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Bursts of Count Rate of Beta-Radioactive Sources during Long-Term Measurements

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Abstract

When scanning the celestial sphere by a reflecting telescope with a radioactive source ^{60}Co at the focus, bursts in the count rate were registered. The probability of their registration depended on the orientation of the telescope. The number of bursts in a day as well as its connection with the orientation of the telescope were not reproduced in a unique manner. There were registered as single bursts with duration of about 1 second and an increase in the count rate up to three orders of magnitude, so more prolonged (up to several hours) events that consisted of short bursts of various amplitude distributed in time in some complicated manner.

Introduction

The radioactive decay refers to the highly stable and predictable processes. According to present views, there occurs an exponential drop in the number of particles radiated in a unit of time with fluctuations corresponding to the Poisson distribution. The detection of the smallest deviation of such behavior points to the existence of unknown actions or not yet studied properties of space and time. The importance of these researches is obvious. It is clear that they require the combination of high accuracy with carefulness of conclusions.

To investigate anomalies in the course of some processes, an experimental setup was build up that was characterized by the completeness and long duration of measurements of great number of simultaneously investigated processes (information was read from 20 channels), thermostatting of the majority of detectors and power sources as well as the possibility of long-standing uninterrupted registration of signals in combination with high accuracy in determining time points of events. Besides the alpha- and beta- radioactivity, rhythms and fluctuations of various processes (lowfrequency noise in semiconductor devices, generation of oscillations by instruments with quartz resonators) together with the analysis of the course of temperature and radiation background, were investigated.

The experimental setup

The signals coming from each detector to the input of recording computer were pulses the spacing of which depended on the value of measured parameter (amplitude of noise, frequency of generation, count rate of the detector of particles, temperature, etc). The computer registered only the number of channel and time point of coming of the next pulse. The pulse repetition frequency was not large (approximately one pulse per minute), therefore information was recorded extremely compactly which was very important during the long-term multi-channel registration. The information stored in the computer was automatically (or on command of an operator) discharged to a floppy disc several times per day, which allowed to transmit information to another computer without disturbing the process of continual registration. The value of the measured parameter was restored when processing the results according to the known dependence of the said parameter on the duration of pulse spacing in each channel.

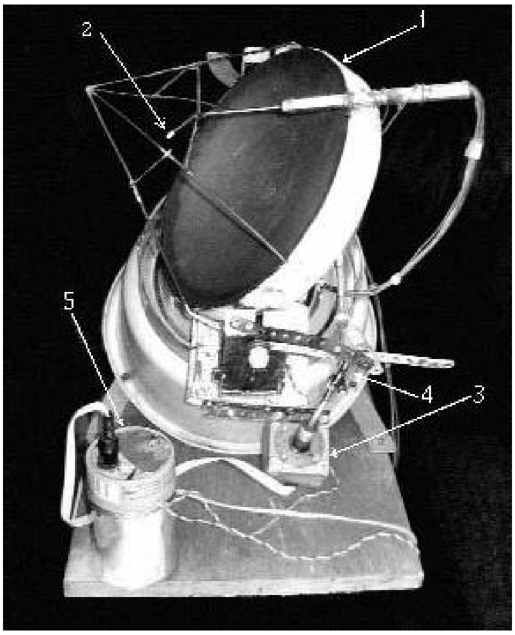

Figure 1: The telescope for observation of bursts.
1 - Steel mirror with parabolic surface,
2 - G-M counter with mounted ^{60}Co-source
3 - motor operating in step-by-step mode
4 - mechanism of rotation around the axis of declinations
5 - control unit for the motor.

The registration of extremely small variations of the radioactive decay count rate or the frequency of generators with quartz resonators, requires the most accurate measurement of time. The exactness of computer′s clock is insufficient for pursuance of good measurements. To improve them, the quartz resonator of the computer′s clock was temperature-controlled. Besides, the radio signals of exact time were applied every hour to one of inputs of the computer. This allowed, when processing the results, to introduce corrections reducing the errors in determination of absolute time down to 0.05 seconds. To minimize temperature influences, the most of detectors together with their power sources were placed in a constant-temperature cabinet or had an individual thermostat. Additionally, the temperature near the setup and in the cabinet-thermostat was recorded to monitor possible thermal influences.

