National Aeronautics and Space Administration
Goddard Space Flight Center
Contract No.NAS-5-12487

ST —PR —GM —10801

ON RELATIONSHIP OF SPORADIC RADIO EMISSION REGISTERED ON SATELLITES OF THE "ELEKTRON" SERIES WITH THE GEOMAGNETIC ACTIVITY

by

E.A. Benediktov
G.G. Getmantsev
N.A. Mityakov
V.A. Rapoport &
A.F. Tarasov

(USSR)

22 JANUARY 1969

ST-PF-GM-10801

ON RELATIONSHIP OF SPORADIC RADIO EMISSION REGISTERED ON SATELLITES OF THE "ELEKTRON" SERIES WITH THE GEOMAGNETIC ACTIVITY

*

Kosmicheskiye Issledovaniya
Tom 6, No.6, 946-949,
Izdatel'stvo "NAUKA", 1968

by E. A. Benediktov, G. G. Getmantsev
N. A. Mityakov, V. O. Rapoport &
A. F. Tarasov

SUMMARY

The relationship between the sporadic radio emission and the geomagnetic disturbances is established as a function of the disposition of orbits of AES Elektron-2 and Elektron-4

*
* *

A special apparatus was installed on AES "ELEKTRON-2" and "ELEKTRON-4" with the view of recording cosmic radio emission in the 0.725 - 2.3 Mc frequency band [1]. It was noted in the latter work that, besides cosmic radio emission, sporadic radio emission was also registered at heights above 10,000 km, with intensity considerably exceeding that of the cosmic background (the plasma resonances, resulting in lower altitudes in a substantial variation of receiving antenna impedance and in the increase of the received signal, were not considered in this work). Characteristic examples of sporadic radio emission registration in the frequency of 1.1 Mc are shown in Fig.1 for the case of ELEKTRON-4.

According to external signs, this radio emission can be practically and conditionally broken down into three types: rejection of separate points (let us recall that the taking down of information from ELEKTRON-2 and -4 was conducted in the course of 1 sec for every two-minute interval) (Fig.1,a); smooth rise of radio emission with subsequent smooth descent (Fig.1,b); periodic intensity variations, whose periods are determined by satellite spin (Fig.1,c). The cosmic radio emission background was registered simultaneously in two frequencies: 0.725 and 1.1 Mc on Elektron-2 and on 1.1 and 2.3 Mc/s on Elektron-4. The sporadic radio emission of the types indicated is present in all frequencies; however, no notable correlation between events in different frequencies were observed. It should be noted that at 1.1. Mc, sporadic radio emission was registered several times with slow ascent and sharp drop (Fig.1,d), which was not noted in other frequencies.

---

* O SVYAZI SPORADICHESKOGO RADIOIZLUCHENIYA, ZAREGISTRIROVANNOGO NA SPUTNIKAKH "ELEKTRON", S GEOMAGNITNOY AKTIVNOST'YU.

As already pointed out in [1], the sporadic radio emission in the frequencies of 0.725 and 1.1 Mc/s has a characteristic latitude course with minimum on the geomagnetic equator. Besides, a link between the sporadic r.-e a d the fluxes of soft electrons (E > 100 kev) was revealed. A subsequent analysis of the results of measurements on AES Elektron-4 has indicated the absence of clear dependence of sporadic r.e. intensity on latitude. The latter's dependence on the fluxes of soft electrons has a qualitatively different character as compared with the analogous dependence for AES Elektron-2.

Such a distinction in the behavior of sporadic r.e. may be caused by the substantially different orientation of Elektron-2 and -4 relative to magnetosphere tail. In this connection it appears to be appropriate to conduct a comparison of sporadic r.e. with the geomagnetic activity.

