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GRAVITATIONAL-ELECTROMAGNETIC RESONANCE OF THE SUN AS ONE OF THE POSSIBLE SOURCES OF AURORAL RADIO EMISSION OF PLANETS IN KILOMETRIC RANGE

Annotation. *Gravitational-electromagnetic resonance of the Sun (GERS) at a frequency of 202.97 KHz may be a secondary source of auroral radio emission in kilometric range (the auroral kilometric radiation — AKR) of planets having magnetosphere, such as Earth, Saturn, Jupiter, Uranus and Neptune. One of the envelopes of solar wind spectrum can be modulated with electromagnetic signal with a frequency of gravitational-electromagnetic resonance of the Sun. This component of the solar wind at a frequency of 202.97 KHz can also be a driver and a source of modulation of radio emission of the planets in kilometric range. In the spectrum of radio emission of the planets, except the Solar, it may present the components caused by their own gravitational-electromagnetic resonance, and gravitational-electromagnetic resonance of their satellites.*

Keywords: *universal Planck proportions, auroral radio emission, gravitational-electromagnetic resonance.*

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ГРАВИТАЦИОННО-ЭЛЕКТРОМАГНИТНЫЙ РЕЗОНАНС СОЛНЦА КАК ОДИН ИЗ ВОЗМОЖНЫХ ИСТОЧНИКОВ АВРОРАЛЬНОЙ РАДИОЭМИССИИ ПЛАНЕТ В КИЛОМЕТРОВОМ ДИАПАЗОНЕ

Гравитационно-электромагнитный резонанс Солнца (GERS) на частоте 202.97 кГц может быть одним из вторичных источников аврорального радиоизлучения в километровом диапазоне планет, обладающих магнитосферой, например, Земли, Сатурна, Юпитера, Урана и Нептуна. Одна из огибающих спектра солнечного ветра может быть промодулирована электромагнитным сигналом с частотой гравитационно-электромагнитного резонанса Солнца. Эта компонента солнечного ветра на частоте 202.97 кГц также может быть как драйвером, так и источником модуляции радиоизлучения планет в километровом диапазоне. В спектре радиоизлучения планет, кроме Солнечной, возможно присутствуют компоненты, обусловленные как их собственным гравитационно-электромагнитным резонансом, так и гравитационно-электромагнитным резонансом их спутников.

Ключевые слова: универсальные пропорции Планка, авроральная радиоэмиссия, гравитационно-электромагнитный резонанс.

1. Introduction

In [1,2,3,4,5,6,7,8,9] it is shown, that the AKR is closely connected with the emergence of magnetospheric storms (during magnetospheric sub storms), and its main source and drivers are the following phenomena: gyromagnetic resonance of electrons with an energy of 1 keV (and more) around the magnetic field lines of a planet in the cyclotron the frequency and on the heights, for example the Earth, from 1 3 of its radius; plasma of planet's magnetosphere and the solar wind plasma. AKR Main characteristics: general energy, for example, for the Earth, can be from 10^6 to 10^7 watts [3]; frequency ranges of the spectrum: for Earth 30 KHz - 800 KHz, for Jupiter from 10 KHz to 1500 KHz, and further in Decameter to 40 MHz, for Saturn from several KHz to 1.2 MHz - 1.3 MHz, for Uranium from tens of KHz to 850 KHz, for Neptune from 20 KHz (and possibly lower) to 600 KHz (and possibly more); polarization in all cases is mostly circular; in all cases there is modulation of frequency of AKR spectrum with the planet rotation and the solar wind [7].

2. Gravitational-electromagnetic resonance of the Sun as one of the possible sources of AKR

In [10,11] it is proposed and experimentally proved the law of "Universal Planck proportions." According to this law, in the observable universe, any body with mass m, creates a gravitational field, which bends the surrounding space with a radius of curvature S (in fact, S - is the length of a gravitational wave) and introduces time delay in signal propagation t_{dm} into this space. Characteristics of the body m, S and t_{dm} are interconnected with universal Planck proportions [10,11]:

$$m = \frac{m_p}{l_p} S; m = \frac{m_p}{t_p} t_{dm}; S = \frac{l_p}{t_p} t_{dm}; S = \frac{l_p}{m_p} m; t_{dm} = \frac{t_p}{l_p} S; t_{dm} = \frac{t_p}{m_p} m, \quad (1)$$

where: l_p, m_p, t_p - is Planck's constant, correspondingly - length, mass and the Planck time.

Each of the characteristics of the body m, S and t_{dm} uniquely determines energetic parameters separately from other's [10,11]:

$$E = mc^2 = F_p S = h_e t_{dm}, \quad (2)$$

where: $h_e = \dfrac{E_p}{t_p}$ – is the quantum of Planck energy, where E_p - Planck energy: $E_p = m_p c^2$; F_p - is the Planck power: $F_p = m_p a_p$, where a_p - is Planck accelerating: $a_p = \dfrac{l_p}{t_p^2}$, and for two bodies with weight m_1 and m_2, length of a gravitational wave S_1 and S_2, the time delay t_{dm1} and t_{dm2}, at a distance R from each other, the law of gravity is given by [10,11]:

$$F = G\frac{m_1 m_2}{R^2} = F_p \frac{S_1 S_2}{R^2} = F_p c^2 \frac{t_{dm1} t_{dm2}}{R^2}. \qquad (3)$$

Based on the data about the mass of astronomical objects [12] and universal Plank proportions (1) there were calculated length value of a gravitational wave and frequency for thus: Earth, Moon, Venus, Mars, Jupiter, Saturn, Sun, Uranus and Neptune:

