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

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Abstract

As for cosmological red shift, which is generally explained by space extension, there is a considerable amount of observational data that don't comply with the theory of purely cosmological origin *of red shifts in the spectra galaxies and quasars. Such data are provided, for example, in [1]. In elaboration of the results presented in [2] the red shift is also regarded in this investigation as a widening of electromagnetic radiation spectra, determined by the existence of gravitational radiation of a banded spectrum of the same level as electromagnetic. Irremovable curvature of space-time related neither to matter nor gravitational field [2] offers another explanation for the nature of the microwave background radiation. It turns out that this radiation is not coming from the deepness of space-time but rather is a thermal radiation of such a black body as vacuum with non-zero energy corresponding to the irremovable curvature.*
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1. Red Shift as a Physical Phenomenon

Cosmological (metagalactic) red shift is a decrease in the frequency of radiation, observable for all distant sources. Cosmological red shift is often associated with Doppler effect. But in fact Doppler effect has nothing to do with cosmological red shift, which is actually determined by space extension according to GR. There is a theory that the observed red shift of galaxies is the result not only of cosmological red shift due to space extension, but also of red and violet shift of Doppler effect due to proper motion of galaxies. However, the contribution of the cosmological red shift prevails at large distances. The formation of cosmological red shift appears to go on as follows. Take a look at light – an electromagnetic wave running from a distant galaxy. While the light goes through the universe, space extends. The wave package extends alongside space, and the wavelength changes accordingly. If space undergoes double extension, the wavelength and the wave package double as well. This theoretically streamlined image fails in many cases to correspond to observational data. For example, Hubble law is inadequate or doesn't hold at all for objects at a distance less than 10-15 light years, that is exactly for those galaxies the distances to which are most reliably estimated without red shift.

Hubble law doesn't hold good also for those galaxies at very large distances, such as billions of light years, to which the value $z > 1$ corresponds. The distances to the objects with such a high red shift lose their single-valuedness. At such distances the specific cosmological effects – nonstationarity and space-time curvature – manifest themselves. In particular, the idea of unique, single-valued time becomes nonapplicable (one of the distances – the red shift distance – reaches here $r = v/H = 3{,}3$ Gpc), as distances depend on the assumed model of the universe and on their reference to a particular moment of time. That is why mere red shift value is used as a characteristic of such large distances (the highest red shift value is registered for object GRB090423 (in Leo), it amounts to $z=8{,}2$).

2. Microwave Background Radiation

Cosmic radiation having spectrum typical for a black body at a temperature of about 3 K defines intensity of the background radiation of the Universe on the shortwave radio-frequency bands (on centimeter, millimeter and submillimeter wavelengths). This radiation is isotropic to the highest degree (its intensity is virtually equal in all directions). This radiation was first discovered on 7.35 cm wavelength and then on the other wavelengths (0.6 mm to 50 cm), too. The temperature of the microwave background radiation was found to be 2.7 K within 10%. Average photon energy of this radiation is extremely low — 3000 times less than that of visible light but the number of the microwave background radiation photons is very big.

For each atom in the Universe there are ~109 photons of the microwave background radiation (400-500 photons per 1 cm^3 average) that corresponds to the radiation density of 4×10^{-14} J/m^3. Neither stars and radio galaxies nor hot intergalactic gas nor reemission of visible light by interstellar dust can produce radiation with features near to those of the microwave background radiation: the total energy of this radiation is too high, and its spectrum is unlike either spectrum of stars or spectrum of radio sources.