The bursts of radioactivity were detected with the aid of a reflecting telescope at the focus of which a beta-radioactive source connected with a G-M counter was positioned. The photograph of the telescope is shown in Fig.1. The reflecting mirror of steel with the parabolic surface 22 *cm* in diameter has the focal length of 10 cm. A foil with radioactive ^{60}Co (of size 2 x 4 mm^2 and 0.1 *mm* thick) is placed at the focus of the mirror and connected with a miniature G-M counter with the sensitive volume 2 *mm* in diameter and 6 mm in length.

The telescope has two reciprocally perpendicular axes of rotation, one of them is parallel to the Earth′s axis and allows changes in the direction of the telescope along the celestial equator (hour angle), and another axis makes possible to vary the deflection from that (declination). The declination can follow a predetermined program.

The pulses from the G-M counter arrived to a frequency-meter, the sequence of pulses time points from divider were recorded into the PC′s memory. The count rate was determined as the ratio of the count-down k of the divider (that is, the number of particles counted over the pulse spacing) to the length of this interval as measured by the computer′s clock [1]. Such a method of continual measurement of count rate offers an advantage over the traditional one (counting the number of pulses over a fixed time) not only in the absence of missing of pulses and simplicity of realization but in the automatic enhancement in speed of measuring with increase of count rate of pulses. This was of primary importance for the study in consideration. The ordinary count rate in the mid-2004 was about of 5 *pulses per second* (at the background counting 0.01 *pulses per second*), which corresponded, if using the divider with k = 256, to the recording of information by the computer with intervals about 1 *minute*. Sometimes the count rate increased up to several thousand *pulses per second* within the span of ~1 *second*. Then the time for collecting 256 pulses (i. e. interval between events of recording) shortened down to some ten′s fractions of a second, which allowed not only recording the fact of a burst but to follow its dynamics, too.

Basic results

Analysis of results obtained over the five-year period of investigations is presented in the paper [1]. The considerable duration of practically uninterrupted observations made it possible to reveal rhythms of periods up to a year as well as to investigate the thin structure of more short rhythms. When measuring the rate of beta-sources ^{60}Co and ^{90}Sr-^{90}Y, rhythmical variations with amplitudes of 0.3 % from the average value with the period of a year, 0.02 % with the period of a month, and 0.005 % with the daily period were found. Stable rhythmical changes in the decay rate for the α-source ^{239}Pu were not detected (the upper limit was equal to 0.01 % from the average). Rhythmical variations in count rate of β-sources were also detected by Yu. A. Baurov with the coworkers [2].

The investigations on the setup with a beta-source at the focus of the parabolic mirror were started in spring of 1999. The processing of averaged results revealed an exponential fall in the count rate that is in a good accordance with the known 5.27-year half-life period of ^{60}Co. The long duration of measurements made it possible to establish that this monotone fall was superimposed by rhythmical changes in the count rate with the period of one year and amplitude of 0.3% from the average count rate [1]. Besides, rather considerable bursts of count rate with duration from some seconds to several hours were sometimes recorded, too. We managed to detect such bursts only due to long duration of almost uninterrupted observations because the summary duration of recorded bursts were no more than 1/1000 of setup operation time.