Name	Weight, kg	Length of a gravitational wave, m	Frequency, GHz
Earth	5.9722 x 10^{24}	0.00443474	67.6
Moon	7.3477 x 10^{22}	0.000054547302	5495.94
Venus	4.8673 x 10^{24}	0.0036143131	82.95
Mars	6.4169 x 10^{23}	0.00047451718	631.78
Jupiter	1.8981 x 10^{27}	1.40948454472	0.2127
Saturn	5.6832 x 10^{26}	0.42201429314	0.7104
Sun	1.989 x 10^{30}	1477.036	2,0297 x 10^{-4}
Uranus	8.68 x 10^{25}	0.0645	4.65
Neptune	1.02 x 10^{26}	0.0757	3.958

It is experimentally confirmed the existence of gravitational-electromagnetic resonance of the Earth (GERE) at a frequency of 67.6 GHz [10,11]. For example, Fig. 1 of [10,11] shows one of the experimental charts, which confirms the existence of gravitational-electromagnetic resonance of the Earth at frequency 67.6 GHz.

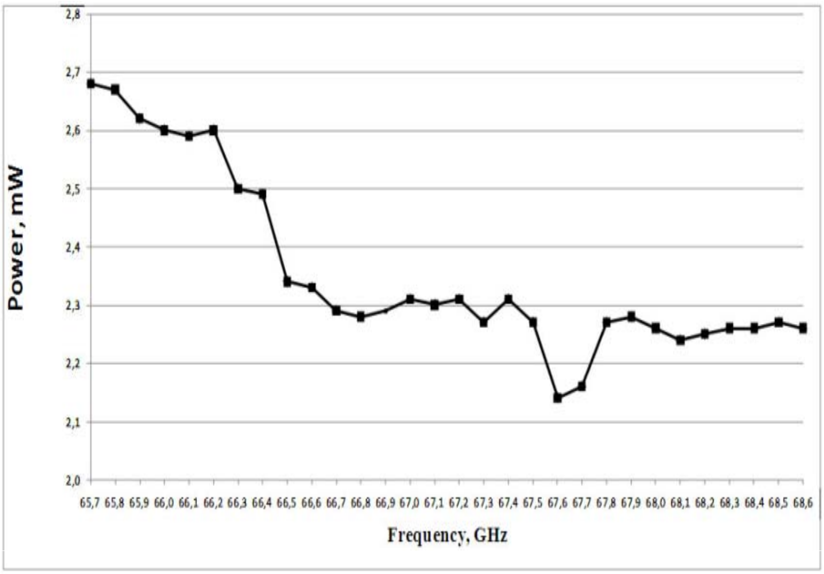

Fig. 1. Graph GERE. The dependence of signal power on frequency in the frequency range from 65.7 GHz to 68.6 GHz with 0.1 GHz at the output of the measuring channel. The signal power at the output of the generator is 4,5 mW [10,11]

The injection of electrons during the magnetospheric storm with an energy of about 1 keV and higher from the plasma region of the magnetosphere of the planet in its auroral region followed by a reflection of some of them because of mirror effect of convergent geomagnetic field leads to resonance and amplification of electromagnetic waves at the cyclotron frequency [4]. Due to the spread of energies of the electrons and the convergence of the magnetic field, it is formed many natural resonance chambers (the effect of the set of natural masers at the cyclotron frequency of electrons), which in its turn leads to multiple resonance in the frequency range from a few KHz to 1.5 MHz. Some of these resonant frequencies and their harmonics are close to the frequency of gravitational-electromagnetic resonance of the Sun 202.97 KHz. Under the influence of the gravitational field of the Sun and envelope of the spectrum of the solar wind, which is modulated by the gravitational-electromagnetic resonance of the Sun, there is a new resonance at frequencies close to the frequency of 202.97 KHz. A distinctive feature of this resonance is that the gravitational-electromagnetic resonance of the Sun is always present, and so it is a relatively stable and slightly damped. While resonance at other frequencies, usually has no permanent recharge of energy and therefore is periodic and damped.

For example, in [13] it is presented the results of experiments conducted on board of the Cassini spacecraft studying the effect of radio waves, the waves in the plasma and of the solar wind at AKR Saturn (AKR for Saturn - is SKR). These experiments are the Radio and Plasma Wave Science experiment (RPWS) [14], the Dual Technique Magnetometer (MAG) [15] and the Cassini Plasma Spectrometer (CAPS) [16]. At Fig. 2a (spectrum was obtained in the experiment Cassini - RPWS in the time interval 08/19/2004 - 08/21/2004, that is, day of year DOY 232.5-234.0) and Fig. 3a (look at the application) (DOY 224.0-240.0) [13] present the dynamic spectra, which was obtained during the experiment Cassini - RPWS. In the figures it is clearly seen almost continuous line of high values of the power spectral density of electromagnetic signals at frequencies close to the frequency of 202.97 KHz. At the same time, at other frequencies the spectral power density of the electromagnetic signal is of an intermittent nature. At Fig. 2b in the experiment Cassini - RPWS presents research of the Stokes parameter (Stokes parameter S = total intensity), and Fig. 2c and Fig. 2d present studies of the degree of polarization of the signal, respectively, the circular 2c and line 2d. All three figures show the line corresponding to the presence of gravitational-electromagnetic resonance of the Sun.

Gravitational-electromagnetic resonance of the Sun has varying degrees of influence on the AKR planets. For comparison, the overall picture of AKR 5 planets is shown in Fig. 4 [7], which shows graphs of dependence of the spectrum of electromagnetic signals AKR to the frequency.

