

Regular Changes in the Fine Structure of Histograms Revealed in the Experiments with Collimators which Isolate Beams of Alpha-Particles Flying at Certain Directions

Simon E. Shnoll*[†] and Ilya A. Rubinstein[‡]

^{*}*Institute of Theor. and Experim. Biophysics, Russian Acad. of Sciences, Pushchino, Moscow Region, 142290, Russia*

[†]*Department of Physics, Moscow State University, Moscow 119992, Russia*

[‡]*Skobeltsin's Institute of Nuclear Physics, Moscow State University, Moscow 119991, Russia*

E-mail: shnoll@mail.ru

As was shown in the works of 1951–1983, the fine structure of distributions of the results of measurements of processes of diverse nature is not casual. The changes in the shape of histograms corresponding to the distributions were called “macroscopic fluctuations”. The universal character of the phenomenon and its independence of the nature of the process studied were demonstrated for various processes: biochemical and chemical reactions, movement of latex particles in the electric field, proton transverse relaxation in the inhomogeneous magnetic field, discharge in the neon-tube RC-generator and radioactive decay of various α - and β -isotopes. Since 1982, the main object chosen to study macroscopic fluctuations has been α -decay. The choice was based on the process being a priori independent of trivial factors and the possibility to conduct continuous long-term automatic measurements while storing the results in a computer archive (database). Started in 1982, these measurements have been carrying on, as unceasingly as possible, until now. Since July 2000, the measurements are conducted using devices designed by one of the coauthors of this review, I. A. Rubinstein. Application of these devices (especially, detectors with collimators which isolate beams of α -particles flying at certain directions), along with the use of Edwin Pozharsky's computer program, which eases histogram comparing by the expert, has allowed us to reveal a number of fundamentally new regularities. In the review, we describe these regularities, device constructions, and the methods of measurement and analysis of the results obtained.

1 Devices, measurement methods, and data analysis

The methods of histogram construction and analysis were described many times in our previous works [11–15]. We analyze the shape of “inconsistent” histograms [33, 34] — distributions of the results of consecutive measurements, the number of which is comparable with the selected number of digits (bins). Usually we cut the sequence of a time series of the results of measurements to equal, non-overlapping segments (60–100 segments in a series), with approximately the same number of bins. In the histograms constructed from such segments of time series, the number of results per bin will vary from 0 to 5. We analyze changes in the distribution of the number of results within a single bin depending on the position (order number) of the bin in the series, and the regularities become more evident (visible) after smoothing of the initially inconsistent histograms by moving summation. All the operations: registration of the quantities measured, their storing and sorting, histogram construction and processing (smoothing, superpositioning, mirroring) — are performed with the aid of a very handy program written by Edwin Pozharsky (see [12]). A weakness of our methodology is visual comparing of histogram shapes: the decision

“similar/non-similar” is made by an expert, after evaluating a pair of histograms drawn on the computer monitor. There is a “radical” way to overcome subjectivity of expert's judgments: comparing histograms after randomization of their sequence. In this case, the expert knows nothing about the histograms compared. Using this approach, we checked all the principal results of our investigations. However, the approach is extremely laborious; the volume of work to do increases greatly. Another way to avoid expert's subjectivity, which was used in most cases, is pairwise comparing — *ceteris paribus* — of two series of measurements, “control” and “experiment”, differing only in a single factor (e.g., comparing histograms constructed from the “direct” and “inverse” sequences of the same time series). This method, which has been conventional in science for 300 years, was used to obtain the results of last years.

It would be good to replace the expert with a computer program. We started such attempts about 20 years ago. This task turned out unexpectedly difficult for yet. The pattern-recognition specialists usually give it up, because what seems obvious for the expert appears vague for the computer program. Recently, however, some progress has been achieved. V. V. Strelkov has made a computer program which reprodu-

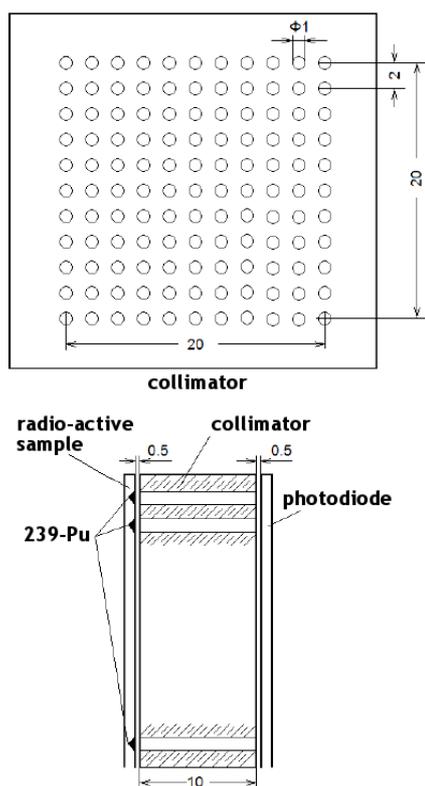


Fig. 1: — Fig. 1a: Collimator. Fig. 1b: Device assembly (radioactive sample, collimator, photodiode).

ces one of the main phenomena we study, namely, the “near-zone effect” [31, 32]. The effect means that the histograms constructed from the neighbor (non-overlapping!) segments of a time series are more probable to be similar than random far-apart histograms. Unfortunately, the program lacks user interface and is still accessible only by the author.

Despite the absence of a computer program and the laboriousness of visual histogram comparing, we have obtained much information on the phenomena studied, which is based on the “control-experiment” comparisons. Among those data, of special interest are the results of experiments, in which α -radioactivity was measured using a collimator-based setup.

Designing a collimator which would yield a narrow beam of α -particles (angle, $\leq 10^\circ$) represents a known difficulty. Since the mean range of 5-MeV α -particles in air is about 32 mm, the length of the collimator can be about 10 mm — then the particle’s energy loss after passing the collimator will be about 20%. In this case, one can be sure that all the α -particles passed through the collimator will be registered, and no vacuumization of the “source-collimator-detector” system would be necessary.

With the collimator length 10 mm, the diameter of the hole for obtaining a narrow beam should not be more than 1 mm. The number of α -particles emitted by the radioactive source from a 1-mm spot cannot be substantially increased

by raising the thickness of the ^{239}Pu layer. Hence, one can achieve a particle flux through a single collimator hole of 5–8 particles per second.

To enhance statistical significance of the experiment, we had to design a collimator in the form of a 120-hole grid (Fig. 1a), and use a larger-area detector.

The radioactive source itself is a grid with hollows filled up with ^{239}Pu . The centers of hollows are strictly coaxial with the centers of collimator holes. Fig. 1b shows the positional relationship between the source, collimator and detector, the latter being a photodiode with the area of sensor surface 400 mm^2 .

2 Regular changes of the histogram shape with time

Regular changes with time is one of the main proofs of non-randomness of the fine structure of histograms obtained upon measuring processes of diverse nature. These regularities gradually emerged in the series of systematic many-year measurements of the rates of enzymatic and chemical reactions and the processes of radioactive decay [1–6]. The main results of those studies were reproduced and substantially extended in the experiments on α -activity measured using a line of new devices.

