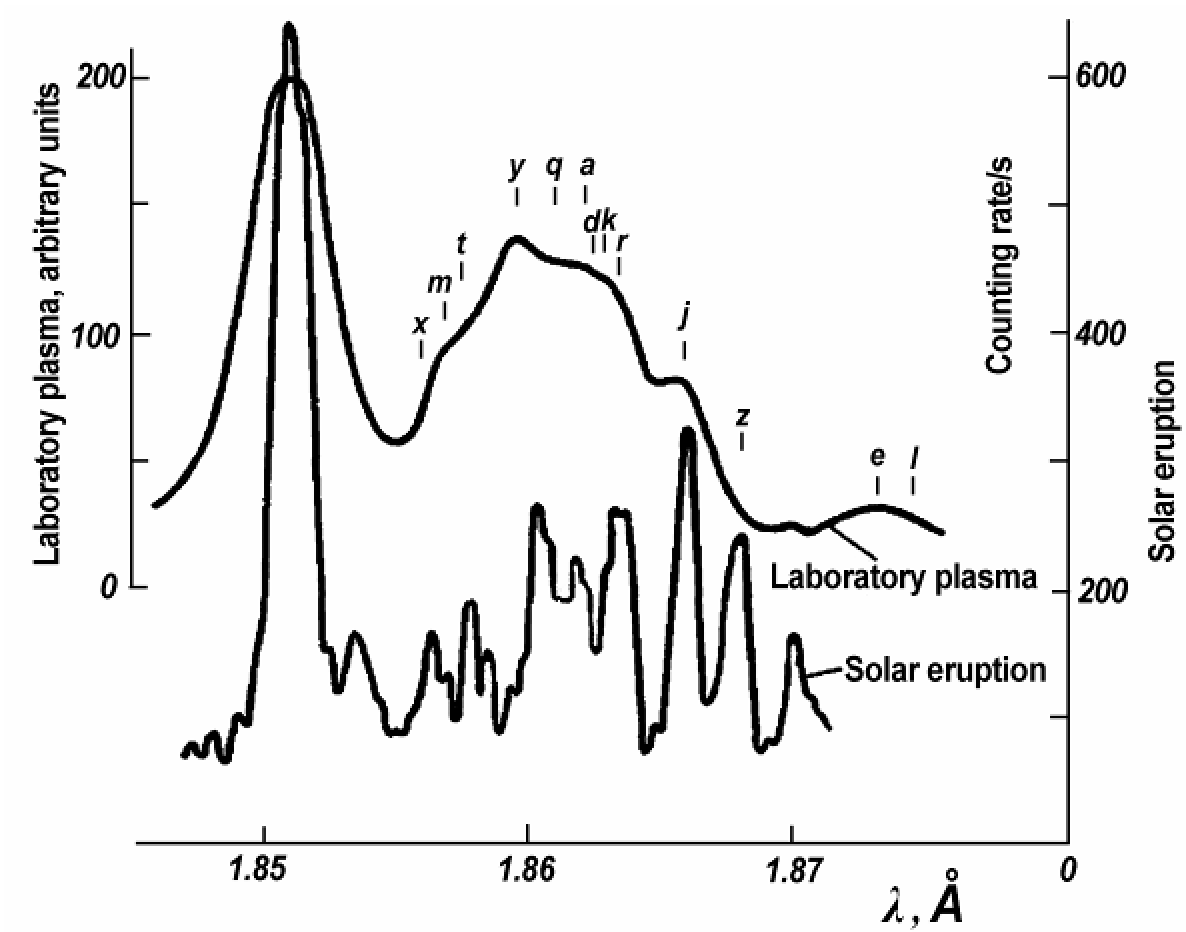


Fig. 9. A part of vacuum sparkle spectrum and a corresponding part of solar flare spectrum. [10].