Table 1

Date	**Start**	**End**	t_{min}	**δ**	K
13.06.1999	8:40	12:10	8:45	23	2,66
13.06.1999	13:40	15:30	8:45	23	1,27
14.06.1999	8:32	8:44	8:45	23	1,22
19.08.1999	11:34	11:47	8:45	23	1,19
21.01.2000	17:56	20:55	8:45	16	1,40
04.02.2000	14:11	14:23	8:45	16	1,62
10.07.2000	19:30	19:58	8:50	21	1,32
07.08.2000	20:40	21:24	8:50	21	1,25
05.09.2000	5:09	5:14	8:50	21	5,63
06.09.2000	8:16	8:45	8:50	21	2,22
07.09.2000	7:55	8:21	8:50	21	1,22
14.09.2000	6:06	6:48	8:50	12	1,59
02.10.2000	5:40	8:40	8:50	12	8,73
02.10.2000	21:40	22:20	8:50	12	96
03.10.2000	0:00	5:50	8:50	12	159
26.03.2001	9:04	9:07	8:50	12	3,53
28.03.2001	20:33	21:27	8:50	12	1,40
29.03.2001	9:35	9:45	8:50	12	3,87
30.03.2001	8:20	12:20	8:50	12	3,70
31.03.2001	8:12	8:17	8:50	12	1,20
03.04.2001	10:12	10:43	8:50	12	1,38
30.06.2001	16:17	16:34	8:50	12	1,09
20.07.2001	4:09	4:16	10:25	17	1,12
24.09.2001	11:49	12:36	10:25	14	1,08
24.09.2001	19:14	23:17	9:25	8	1,14
25.09.2001	15:30	16:20	9:25	8	1,38
12.12.2001	4:38	5:40	9:25	8	1,30

In the first stage of investigations, the telescope was oriented in a nearly eastward direction at a fixed inclination to the horizon. When rotating together with the Earth, the telescope "scanned" a strip of the celestial sphere around 1° of width. The astronomic coordinates of the place on the celestial sphere to that the telescope was directed at the moment (declination and right ascension) were determined accurate to ~1° with the aid of astronomic tables from the solar image motion observations.

The Table 1 gives information on the bursts recorded from June, 1999, till January, 2002 (date, Moscow summer time of starts and ends of anomalous parts, time of the minimum distance t_{min} between the direction of the telescope and the Sun, declination of the scanning line δ (in degrees), and the ratio K of the maximum count rate in the anomalous part to the average count rate before and after the anomaly). In the time indicated, the average count rate changed from 15.8 to 10.5 *pulses per second.* The count rate was determined by the time of accumulation of 4096 pulses. The Table 1 contains the bursts with an increase of the count rate of more than 8% (an excess above the average more than 5 standard deviations).

From April, 2002, to March, 2004, additional 22 such bursts were recorded. In Fig.2 is shown the change in count rate for one of the bursts. The recordings of some other bursts are given in the paper [1].

The effectiveness of observations was sharply enhanced when going from one-dimensional scanning to two-dimensional one. For this purpose, oscillating motion perpendicular to the line of scanning associated with the daily rotation of the Earth, was given to the telescope (amplitude up to 40°, "right" motion = 5-10 *minutes*, "reverse" motion = 30-60 *seconds*, start and end times of the reverse motion were recorded by the computer). Examples of the images obtained are shown in Fig.3. It is seen that the positions of bursts are different for neighbouring days.

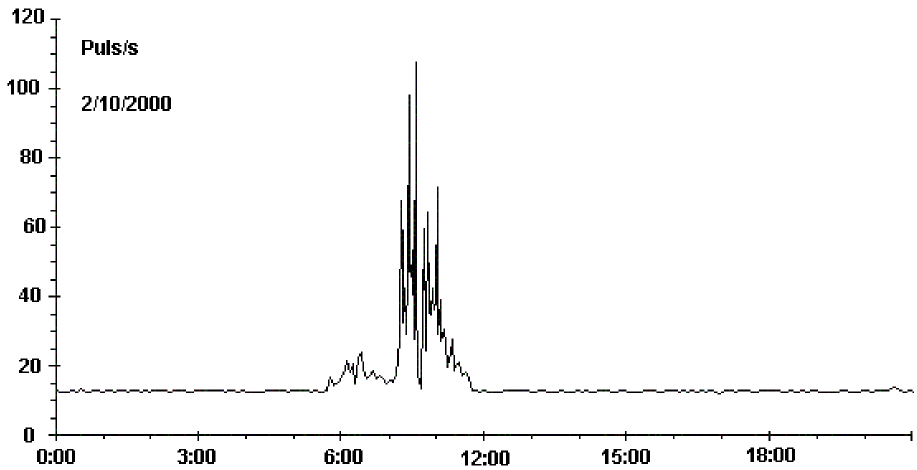

Figure 2: An example of registration of the count rate of ^{60}Co source located at the focus of reflecting telescope. Declination of scanning line is 12°. The most near approach to the Sun is 14° at 8:50.