3. Gravitational radiation of electrons with a banded spectrum as radiation of the same level with electromagnetic radiation

Generally covariant equations form in gravity relativity theory, as it is well-known, is as follows:

$$R_{ik} - \frac{1}{2} g_{ik} R - \Lambda g_{ik} = \chi T_{ik} \qquad (1)$$

In these equations χ is the constant, connecting the space-and-time geometric property with the distribution of physical material, so the origin of the equations is not connected with numeric limitation of χ quantity value. Only the necessity to correspond classical Newtonian gravitation theory brings us to numeric value $\Lambda = 0, \chi = 8\pi G / c^4$, where *G is* Newtonian gravitation constant. The equations with the defined constants are the equations of the Einsteinian general relativity theory (GR). The equations (1) are common mathematical form of gravitational field equations, corresponding to the equivalency principle and general covariance axiom. The equations in form (1) were acquired simultaneously with Einstein but independently from him by Hilbert [3]. In [2] there was made a simple and at the same time strict assumption of the existence of such numeric values of gravitational constant K and constant Λ in quantum sphere, that bring to stationary states in proper gravitational field, and these are already emitters of gravitational field with Newtonian gravitational constant. The very numeric values of K and Λ are estimated independently, exactly within this approach. Herewith we make reference to A. Salam [5], as he was one of the first to pay attention to the fact that Newtonian gravitational constant's numeric value does not conform to quantum level.

He was the one to propose the concept of "strong" gravity, that was based on the assumption of f-mesons spin 2 existence, that form SU(3)- multiplet (described by Paul-Firz). It was proven that a possibility of a different link constant along with Newtonian one does not contradict the observed effects [5]. Due to a number of reasons this approach was not developed further. As it is clear now, this numeric value of "strong" gravity constant is to be used in equations (1) with $\Lambda \neq 0$. Besides, precisely with $\Lambda \neq 0$ stationary solutions of general Einsteinian equations can be found, which was noticed by Einstein himself, but after the discovery of functionary solutions with $\Lambda = 0$ by A. Friedman [6], the modern shape of the GRT was finally formed. The decisive argument of GRT to equal Λ - element to zero is the necessity of right limit passage to Newtonian gravitation theory.

In the simplest (from the point of view of the original mathematical estimations) approach the problem on steady state in proper gravitational field (with constants K and Λ) is solved in [2]. From the solution of this problem it becomes evident:

a) With numeric values of $K \approx 5.1\times10^{31}$ Nm^2kg^{-2} и $\Lambda = 4.4\times10^{29}$ m^{-2} there is a spectrum of electron's stationary states in proper gravitational field (0.511 MeV …0.681 MeV). The main state is detected electron's rest energy 0.511 MeV. *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.*

b) These stationary states are the emitters of gravitational field with *G* constant.

c) The transition to stationary states in proper gravitational field causes gravitational emission that is characterized by constant K, and with this is the emission of the same level with electromagnetic (electric charge e, gravitational charge $m\sqrt{K}$). In this respect it is meaningless to say that gravitational effects in quantum area are characterized by G constant, this constant belongs only to microscopic level and it cannot be transferred to quantum level (which is evident from negative results of gravitational waves with G constant registration tests, these do not exist).

d) The spectrum of electron's stationary states in proper gravitational field and transitions to stationary states are represented on Fig. 1. We should mention straight away that the numeric value is approximate. The largest inaccuracy belongs to the numeric value of the first stationary state E_1, but it is more and more accurate coming closer to $E_\infty = 171 keV$.

