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VARIATIONS OF SOLAR WIND'S ION FLUXES DURING THE INCREASE OF SOLAR ACTIVITY LEVEL ACCORDING TO THE MEASUREMENT DATA OF "VENERA-2" AND "VENERA-4"

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SUMMARY

Comparison is made of the results of observations of solar wind fluxes near Earth, obtained from "Venera-2" in 1965, and "Venera-4" in 1967. Conclusion is derived about the increase of solar wind fluxes with the rise of solar activity.

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Beginning from the middle of the 19th century, when Schwabe and Wolf established for the first time the 11-year cyclical-events in the variation of the number of sunspots, multiple occurences of similar 11-year cycle of events were revealed for a series of other heliophysical and geophysical characteristics. The 11-year cycle is manifest in particular in the course of the curves for the values of Sun's shortwave radiation fluxes of indices of geomagnetic disturbances and of critical frequencies of Earth's ionosphere [1,2]. The ideas that geomagnetic disturbances are caused by the action on the Earth's magnetic field by charged-particle fluxes coming from the Sun, have been long in existence. However, the mechanism of this action is not yet clear, for it is not known exactly which particular variations of solar plasma fluxes, namely the values of magnetized plasma flux, its velocity, magnitude and direction of magnetic field, etc, cause these disturbances. That is why the presence of the 11-year cycle of geomagnetic disturbances gives reason to assume that such a cycle of events is to be found in the variations of some characteristics of solar plasma fluxes, but does not allow to assert it in regard to any specific physical characteristic of these fluxes.

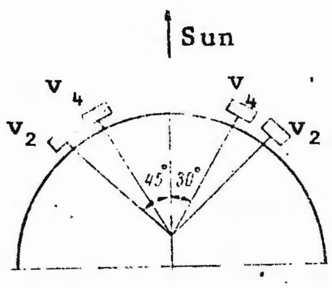

Fig. I

In the present paper the results of measurements of ion flux values of solar plasma, carried out in the interplanetary space, during the flights of "Venera-2" (launched in Nov. 1965), and "Venera-4" (launched in June 1967, provide the basis to assume, that with the rise of solar activity level, the value of solar plasma fluxes (solar wind) increases.

The measurements were carried out by means of charged-particle traps, with fixed potentials in electrodes, differing only in details from the traps applied on the first lunar rockets [3].

The circuit of charged particles ion traps applied on "Venera-4", is presented in [4]. The traps installed on "Venera-2" differ from those described in [4] in that the d.c. voltage of 50 v. was fed to the second grid, and not the pulse tension of 50 v.

Positive ions of practically all energies characteristic of solar wind, could hit the collectors of such traps; as to solar wind electrons, traps are closed by the potential of an antiphotoelectrical grid.

The position of traps on the mentioned devices relative to the direction at the Sun is brought forth in Fig.1 (V_2 are the traps installed on "Venera-2", V_4 are those of "Venera-4"). During the flights, orientation of spacecraft relative to the Sun was sustained with high precison.

As is well known (see [3]), a collector-current component which is induced by photoelectrons emitted by the antiphotoelectric grid, emerges in similar sunlit charged-particle traps.

In cases when the current induced by the positive ions of solar wind, hitting the collector, is less than the said component, the collector-current I_k could become negative.

As was shown by laboratory investigations the photocurrent difference linked with various trap orientations can be ignored in both cases.

The I_k measurements were conducted once every four hours, were registered in a memory device, and then transmitted to Earth during the radiocommunication session.

Numerous lenghty measurements conducted in interplanetary space (starting from the experiments on spacecraft "Mariner-2", conducted in 1962 [5]) showed that solar wind velocity, possesses a distinct 27-day cycle of events. This doubtless indicates that the interplanetary plasma (solar wind) rotates together with the Sun and that various regions of solar corona, emit plasma in different manners.

Hence follows that in order to evaluate the variations of the mean ion flux emitted by the Sun at different periods of solar activity cycle, the time intervals to be taken should be either equal to or multiple of the 27-days period with the condition that the emission of more active as well as less active solar regions be accounted for at the same time.

The values of collector current sums (see Fig.2) of both traps are registered in the course of the first 27 days' flight of "Venera-2" (light circles and relative to the period of 15 Nov. to 11 Dec. 1965, and analogous data, relative to "Venera-4" (dark circles) obtained during the period of 12 June to 8 July, 1967.

At the end of each of these time intervals, the drifting of spacecrafts away from the Earth's orbit did not exceed 10 million km.

As can be seen from Fig.2, in most cases, the registered current values from "Venera-4", exceed the current values obtained from "Venera-2". Averaging of current values registered on both spacecrafts during the 27-day period, showed that the collector-current's mean value according to "Venera-4" data, exceeds the corresponding value of "Venera-2" data by a factor of 6.