AKR of Uranus and Neptune, as seen from their graphs in Fig. 4 are similar to each other. Despite the fact that the frequency of GERS is in the local maxima of the graphs, the impact of GERS on AKR of Uranus and Neptune is minimal. This is due to the considerable distance of the planets from the Sun and therefore a significant reduction in its gravitational potential and a decrease in the density of the solar wind at the location of Uranus and Neptune.

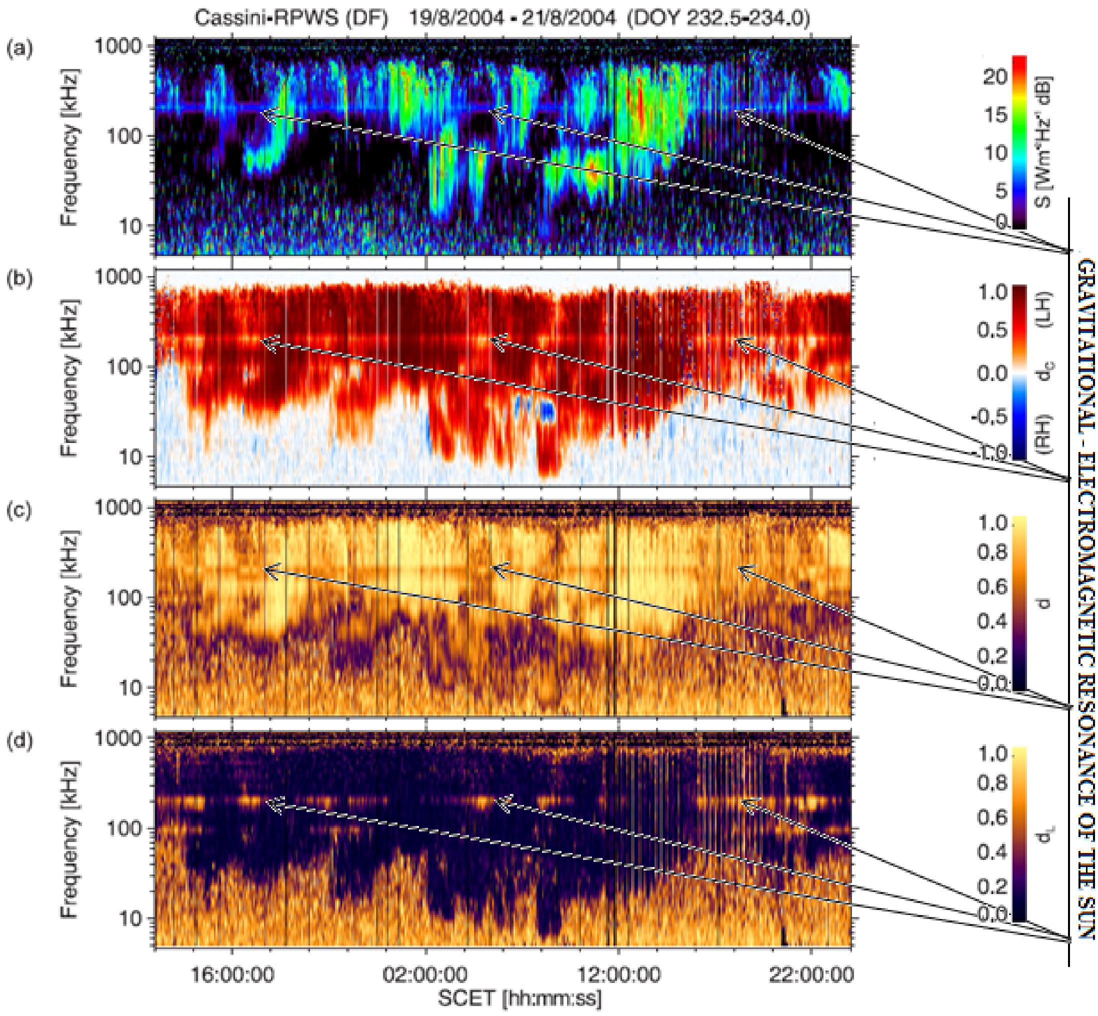

Fig.2. Cassini-RPWS dynamic spectra for (a) the Stokes parameter S (= total intensity), (b) the degree of circular polarization dc, (c) the degree of polarization d and (d) the degree of linear polarization d_L as a result of the Direction-Finding computations for the time period DOY 232.5–234.0, 2004 [13]

