Ionization chamber noise fluctuations during lunar eclipse on 15.04.2014

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Dynamics of intervals between moments of an ionization chamber КНТ-31-1 background pulses registration during lunar eclipse on 15.04.2014 has been studied. That chamber is intended for neutron registration, but in neutrons absence it has background current, which arises from alpha decay of electrodes materials and noises of electronics, and fluctuations of which were registered. It have been revealed, that for all standard moments of lunar eclipse phases changing, there were typical peculiarity in intervals dynamics. Especially interesting are occurrence of small series of very short intervals. The duration of such intervals are of some microseconds (3 – 4 order smaller than all intervals mean value), and length of series is up to 20 pulses. This is direct and clear observation of lunar eclipse influence on the velocity of physical processes on the Earth.

Introduction

There are many demonstrations that there is close connection between such cosmic events as sunrise and sunset, moon phases, sun and lunar eclipses, the Earth movement around the Sun, and behavior of noises of a different nature, including radioactive decay fluctuations [1 – 4]. An interest to this question is not only due to its obvious contradiction with classical statements of textbooks about impossibility to influence on this process. There are also inexplicable contradictions in published results.

Thus, in [3] it is stated, that effect of a year periodicity is observed only for beta-decay, while many years investigations of [1, 2] have been made just for alpha-decay. In addition some effects, for instance influence of the Moon, become apparent only statistically and on the level only as a part of a percent. That is why attitude to these works still is alerted.

In our work an intrinsic noise of ionization fission chamber of КНТ-31-1 type, which is intended for neutron registration, have been investigated during lunar eclipse on 15.04.2014. The peculiarities of an experimental equipment (see below) permit to fix the moments of every impulse occurrence. One of the main results of [1] is, they see some internal structure in such random sequence

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as count rate of alpha decay (for instance day periodicity). Thus we hope that such regularities will be displayed more clearly if we will control every impulse without averaging due to count rate calculation during some time diapason.

Parameters of the eclipse (time of the beginning and ending of phases) were taken from the site of the Main astronomical observatory of National Academy of Sciences of Ukraine (www.mao.kiev.ua).

Experimental setup

Experimental setup consists of a) neutron detection assembly with a KHT-31-1 fission chamber and a charge sensitive impulse preamplifier; b) block of signal amplifiers; c) two identical plates of a gauge of time of events registration (GTER), which are installed in a computer; d) an amplitude analyzer of pulses; e) a digital oscillograph.

Functionally neutron detection assembly and a block of signal amplifiers create a neutron measuring channel, which transform flow of neutron into distributed in time sequence of voltage pulses, a mean count rate of which is proportional to neutron flux density.

The GTER plates register and fix in a memory (using special software) relative time of each input event (a voltage impulse) with time resolution about 1 μs. Such impulses arise when intensity of current in an electronic circuit, which includes an ionization chamber, exceeds some pre-established discrimination level.

There is a possibility on each a plate to assign a discrimination level independently. The measurement results are written to a file of binary format. In each file the times of registration (relatively to the moment of a start of measurement) are written consequently in microseconds. As a result we can receive a continuous sequence of intervals between impulses occurrence, which is analyzed subsequently.

The signal in a fission chamber is formed by the next way. In a fission chamber one of the electrodes is covered by the special radiator – an oxide of ^{235}U. At capture of a neutron by uranium nucleus, this nucleus is broken down, the fission fragments ionize a gas in a working volume of a chamber, impulse of a charge on chamber electrodes is amplified by the outer electronics and the voltage impulse (a useful signal) is formed.

In absence of a neutron emission and corresponding choice of a discrimination level it is possible to register background impulses, caused by intrinsic alpha-decay of a radiator (mainly alpha active isotope ^{234}U, which exists as 1 % impurity [5] in ^{235}U) – the so called background alpha-current of a fission chamber. Of course, these impulses are observed on a background of more weak impulses from electronics noises, that is really we register a mixed noise from alpha decay and noise of electronics.