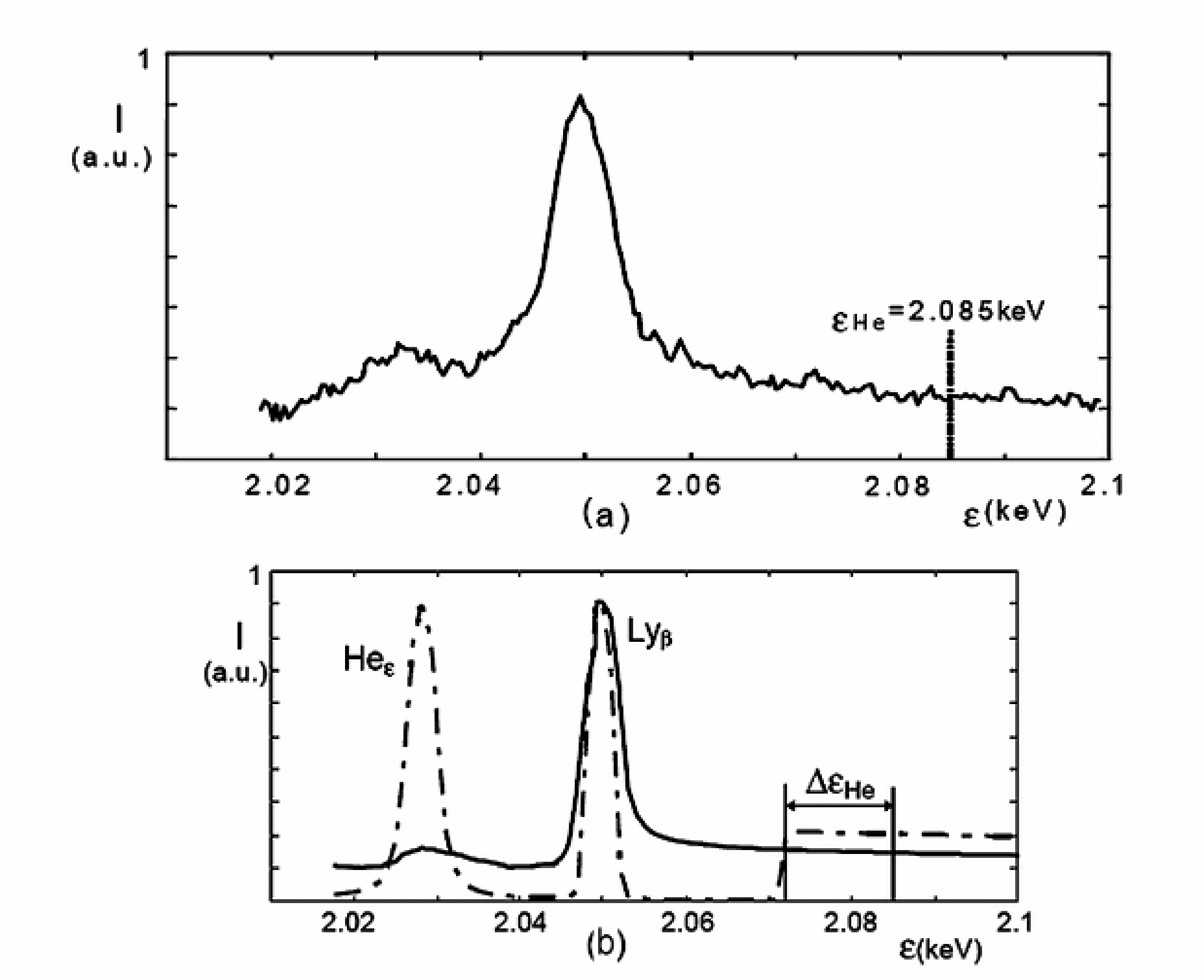


Fig. 10. Experimental (a) and calculated (b) parts of a micropinch spectrum normalized for line Lyβ intensity in the area of the basic state ionization threshold of He-like ions.

The firm line in variant (b) corresponds to density of 0.1 g/cm^3 , the dotted line – to 0.01 g/cm^3; it was assumed that T_e = 0.35 keV, (see [2]).

It should be noted that widening of the spectral characteristic of the electromagnetic radiation [11] gave rise to a wrong conclusion about abnormal increase of the energy conservation law, while the widening of the spectral lines has a distinct and explicable nature, as stated above.

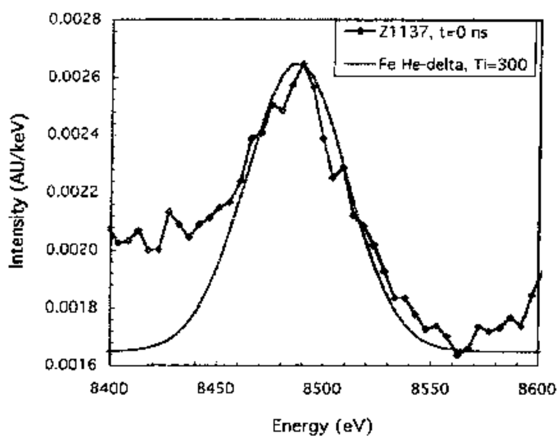


Fig. 11. Measured Fe He-δ line at 8.488 keV (broken curve) compared to calculation (smooth curve), [11].