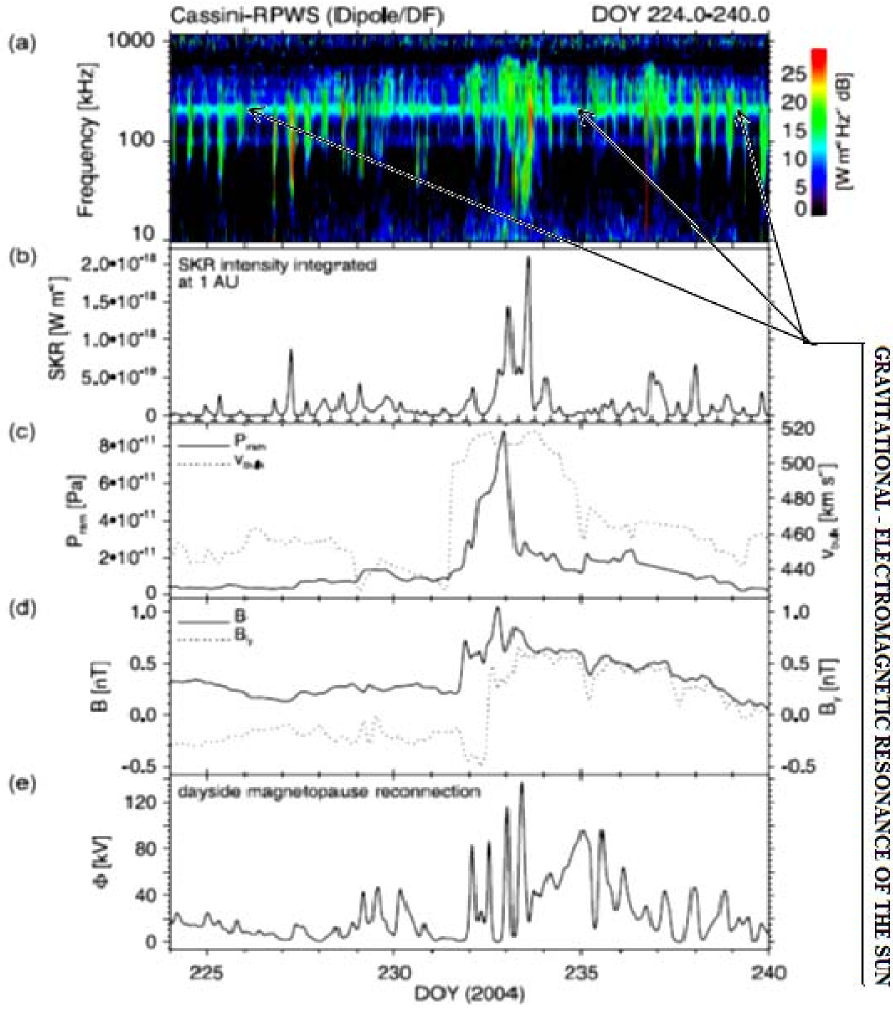

Fig. 3. (a) The RPWS dynamic spectrum, (b) the integrated SKR intensity profile, (c) profiles for the SW ram pressure (solid) and bulk velocity (dotted), (d) profiles for the interplanetary magnetic field strength (solid) and its y-component (dotted) in KSM-coordinates and (e) the profile of the reconnection voltage at the dayside magnetopause of Saturn during DOY 224–240, 2004 [13]

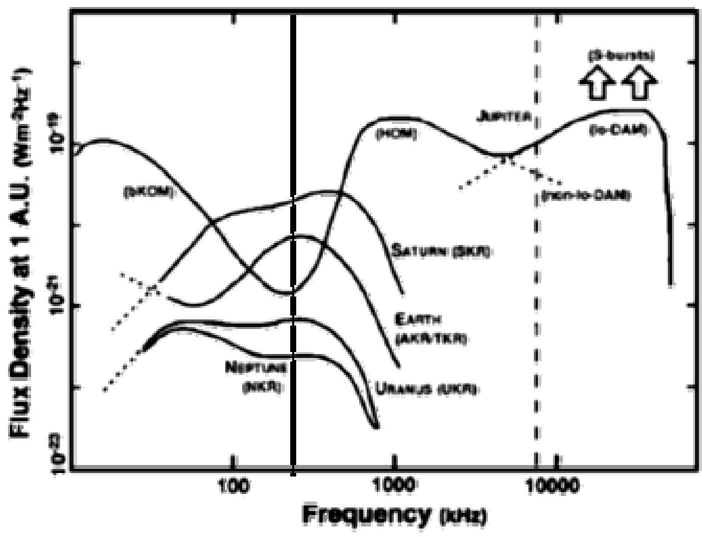

Fig. 4. Comparative spectra of auroral radio emissions of 5 planets [7]

Influence of GERS on the magnetosphere of Jupiter and consequently on his AKR is lower than for example in the AKR of Earth and Saturn (see. Fig. 4). This is due to the fact that the gravitational potential of Jupiter in AKR is much higher than gravitational potential of the Sun and planet's magnetic field is so strong that the effect of modulation of electromagnetic signals using AKR solar wind does not have a dominant influence on the characteristics of AKR, compared with other physical processes.

cThe frequency of gravitational-electromagnetic resonance of Jupiter (GERJ) 212.7 MHz is in the area, which is called synchrotron radio waves (synchrotron radiation), or abbreviated JSR.

In the frequency range from about 100 MHz to about 4 GHz, Jovian synchrotron radiation (hereafter referred as JSR) is emitted from the relativistic electrons, which is a non-thermal and incoherent radiation. JSR has a flat spectrum which is mainly in the decimeter (DIM) range.

Fig. 5 [17] shows a frequency spectrum of the power of radio emission of Jupiter (in comparison with the spectrum of the Earth's AKR), where in the radio DIM (JSR) it is marked the frequency 212.7 MHz. As can be seen from the graph, the power spectrum of the radio emission at a frequency of 212.7 MHz is in the area of global maximum of JSR.

A more detailed structure of JSR spectrum shown in Fig. 6 [18].

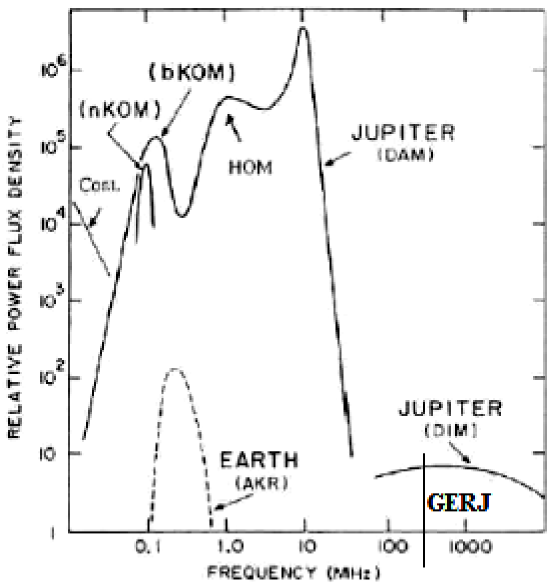

Fig. 5. Spectra of Jovian magnetospheric radiations. The power flux is normalized to constant distance. The spectrum of the Earth's is also shown as a comparison with Jupiter [17]