A signal of alpha-current from a fission chamber goes to two practically identical GTER plates, for which two different discrimination levels were installed. Installation of two different discrimination level results in a different signal to noise ratio in the measured signals. Thus from one a source practically two different signals are registered, which have different statistical properties: the impulses are registered in different moments of time. Appearing of specific signals on both plates simultaneously argues about their nonrandom nature.

The measurements were carried out from $7^h\,58^m$ to $14^h\,19^m$ (UT+3 local time) on 15 April 2014. From technical reasons the measurements were carried out by the series with duration of 60 minutes for file recording. In the sequel the plate with high a level of discrimination we will name GTER-1, and received results from it – the first set of measurements. Correspondingly for the lower discrimination level it will be the GTER-2 plate and the second set of measurements. File recording and system restarting require time about 1-2 min. Therefore an absolute time of signal registration was not better than some minutes.

Registration of moments of each pulses occurrence has his advantages compared with usual method of counting rate registration: the possibility is appeared to analyze directly each impulse statistics. This, as the results have been showed, is found to be fundamental, because of effects, which were observed, are exceptionally short-time and in usual count-rate measurements, when pulses number during given enough big time interval are counted, can not be registered.

Experimental results

The technique created gives the possibility to measure a time of each impulse arriving on GTER plate (from the relative moment of measurements beginning) in microseconds. As a result a sequence of increasing numbers is formed. Differences between neighboring numbers form a continuous series of time intervals between impulses occurrence. Such series contain primary information about impulses dynamics. Thus, in contrast to measurements, described in a literature, which are based on count rate (that is on a sequence of summarized impulses amount per a unit of time), in a given work an every impulse is controlled directly.

In the Fig. 1 phases of the eclipse and moments of its occurrence are shown, with which we compared our results.

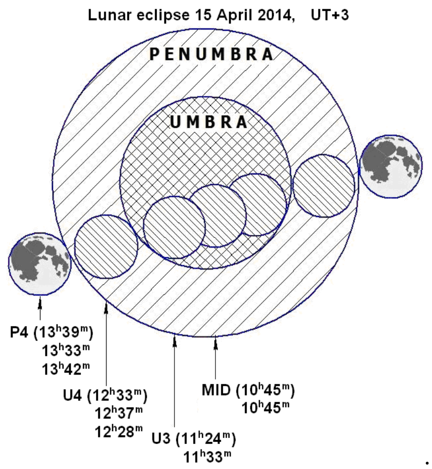


Fig. 1. The sketch of marking out of the moments of Moon passing through the shadow, and fixed moments of occurrence of peculiarities in intervals flow. In brackets – astronomical data (UT+3), below them – experimental ones.

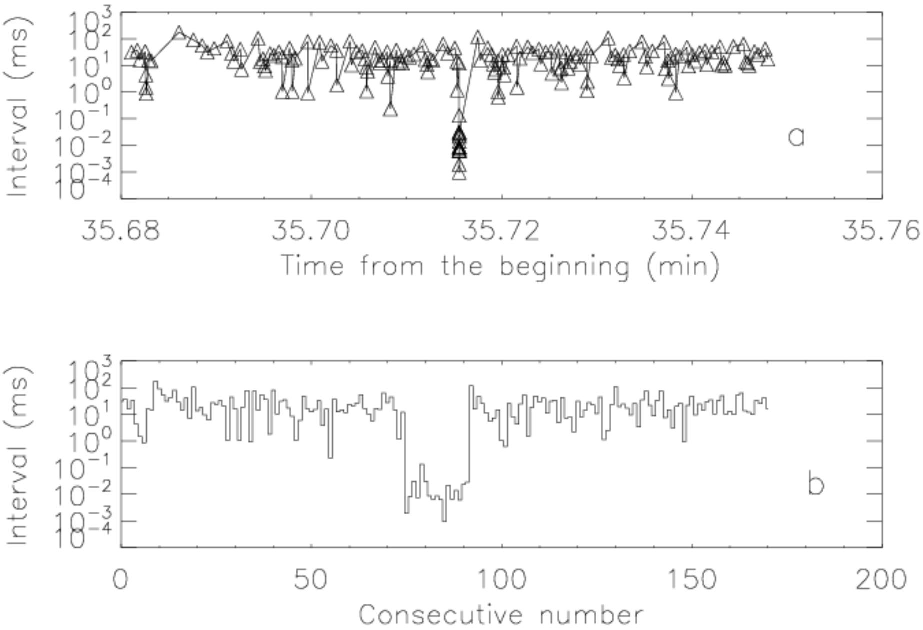
The observed effect is that minimal values of intervals between impulses are reliably registered in moments of an eclipse phases changing without any special data treatment or fitting. At careful examination it was found, that these minimal values mainly belong to short series of intervals, values of which were 3-4 orders less then mean value of the whole set of intervals. We emphasize once more, that this effect is not statistical, in spite of in general the sets of measurements have the random appearance.