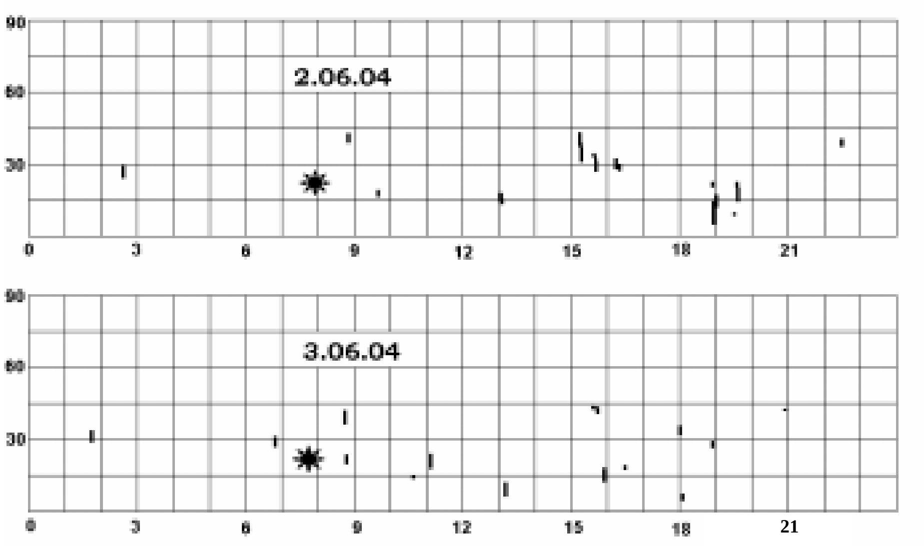

Figure 3: The bursts in the count rate during two-dimensional scanning the celestial sphere, June 2-3, 2004. Horizontal axis is Moscow summer time, vertical axis is declination in *degrees*. The range of swinging 4 - 44 *degrees*, time of forward motion 320 *s*, time of reverse motion 32 *s*. Image of the Sun in the focus of telescope at 7:56, the declination 23°. The location of the Sun is asterisked. Shown are bursts with the count rate exceeding the average one by more than 5 standard deviations.

Within 65 days of experiments from April, 2004, till April, 2005, 310 bursts exceeding the average count rate by more than 5 standard deviations, were registered (average count rate about of 5 *pulses per second* was determined from the time of accumulation of 256 pulses).

Fig. 4 shows the distribution of the bursts over the celestial sphere relative to immobile stars (above) and relative to the immobile Sun (below). The data of four-months` observations were generalized. On the upper image there are seen condensations of bursts in areas of celestial sphere with right ascensions α being equal to approximately 4, 12, and 16 hours that correspond to the constellations Taurus, Canes Venatici, and Serpents. In the regions of α = 2-3 *hours* and α = 14-15 *hours* (near the constellations Pisces and Bootes), no bursts at all were recorded.

On the lower image, a condensation of bursts is seen near the telescope′s direction to the Sun up to the angular distance about of 10° as well as the absence of recorded bursts within the span between 2 and 5 hours (30°-75°) before the approach of telescope′s orientation to the Sun.

Fig. 5 shows the count rate during one of short single bursts. The general duration of the burst was about of 20 *seconds*, and the interval with the highest count rate (more than 1000 *pulses per second*) lasted lesser than a *second.*

Fig. 6 represents the dynamics of count rate changes when recording a burst appeared close to 19:00 2/06/2004 during two consecutive scans displaced in time by 6 *minutes* which corresponded to a shift of 1.5° in right ascension. The presence of a burst in two consecutive scans testifies that the area of the celestial sphere associated with the indicated event, has an angular dimension of several degrees and “life time” more than 6 *minutes*. The scanning after a day did not found any burst in this place (see Fig. 3).