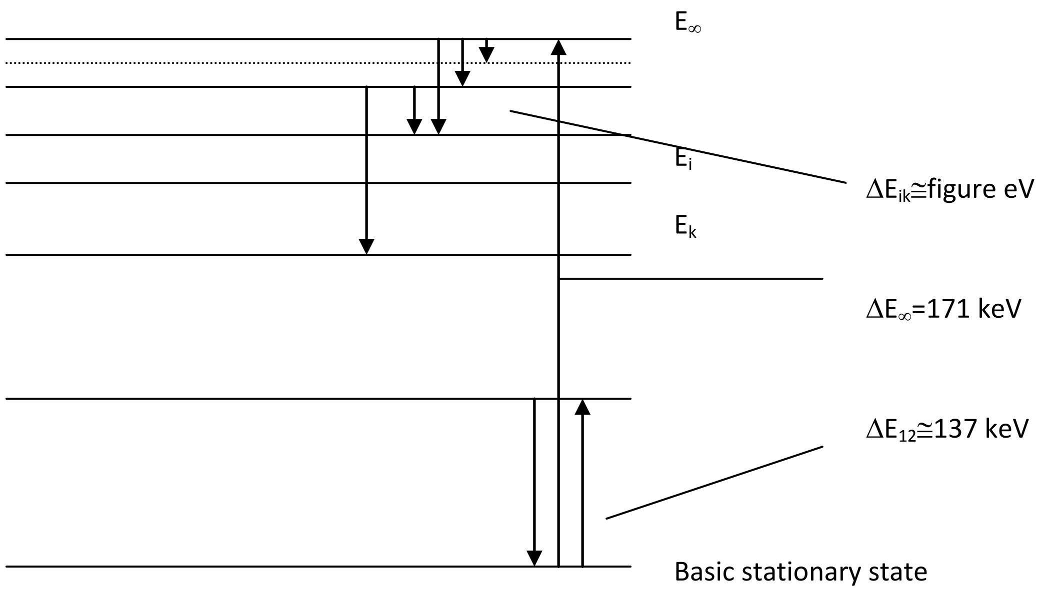

Figure 1. Transition over stationary states of electron in proper gravitational field

Energy spectrum estimation given on Fig. 1 is made exactly within this approach[2]. A closed trajectory defined mathematically by wave function and set of quantum numbers with orbital momentum values among them corresponds to all the stationary states (beginning with the ground one). We return to estimation of the numerical value of K . Using Kerr-Newman metric for estimation of the numerical value of K one can obtain the formula [4,7]

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

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 (2), 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 (2) 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.

4. Gravitational Radiation in Galaxy Spectra

Fig. 2 shows electronic energy levels of multielectron atoms, while fig. 3 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. 1 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. Fig.4 shows 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, the radiation flashes of which take 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. 4. Adjustment of the expected spectrum portion to the experimental one [2] was made by selecting average values of density ρ, electron temperature T_e 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 the existence of an additional widening mechanism 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 thermalization of accelerated plasma with the power of gravitational radiation not sufficient for maintaining steady states. 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).

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. 2) and the spectrum of rotational energy levels of nuclei (see fig. 3). This widening of spectral radiation lines of space objects must take place in the whole radiation spectrum of these objects.

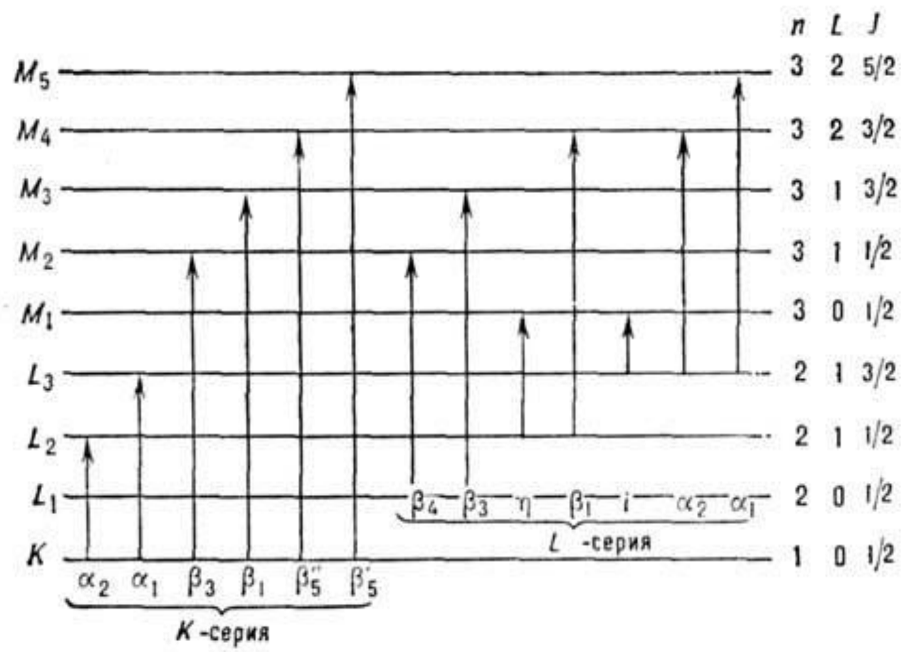

Figure 2. A scheme of K-, L- and M-levels of energy of the atom, and the main lines of K- and L- series; n, l, j are the principal, the orbital and the inner quantum numbers of energy levels к, L_1, L_2 etc. The energies of photons of the main lines reach units and scores of keV.