2.1 The “near-zone effect”

As shown in many our papers published earlier, changes in the histogram shape reveal an “effect of near zone”, which states for a high probability of the histograms constructed from the non-overlapping neighbor segments of a time series to be similar. The nature of this effect remains mysterious, much because of its fractality: the effect manifests itself on different time scales, when histograms are constructed from hour, minute, second and 0.01-second segments of a time series [12, 14, 15].

2.2 Daily periods

The high quality of experimental setups and accurate determination of time intervals (and most of all, independence of the histogram shape of time series trends!) enabled us to see that the periods of appearance of a certain histogram shape split to the “sidereal” and “solar” ones. Now, with histograms constructed for 1-min segments, the daily period split to the “sidereal” (1436 min) and “solar” (1440 min) days. Determination of the yearly periods with the accuracy of 1 h also yielded two peaks: one equal to 365 average solar days (calendar year) and another equal to 365 days plus 6 h (sidereal year). When yearly periods were determined with the accuracy of 1 min (!), the calendar and sidereal periods, as expected from calculations, turned out to be 525599–525600 and 525969 min respectively. The calendar period seems to mean the recurring orientation of the laboratory relatively to the Sun, whereas the sidereal period reflects orientation in re-

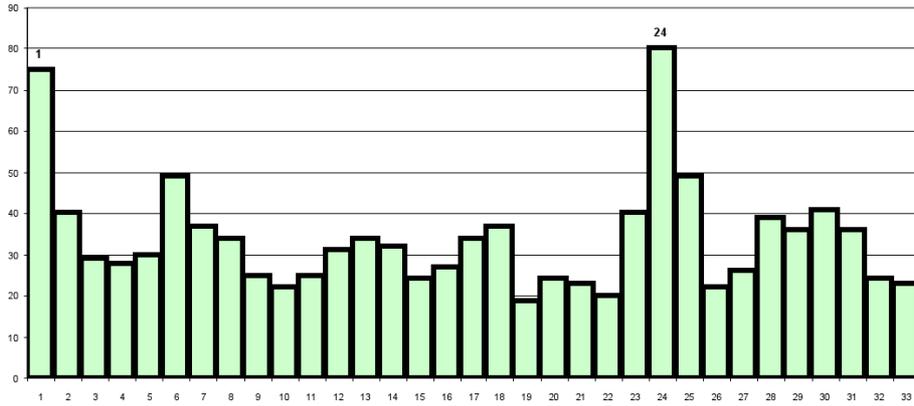


Fig. 2: A typical dependence of the probability of reappearance of histograms of a certain shape on the interval between them. The “near-zone” effect and the near-daily period of reappearance of similar 1-hour histograms in the measurements of ^{239}Pu α -activity at Novolazarevskaya station (Antarctic) on March 1–2, 2003. The measurements were made by A. V. Makarevich. In the figure, the number of similar histogram pairs (Y -axis) is plotted vs. the corresponding interval between histograms (X -axis, h) [20].

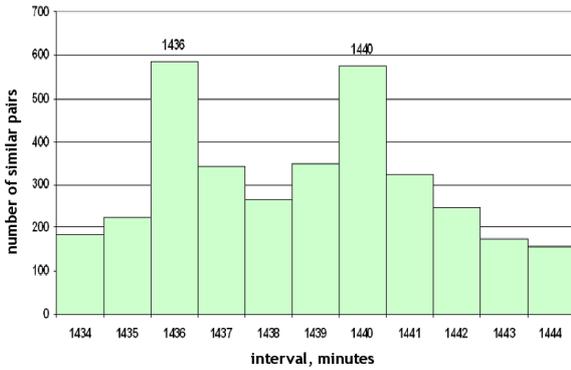


Fig. 3: When ^{239}Pu α -activity is measured with the detectors oriented in a plane parallel to the celestial equator, two distinct periods of the appearance of similar histograms can be seen: one equal to the sidereal day (1436 min) and another corresponding to the solar day (1440 min). The measurements were made in Pushchino on June–October, 2004. Axis legends as in Fig. 2 [22, 25].

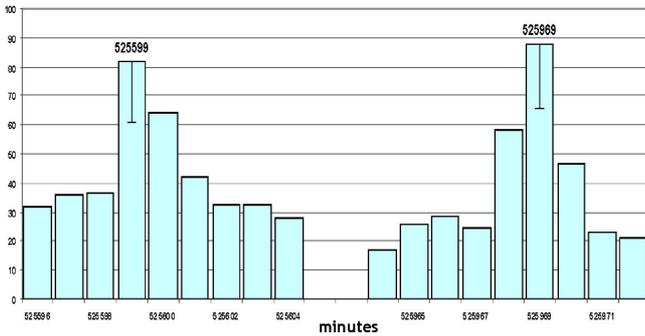


Fig. 5: With the accuracy of 1 min, similar histograms reappear after a year with two main periods: the double (split!) calendar (with 525599- and 525600-min peaks) and the sidereal, equal to 525969 min. The measurements of ^{239}Pu α -activity were made on November 24, 2001 and 2002. In the figure, the number of similar histogram pairs (Y -axis) is plotted vs. the corresponding interval between histograms (X -axis, min) [22, 25].

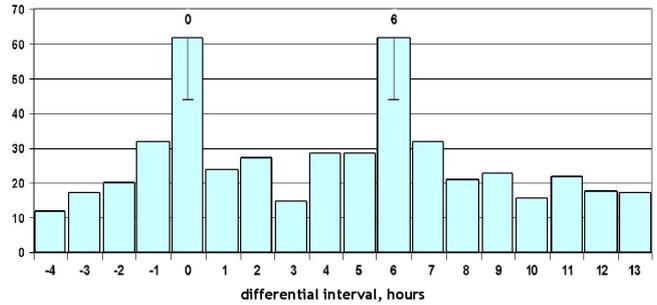


Fig. 4: Similar 1-hour histograms appear in the measurements of ^{239}Pu α -activity with the interval of exactly a year (“calendar year”) and a year plus 6 hours (“sidereal year”). In the figure, the number of similar histogram pairs (Y -axis) is plotted vs. the corresponding interval between histograms minus the number of hours in a year (8760 h) (X -axis, h) [22, 25].

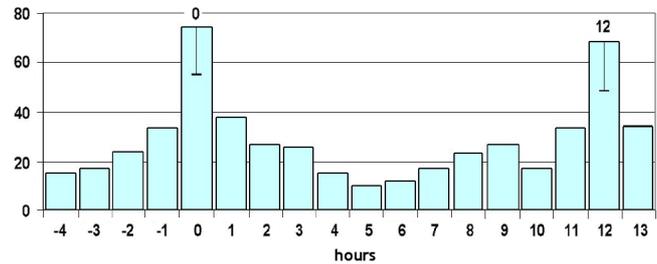


Fig. 6: With the accuracy of 1 h, similar histograms reappear with two periods: exactly 2 years and 2 years plus 12 h. The measurements of ^{239}Pu α -activity were made on August–September, 2000–2002. In the figure, the number of similar histogram pairs (Y -axis) is plotted vs. the corresponding interval between histograms minus the number of hours in two years (X -axis, h) [22, 25].