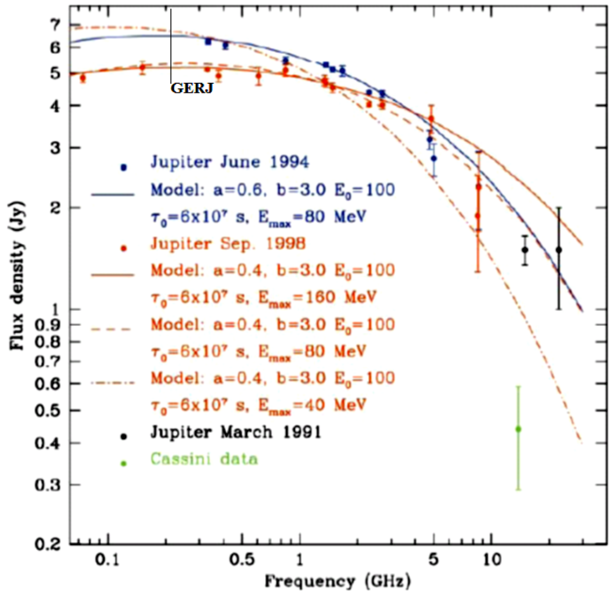

Fig. 6. JSR spectrum from 74 MHz to 8 GHz measured in July 1994 (blue circles) and September 1998 (red circles). The red and blue solid lines are the results of a model simulation [18]

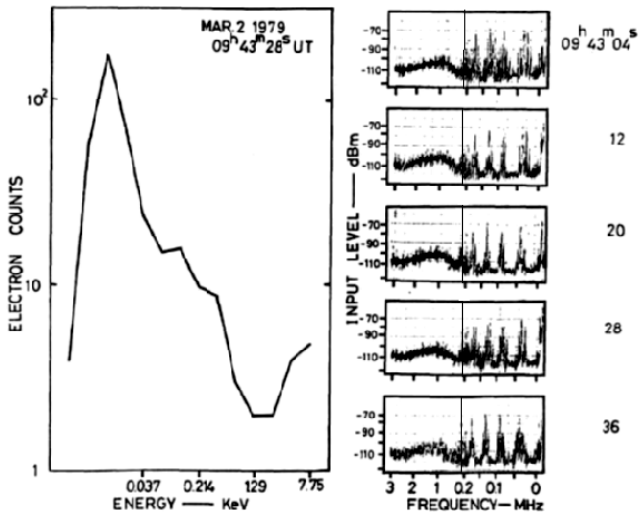

Fig.7. The energetic particle spectrum measured by ESP [19]

Fig. 6 as well as Fig. 5 confirms that the frequency GERJ is within range of global maximum of spectrum diagram JSR. Based on this, it can be assumed that GERJ may be one of the secondary sources JSR.

GERS has the greatest influence on the Earth's AKR (AKR Earth also called terrestrial KR, or TKR) and AKR Saturn – SKR.

Nature, sources and parameters of TKR are studied, for example, in [1,2,7,19,20,21,22]. In [19] it is presented the results of experiments on TKR research, carried on a space probe JIKIKEN (EXOS-B). The authors note that the peak of the power spectrum of signals TKR is in the range from 100 KHz to 300 KHz, and the amplification of electromagnetic waves, associated with the acceleration of charged particles, occurs in magneto- Earth at height of 1.5 to 2.15 of its radius. In the experiment, Energy Spectrum of Particles (ESP) it was studied spectra of electrons and protons with energies from 10 eV to 20 keV. Fig. 7 of [19] shows a typical dynamic spectrogram of electrons in the TKR, obtained under the ESP.

Fig. 7 shows that at a frequency of about 200 KHz resonance is observed, which is much less intense than, for example, resonances of about 150KHz - 175 KHz, 120 KHz, 80 KHz, 40 KHz. Fig. 8 of [19] shows the dynamic range of TKR.

On the spectrum of TKR in Fig. 8 it is clearly seen almost continuous line of signal intensity TKR at a frequency of approximately 202.97 KHz. At the same time, at other frequencies the signal intensity TKR is usually intermittent nature. The presence of a solid line at the frequency of 202.97 KHz says about the relative stability of the signal source at that frequency. The nature of the spectra in Fig. 7 and Fig. 8 confirms the earlier suggestion that the cyclotron maser mechanism is the primary source of TKR. Further, the primary resonance frequencies near 202.97 KHz is captured by electromagnetic gravitationally resonance of the Sun and as the gravity of the Sun is always present, there is the effect of gravity - electromagnetic generator on frequency 202.97 KHz with paging signal at the cyclotron frequency (or its harmonics).

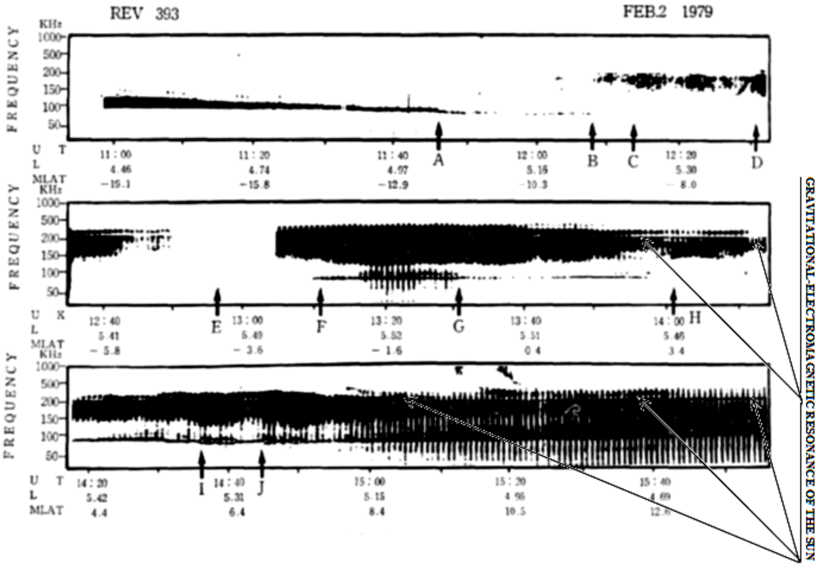

Fig.8. Dynamic spectra of the terrestrial kilometric radiation [19].