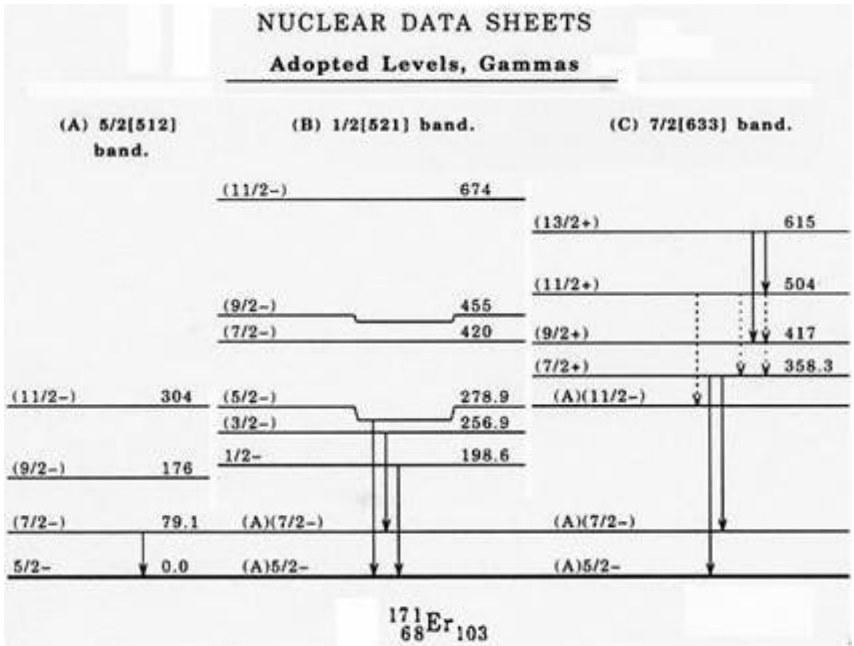

Figure 3. Regular rotational bands in the nucleus of ^{171}Er. Lower rotational energy levels of nuclei are apart from the main one by scores and hundreds of keV.