Time dependences of sporadic r.e. intensity in the frequencies of 0.725 and 1.1 Mc and of the planetary index of geomagnetic activity, K_p, are plotted in Fig.2, where the aggregate intensities of sporadic r.e. ΣI are plotted in relative units in ordinates for half of the AES rotation period of the AES around the Earth ($T/2 \approx 11$ hrs), alongside with the three-hourly values of K_p. The averaging time of r.e. intensity assumed here, and equal to 11 hours, is not too high, on the one hand, inasmuch as the characteristic variations of ΣI and K_p have a duration of no less than 2 - 3 days. On the other hand, it is not too small, for the averaging of r.e. intensity for half a revolution around the Earth allows us to compare these data precisely with the planetary index K_p, that characterizes the global state of geomagnetic activity.

From the comparison of graphs of Fig.2, one may see that the correlation between the curves for ΣI and K_p is significantly higher for Elektron-4 than for Elektron-2's measurements. The calculation of the correlation factor has shown indeed that if for Elektron-2 (observations from February to April 1964) it is 0.2, for Elektron-4, whose observation period runs from July to November 1964, the correlation factor already is 0.6. The noted divergence in the degree of correlation between ΣI and K_p for the two satellites may be partly related with the difference in frequencies of registartion of sporadic r.e (0.725 and 1.1 Mc). At the same time, according to authors' opinion, this distinction is determined mainly by the difference in spatial (with respect to the Sun) orbit disposition of both satellites (Fig.3). For AES Elektron-2 the orbit is mostly disposed on the night side of the Earth, while that of Elektron-4 lies on the daytime side. Schematically represented in Fig.3 is also the structure of the Earth's magnetosphere (see [2]).

If we consider that the sporadic radio emission is induced by fluxes of fast charged particles, the difference in the magnetosphere structure on the daytime and nighttime sides of the Earth must result in a difference in the characteristics of sporadic r.e. observed on Elektron-2 and -4. Note also that the conditions of sporadic r.e. generation may substantially differ as a consequence of different distribution of electron concentration with height at day and nighttime.

Therefore, the relationship between the sporadic radio emission and the geomagnetic disturbances and its dependence on satellite orbit position in the Earth's magnetosphere, may be considered as established. We must underline the fact, however, that the details characterizing the physical pattern of the indicated phenomenon, are still unclear and require further study.

(.. Follow Figs and References)

