ANISOTROPY OF FAST-GOING PROCESSES IN THE SUN AND NEW INTERACTION IN NATURE

Yu.A. Baurov

Central Scientific Research Institute of Machinery
141070, Kaliningrad, Moscow region, Russia

A.A. Efimov & A.A. Shpitalnaya

State Astronomical Observatory of Russian Academy of Sciences,
190000, Pulkovo, Leningrad region, Russia

ABSTRACT

The processing of the galactic coordinates of 3543 solar flares with a magnitude of 2 or more has shown that the distribution of these fast-going processes on the surface of the "nonrotating" Sun is irregular and non-random what testifies that in the near-Sun space an anisotropy takes place which practically coincides with that predicted and obtained in laboratory experiments and caused by existence of the intergalactic vector potential \( \mathbf{A}_g \).

Subject headings: Sun: flares - Sun: magnetic fields - Cosmology: theory.
I. INTRODUCTION AND MOTIVATION.

In the works 1–5 the results of experimental investigations to find a new natural interaction arising when magnet systems act on physical vacuum through their vector potential, are presented. The essence of the new interaction lies in the fact that according to developed in Refs. 6,7 ideas of physical vacuum structure, masses of elementary particles are proportional to the magnitude of the intergalactic vector potential $A_g$, a new fundamental vectorial constant, related to one-dimensional discrete “magnetic” fluxes which, by the model of the Universe 8,9, form our entire world. In the theory developed, processes of forming elementary particle charge numbers are investigated (in particular, with variation of electric charge and, hence, violation of gauge invariance), therefore potentials, at such an approach, assume a physical meaning. By the theory the modulus $|A_g|$ has a limiting value $|A_g| ≈ 1.95 \times 10^{11}$ CGSE units) and cannot be increased but diminished, for instance, by the vector potential of a certain magnet directed towards $A_g$. Inasmuch as masses of elementary particles are uniquely related to the value $|A_g|^{6,7}$, an assumption may be made about existence, in a region with lowered $|A_g|$, of a new type of interaction, acting on any material body located there.

The new force is essentially non-linear and non-local in character with respect to the value $\Delta A$, a variation of the modulus of $A_g$, and to the gradient of $\Delta A$ in direction of the vector $A_g$. This force is mainly in the same direction as the vector $A_g$ which according to Refs. 1–5 has the following coordinates: right ascension $\alpha ≈ 270^\circ ± 7^\circ$, declination $\delta ≈ +30^\circ$ (the second equatorial coordinate system).

Thus, the direction of the vector $A_g$ determines global space anisotropy in the vicinity of the Sun. It is necessary to note that the measured direction of $A_g$ under terrestrial conditions can differ from the true one because the fundamental vector $A_g$ is superimposed by vector potentials of galactic and intergalactic magnetic fields, i.e. on the Earth (in the Sun’s vicinity) we measure, really, a summary potential $A_\Sigma$ which can be some what lesser in magnitude than $|A_g|$ and rotated relative to the true undisturbed vector $A_g$. The new interaction has to show itself not only in the process of interacting of the entire Sun’s magnetic system with physical vacuum 5,9 but also in phenomena associated with fast-going electromagnetic processes in the Sun proceeding with energy release. Among these are solar flares and a spontaneous disappearing of fibres, solar eruptive prominences 10–12. Here we shall demonstrate that the solar flares with a magnitude of 2 or more are distributed over the surface of the ”stationary” Sun anisotropically with the maximum of this anisotropy practically coinciding with the direction of the vector $A_g$.

II. THE NEW INTERACTION AND SOLAR FLARES.

Let us refer to Fig.1 where is shown a diagram of the new force $\vec{F}$ ($A_g||\vec{F}$) action on a magnetic tube (1) located under the Sun’s surface (2) and related to sunspots (3). As a rule, the flares are observed in large groups of sunspots with a complex configuration of magnetic field and are determined, in accordance with the available models 12, by storing magnetic energy in the upper chromosphere and the lower corona. The crosshatched area shows schematically a space region with the vector potential $\vec{A}$ of the tube (1) directed towards the vector $A_g$. Just in this region the new force $\vec{F}$ arises, which forms, in our opinion, the space anisotropy as the result of Archimedes’ floating up of the tubes.

