GLOBAL ANISOTROPY OF SPACE AND EXPERIMENTAL INVESTIGATION OF CHANGES IN $\beta$-DECAY COUNT RATE OF RADIOACTIVE ELEMENTS

Yu.A. BAUROV
Central Research Institute of Machine Building,
141070, Korolyov, Moscow Region, Russia

A.A. KONRADOV
Academy of Sciences, Institute of Biochemical Physics,
117977, Moscow, Russia

V.F. KUSHNIRUK and Yu.G. SOBOLEV
Flerov Laboratory for Nuclear Reactions (FLNR),
Joint Institute for Nuclear Reactions,
141980, Dubna, Moscow Region, Russia

ABSTRACT

The results of experimental investigations of changes in $\beta$-decay count rate of radioactive elements, are presented, and an explanation of those on the base of a new physical conception of forming the observed three-dimensional space from a finite set of one-dimensional discrete vectorial objects (byuons), containing the cosmological vectorial potential $A_g$, a new fundamental vectorial constant, is given. In the theory, the vector $A_g$ direction corresponds with that of the axis of Universe rotation being discussed in literature.

PACS numbers: 11.23

I. Introduction

Since the works of Birch [1,2], the question of a possible rotation of the Universe is under discussion in scientific publications (even Aristoteles had touched on this subject [3]). When observing a correlation of polarization angles for light from distant sources, Birch anticipated that the Universe might have an axis of rotation with coordinates $\alpha \approx 180^\circ \pm 30^\circ, \delta \approx 35^\circ \pm 30^\circ$
in the second equatorial system. In Ref. [4], these are presented, too ($\alpha \approx 315^\circ \pm 30^\circ, \delta \approx 0^\circ \pm 20^\circ$), which differ, as is seen, from those of Birch, and are doubted by the authors of this article because of the arrangement of the Universe’s rotation axis in plane of the celestial equator.

In the new physical conception [5,6] of forming the observed three-dimensional space $R_3$ from a finite set of one-dimensional discrete vectorial objects (byuons) as a result of their dynamics, the global anisotropy of the Universe originates necessarily and is caused by the direction of the cosmological vectorial potential $A_g$, a new fundamental vectorial constant appearing in definition of the byuons. Through minimization of the potential energy of byuon interaction in the one-dimensional space formed by them, rotation of the observed objects and of the Universe as a whole, comes into existence. The axis of rotation of the Universe is to be perpendicular to the $A_g$ vector which, according to experimental investigations with the use of high current magnets [7-9] and a gravimeter joint with a magnet [10], as well as in agreement with astrophysical researches [11,12], has coordinates $\alpha \approx 270^\circ \pm 7^\circ, \delta \approx 34^\circ$. These values are in good correspondence with the results of Birch.

According to the theory [5], the value $A_g \approx 1.95 \times 10^{11}$ CGSE units is the limiting one. In reality, there exists, in the vicinity of the Earth, a certain summary vectorial potential $A_\Sigma$, i.e. the vectorial potentials of magnetic fields from the Earth ($A_E \leq 10^8$ CGSE units), the Sun ($A_\odot \approx 10^8$ CGSE units), the Galaxy ($\sim 10^{11}$ CGSE units), and the Metagalaxy ($> 10^{11}$ CGSE units) are superimposing on the constant vector $A_g$ resulting probably in some turning of $A_\Sigma$ relative to $A_g$ in the $R_3$ space, or in a decrease of $A_\Sigma$.

Hence in the theory of physical space (vacuum), which the present article leans upon, the field of the vectorial potential introduced even by Maxwell, gains a fundamental character. As is known, this field was believed as an abstraction. All the existing theories are usually gauge invariant, i.e. a vectorial potential $A$ (for example, in classical and quantum electrodynamics) is defined with an accuracy of an arbitrary function gradient, and a scalar one is with that of time derivative of the same function, and one takes as real only the fields of derivatives of these potentials, i.e. magnetic flux density and electric field strength.