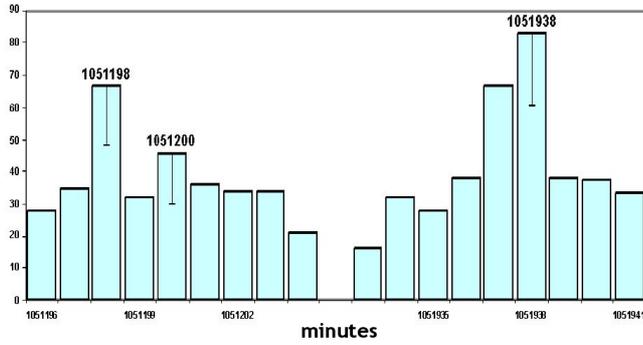


Fig. 7: When ^{239}Pu α -activity is measured with a 1-min resolution, similar histograms reappear with two main periods: calendar and sidereal. The calendar period consists of two subperiods: one is equal to the theoretical value (1051200 min) and another is 2 min shorter (1051198 min). The sidereal period exactly meets the theoretical value of 1051938 min. The measurements of ^{239}Pu α -activity were made on April 20, 2001–2003. In the figure, the number of similar histogram pairs (*Y*-axis) is plotted vs. the corresponding interval between histograms (*X*-axis, min) [22, 25].

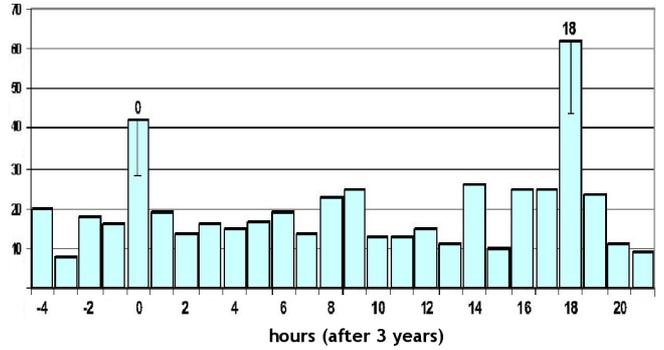


Fig. 8: With the accuracy of 1 h, similar histograms reappear exactly after 3 years and 3 years plus 18 h. The measurements of ^{239}Pu α -activity were made on August–October, 2000–2003. In the figure, the number of similar histogram pairs (*Y*-axis) is plotted vs. the corresponding interval between histograms minus the number of hours in three years (*X*-axis, h).

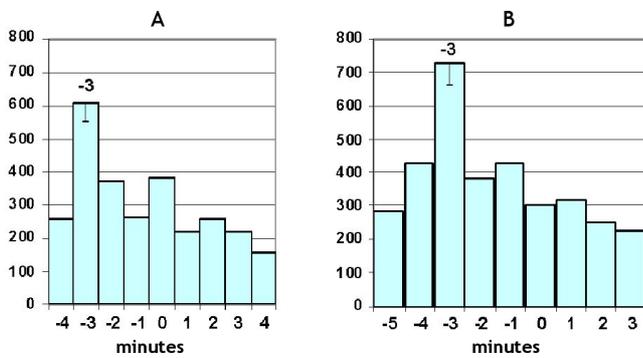


Fig. 9: When compared are histograms with a 3-year interval between them, the calendar period of reappearance of similar histograms is 3 min shorter than the theoretical value. The measurements of ^{239}Pu α -activity were made on the same dates of October (A) or August and November (B), 2000–2003. In the figure, the number of similar histogram pairs (*Y*-axis) is plotted vs. the corresponding interval between histograms minus the number of minutes in three years (1576800 min) (*X*-axis, h).

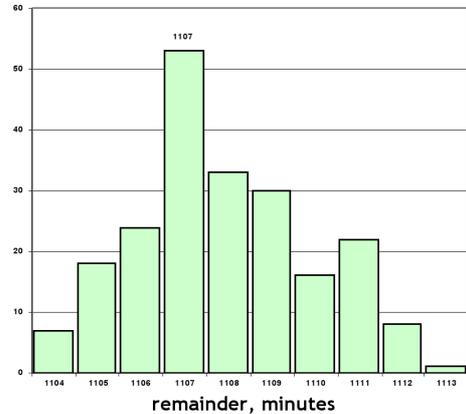


Fig. 10: When compared are histograms with a 3-year (1576800-min) interval between them, the sidereal period of reappearance of similar histograms is realized with a triple “leap shift”, i.e. $369 \times 3 = 1107$ min later of the calculated calendar time. In the figure, the number of similar histogram pairs (*Y*-axis) is plotted vs. the corresponding interval between histograms minus the number of minutes in three years (1576800 min) (*X*-axis, h).

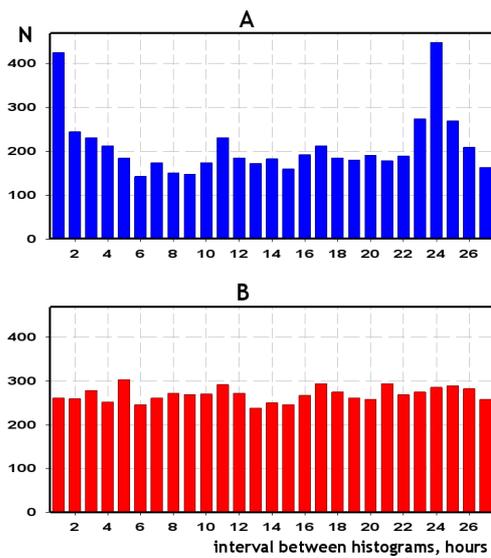


Fig. 11-1: The distribution of intervals between similar histograms depends on the direction that α -particles fly in upon ^{239}Pu radioactive decay. The measurements of ^{239}Pu α -activity were made on January–June, 2002. (A) α -Particles emitted by a flat sample are registered with a flat detector without collimator; (B) before registered by a detector, α -particles pass through a narrow collimator directed at the Pole Star. In the figure, the number of similar histogram pairs (Y -axis) is plotted vs. the corresponding interval between histograms (X -axis, h) [23, 26].

lation to the sphere of fixed stars.

Apparently, the phenomenon of period splitting is underlain by the spatial anisotropy of factors that determine the shape of histograms. All the aforesaid is illustrated by Fig. 2–Fig. 9.

Fig. 2 shows a typical picture: a high probability of appearance of similar 1-h histograms in the nearest, neighbor intervals (the near-zone effect) and the increase of this probability after 24 h. We obtained analogous distributions with a pronounced near-zone effect and 24-h period many times — for processes of diverse nature measured at various geographical points.

Fig. 3. More accurate determination of the daily period in the appearance of similar histograms (with the 1-min resolution), undertaken on Yu. I. Galperin’s advice, showed that the daily period is distinctly resolved to two peaks: the “sidereal day” (1436 min) and the “solar day” (1440 min).