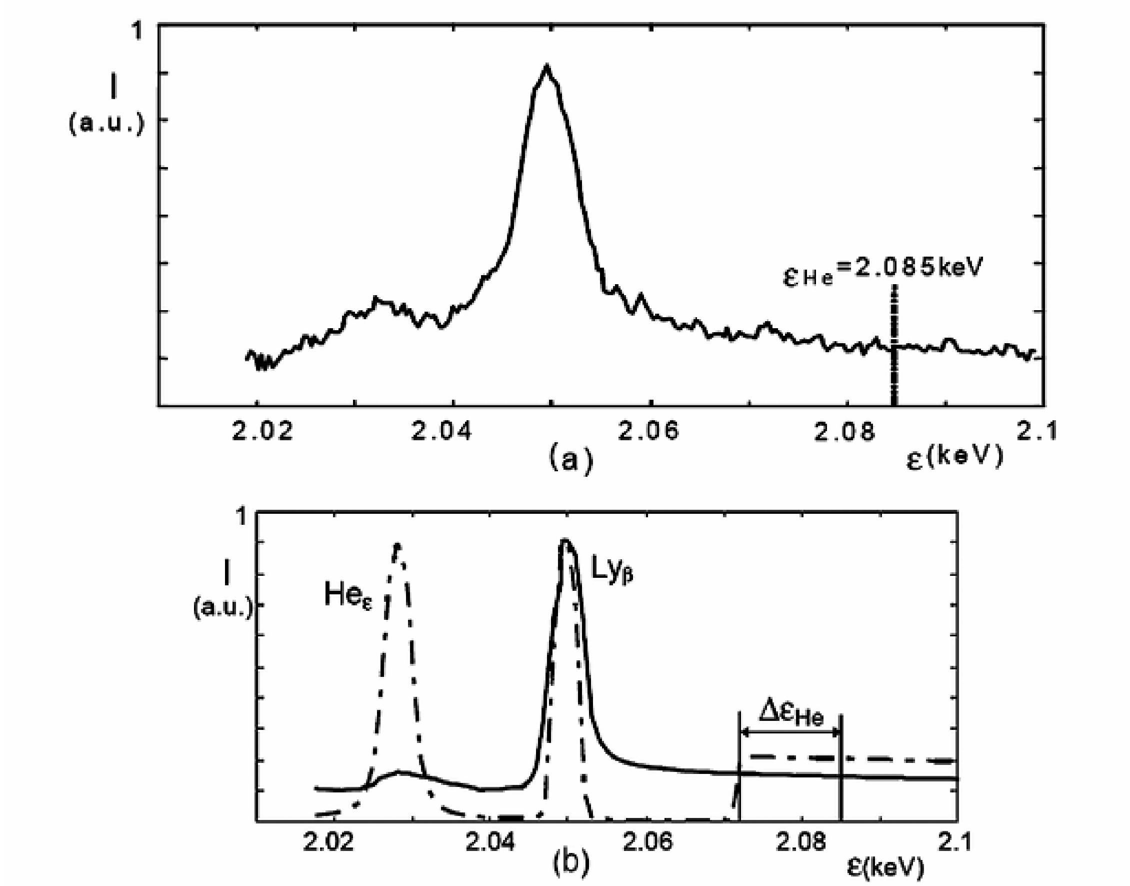

Figure 4. The experimental and the calculated areas of a micropinch spectrum, normalized for line Lyβ intensity, in the area of the basic state ionization threshold of He-like elements. The firm line in variant b) corresponds to density of 0,1 g/cm^3, and the dotted line – to that of 0,01 g/cm^3; it was assumed that T_e=0,35 keV, [2].

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. 4), and in the shift of the lines of galaxy radiation spectrum (alongside Doppler shift). 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. Phisically 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 [2]. In case when the consentration of multicharged ions is insignificant and their energy states spectrum does not allow to quench the lower excited state of electrons, a micropinch [2] 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.

5. 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 [2]. 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 [2].

> *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.*

It is understood that for a final conclusion detailed calculations would be needed. Even so, such system is closed and logically consistent to the approximation discussed. However, the existence of stationary states of particles in proper gravitational field is indisputable being confirmed, in particular, by widening of radiation spectra of multiple-charge ions. For instance, there are such typical data as follows (in addition to the mentioned above).

Figure 5 demonstrates data from [8]. The discrepancy between observed and calculated radiation line widening patterns cannot be set off against electromagnetic interaction effects only. Additional mechanism of spectral line widening of multiple-charge ion characteristic electromagnetic radiation again involves quenching of electrons exited states on ions' radiating energy levels and excitation of these levels by resonance frequency gravitational radiation.

Such increment in probability of ion transition into other states results in additional widening of characteristic electromagnetic radiation spectral lines. It should be noted that the widening of characteristic electromagnetic radiation spectral lines registered in this work had fostered, in it's time, a false conclusion about abnormal ion temperature increase. Such conclusion is in conflict with energy conservation principle, while the spectral line widening is of clear physical nature as described above.