The new interaction must be very strong in that case because the vector potential $\vec{A}$ of the tubes is of the order of $\sim 10^{11}$ Gs-cm and comparable to the value $|A_g|$ ( the mean diameter of the flare is equal to $5 \times 10^9$ cm, the magnetic field value $B ≈ 50$ Gs; the typical sunspot diameter is about $10^8$ cm, the greatest value of $B$ goes up to 5000 Gs; in Ref. 13 it is shown that the splitting of metal spectral lines observed in solar flares requires that the fields be about $10^4$ Gs). These circumstances lead, in our opinion, to the observed anisotropy in solar flare distribution on the surface of the ”stationary” Sun.

III. METHOD OF INVESTIGATION AND RESULTS.

In Refs. 14,15, as a result of investigating distribution of a large number of different nonstationary processes in our Galaxy including also solar flares (in galactic longitude), the clearly defined space anisotropy was found. In the work 16 proposed, and in 17 realized is a differential method of determining the direction of the maximum space anisotropy. Processing coordinates of 3324 solar flares with a magnitude 2 or more taken from catalogues 18–21 has given the following results in the second equatorial coordinate system: $\alpha ≈ 271^\circ, \delta ≈ +15^\circ$.

We proposed an integral method of determining the direction to be found. For this purpose the entire Sun’s surface was divided into 648 elements of area measuring $10^6 \times 10^6$ according to 648 directions, onto which the unit vectors were projected whose ends corresponded to the spherical coordinates of 3543 solar flares with magnitude $\geq 2$ (the
The galactic coordinate system was used: \( l \) is longitude, \( b \) is latitude. The sum of all the projections of the unit vectors onto a chosen direction \( i \) (\( \sum \gamma \cos C_\gamma \)), where \( \gamma \) is an index characterizing the spherical coordinates of a flare) served as a characteristic of \( i \)-th semisphere. In Fig.2 for semispheres situated in the same diameter coinciding with the \( i \)-th direction, a matrix of values \( \alpha_i \), the deviations of relative frequency from the most probable value \( \sigma \) (the isotropic distribution), which matrix was computed by the method proposed in Ref. 22, is presented.

At a concrete value of the index \( i \) we have for \( \alpha \):

\[
\alpha = \frac{q\Sigma_1 - p\Sigma_2}{\sqrt{\Sigma_1^2 + \Sigma_2^2}} \sqrt{\sigma},
\]

where \( \Sigma_1 = (\sum \gamma \cos C_\gamma)_{up} \) denotes the magnitude of the sum of cosines for the semisphere from which vector \( i \) comes out; \( \Sigma_2 = (\sum \gamma \cos C_\gamma)_{down} \) is an analogous demotion for the diametrically opposed semisphere; \( p \) and \( q \) are probabilities of occurrence of \( \Sigma_1 \) and \( \Sigma_2 \) values.

In our case \( p = q = \frac{1}{2} \), i.e. the formula (1) may be rearranged to

\[
\alpha = \frac{\Sigma_1 - \Sigma_2}{\sqrt{\Sigma_1^2 + \Sigma_2^2}} \sigma
\]

In the absence of anisotropy the equality of sums \( \Sigma_1 = \Sigma_2 \) would take place, and the isotropic distribution would exist. In our case for the extremal anisotropy we have \( \Sigma_1 = 878 \), \( \Sigma_2 = 555 \), i.e. \( \alpha = 8.5\sigma \). It is seen from Fig.2 that the direction of maximum anisotropy for the diametrically opposite Sun’s semispheres lies in the region of standard Sun’s apex and has the following coordinates:

\[
\max \left\{ \begin{array}{l}
\alpha (\text{right ascension}) \approx 277^\circ \\
\delta (\text{declination}) \approx +38^\circ
\end{array} \right. 
\]

(the second equatorial coordinate system), \( l = 65^\circ \), \( b = +20^\circ \) (the galactic coordinate system). The methodical error is equal to \( \pm 5^\circ \).