2.3 Yearly periods

Fig. 4 shows that determined with the accuracy of 1 h, yearly periods split — like do daily periods determined with the 1-min accuracy — to two peaks: the “solar” (calendar) peak and the “star” (sidereal) one.

With the results of 1-s measurements collected for many years, yearly periods were determined with a 1-min accuracy. Then, apart from resolving the solar and sidereal yearly periods, we were able to see a surprising shift of the solar period

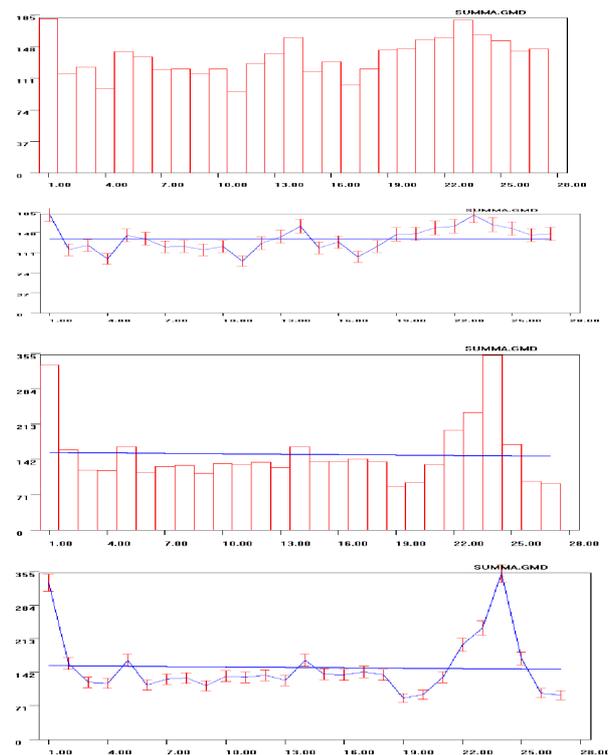


Fig. 11-2: Distribution of intervals between similar 1-hour histograms in the experiments with collimators aimed at the Pole Star (A) and directed west (B). The measurements of ^{239}Pu α -activity were made in Pushchino (at a latitude 54° north) on February–May, 2003 [23, 26].

by a minute per year: by one minute in the first, by two minutes in the second, and by three minutes in the third year. Strangely enough, the sidereal period did not shift; and since both observations were made in the same experiments, the shift of the solar period looked more reliable.

Constructing 1-h histograms after 3 years, we again obtained two periods: the “calendar” period, which was equal to the number of hours passed for 3 years, and the “sidereal” one, differing from the first by 18 h, i.e. by three “leap shifts”. This can be seen in Fig. 8.

To obtain statistically significant values of the duration of “calendar period” after 3 year with a 1-min resolution, we compared about 200000 histogram pairs. The results are represented in Fig. 9.

It is also important that the 2nd “sidereal” period corresponds exactly to the leap shift and is equal to $369 \times 3 = 1107$ min (i.e., $1576800 + 1107 = 1577907$ min) — see Fig. 10. Analogous results were obtained time and again.

3 Dependence of the histogram shape on the direction in space

The use of collimators, isolating directed α -particle beams, allowed us to start studies on the spatial regularities in the change of the histogram shape.

3.1 The collimator is directed at the Pole Star [23, 26]

In 2002 we started measurements with collimators, which isolate directed beams of α -particles flying at different directions upon radioactive decay. The devices were constructed by I. A. Rubinstein. It was already in the first experiments, when we found that the histogram shape depended on the direction of α -particles escape. With the collimator directed North (at the Pole Star), we saw disappearance of the daily periods in the change of the histogram shape. The control measurements were conducted either without collimators or with a collimator directed west or east. These measurements lasted several months in 2002 and were repeated in 2003 and 2004 [23].

The dependence of the histogram shape on the direction of α -particles escape upon radioactive decay has quite a deep significance. The measurements were carried out in Pushchino laboratory (at the latitude 54° north and longitude 37° east), and the result was similar to that observed near the North Pole (at the latitude $80\text{--}82^\circ$ north) [20]. In the air, α -Particles (^{239}Pu) will run a distance of ~ 4 cm. Hence, the matter does not concern any factors of the Earth Pole region affecting the shape of histograms. Evidently, a suggestion of radioactive α -decay being influenced by something is out of consideration too. The measure of radioactive decay intensity (the number of decay events per time unit) is independent of the conditions of measurements and did not change in our experiments. The fluctuations of the radioactive decay intensity we observed were well-correspondent, according to the conventional criteria, to Poisson statistics. The only thing dependent on the orientation of the collimator was the change of the histogram shape in time, or rather the change associated with the daily rotation of the Earth. Considering the disappearance of that dependence in the experiments conducted near the North Pole, one could assume an interference of some local environmental factors. For the results of Pushchino experiments, when the collimator was directed at the Pole Star, no such explanation is possible, as daily periods did not disappear in the control, *ceteris paribus*, measurements. There remains only one conclusion: the phenomenon is a manifestation of sharp anisotropy of the space-time continuum. It should be noted here that this anisotropy reveals itself at the moment of α -particles escaping the nucleus. Given the nucleus diameter to be $\sim 10^{-13}$ cm, the spatial anisotropy should be of the same scale. With the energy of α -particles being several MeV, the fluctuations of the Earth magnetic field and its influence on the direction of α -particles run, let alone on the fine structure of histograms, may well be neglected.

3.2 Rotation of collimators [26, 27]

Following the experiments discussed above, we started, in 2004, measurements with collimators that were being rotated clockwise or counterclockwise with a special apparatus.

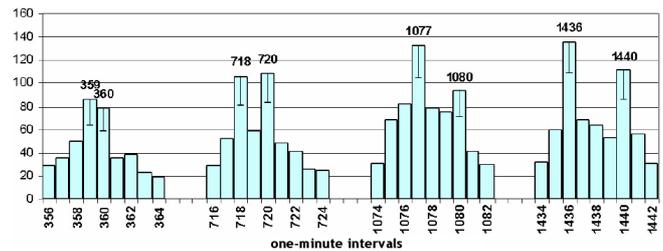


Fig. 12: When ^{239}Pu α -activity was measured with collimators being rotated counterclockwise in a plane parallel to the celestial equator, the probability of similar histograms to reappear periodically increased. These “artificial” periods turned out to be split to the sidereal and solar peaks too.

When the collimator was rotating counterclockwise (i.e., corotating with the Earth), the shape of histograms was changing with periods equal to the number of collimator rotations per day plus one rotation made by the Earth itself. We observed periods of 12, 8, 6, 4, 8, 3 and 1 h. When the collimator made one clockwise rotation a day, the Earth’s rotation got compensated for, and the daily period in the change of histogram shape disappeared. All these results confirmed the conclusion on the dependence of histogram shape changes on “scanning” of the surrounding, sharply anisotropic, space. And again, we found that these “artificial” periods split to the “solar” and “sidereal” ones (Fig. 12) [26, 27].