The received results are shown in the table and in Fig. 2. In the figure the area of the set of intervals measurements is shown, on which the specified series of short intervals were observed. That short values on the upper graph belong to series of short intervals, which were observed during short period of some microseconds. Due to that in a real time scale (upper of the graphs) such short intervals are not displaying separately, on the lower graph the same area of minimal values is shown simply as consecutive values of the set's elements (intervals values). We see the minimum on the upper graph at 35.7 min, thus the absolute time of its occurrence is $12^h\ 01^m\ +35.7^m$ $=12^h\ 36.7^m$.

Thus, the exactness of this moments is determined by the exactness of determination of the beginning time of $12^h\ 01^m$ and can be improved in the future (in principle), if this beginning moment will be determined automatically. And that fact, that effects of short intervals generation are very short-time and close connected to phase changing, rather than be smeared on the time of an eclipse, open the possibility for theoretical scheme of these effects [6].

Discussion and conclusions

1. The measurements of an intrinsinc noise of a fission chamber KHT-31-1 during lunar eclipse on 15 April 2014 have been carried out. The set of time intervals between occurrence of neiboring pulses, with the dead time not more than 1 μs have been received as a result. Registration of the moments of individual impulses occurrence has his advantages comparatively with usual measurements of count rate: the possibility appeared to analyze statistics of every impulse. This, as the results showed, turned out principle for detecting of noticed effects, because they are very short-time



. Fig. 2. The area from the set of intervals near the moment of U4 phase: a) intervals values in a real time scale from the measurements beginning at $12^{h} 01^{m}$; b) the same intervals values as consecutive set, where sharp shortening of intervals duration and, correspondingly, increasing of impulses amount during some microseconds is evident.

and at count rate measurements, that is at counting numbers of impulses during some time diapason, usually enough big comparatively to intervals duration, can not be detected.

2. It was revealed, that minimal intervals occurrence enough good correlates with the moments of phase changing.

3. It was revealed, that sometimes these minimal intervals belong to series of very short intervals (in our measurements this effect was observed 5 times at a general length of the set more then 1 000 000 impulses). Duration of such series do not exeeds some tens of microsecond, and length – two tens of impulses. Such series were revealed after middle of eclipse (U_{MID}), see Fig. 1.

4. The magnitude of the effect, that is the magnitude of shortening of these intervals comparatively to the set mean value is of 3 - 4 orders. Statistically random formation of such series is impossible.

5. The strict coincidence of experimental and astronomical data has been observed only for the moment of middle a phase of the eclipse. For other phases the discrepancies in about 5 minutes exist. The peculiarity of equipment performances and the method of measurements do not permit to fix an absolute time with the accuracy, better then some minutes. Then as yet it is not clear, firstly, how real

Table. Astronomical moments of the lunar eclipse phases occurrence, and experimentally observed moments of short interval series occurrence. The local time (UT+3).		
Phenomenon	The local time (UT+3) of phenomenon occuring.	Experimental time of short interval series occuring. GTER-1.
Total eclipse begins (U2)	$10^h 06^m$	Not observed
Middle of eclipse (U_{MID}),	$10^h 45^m$	$10^h 45^m$
Total eclipse end (U3)	$11^h 25^m$	$11^h 33^m$
Moon leaves umbra (U4)	$12^h 33^m$	$12^h 36.7^m$
Moon leaves penumbra (P4)	$13^h 39^m$	$13^h 33^m$ $13^h 42^m$

are discrepancies between tabular and experimental data and, secondly, how can we explain observation of two series of short intervals in the phase P4 (see Fig. 1 and the table)).