4. Cosmological Redshift and Microwave Background Radiation as a Consequence of Irremovable Space-Time Curvature

A. Gravitational radiation in galaxy spectra

Fig. 13 shows electronic energy levels of multielectron atoms, while fig. 14 presents rotational level in the nucleus of ^{171}Er (as an element taken approximately from the middle of the Periodic table). Simple comparison of these spectra with the spectrum given in fig. 12 shows the possibility of resonance transitions between these energy levels. The result of such resonance transitions is additional widening of corresponding spectrum lines, which is experimentally proved.

Thus, resonance transitions determined by spectral foldover, electrons and multiple-charge ions in the situation under consideration, bring about the widening of radiation spectrum of dense high-temperature plasma (as it is exactly in such plasma that the conditions of resonance transitions are realized).

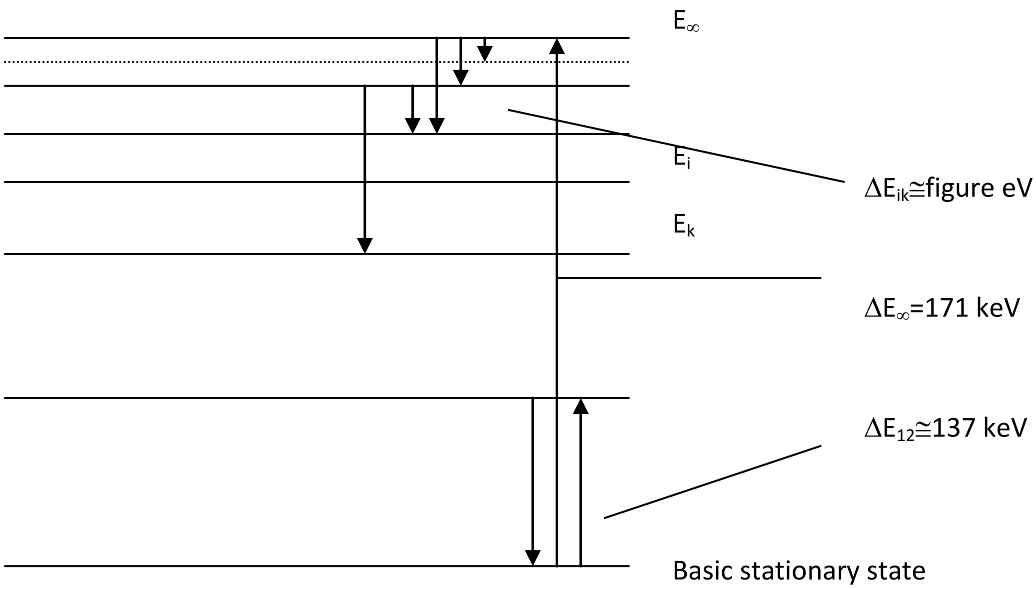


Fig. 12. Transition over stationary states of electron in proper gravitational field

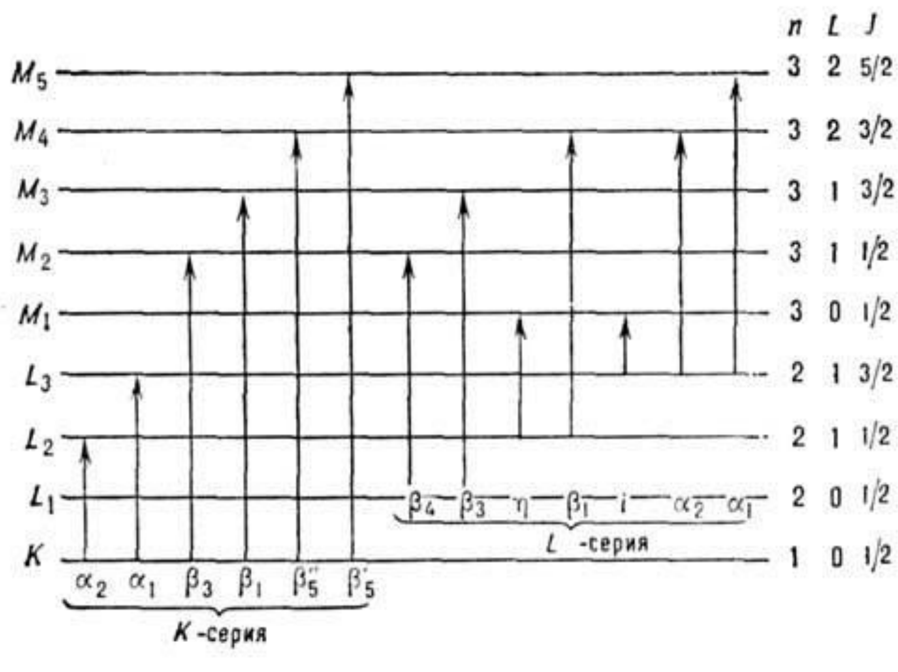


Fig. 13. A scheme of K-, L- and M-levels of energy of the atom, and the main lines of K- and L-series; n, l, j are the principal, the orbital and the inner quantum numbers of energy levels κ, L_1, L_2 etc. The energies of photons of the main lines reach units and scores of keV.