Fig. 12 shows the results of an experiment, in which a collimator made three rotations per day counterclockwise. Together with one counterclockwise rotation made by the Earth itself, this amounts to four rotations per day, i.e., a period equal to 6 h (360 min). It can be seen that after the first rotation, the extremum consists of two unresolved peaks (359 and 360 min). After the second rotation, two distinct extrema (718 and 720 min) are visible, and they get to 1077 and 1080 min after the third rotation. After the fourth rotation we finally see two extrema corresponding to the “normal” solar and sidereal day.

Analogous splitting was observed in the case of other “artificial” periods.

3.3 Collimators are directed west and east [27, 28]

The experiments, in which collimators were directed west and east, confirmed the main conclusions made before and revealed two new phenomena:

1. Simultaneous measurements with two collimators placed at the same point but counter-directed, aiming east and west, showed disappearance of similarity between histogram shapes. It was important, since earlier we considered similarity of histograms obtained at the same place and time as the main argument in favor of nonrandomness of the histogram shape;
2. Not less important was another phenomenon: there was a 12-hour difference in the appearance of similar his-

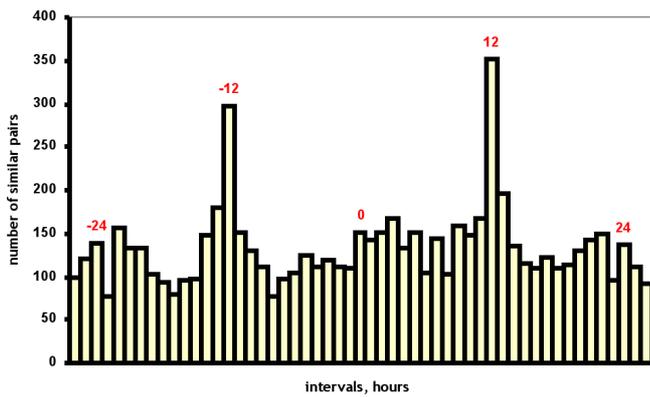


Fig. 13: With the collimators aimed at opposite directions, the probability of similar histograms to reappear sharply decreases. The histograms of a certain shape appear “in the west” exactly half a day later than “in the east”. The measurements of ^{239}Pu α -activity were made in Pushchino on June 22 and October 13, 2003.

tograms in the series obtained with the “eastern” and “western” collimators. Essentially, this result was analogous to that obtained in the experiments with rotating collimators. Indeed, as the Earth rotates, the surrounding space is being scanned, and there should be a correspondence between histograms of a particular shape and certain directions in the space, which will consecutively appear in the collimator’s “field of view” (Fig. 13).

3.4 A strange 1444-minute period emerging when the collimator is always aimed at the Sun

In the spring of 2004, we started continuous, 24/7 registration of ^{239}Pu α -activity with a collimator, which made one clockwise rotation per day — that is, it was always aimed at the Sun. The objective was to distinguish between changes dependent on the Earth’s revolution around the Sun and changes caused by the Earth’s movement in relation to the sphere of fixed stars. As expected, no daily periods was revealed in those measurements. The changes of the histogram shape seen under such conditions could, therefore, be only attributed to the Earth’s movement along the circumsolar orbit. So it was even more surprising when in the second half of July 2005, we found a strange period equal to 1444 min. The similarity between histograms gradually grew, the peak became more distinct and reached its maximum on July 24–29, this followed by its rapid decline until complete disappearance by August. This phenomenon is illustrated in Fig. 14–Fig. 16.

Fig. 14 shows the distribution of the number of histogram pair matches for measurements with a “solar” collimator on July 25 and August 10, 2005. It can be seen that there are no distinct daily periods on August 10 — as well as on any other day, which is typical for measurements with the “solar” collimator. There is an exception though: on July 25 the probability of similar histograms to reappear jumped, the period

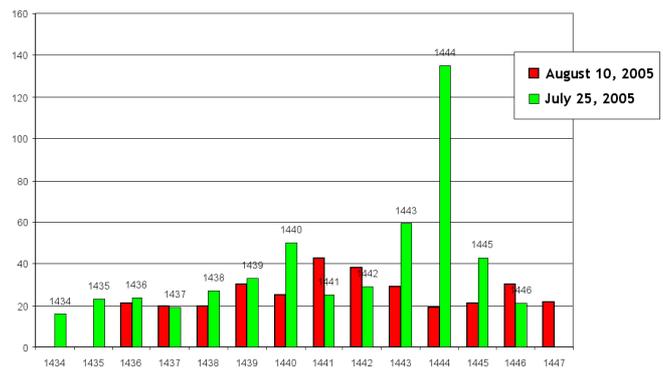


Fig. 14: The figure illustrates emergence of an “anomalous” period of similar histogram reappearance (July 25, 2005), which is equal to 1444 min. Usually, there are no marked daily periods in the experiments with the “solar” collimator — as can be seen on August 10, 2005.

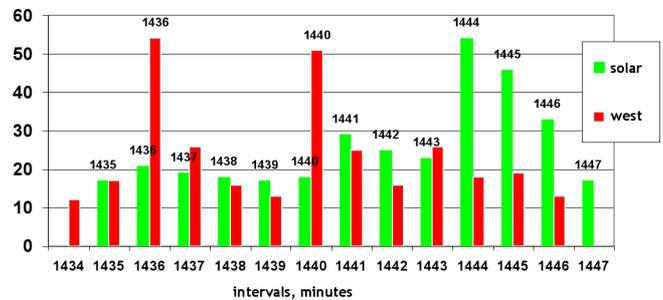


Fig. 15: The period of 1444 min emerges in the measurements with the “solar” collimator and is absent in the ceteris paribus measurements with the “western” collimator. In the experiments with a solar collimator, there is also no 1436- and 1440-min periods, which can be seen when a western collimator is used. The measurements of ^{239}Pu α -activity were made on July 24, 2005.

of appearance being 1444 min. Such a period does not correspond to any cosmophysical process we are aware of, and the fact of its emergence seems very strange.

It was important to ascertain that this period would emerge only in the experiments with the “solar” collimator. So we compared these data with the results obtained in parallel experiments with a “western” collimator. An example of the comparison is given in Fig. 15. The figure shows distributions of the number of histogram matches; compared are the results of simultaneous “solar” and “western” collimator-based measurements on July 24, 2005. It can be seen that in the “western collimator” measurements, there are distinct 1436-min and 1440-min periods and no 1444-min period. In the experiments with the “solar” collimator there is, *vice versa*, the 1444-min period and no the solar and sidereal daily periods. Thus, the phenomenon should be somehow related to the situation of α -particles running towards the Sun.