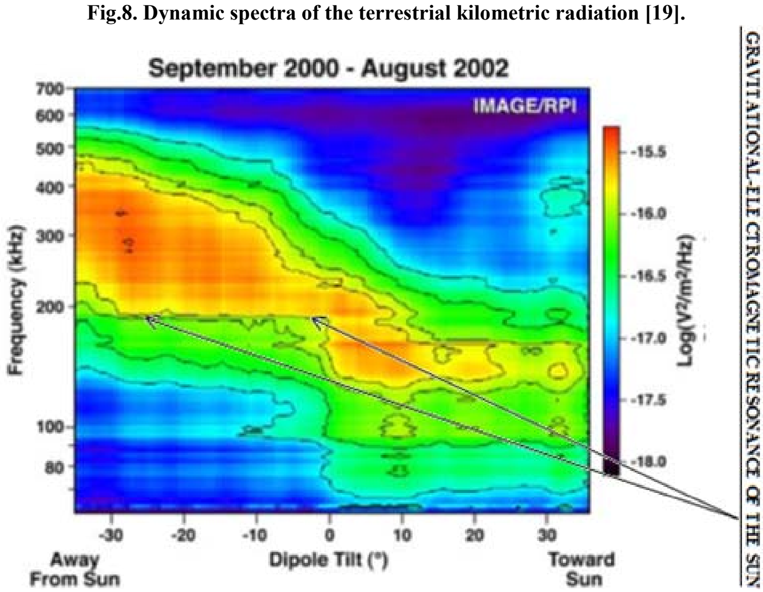

Fig. 9. **The average spectra of AKR as a function of dipole tilt angle from observations by the IMAGE/RPI instrument [21]**

In [21] it is presented the results of some years of research on board of the Imager for Magnetopause-to-Aurora Glob Exploration (IMAGE) and Polar spacecraft. They were studied the seasonal and solar cycle variations in the spectrum of auroral kilometric radiation (AKR), influence on the spectrum of AKR, dynamics of seasonal and solar cycles. It is also investigated the dependence of the averaged spectra of AKR as a function of dipole tilt angle magnetic field of the Earth. For example, in Fig. 9 [21] is a graph of this dependence.

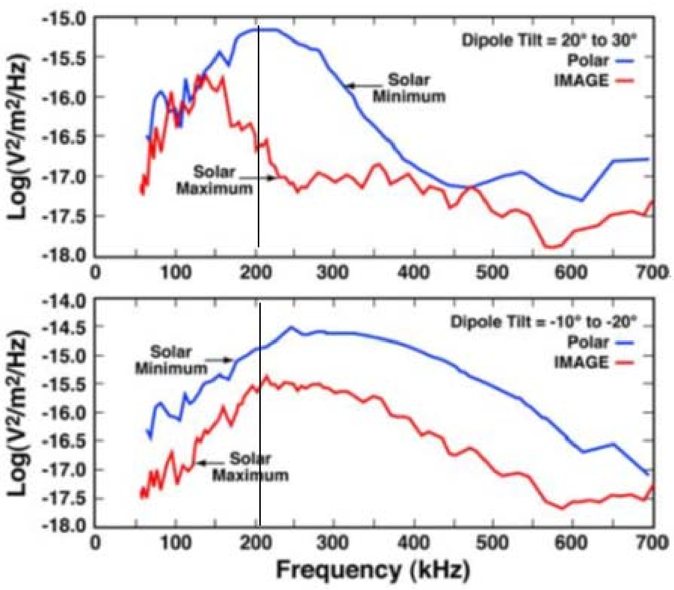

Fig.10. Comparison of the average spectra over the same dipole tilt ranges where the emission peak is approximately constant for both Polar/PWI (blue) and IMAGE/RPI (red) for positive (top) and negative (bottom) dipole tilt angle.[21]

Distribution of the spectrum signals AKR is following: for negative inclination angles of the dipole from 80 KHz to 500 KHz with a peak power of about 260 KHz, for positive angles of inclination of the dipole from 60 KHz to 250 KHz with a peak power of about 150 KHz. Noteworthy is almost unnaturally straight line on the boundary between the two ranges of the spectrum intensity signals (-16 and -16.5 units) AKR in the area of about 200 KHz for negative inclination angles the dipole. This straight line means that for maintaining constant power of AKR signal at about -16 units, at frequencies of about 200 KHz, the tilt range of the dipole from 0 degrees to - (27-28) degrees it is used stationary process of paging signal at one and the same frequency - 200 KHz and with the same intensity. It can be assumed that this process - is the gravitational-electromagnetic resonance of the Sun.

For comparing, Fig. 10 [21] shows graphs of averaged spectra of AKR signals for different inclination angles of the dipole of magnetic field of the Earth and the varying intensity of solar activity, obtained from IMAGE and Polar.