In Refs. [5,13] local violation of gauge invariance was supposed, and the elementary particle charge and quantum number formation processes were investigated in some set, therefore the potentials gained unambiguous
physical meaning there. In the present paper, this set is a finite set of byuons.

The works by D. Bohm and Ya. Aharonov [14], discussing the special meaning of potentials in quantum mechanics, are the most close to the approach under consideration, they are confirmed by numerous experiments [15].

In the Refs. [13,16] which are generalized by the byuon theory, the probability $W$ of the $\beta$-decay of radioactive elements is shown to be proportional to the summary potential $A_\Sigma$ into which also the $A_g$ vector enters. Hence from changes in $A_\Sigma$ and, correspondingly, in $W$, the direction of $A_g$ in space may be judged despite the fact that, as was thought earlier, the $\beta$-decay of the radioactive elements practically could not be effected by any physical influence (pressure, magnetic field, etc. [17]).

II. Experiments

By now three runs of experiments have been performed to verify this assumption, initially at Sankt-Petersburg State Technological University in 1994 (Fig.1) [18].

The magnitude of oscillations for $^{137}\text{Cs}$ equaled $\sim 25$ thousand photons (with a starting level of $\sim 18.6$ million) in a period of $\sim 16$ min., which corresponded to $\sim 6\sigma$ (the standard deviation $\sigma = 4307$). The repetition of the effect throughout the whole cycle of measurements proved it was not accidental. The minimum intensity of $\beta$-decay corresponded to $\sim 10^6$ of Moscow time ($8^h$ of astronomical time, i.e. $8^h$ a.m.).

Concurrently, similar measurements were conducted during several days with the use of $^{60}\text{Co}$ (see Fig.1). Analogous oscillations had an amplitude of 20 thousand events (with the average level of $8.6 \times 10^6$) in an exposure time of $\sim 7$ min, i.e. approximately $7\sigma$.

In August-September 1996 and in February 1997 two runs of experiments on investigation of $^{90}\text{Sr}$ $\beta$-decay count rate were carried out at FLNR JINR (Dubna) (1st and 2nd experiments, respectively).

The electrons were detected by a fast scintillation counter (with a crystal YAG:Ce) optically coupled to a low noise photomultiplier FEU-143PM with a standard divider.

In each measurement the following information was recorded:
- the number of pulses counted by the electron detector in 1s;
- the number of pulses arrived from the "Quartz 10^6" generator and nec-
necessary to control the exposure time;
- the astronomical time of the measurement of interest obtained from a timer.

The entire set was situated in a thermostable room where fluctuations in temperature were no more than $2^\circ C$ for the whole time of an experiment. Before a session of measurements, the set was forced into an operating regime in a week. The high voltage applied to the photomultiplier from a HV unit ($= 1kV$) of POLON 1904 type as well as voltages of powering CAMAC units in a crate, checked periodically during the entire measurements, were stable, the first one with an accuracy of $1V$, the next ones ($\pm 24$ and $\pm 6 V$) with that of $\pm 1\%$.

III. Analysis of experiments

The analysis was made with the purpose of determining the presence of a daily periodicity and a degree of irregularity in distribution of decay number over the astronomical day. The initial sequence of every second measurements had a length of nearly $1.2 \times 10^6$ points, and formed a base for next computations. Since we were interested in almost daily periodicity, the initial sequence was averaged over the minute period. The result is shown in Fig.2. Seen is a slow dynamics that may be related to the presence of long-period oscillations. Those of high frequency were viewed, too, but the daily rhythm could not be perceived in such a form at once. The dynamics as a whole is of complicated character, therefore to analyze a daily component, the slow (two-weekly) nonlinear trend was excluded through selecting the best function from the large family of those and subtracting it from the series (2). The presence of periodical components in the remainder (after withdrawal of the trend, see Fig. 3) was revealed by two methods.