We tried to seek for this period on other days of the year, yet the search yielded no results — at first. We continued to register the period on the same July days in 2006 (incomplete data) and then in 2007 and 2008. Finally, a key step was

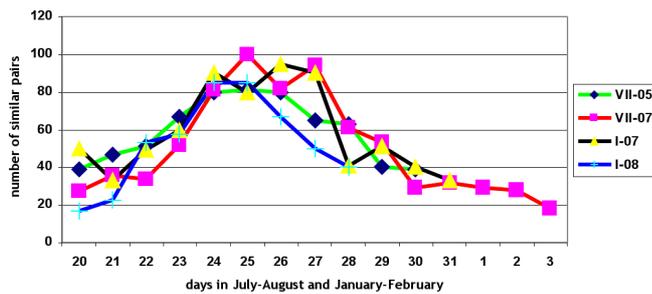


Fig. 16: In the experiments with a collimator directed at the Sun, the 1444-min period reappeared on the same dates of July and January, 2005–2008.

made: we found an analogous period in January, with the interval between the July and January peaks being exactly half a year, which meant they were right at the opposite points of a diameter of the circumsolar orbit.

As can be seen in Fig. 16, the July and January waves of the 1444-min period are quite synchronized to each other and also self-synchronized in different years (2005, 2007, 2008).

These results indicate that moving along the circumsolar orbit, the Earth will enter — at least twice a year — a spatial region with “anomalous characteristics”, which change with a period of 1444 min. This spatial region represents an “anomalous band”, crossing the center of the circumsolar orbit and stretched along the “July-January” line. It is remarkable that the characteristics of this anomaly are not shielded by the Sun, i.e., manifest themselves equally on both sides of the orbit. No analogy with the Doppler effect was revealed: the 1444-min period emerges “suddenly”, does not change for several days (while the Earth is moving), and “suddenly” disappear. It should be stressed that the phenomenon is not observed in the parallel experiments without collimators or with collimators not aimed at the Sun. The “anomalous direction” crossed by the Earth on its way along the circumsolar orbit roughly corresponds to the direction from the constellation Cancer (July 21 — August 11) to the constellation Capricorn (January 19 — February 16). The nature of this period is enigmatic. The 1444-min period is 4 min longer than the daily period and, thus, cannot be explained by influence of any factors within the Solar system.

3.5 Effects of “half-day” and “half-year” palindromes [35, 36]

As follows from the data presented above, changes in the histogram shape depend on changes of the object’s orientation in the space-time continuum. If we look in more detail at the path that the “laboratory” (the place where the measurements are performed) moves along over a day, we can see that during the “astronomical night” (i.e., from 18:00 to 6:00 by local time), the laboratory speeds up, since the Earth adds revolution about its own axis to the movement along the circumsolar orbit. From 6:00 to 18:00 (during the “astronomical day”),

the laboratory, correspondingly, slows down, as the Earth’s spinning is subtracted from its revolution around the Sun. In relation to the sphere of fixed stars, the objects studied will, correspondingly, move in the reverse order. Our investigations with V. A. Pancheluga showed that these circumstances would give rise to the “effect of half-day palindromes”, which is a high probability of a series of “night histograms” to be similar with the inverted series of the correspondent “day histograms” [35]. As supposed by M. N. Kondrashova [39], an analogous palindrome effect should exist for the histogram series obtained from measurements at the “opposite sides” of the circumsolar orbit [2]. Subsequent studies confirmed this supposition. Indeed, in addition to the “half-day palindrome effect” we found the effect of “half-year palindromes”. The half-year palindromes can be revealed when one takes into account the direction of night and day movement in relation to the sphere of fixed stars. At the opposite sides of the circumsolar orbit, the movement is counter-directional at day and night. That is, on vernal equinox the series of day histograms will be inverse to the day and similar to the night series on autumnal equinox. This proved valid for any opposite points of the circumsolar orbit. Therefore, the spatial characteristics that determine histogram shape must not change markedly over the year (the same being indicated by the existence of yearly periods). Holding true is also the converse: *histograms are a stable, regular characteristic of a direction (domain) of the space-time continuum* [36]. The aforesaid is illustrated by Fig. 17.

3.6 Collimators and the phenomenon of half-day and half-year palindromes

The effects of half-day and half-year palindromes are one of the most illustrative piece of evidence for the dependence of the phenomena under discussion on the movement of the objects studied in the space-time continuum. Of special interest is, thereby, palindromes that were revealed under the use of collimators. At the beginning of those experiments, we encountered an unexplainable irreproducibility of the results. In the experiments with a fixed west-oriented collimator, the half-day palindromes might either be seen quite clearly or be almost absent. Further studies with two collimators directed west and east correspondingly revealed a more complicated picture.

It turned out that this two-collimator setup yielded data series in which the orders of “day-night” and “night-day” were not equivalent. In the measurements with the eastern collimator, a clear palindrome was observed at comparing a sequence of day histograms with the *inverted* sequence of the *follow-up* night histograms. On the contrary, the western collimator gave series in which the *inverted* sequence of the *preceding* night histogram was a palindrome to the sequence of the *follow-up* day histograms.