On the other hand, the nature of appearing of the observed effects is unknown; therefore the full coincidence with the astronomical data may not be obligatory.

6. It should be noted also, that presence (or magnitude) of that or another effects in the measurements during eclipses can be connected both with eclipse parameters and other causes also. Thus, in measurements [7] of torsion pendulum behavior during solar eclipse, from five of the same type devices the evident effect was in the four of them, and appearance of experimental curves was enough different. And in [8, 9] any effects were observed at all. In connection with that it is worse to notice, that during our measurements the eclipse proper in Ukraine (that is in a place of measurements) did not observed at all.

7. We can point three possible causes for the observed effects: a) outer disturbances as a train of electromagnetic waves with period about some microseconds. Because we observe the effects in prescribe moments of eclipse phases changing, such disturbance (cause) can not be random. But it is possible, that they are generated by the unknown source in these moments; b) the cosmic particles [10 – 12], or neutrons [13, 14], which are generated during an eclipse; c) changing of an internal noise of our measurement setup. The choice between last two reasons must be a subject of future investigations.

8. And at last we notice that it is, as authors know, in the first time, when influence of lunar

eclipse (cosmophysical factors) on noise fluctuations has been observed not statistically, but directly, and magnitude of effects was not parts of percents but 1000 times. And this effect is very different from smooth longtime changing of some parameters during an eclipse (see [7, 10-14]), but agrees with observation of [1], where specific effect (histograms) were observed just in the U_{MID} moment. That is we directly and undeniably saw influence of external conditions on noise fluctuations, although in very short and specific moments.

References

[1] S. E. Shnoll , *Cosmophysical factors in stochastic processes*. (American Research Press, Rehoboth (NM)), p. 433 (2009)

[2] S. E. Shnoll, V. A. Kolombet, P E. Pozharski, T. A. Zenchenko, I. M. Zvereva, A. A. Konradov. Phys. Usp. 41. 1025–1035 (1998).

[3] A. G. Parkhomov, E. F. Makliaev. Physical thought of Russia 1. 52 – 77 (2005) (in Russian).

[4] J. H. Jenkins, E. Fischbach, J. B. Buncher, J. T. Gruenwald, D. E. Krause, J. J. Mattes. arXiv:0808.3283v1 [astro-ph]. (2008).

[5] A. B. Dmitriev, E. K. Malyschev. Neutron ionization chambers for reactor techniques. (Moscow: Atomizdat), p. 94 (1975). (in Russian)

[6] D. P. Rothall_ and R. T. Cahill. Progress in physics 4. 44 – 47 (2013).

[7] T. J. Goodey, A. F. Pugach, D. Olenici. Journal of Advanced Research in Physics 1(2). 1-7 (2010).

[8] L. Jun, L. Jianguo, Z. Xuerong, V. Liakhovets, V. Lomonosov, A. Ragyn, Phys. Rev. D 44. 2611 – 2613 (1991).

[9] H. R. Salva. Phys. Rev. D 83, 067302 (2011).

[10] J. N. A. Rao, Phys. Lett. A 25. Issue 2. 74 (1967).

[11] A. Bhaskar, A. Purohit, M. Hemalatha, et al. Astroparticle Physics 35. Issue 5. 223–229 (2011).

[12] D. Pareek and S.N.A. Jaaffrey, Research Journal of Physical Sciences 1(4). 22-27 (2013).

[13] N. N. Volodichev, V. A. Zakharov, B. M. Kuzhevskij, O. Y. Nechaev, A. N. Podorolski, A. P. Chubenko, Proceedings of the 27th International Cosmic Ray Conference. 07-15 August, 2001. Hamburg, Germany, p.4204.

[14] N. N. Volodichev, B. M. Kuzhevskij, O. Y. Nechaev, A. N. Podorol'skii, P. I. Shavrin, Solar System Research 34. Issue 2. 173 (2000).