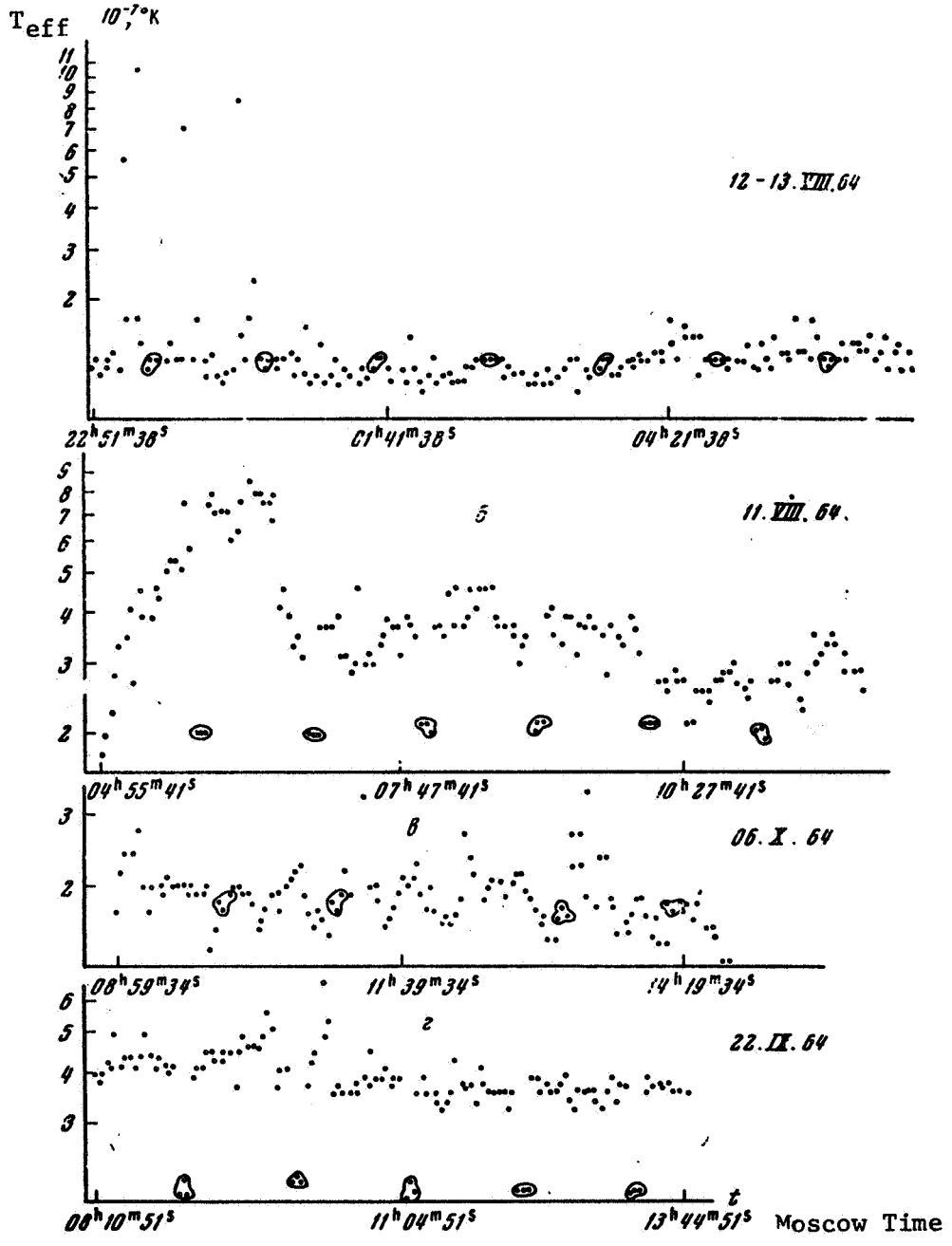

Fig.1

Various types of radio emissions, registered on AES "Elektron-4 in the frequency of 1.1 Mc