The eastern collimator “faces the stream of time”, the

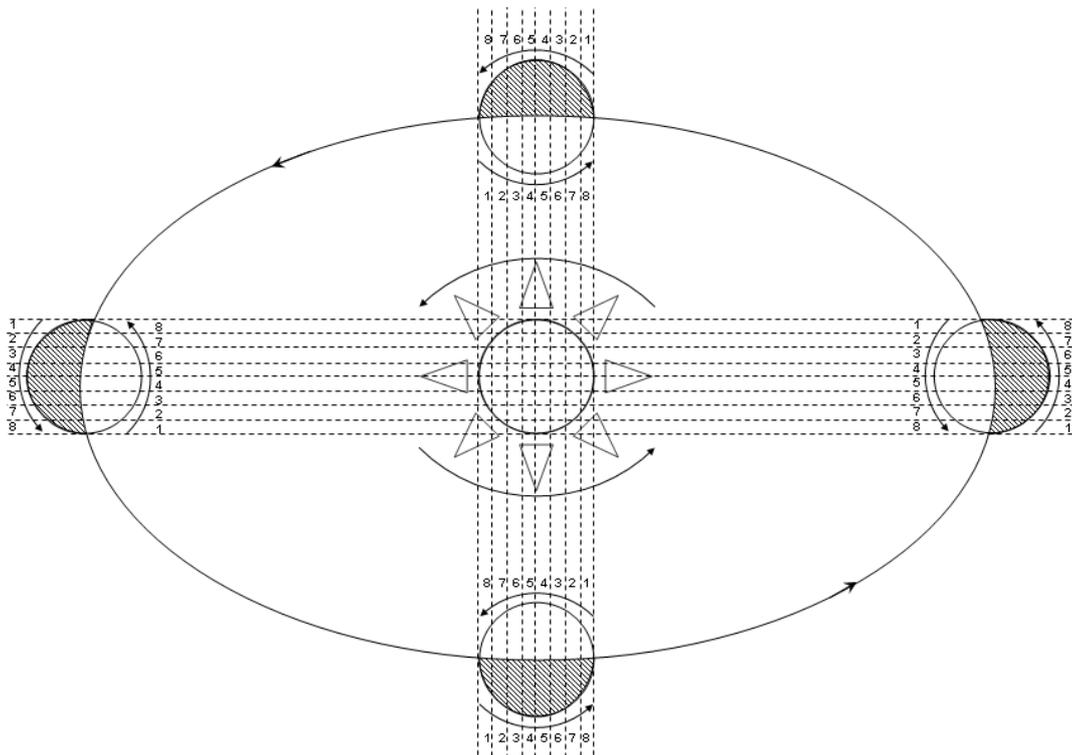


Fig. 17: A scheme illustrating the “palindrome effects”. With the Sun in the center, the scheme shows four positions of the Earth on the circumsolar orbit. Both the Earth and the Sun are rotating counterclockwise; movement of the Earth along the circumsolar orbit is counterclockwise as well. As seen in the figure, the Earth’s rotational movement in the nighttime is co-directional to its movement along the circumsolar orbit and to rotation of the Sun. In the daytime, the direction of these movements is opposite. Hence, in the case of “backward” movement (in the daytime), the object measured passes in the inverse order the same spatial regions that it has passed in the direct order in the nighttime. The effect of the “half-day palindrome” consists in the high probability of a “nighttime” histogram sequence to be similar to the inverted “daytime” sequence taken on the same day. Equally, the “daytime” sequence will be similar to the inverted “nighttime” one. For example, the 1–2–3–4–5 sequence of nighttime histograms is similar to the 5–4–3–2–1 sequence of the daytime ones. The effect of the “half-year” palindrome is determined by the fact that at the opposite points of the circumsolar orbit, the movements during the same halves of the day are opposite to each other. The effect consists in the high probability of a “nighttime” histogram sequence taken on one side of the circumsolar orbit to be similar to the “daytime” (not inverted) sequence taken on the opposite side. Correspondingly, nighttime (daytime) sequences on one side of the orbit will be similar to the inverted nighttime (daytime) sequences on the opposite side [36].

western one “looks after its flowing away”...

This strange effect still needs to be reproduced once and again, and many circumstances are to be clarified. We report it here due to its mysteriousness and, apparently, deep meaning.

3.7 The phenomenon of absolute-time synchronism in the measurements with collimators directed at the Pole Star and the Sun

The appearance of similar histograms in measurements at different geographical points at the same local time — the “local-time effect” — is quite regular. Sometimes, however, we obtained similar histograms at different geographical points not only at the same local but also at the same absolute time. The clearest observations of such an absolute-time synchronism were made during solar eclipses and new moons [37, 38]. At

these moments, histograms of a certain shape appear simultaneously (with the accuracy of a few minutes) at different geographical points. We also observed absolute-time synchronism during the Antarctic expedition of 2001 (S. N. Shapovalov’s measurements). Recently, we have compared the occurrences of absolute-time synchronism in the experiments without collimators and with collimators directed at the Sun and the Pole Star. Compared were data of simultaneous measurements made by S. N. Shapovalov in the Antarctic (Novolazarevskaya station) and data of Pushchino measurements. The results of comparison was unexpected: the extent of the “local-time effect” and absolute-time synchronism depended on the type of the measuring setup used. The local-time synchronism was clearly seen in the experiments without collimators or in the data obtained using the western Pushchino collimator; the absolute-time synchronism was almost absent. On the contrary, the measurements with Pushchino collima-

tors directed at the Pole Star or the Sun showed no local-time but good absolute-time synchronism (Fig. 18–20). This phenomenon also needs to be confirmed.

4 Discussion

Proving that the histograms obtained by measuring processes of diverse nature change regularly and in relation to the characteristics of the space-time continuum is the reason to pose questions on the nature of this relation. To answer these questions, additional studies are necessary.

The phenomena discovered are quite unusual and require alteration of conventional views. First of all, it applies to establishing the regular, non-casual character of the fine structure of amplitude fluctuation spectrum (histogram shape) for “quite stochastic”, according to conventional criteria, processes. In fact, there is no contradiction here: the processes that are quite stochastic *X*-directionally can be absolutely non-stochastic *Y*-directionally. There is not — in principle — any determinate connection between the time course of a process and the spectrum of its amplitude fluctuations: the same histogram shape may correspond to many variations of time series.

Collecting the results of once-a-second measurements of ^{239}Pu α -activity for many years, which became possible after application of perfect enough detectors, and the use, upon necessity, of collimators — fixed or rotated by different ways — was extremely valuable for discovering and studying the phenomena discussed. The nature of many (most of) these phenomena is far from comprehension.

First of all, this is the *near-zone effect*. The statistically significant similarity of histograms constructed for different, independent segments of time series of the results of measurements is one of convincing indications of nonrandomness of the histogram shape. It seemed logical that the similarity of the nearest neighbor histograms should be the result of action of a common external “force” (cause). This cause changes in time, and while these changes are not significant, histograms remain similar. In other words, it would be natural to think that there is a “lifespan” of a certain “shape idea” [29]. However, the numerous attempts to determine even the order of magnitude of this “lifespan” were unsuccessful. Until now we failed to find such a small interval that the shape of histograms would not change (intervals were varied from minutes to tens of milliseconds).

The next mysterious phenomenon is the *splitting of the daily period* in change of the histogram shape to two peaks: the sidereal and solar days. Should only one of them be revealed, we would conclude that the shape of histograms is determined by the exposition (vector) of the object studied in relation to the Sun or the sphere of fixed stars. However, the fact that we observe two highly resolved extrema, with the periods of 1436 and 1440 min, seems quite unusual. The

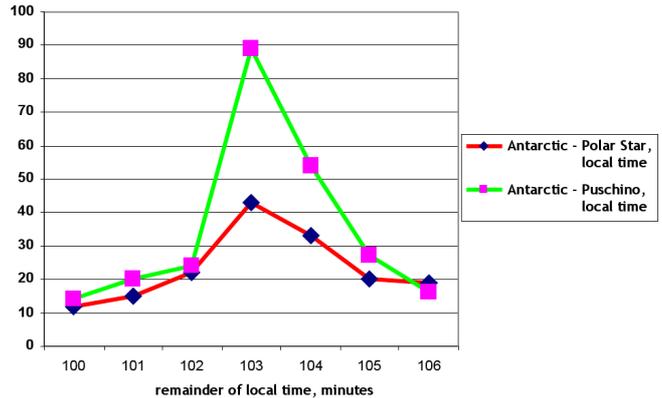


Fig. 18: Comparison of histograms corresponding to the parallel measurements of ^{239}Pu α -activity at Novolazarevskaya station (Antarctic) and in Pushchino shows that the effect of “local-time synchronism” is well-expressed when Pushchino measurements were performed with a west-directed collimator and it is weak when the collimator was directed at the Pole Star. The measurements were made by S. N. Shapovalov (in the Antarctic) and K.I. Zenchenko (in Pushchino) on March 19, 2003. The calculated difference in local time is 103 min. In the figure, the number of similar histogram pairs (*Y*-axis) is plotted vs. the corresponding interval between histograms (*X*-axis, min).