As can be seen from Fig. 10 AKR spectrum signals at a frequency of 202.97 KHz are in the area of local maxima, and for the positive slope of the dipole with a minimum of solar activity on the data from Polar – is in the area of global maximum.

In [20] it is presented experimental studies of MF / HF ionospheric radio emission of the Earth's magnetosphere at altitudes between 4 and 7 radiuses of the Earth, obtained by satellite Wind. During the experiment, it was found sporadic intense radiation at frequencies of about 1.8 MHz and more stable, but also less intensive radiation at frequencies of about 4.4 MHz. Fig. 11 [20] shows graphs of power spectrum of AKR signals and the ranges MF / HF, obtained during the mission Wind.

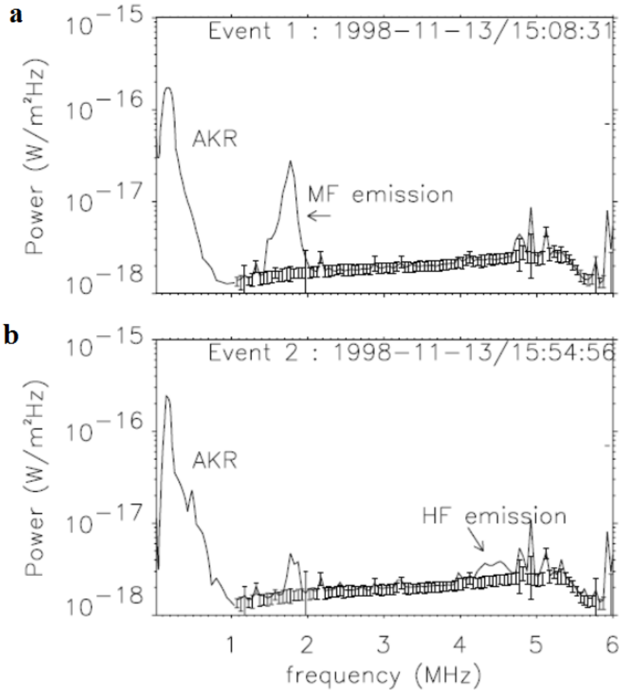

Fig. 11. Power spectra during the MF (top) and HF (bottom) events from the RAD1 (0.02-1.04MHz) and RAD2 (1.075-14MHz) receivers. The MF emission in the top panel peaked at f ≈ 1.8 MHz has bandwidth δf/f ≈ 0.14 HF emission is peaked near $f_{HF} \approx$ 4.5 MHz and has a similar FWHM bandwidth [20]

In a part related to the frequency range AKR in the graph in Fig. 11, it can be seen that the frequency 202.97 KHz is in the region of maximum radiation. On the falling part of the chart it can also be seen the zone of its AKR correction towards increasing signal power at frequencies of about 400 KHz, 500 KHz, 600 KHz and 800 KHz. If we exclude the frequency of 500 KHz, we can assume that, as in the formation of secondary sources AKR, except GERS signal at the fundamental frequency 202.97 KHz, and its harmonics 2, 3, 4 are involved. And in formation of high intensity radiation in the frequency range of VHF and HF it is involved respectively: in the frequency range of about 1.8 MHz - 9 th harmonic GERS, and in the frequency region of about 4.4 MHz - 4.6 MHz - 22 and 23 GERS harmonic.

In the graph in Fig. 12 [22] it is shown fine structure of the Earth's AKR signal, obtained during the experiment MEMO on the spacecraft Interball 2.

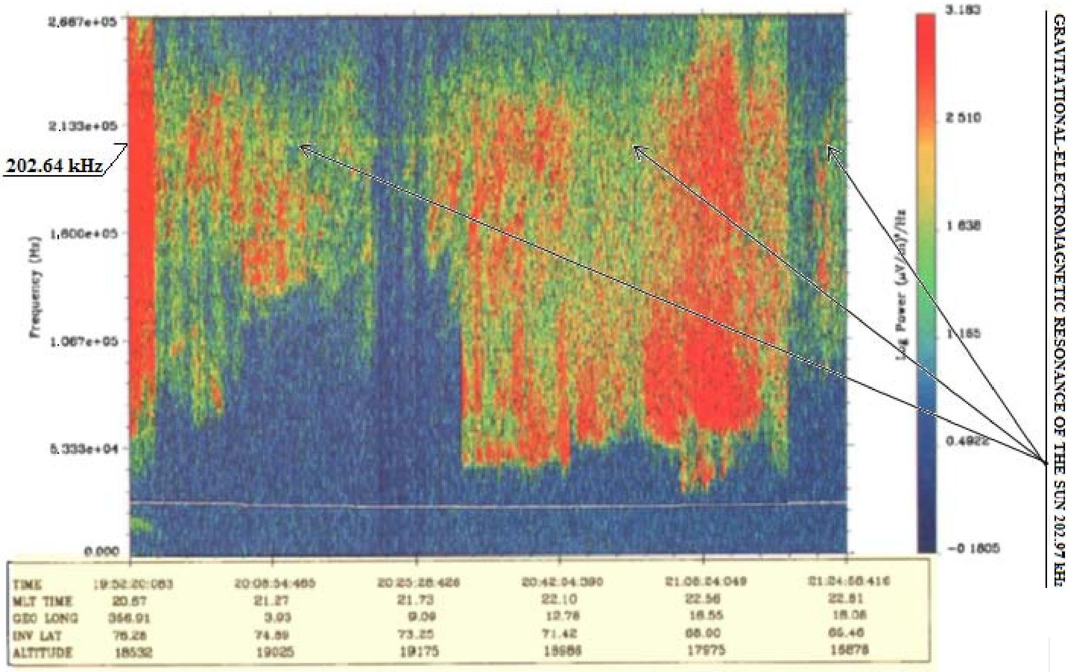

Fig. 12. AKR event recorded by MEMO on January 28, 1997, with an electric sensor.
The spectrogram starts at 1952:20 UT and ends at 2124:58 UT.[22]

In Fig. 12 under division of 202.64 KHz it is clearly seen almost solid line of secondary AKR source at a frequency of 202.97 kHz by GERS. Also during the experiment POLRAD mission Interball 2 it was obtained AKR spectra of Earth in the range of 4 KHz - 1 MHz. In Fig. 13 [23] in addition to the fundamental frequency of 202.97 KHz GERS it is shown second and third harmonics at frequencies of about 406 KHz and 609 KHz.