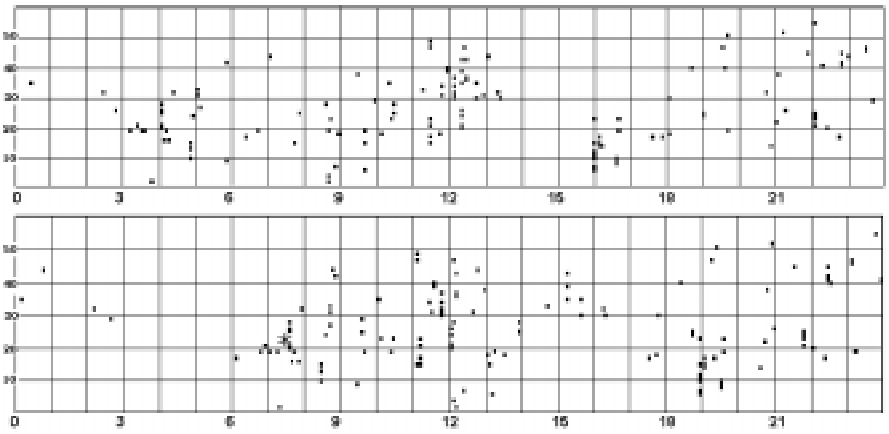

Figure 4: Distribution of bursts over the celestial sphere. Generalization of scanning results from May till August 2004. Above data are in the equatorial coordinate system, below data – relative to the immobile Sun (asterisked). The vertical axis is declination in *degrees*, the horizontal scale represents above the right ascension, and below the Moscow summer time. One *hour* corresponds to 15 *degrees*. Noted are the places of bursts with exceeding by more than 5 standard deviations above the average count rate.

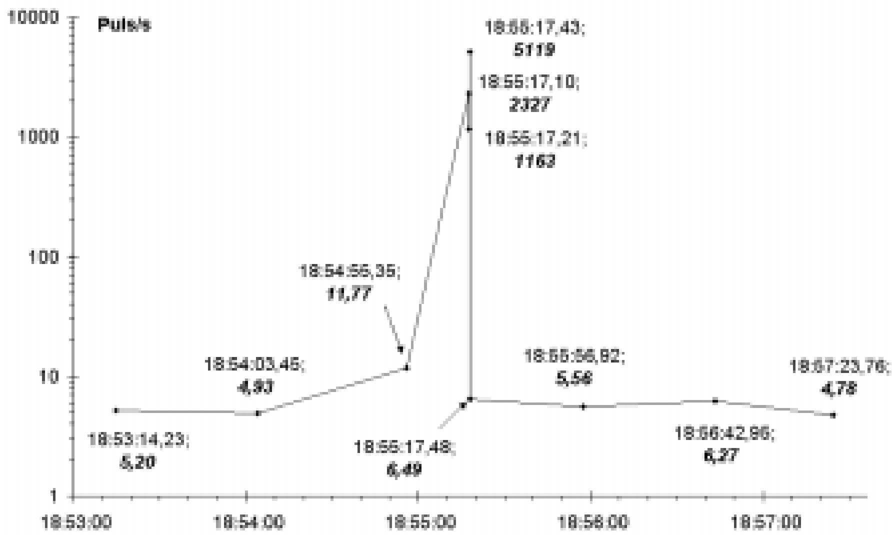

Figure 5: The burst recorded the 3-d of June, 2004, at the declination of 26°. There are indicated the count rate and time (accurate within hundredth parts of second).