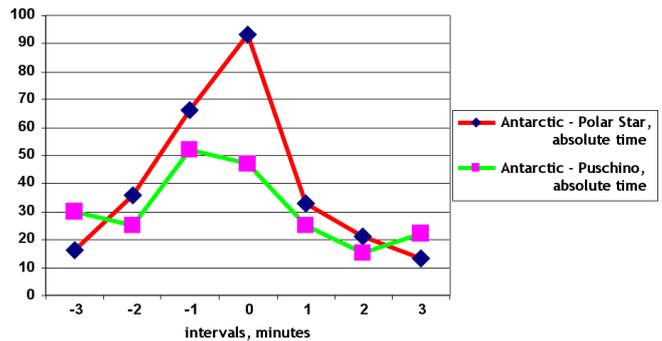


Fig. 19: In the Antarctic and Pushchino measurements, the absolute-time synchronism is more evident when measurements in Pushchino were made with a collimator aimed at the Pole Star, rather than a west-directed collimator. The measurements of ^{239}Pu α -activity were made on March 19, 2003.

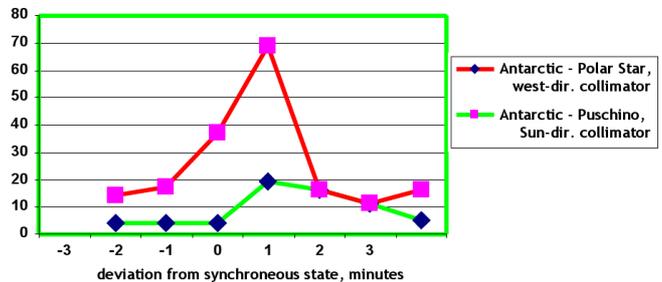


Fig. 20: In the Antarctic and Pushchino measurements, the absolute-time synchronism is more evident when measurements in Pushchino were made with a collimator aimed at the Sun, rather than a west-directed collimator. The measurements of ^{239}Pu α -activity were made on July 16, 2005.

time resolution of 1 min corresponds to the coelosphere resolution of 0.25° (15 angular minutes). And we can see this effect not only in the experiments with collimators but also in the measurements made with flat detectors, without collimators. This should be investigated in more details, yet even by now we have repeatedly registered the dependence of peak resolution on the orientation of the detectors. When flat detectors are positioned in the horizontal plane, one of the extrema (as a rule, the solar day) may not be seen. A good resolution was achieved when a flat detector was oriented in the plane of celestial equator. Also, we saw well-resolved sidereal and solar periods in the experiments with collimators, both fixed (directed east and west) and rotated counterclockwise. Phenomenology of these effects is far from being complete, and additional studies are necessary. The problem became more enigmatic after V. A. Pancheluga's experiments [40–43]. When measuring noise fluctuations in electronic circuits with frequency band up to 100 kHz, he determined the periods of reappearance of histograms of a certain shape. The splitting of extrema to the sidereal and solar days was found at a distance between the objects studied about several kilometers. The splitting corresponded to the period difference of several milliseconds, which in terms of angular units would mean an incredibly high resolution. Thus, the problem of period splitting grew even more paradoxical. This paradoxicality had long been noted by D. P. Kharakoz, who drew our attention to the fact that the collimator aperture allowed one to resolve coelosphere segments of approximately 5° (20 minutes), while we spoke about a second-order resolution (“Kharakoz’s paradox” [44])! This paradox is, probably, seeming, as we use not single collimators but a setup in which 120 collimators are arranged on a small area. Perhaps, this is the cause of such a sharp “focusing”.

All that was said about splitting of daily periods can be referred to the *splitting of yearly periods* as well. Now, what we see here are the same effects of discriminate orientation relative to the Sun and stars. And the same problems. Plus, what appears impossible at first glance — an extremely precise determination of yearly periods: with the accuracy of a minute, we determine the yearly period as equal to 525600 min! The accuracy is so high that we are able to register the diminishing of the “calendar” (solar) period by a minute (!) per year. One of possible explanations may be the movement of the solar system through the Galaxy. Any explanation, however, would still lack solid grounds.

It is necessary to emphasize that the largest puzzle, underlying all the observed phenomena, is the *nature of the histogram shape*. As follows from all our results in total, the shape is independent of the nature of the processes studied. The only cause common for all these processes can be the features of space-time. However, the nature of the relation between the shape of the histogram, i.e., the spectrum of amplitude fluctuations of the quantity measured, and the space-time fluctuations is absolutely unclear. What magnitude should

these fluctuations be to affect the results of measurements? Why the sensitivity of different processes to these fluctuations ranges so much: the “scatter of the results of measurements” in piezoelectric quartz has an order of 10^{-6} of the measured magnitude, in chemical reactions the order is 10^{-2} , and in radioactive processes the scatter is proportional to \sqrt{N} ?

Discovering the effect of daily and yearly palindromes substantially complements the mosaic of facts assembled earlier. The main conclusion, which can be drawn from the analysis of these effects, is that peculiarities of each region of the space-time continuum are rather stable; they keep unchanged for years, and the shape of histograms is, correspondingly, a stable characteristic of these peculiarities. It should be noted, however, that this stability is relative. The basic “local peculiarities” of the space-time continuum are overlaid with patterns of second, third etc. order: rotation of the Sun about its axis (near-27-day periods), revolution of the Moon round the Earth, changes in the relative positions of the Earth, Moon and Sun, effects of new moons, solar and lunar eclipses, solar flares etc. Perhaps, these “overlays” manifest themselves in the *effect of absolute-time synchronism*. For many years, we have mainly paid attention to the effect of local-time synchronism. The observations of a more distinct absolute synchronism in the experiments with collimators aimed at the Pole Star and the Sun bring hope that these questions will be answered.

The *effects of daily and yearly palindromes* essentially clarify the overall picture. Nevertheless, there remains a lot of work to do. The simplified picture of daily palindromes does not take into account the shift by 4 min per day in the course of the Earth’s movement along the circumsolar orbit. Fig. 17 depicts movement of the Earth as a circle. It is still unclear how the picture would change with the “sidereal day” taken into consideration.

Finally, the recently found effect of *palindrome’s time-vector asymmetry* in the measurements with the western and eastern collimators may happen to be — when reproduced and detailed — highly interesting.

Our works of the last years almost do not consider an important feature of “macroscopic fluctuations”, which was found several decades ago: the shape, fine structure, of histograms and the average amplitude of fluctuations change independently of each other. The same “shape idea” may emerge in “narrow” and “wide” histograms. Comparing such histograms, we normalize them by abscissa. Regularities in the change of the average amplitude would also be very interesting to study, yet it is still in the future. A lot of work should be done to sort out all these problems.

Nevertheless, there is one conclusion we are certain of: *the apparently casual shape of histograms and its change over time are determined by the natural movement of the object studied through quite a complex space-time continuum*.

As for the nature of anisotropy and inhomogeneity of the space-time continuum, it is a matter of future research. Now

we may just adopt a notion of “interference pattern” resulting from the influence of numerous moving celestial bodies and radiant fluxes, whose effects are summed up in each point of the space.

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