The found coordinates practically coincide with the experimentally determined coordinates of the vector \( A_g \) and are trustworthy since the observed anisotropy accounts for more than \( 8\sigma \) with respect to the isotropic state. Thus, the space anisotropy associated with the vector \( A_g \) plays, as is seen, an important part in nonstationary explosive processes of electromagnetic nature in the solar plasma.

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Legends of the figures:
Fig.1. A schematic sketch of acting of the new force on a magnetic tube.
1 - magnetic tube, 2 - Sun’s surface, 3 - sunspot,
4 - direction of the magnetic field in a tube;
$\vec{A}$ - direction of vector potential of the magnetic field $B$;
$\vec{A}_g$ - direction of the intergalactic vector potential;
5 - region of lowered magnitude of the vector $\vec{F}$;
$\vec{F}$ - direction of the new force; Z - zenith point.
Fig. 2. Magnitude of the quantity α in i-th direction in the galactic coordinate system.

| i \(\alpha\) (deg) | 0° | 10° | 20° | 30° | 40° | 50° | 60° | 70° | 80° | 90° | 100° | 110° |
|-------------------|----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 0°                | 2.6 | 3.5 | 4.2 | 4.8 | 5.2 | 5.5 | 5.7 | 5.6 | 5.4 | 5.1 | 4.5 | 3.9 |
| 10°               | 2.7 | 3.7 | 4.6 | 5.3 | 5.8 | 6.3 | 6.4 | 6.4 | 6.2 | 5.8 | 5.2 | 4.5 |
| 20°               | 2.8 | 3.9 | 4.9 | 5.6 | 5.9 | 6.3 | 6.4 | 6.4 | 6.2 | 5.8 | 5.2 | 4.5 |
| 30°               | 2.8 | 4.0 | 5.1 | 6.1 | 6.9 | 7.4 | 7.6 | 7.4 | 6.9 | 6.2 | 5.3 | 4.4 |
| 40°               | 2.8 | 4.1 | 5.3 | 6.4 | 7.2 | 8.0 | 8.2 | 8.1 | 7.9 | 7.2 | 6.4 | 5.9 |
| 50°               | 2.8 | 4.1 | 5.4 | 6.5 | 7.5 | 8.2 | 8.6 | 8.5 | 8.1 | 7.5 | 6.6 | 5.6 |
| 60°               | 2.8 | 4.0 | 5.5 | 6.5 | 7.6 | 8.3 | 8.9 | 8.8 | 8.3 | 7.5 | 6.6 | 5.5 |
| 70°               | 2.8 | 4.0 | 5.2 | 6.4 | 7.6 | 8.5 | 8.9 | 8.8 | 8.3 | 7.5 | 6.3 | 5.1 |
| 80°               | 2.7 | 3.9 | 4.9 | 6.1 | 7.2 | 8.0 | 8.3 | 8.3 | 7.8 | 6.8 | 5.7 | 4.6 |
| 90°               | 2.6 | 3.5 | 4.5 | 5.6 | 6.5 | 7.2 | 7.3 | 7.2 | 6.8 | 5.8 | 4.8 | 3.8 |
| 100°              | 2.5 | 3.3 | 4.0 | 4.8 | 5.6 | 6.4 | 5.9 | 5.4 | 4.5 | 3.6 | 2.7 | 1.9 |
| 110°              | 2.4 | 2.9 | 3.5 | 3.9 | 4.4 | 4.5 | 4.6 | 3.7 | 3.0 | 2.3 | 1.6 | 1.0 |

Note: The values are in arbitrary units.