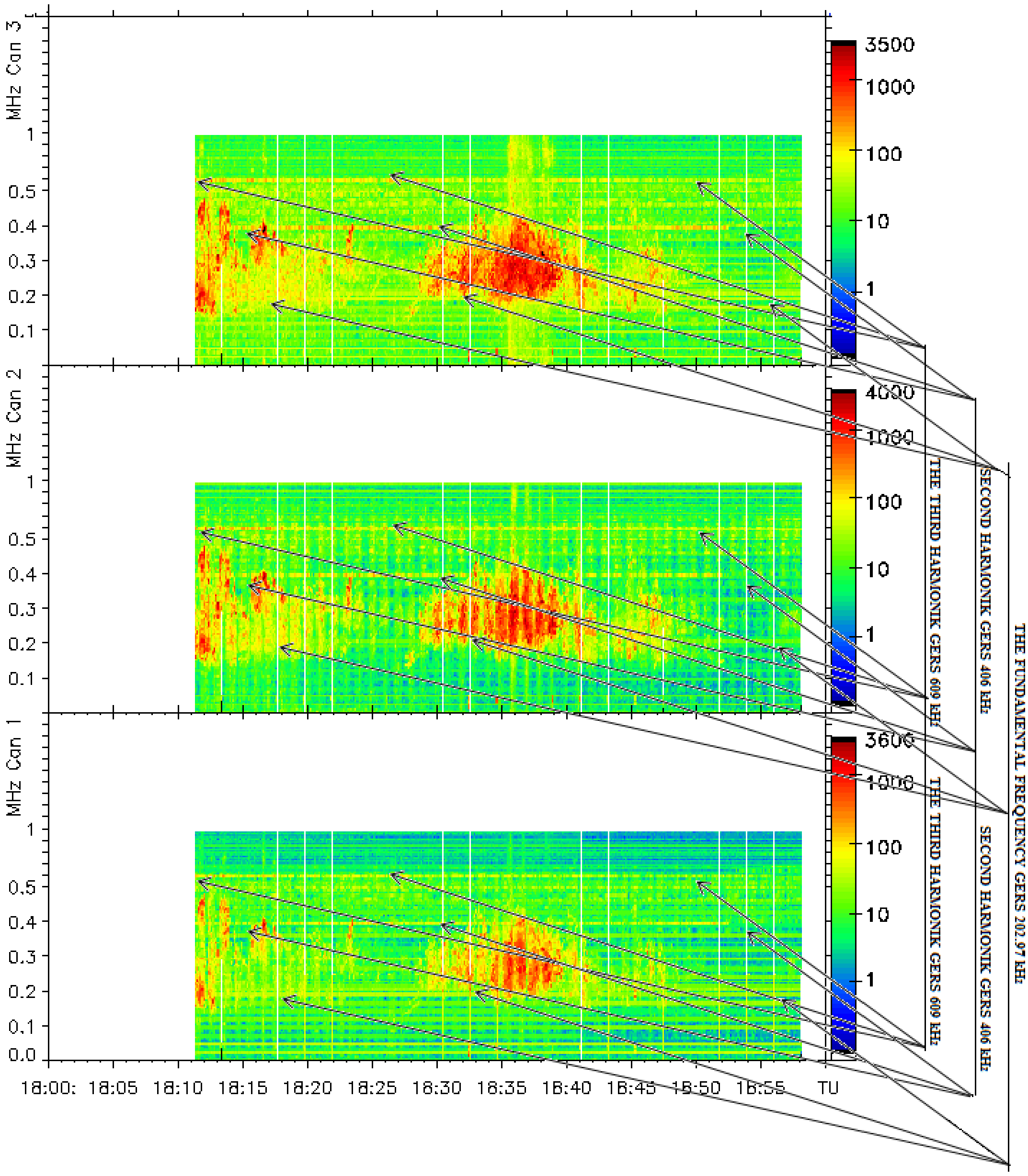

Fig.13. An example of the AKR recorded with Interball 2 by the POLRAD radio-spectro-polarimeter [23]

The presence of higher harmonics GERS in the spectrum AKR says that the GERS is stable and stationary secondary source of AKR.

According to the experimental studies Cassini and Voyager missions, according to [24,25] frequency AKR range of Saturn is in the range from several KHz to 1.2 MHz - 1.3 MHz with a peak of signal at a frequency of about 200 KHz. That also confirms the assumption: GERS can be a secondary AKR source of Saturn at a frequency of 202.97 KHz.

3. Conclusion

Gravitational-electromagnetic resonance of the Sun (GERS) at a frequency of 202.97 KHz can be one of the secondary AKR sources of planets, which have magnetosphere, first of all, Earth and Saturn. Gravitational electromagnetic resonance of Jupiter (GERJ) on frequency 212.7 MHz may be one of the secondary sources of JSR.

If you measure the wavelength of enveloping signal of the electromagnetic spectrum from any remote object of the observed Universe, it can determine the mass of the object, based on the law "Universal Plank proportion".

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