First, the standard Fourier analysis of the series (3) was carried out. In Fig. 4 where the results are presented, at least two frequencies stand out, of which the former (“great peak”) corresponds to approximately half-week period, and the latter (“small peak”) does to the daily one. The half-week period will be considered subsequently. The daily periodicity found by Fourier-method gives, however, no way to determine the astronomical time of an event when the measured value is greater or less than the average.

Second, the following procedure was used to refine the distribution of
β-decay numbers over the astronomical day. Each moment (minute) of measurement was represented as a point of a circle (corresponding to an astronomical day) and expressed in degrees, so that the whole series could be “coiled” around that circle. Thus, each measurement was related to a certain time of day (in degrees). If the quantity to be measured was uniform in time, then the distribution thereof over the circle would be uniform, and the hypothesis for uniformity of said distribution could be verified by statistical methods. For this purpose we used the Kolmogoroff-Smirnoff’s test based on computation of maximum difference between the theoretical and experimental distribution functions and on comparing it with a tabulated value. If this difference was sufficiently large for a given sample size and an accepted significance level, the conclusion was drawn that the experimental and theoretical distributions were different. In our case, with the theoretical distribution chosen being uniform, this signifies the nonuniform distribution of the metered quantity in time. The Kolmogoroff-Smirnoff’s test is convenient also in view of obtaining, in parallel with estimation of confidence level, a point (day time) at which the deviation from uniformity is maximum.

According to our conception of influence of changes in $A_\Sigma$ on the β-decay count rate, we are interested primarily in values of fluxes lesser than the average indication of the instrument because the modulus $|A_\Sigma|$ is always below $|A_g|$. On this basis, when analyzing a distribution, we take into account only the values lesser than the average by $L \times \sigma$ where $L$ is a factor determining the extent of deviation from the average. For each such an extreme value, one notes the point in time at which that takes place, and tests the hypothesis for uniformity of distribution of those points over the astronomical day expressed in degrees (24 hours are equal to 360°).

In Fig.5 are graphically represented the results of computation for $L = 2$. The X axis is astronomical time in degrees (from 0 to 360°), the Y axis is deviation from the uniform distribution. The confidence interval for $P = 0.05$ is shown dashed. It is clearly seen that the frequency function of the sample is highly nonuniform and peaks at an angle of about 90°. At this point, the 5% level of significance is far exceeded.

Since the counting in the experiment on 23rd August 1996 began at 20h of Moscow time (i.e. at 18h of astronomical time), the angle of 90° corresponds to 24h of astronomical time (12h p.m.). In Fig.6 the indicated point of time is asterisked.

In the experiment carried out in February 1997, in connection with the
enormous massive of data obtained in the previous one, the events were recorded not at secondly intervals but every 10 seconds. The results of this experiment, processed analogously, are shown in Fig.7. The experiment began on 22nd February at 5\textsuperscript{h}21\textsuperscript{m} of Moscow time. In Fig.8 is shown the Fourier spectrum of the same signal as in Fig.7. As in the preceding experiment, a huge peak corresponding to half-week period as well as a less significant one corresponding to 24-hour period, stand out. A significant difference was the fact that in this experiment the events beyond the scope of 2\sigma in direction of decay moderation practically did not observed, but did those beyond 2\sigma directed to increase in \( \beta \)-decay rate. In Fig. 9, the maximum of said events corresponds to an angle of 280\textdegree, i.e. to a shift in time of about 19\textsuperscript{h} from the start (23\textsuperscript{h}21\textsuperscript{m} of astronomical time, i.e. 11\textsuperscript{h}21\textsuperscript{m} p.m.). In Fig. 6, the point in time corresponding to the maximum intensity of \( \beta \)-decay within the 24-hour observation period, is asterisked. By (*) denoted are in this Figure the times of maximum deviations from the average value of \( \beta \)-decay intensity of radioactive elements for all three runs of experiments, such points are coincident with the times of maximum changes of \( \mathbf{A}_\Sigma \) due to the vectorial potential of the Earth \( \mathbf{A}_E \). However, in the experiment of February, we observed an increase in \( \beta \)-decay count rate at the point of extremum, but not the decrease, as in August-September 1996, which may be explained by the fact that in February \( \mathbf{A}_\Sigma \) had been augmented due to a decrease in the vectorial potential of the Sun \( \mathbf{A}_\odot \) by that of the Earth \( \mathbf{A}_E \), which is clearly seen in the Fig.6.