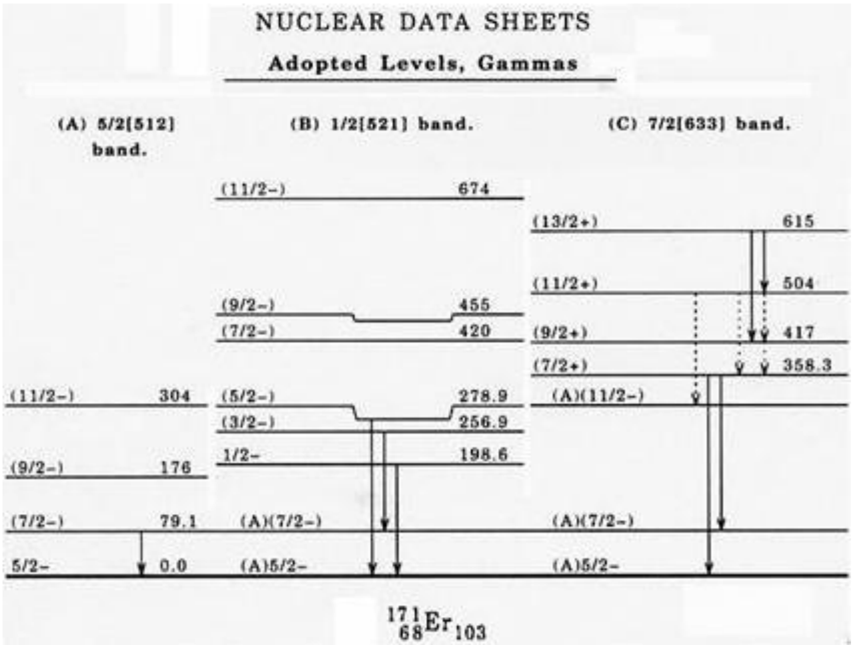


Fig. 14. Regular rotational bands in the nucleus of ^{171}Er. Lower rotational energy levels of nuclei are apart from the main one by scores and hundreds of keV.

The qualitatively same situation takes place in the plasma of space objects, differing in quantitatively in the range of spectrum widening.

A contribution into such widening of spectral lines may be given by a resonance of the energy spectra of electrons (in proper gravitational field) with the energy spectra of multicharged ions (see fig. 13) and the spectrum of rotational energy levels of nuclei (see fig. 14). This widening of spectral radiation lines of space objects must take place in the whole radiation spectrum of these objects [14].

Thus, in qualitative respect a part of radiation should be present in the whole spectrum of electromagnetic, as well as of local sources of diffuse radiation, as a result of resonance transitions between the spectra of electromagnetic and gravitational interactions. This means that in dense high-temperature plasma on multicharged ions (momentum high-current discharges), as well as in the plasma of space objects, the presence of excited states of electrons (as a result of undeniably existing spectrum of stationary states in proper gravitational field), regardless of further development of the situation, will lead to widening of the corresponding electromagnetic radiation spectrum lines. This is exactly what is observed in laboratory experiments with plasma (see fig.9,fig.10,fig.11), and in the shift of the lines of galaxy radiation spectrum (alongside Doppler and gravitational shifts). The further development of the situation is determined by the parameters of plasma.

The populations of quantum levels and, consequently, the spectrum characteristics appear considerably different in cases of plasma with different amount of multicharge ions. Physically it is determined by the competition of processes of radiative transition (i.e. spontaneous emission) and non-radiative transition in case of a collision of an atom with an electron. In case of excitation of upper energy levels of an electron in multicharged ion plasma (in the process of drag in ion nuclei), cascade transitions to lower energy levels will bring about the transfer of gravitational radiation into long-wave part of the spectrum, with the following blocking and intensification of radiation. In case when the concentration of multicharged ions is insignificant and their energy states spectrum does not allow to quench the lower excited state of electrons, a micropinch will take place, followed by its rapid decomposition. This scheme is specially characteristic of laboratory plasma of multicharged ions, but not of the plasma of cosmic objects. The colossal geometrical dimensions of cosmic objects plasma will naturally cause absorption of the emitted gravitational quanta, leaving its impact in widened spectra of electromagnetic radiation.