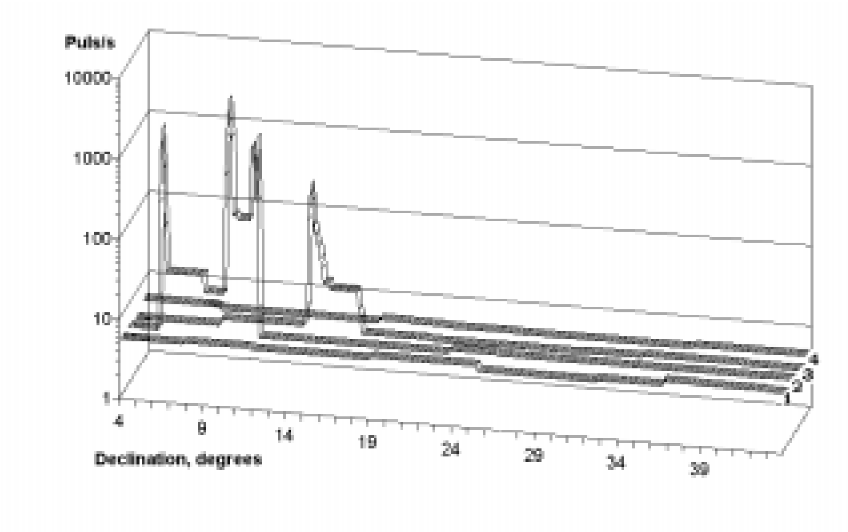

Figure 6: The burst recorded the 2-d of June, 2004. Four sequential scans in the neighbourhood of 19:00.

The information accumulated leads to the following conclusions.

1. The probability of recording a burst depends on the orientation of the telescope. In some intervals the number of registered events riches 0.1 *per square degree*, whereas in other parts of the celestial sphere of more than 1000 *square degrees* there is no event.
2. The number of bursts per day and their connection with the orientation of the telescope are not reproduced unambiguously, though in the following days bursts in the nearest regions of the celestial sphere are sometimes observed.
3. The time dynamics of bursts is very variable. The simplest type is single bursts with duration of some *seconds* at a rather common increase in count rate by more than three orders of magnitude. More long events (with duration up to several hours) consist of short bursts of different amplitude and are distributed in time in an intricate manner.
4. With the availability of ten-tenths cloud, no statistically reliable bursts are recorded.
5. Placement of the telescope beyond a window glass as well as the shielding by aluminum foil, do not noticeably influence experimental results.

Discussion of results

Foremost a question arises of whether or not the effects observed were connected with the action of ordinary factors of the type of electromagnetic interferences, instabilities in power supply or noise and defects in electronics. This question may be answered negatively with a high degree of confidence since:

1. There were no bursts when the G-M counter used in the setup, operated outside the telescope during several months (as with a radioactive source so without it).

2. Together with the signals coming from the setup in consideration, that same computer registered signals from another counter (with the beta-source ^{90}Sr-^{90}Y) also located outside the telescope and fed from the same source of power [1]. The reference counter detected no bursts.
3. Burst was observed in two consecutive scans (see, for example, Fig. 6). It was improbable that interferences or instabilities in the instrumentation were so exactly synchronized with the orientation of the telescope.
4. It is doubtful that the absence of interferences could be connected with the availability of cloud.

The second question is whether the effects observed were associated with the variation of radioactivity or with some processes in the G -M counter. The experiments with a counter without radioactive source that was placed at the focus of the telescope, give grounds to a conclusion about the influence just of change in radioactivity. In experiments without radioactive source, bursts in count rate were recorded too, but no more than up to 10 *pulses per second* at a background value of about 0.01 *pulses per second* [8-10]. As that background was due to the radioactivity of the substance from which the counter was made, the effect observed was probably also connected with the influence on the radioactivity.

Eloquent evidences that there were registered precisely the bursts of radioactivity were obtained when using, for detecting bursts, two counters of different type fed from different power sources (Fig. 7).