For the ultimate conclusions, the experiments of 1996-97 on investigating the time changes in the decay rate of radioactive elements were replicated in March 1998. In Fig.10 given are the temporal series of \( ^{60}Co \) \( \beta \)-decay intensity values, smoothed out by the moving average with a window of \( \sim 100s \), as well as the results of evaluation of irregularity obtained by the same procedure as when analyzing experiments of August-September 1996 and February 1997. The Fourier-analysis has shown presence of a clearly defined near-daily period with a phase of maximum decrease in \( \beta \)-decay intensity (from the beginning of the experiment) being in the region of around 200÷230 degrees (Fig.11). In Fig.6 the said maximum is asterisked, this point corresponds to the maximum decrease in \( \mathbf{A}_\Sigma \) due to the vectorial potential \( \mathbf{A}_E \).

Thus, the analysis of 24-hour variations in the count rate of \( \beta \)-decay of radioactive elements for all four runs of experiments has confirmed our theoretical assumptions and corresponds to the direction of \( \mathbf{A}_g \) vector exper-
imentally determined earlier [7-9].

Fig.12 demonstrates the results of measuring noise in the experimental set, which were obtained through a two-weekly observation of the background at the experiment place without a radioactive source. As is seen in Fig.12, a weekly drift in readings similar that of Fig.2, takes place. Therefore, the weekly drop in the decay intensity observed in August-September 1996, was probably caused exactly by the drift in the set. The background may not act on the position of the extremum points (*) in Fig.6, because the flux $Y$ from that is two orders of magnitude lesser than from the radioactive source. Therewith the number of decay events beyond $2\sigma$ is nearly an order of magnitude greater than the similar one in the background (Fig.12).

Now let us discuss the half-weekly peak obtained on base of Fourier analysis of signals in the experiments. To reach a sure conclusion about reasons of its origin, an experiment with duration of at least a month is of a prime necessity. Nevertheless, proceeding from the sectorial structure of the interplanetary magnetic field (one sector corresponds to a week), we may assume that the 3.5-daily period of $\beta$-decay count rate variation, found by us, is probably related just to the behavior of the Sun’s vectorial potential. In all likelihood, we are dealing here not with that related to the interplanetary magnetic fields blown by the solar wind plasma fluxes, but with a vectorial potential originated within the Sun and distorting the physical space around it, i.e. changing $A_{\Sigma}$ entering into the definition of byuons.

Thus, the experiments carried out have shown the relation between the global anisotropy of space caused by the existence of $A_{g}$ and the count rate variations in the $\beta$-decay of radioactive elements.

Acknowledgments

The authors would like to thank acad. S.T. Beljaev, Yu.Ts. Oganesjan, Yu.E. Penionzhkevich, V.V. Dvoeglazov for supporting their work and valuable discussions.

References

[1] P.Birch, *Nature* 298, 451 (1982).

[2] P.Birch, *Nature* 301, 736 (1983).
[3] Aristoteles (v.3), *Publishing House "Mysl", Moscow* (1987) (in Russian).

[4] B.Nodland, J.P.Ralston, *Phys. Rev. Lett.* **78**, 3043 (1997).

[5] Yu.A.Baurov, *Fizicheskaya mysl Rossii* 1, 18 (1994).

[6] Yu.A.Baurov, E.-print [hep-ph/9702329](http://arxiv.org/abs/hep-ph/9702329).