B. Microwave radiation as a consequence of non-zero curvature of space

The nature of the dark energy is a matter of speculation. It is known to be very homogeneous, not very dense, and is not known to interact visibly through any of the known fundamental interactions other than gravity. Dark energy can only have such a profound impact on the Universe (making up 70% of all energy) because it uniformly fills otherwise empty space. The simplest explanation is that dark energy is that a volume of space has some intrinsic, fundamental energy. It is sometimes called a vacuum energy because it is the energy density of empty vacuum. Such energy is estimated to be on the order of 10^{-29}g/cm³ or 5×10^{-10} J/m^3. Quantum theory requires that empty space is filled by particles and antiparticles which continuously emerge and annihilate. And it must have yielded in resultant non-zero vacuum density which must manifest itself as irremovable curvature of space-time related to neither observed matter nor gravitational field. And it is the existence of such irremovable curvature with radius on the order of the classical electron radius considered as a fundamental physical quantity that is shown in the Section 1. Vacuum energy has negative pressure equal to its energy density. The reason why a cosmological constant has negative pressure can be seen from classical thermodynamics. The amount of energy in a box of vacuum with volume V is equal to ρV, where ρ is the energy density. Increase of the box volume (dV is positive) causes its internal energy to increase meaning a negative work done by it, which purely mathematically is used in the Section 1.

Thus, the space-time features irremovable curvature with specific magnitude of the curvature radius and non-zero vacuum energy density. This conclusion follows from the results outlined in [2] and sketched in Section 2 above. And at the same time the space-time features the microwave backgroung radiation with black body spectrum corresponding to a temperature of 2.7 K and radiation density of 4×10^{-14} J/m^3. It would appear reasonable that this is a single system of interrelated features of the space-time, that is the vacuum with such features is a black body at a temperature of 2.7 K and with a radiation spectrum corresponding to this temperature.

5. Conclusion

a) Stationary states in the proper gravitational field (their existence arises from combination of principles of quantum mechanics and relativistic gravitation theory) result in hidden mass phenomena and spectra resonance of stationary states of electromagnetic and gravitational interactions, while transitions over stationary states give the spectrum of gravitational emission as emission of the same level with electromagnetic emission.

b) A resonance between energy levels of stationary states of electromagnetic and gravitational interaction combined with cascade transitions over the stationary states of electron in the proper gravitational field is a mechanism for transfer of gravitational emission spectrum into the long wavelength region in multiple-charge ion plasma with subsequent forming of stable states of a high-temperature plasma in the emitted gravitational field.

c) The shift of spectra of radiation of galaxies (not connected with gravitational and Doppler shifts) as consequence of presence of stationary states of particles in own gravitational field and possible interrelation of background microwave radiation with irremovable curvature of space-time, certainly, calls into question the Big Bang theory, which itself is of a fragmentary nature to a pretty great extent.

References

1. Siravam C. and Sinha K., Phys. Rep. **51** (1979) 112.
2. Fisenko S. I., Fisenko I. S.,"The old and new concepts of physics" V6, Number **4** (2009), p 495.
3. Ivanenko D. D. et al. Guage Theory of Gravity, Moscow, MGU Publishing House (1985).
4. Landau L. D. and Lifshitz E. M., Field Theory, Moscow, Publishing House «Nauka» (1976).
5. Warshalovich D. A. et al. Quantum Theory of Angular Momentum, Leningrad, Publishing House «Nauka» (1975).
6. Wu Z. S., Moshkovsky S. A., β-Decay, Atomizdat, Moscow (1970).
7. Fisenko S. I., Fisenko I. S. Applied Physics Research, Vol. 2, No. **2**, p. 71 (2010).
8. Fisenko S., Fisenko I., PCT Gazette № 46(2005) 553 (IPN WO2005/109970A1).
9. C. Christensen et al. Phys. Rew. D**5**, 1628 (1972).
10. E. Ya. Goltz, I. A. Zhitnik, E. Ya. Kononov, S. L. Mandelshtam, Yu. V. Sidelnikov, DAN USSR, Ser. Phys., V. **220**, p. 560 (1975).
11. M. G. Haines et al., PRL, **96**, 075003 (2006).
12. R. Lindemuth at al., PRL, v. 75, #**10**, p 1953 (1995).
13. Arp H., "Astrophys J.", 263, № 1, **54**, (1982).
14. Fisenko S. I., Fisenko I. S International Journal of Applied Science and Technology, (IJAST), Vol. 1, No. **4**, p. 11, (2011).