Taking into account the different inclination to the Sun,on both spacecrafts' trap-axes (see Fig.1) the indicated excess should be decreased to 5 times.

The variation of ion fluxes inducing positive collector-currents, could indeed substantially depart from the indicated value.

This is linked with the fact, that at computation of the mean current values, the negative components of collector-currents induced by photoelectrons, as indicated above, and diminishing the registered currents by comparison with those induced by ion fluxes, were not excluded. For example, if the mean value, on "Venera-2", of the ion component of collector current approached in magnitude the negative photoelectron component in case of "Venera-4", then, the apparent excess of the ion flux of solar wind, would excessively increase. If at computation of fluxes we took the measured collector current values, then, the mean value of ion fluxes, according to "Venera-2" data for the indicated period, could be estimated at $\sim 2\cdot10^{7}$ $cm^{-2}\cdot sec^{-1}$, and on "Venera-4", at $\sim 10^{8}$ $cm^{-2}\cdot sec^{-1}$. The maximum value of the ion solar wind flux

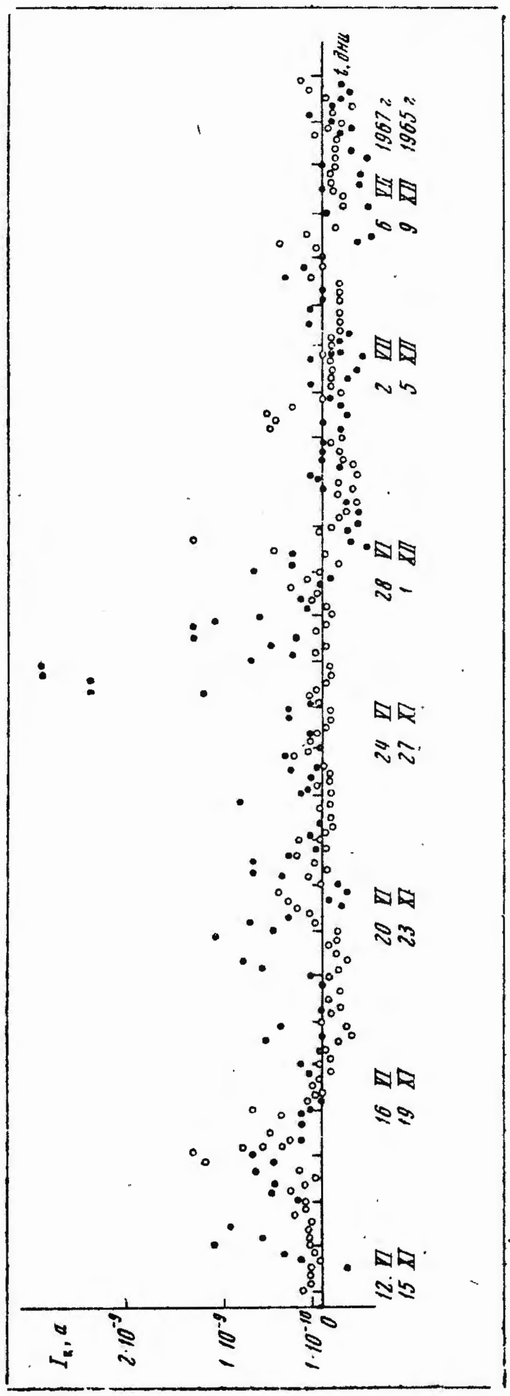

FIG.2

was registered on June 25, 1967, during a geomagnetic storm (K_p = 5-6) and was equal to $1.3 \cdot 10^9$ $cm^{-2} \cdot sec^{-1}$.

As follows from the above mentioned statement, all the indicated values N_i are somewhat underrated.

However, despite the indicated difficulty of quantitative estimates, the results of measurements brought up in Fig.2, show that, as compared with Nov.-Dec. 1965 the effect of increase of the mean solar wind ion flux during Sun's revolution around its axis in June-July 1967, leaves no doubt.

The electromagnetic radiation of the Sun increased substantially for the period Dec. 1965-July 1967, in the course of which, the level of solar activity has considerably increased. Thus, the solar radioemission flux in 10.7 cm wavelenght increased from $81 \cdot 10^{-22}$ to $143 \cdot 10^{-22}$ w/m^2 as an average, i.e., by about a factor of 2 [6,7].

The above measurement data by means of charged particle traps on spacecrafts "Venera-2" and "Venera 4" are evidence that as the level of solar activity increases, the fluxes of not only electromagnetic but of the solar corpuscular radiation increase also.

* * * THE END * * *

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