The calibration points are outlined by circles

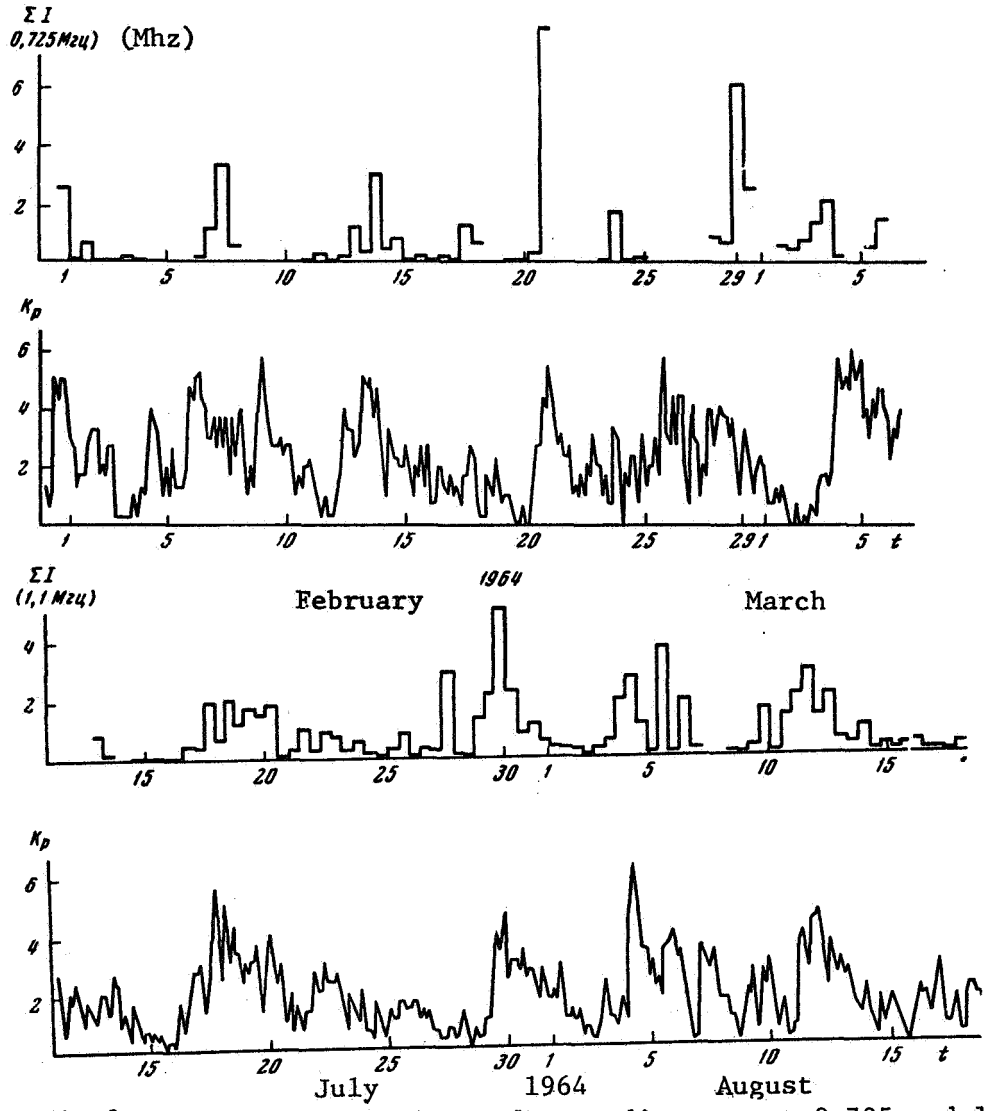

Fig.2. Intensity variations of sporadic r.e. at 0.725 and 1.1.Mc and of K_p-index

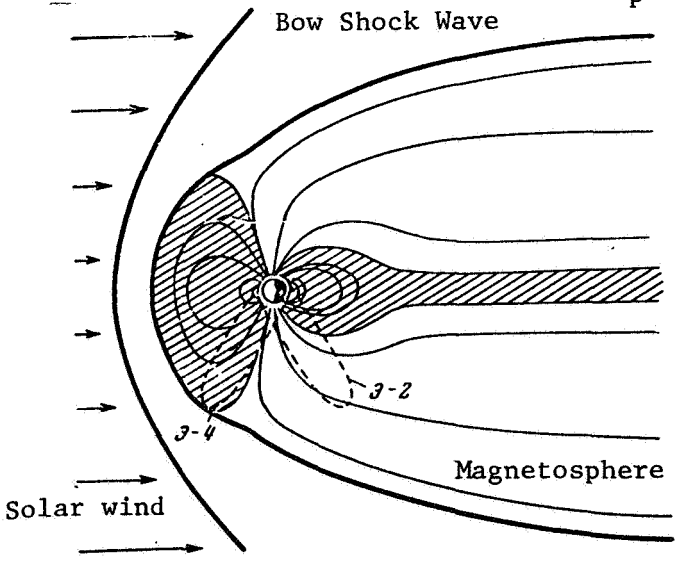

Fig.3

Sketch showing the orbit disposition of AES Elektron-2 and Elektron-4

REFERENCES

1. E. A. BENEDIKTOV, G. G. GETMANTSEV, N. A. MITYAKOV, V. O. RAPOPORT, YU. A. SAZONOV, A. F. TARASOV. Sb'Issledovaniya Kosmicheskogo Prostr." (Space Investigations). Iz. "NAUKA", 1. 1965.

2. B. J. O'BRIEN. Interrelations of Eenergetic Charged Particles in the Magnetosphere. - Inter-Uniom Symp. on Solar-Terr. Physics, Belgrade, August-September 1966.

CONTRACT No.NAS-5-12487
VOLT INFORMATION SCIENCES, INC.
1145- 19th St.NW
WASHINGTON D.C. 20036.
Telephone: (202)- 223-6700 (X-36)

Translated by ANDRE L. BRICHANT
on 22 January 1969