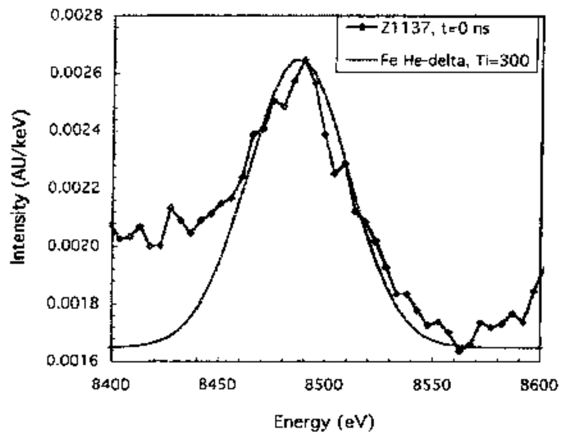

Figure 5. Measured Fe He-δ line at 8.488 keV (broken curve) compared to calculation (smooth curve), [8].

In just the same way, taking Doppler, radiation and impact widening into account as mechanisms of spectral line widening does not lead to a complete quantitative description of the observed widening in vacuum spark with multiple-charge ions. Typical examples of such spectra are those shown in the Figure 6. Thus, the outlined results are supported by, though incomplete, but non-contradictory experimental data that fit themselves in the consistent scheme of quantum systems radiation spectra widening exactly in such conditions where the quantum nature of the gravitational interaction manifests itself. However, the spectrum of stationary states of electron in proper gravitational field exists in its location area at numerical values of $K \sim 10^{31}$ N m^2 kg^{-2} and $\Lambda \sim 10^{29} m^{-2}$ which implies existence of irremovable space-time curvature not related neither to matter, nor to gravitational field. This very fact gives ground to consider vacuum to be a source of microwave radiation as black body equilibrium thermal radiation.

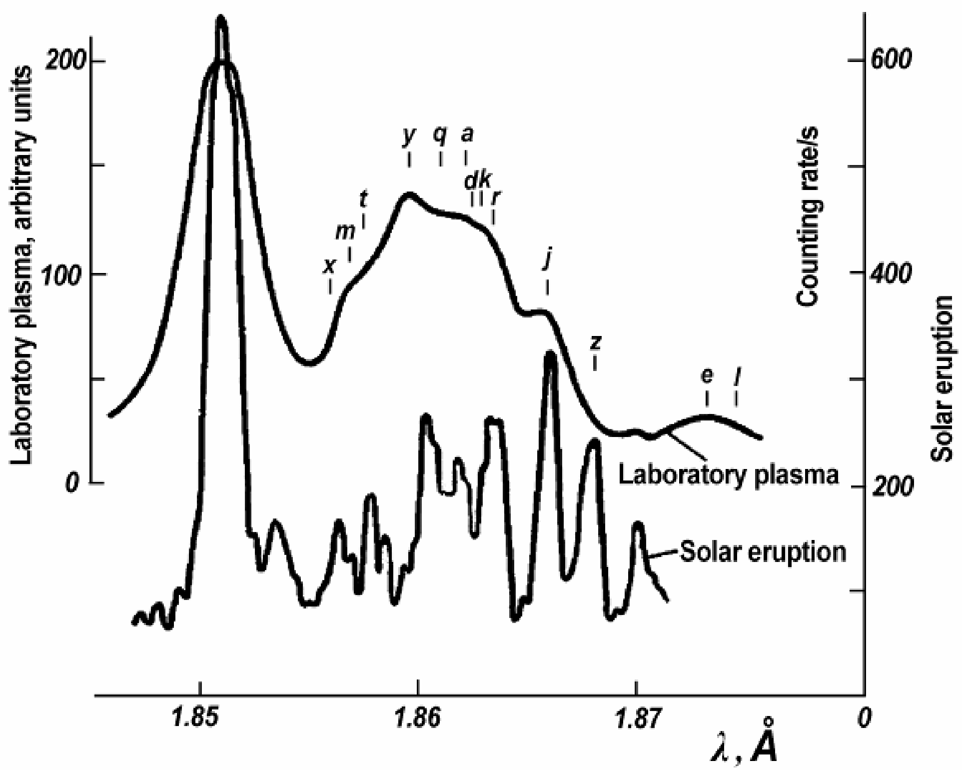

Figure 6. A part of vacuum sparkle spectrum and a corresponding part of solar flare spectrum, [9].

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