[7] Yu.A.Baurov, E.Yu.Klimenko and S.I.Novikov, *Dokl. Akad. Nauk SSSR*, **315**, 1116 (1990);
Yu.A.Baurov, E.Yu.Klimenko and S.I.Novikov, *Phys. Lett.* **A162**, 32 (1992).

[8] Yu.A.Baurov, P.M.Rjabov, *Dokl. Akad. Nauk SSSR* **326**, 73 (1992).

[9] Yu.A.Baurov, *Phys.Lett.* **A181**, 283 (1993).

[10] Yu.A.Baurov, A.V.Kopaev, *Fizicheskaya mysl Rossii*, **2**, 1 (1996);
Yu.A.Baurov, A.V.Kopaev, E.-print [hep-ph/9702329](http://arxiv.org/abs/hep-ph/9702329).

[11] Yu.A.Baurov, A.A.Efimov and A.A.Shpitalnaya, *Fizicheskaya mysl Rossii*, **3**, 10 (1995);
Yu.A.Baurov, A.A.Efimov and A.A.Shpitalnaya, E.-print [hep-ph/9702329](http://arxiv.org/abs/hep-ph/9702329).

[12] Yu.A.Baurov, A.A.Efimov and A.A.Shpitalnaya, *Fizicheskaya mysl Rossii*, **1**, 1 (1997).

[13] Yu.A.Baurov, Yu.A.Babaev and V.K.Ablekov, *Dokl. Akad. Nauk SSSR* **259**, 1080 (1981);
Yu.A.Babaev, Yu.A.Baurov, Academy of Sciences of the USSR, Institute for Nuclear Research, *Preprint P-0362* (1984).

[14] Y.Aharonov, D.Bohm, *Phys. Rev.* **115**, 485 (1959);
Y.Aharonov, D.Bohm, *Phys. Rev.* **123**, 1511 (1961).

[15] M.Peshkin, A.Tonomura, The Aharonov-Bohm Effect., Berlin, Springer-Verlag, 1989

[16] Yu.A.Babaev, Yu.A.Baurov, Academy of Sciences of the USSR, Institute for Nuclear Research, *Preprint P-0386* (1985).

[17] G.T. Emery, In: *Annual Rev. of Nucl. Sci.* **22**, 165 (1972).
Subscripts to drawing

Fig.1. The changes of $^{137}\text{Cs}$, $^{60}\text{Co}$ $\beta$-decay count rate in time in experiments 19-23.04.94; a - $^{137}\text{Cs}$; b - $^{60}\text{Co}$

Fig.2. The initial sequence averaged over the minute’s periods; t - time in weeks (1st experiment)

Fig.3. The normalized count rate averaged over 1 minute versus time after extracting of the nonlinear trend from the initial series of measurements (1st experiment).

Fig.4. The Fourier spectrum of the signal shown in Fig.3 (1st experiment). The first peak corresponds to half-week period, the second one corresponds to 24-hour period.

Fig.5. The dynamics of the ununiformity for a 24-hour period (1st experiment). $Y$ is the Kolmogorov statistic value.

Fig.6. The directions of the $A_\odot$ vector and vectorial potentials of magnetic fields from the Sun $A_\odot$ and the Earth $A_E$.

$8^h$, (*) - astronomical time points corresponding to extremum changes in $\beta$-decay count rate.

Fig.7. The same as in Fig.3 for the 2nd experiment.

Fig.8. The same as in Fig.4 for the 2nd experiment.

Fig.9. The same as in Fig.5 for the 2nd experiment.

Fig.10. The experiment on 15-19 March 1998. Start in $1^h$ of Moscow time ($0^h$ of astronomical time, i.e. $0^h$ a.m.). The temporal series of $^{60}\text{Co}$ $\beta$-decay intensity values, smoothed out by the moving average with a window of 100s. $N_1$ - moving average of intensity, t - time in 100s.

Fig.11. Daytime dependence of the relative frequency of events $F(\theta)$ going out of $2\sigma$ ($\theta$ in degrees).

Fig.12. The results of measuring noise in the experimental set.