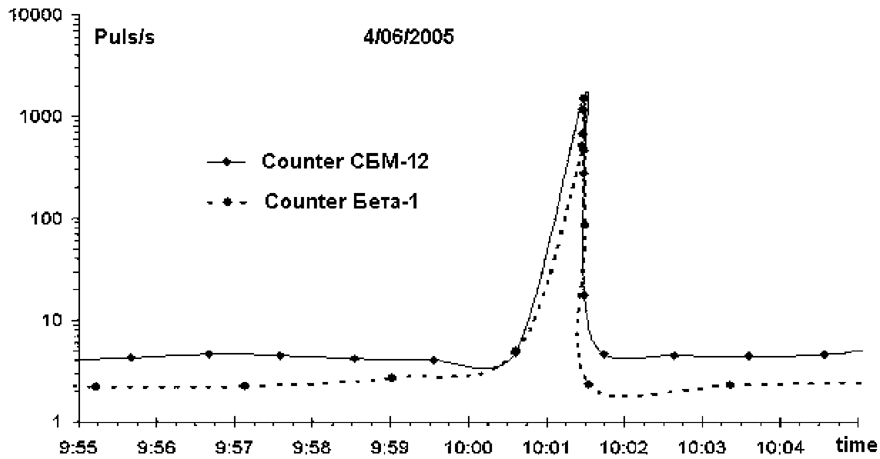

Figure 10: The simultaneous registration of count rate by two G-M counters. The cylindrical counter CBM-12 is positioned adjacent to a source being at the focus of the telescope. The end-window counter BETA-1 is at the distance of 1.5 *cm* from the source.

The totality of data obtained allows an assumption that the appearance of bursts is connected with the presence of a focusing mirror that concentrates flows of some agent coming out of space. That agent should have the following properties:

1. Ability for influencing the beta-radioactivity;

2. Capacity to specular reflection from smooth surfaces.

In conclusion, it should be mentioned that the above results bear similarities to those presented in Refs. [3-6]. One can become acquainted with ideas on the nature of the effect detected in the works [7-11].

References

[1] Parkhomov A.G., Maklyaev E.F., 2004, "Investigation of Rhythms and Fluctuations during Long-term Measurements of Radioactivity, Frequency of Quartz Resonators, Noise in Semiconductors, Temperature, and Atmospheric Pressure," *Fizicheskaya Mysl Rossii*, No.1, pp. 1-12 (in Russian). http://www.chronos.msu.ru/PREPORTS/parkhomov_ritmy/.htm

[2] Baurov Yu. A., Konradov A. A., Kushniruk V. F., et al, 2001, "Experimental Investigations of changes in β-decay rate of ^{60}Co and ^{137}Cs". *Modern Physycs Letters A*, 16(32), pp. 2089-2101.

[3] Akimov A. E., Kovalchuk G. U., Pugach A. F., et al, 1992, "Preliminary Results of Astronomical Observations by the N. A. Kozyrev's Procedure", *Preprint of ГАО-92-5P*, Kiev , 16 p. (in Russian).

[4] Lavrentyev M. M., Yeganova I. A., Lutset M. K., et al, 1990, "About Distant Influence of Stars on Resistor", *Doklady AN SSSR*, 314 (2), pp. 355-368 (in Russian).

[5] Kozyrev N. A.,1991, Selected Works, Leningrad University Publishing House, 448 p. (in Russian). http://www.timashev.ru/Kozyrev.

[6] Baurov Yu. A., Timofeev I. B., Chernikov V. A. et al, 2003, "Experimental investigations of the distribution of pulsed-plasma-generator radiation at its various spatial orientation and global anysotropy of space", *Physycs Letters A*, 311, pp.512-523.

[7] Baurov Yu. A., Klimenko E. Yu., Novikov S. I., 1990, *Doklady AN SSSR*, 315(5), p.1116.

[8] Parkhomov A. G., 1998, "Dark Matter: Role in Cosmo-Terrestrial Interactions and Perspectives of Usages", *Soznaniye I Fizicheskaya Realnostj*, 3(6), pp.24-35 (in Russian). http://www.chronos.msu.ru/Public/parkhomov_astronomicheskiye.html.

[9] Parkhomov A. G., 2000, "Astronomical Observations by the N. A. Kozyrev's Procedure and the Problem of Instantaneous Transmission of Signal", *Fizicheskaya Mysl Rossii*, No.1, pp.18-25 (in Russian). http://www.chronos.msu.ru/Public/parkhomov_astronomicheskiye.html.

[10] Parkhomov A. G., 1995, An Unusual Cosmic Radiation. Detection, Hypotheses, Testing Experiments., *Moscow, MNTTs VENT*, 51 p. (in Russian).

[11] Parkhomov A. G., 1993, Distribution and Motion of Dark Matter, *Moscow, MNTTs VENT*, 76 p., second edition 2004 (in Russian). http://www.chronos.msu.ru/PREPORTS/parkhomov_raspredelenie.pdf