M. A. Kolosov, N. A. Savich, M. B. Vasil'ev, A. S. Vyshlov, V. I. Rogal'skii, V. A. Samovol, and L. N. Samoznaev. *Investigations of the plasma near the sun by the dispersion-interferometer method during the flight of the satellites "Venera-9, 10."* Using coherent radio signal broadcast by the stations on "Venera-9, 10," measurements were made of the variations of the integral electron density $\Delta N_p(t)$ along the path from the satellite to the earth. Owing to the relative motion of the earth and the satellites, the radio-communication path approached the sun and on 18 March 1976 it crossed the orbit of Mercury. This made it possible to investigate subsequently the regions directly adjacent to the sun.

The character and magnitude of the variations $\Delta N_p(t)$ were subject to strong changes during the measurement runs, thus indicating the existence of a broad spectrum of the electron-density fluctuations in the investigated medium. Thus, during the period from 30 March 1976 through 3 May 1976, when the line-of-sight radio-communication distances to the center of the sun were $R \approx (76-46)R$, the maximum value of $\Delta N_p(t)$ during an observation time $\Delta t \approx (18-80)$ min was $|\Delta N_{pm}| = (0.67-7.32) \cdot 10^{13}$ cm^{-2} at an average rate $|\Delta \dot{N}_p| = (0.6-2.24) \cdot 10^{10}$ cm^{-2} sec^{-1} (with the exception of the run of 3 May 1976). In individual shorter time intervals $\Delta t \approx 0.5-3$ min, the rate of change of the integral density increased $|\Delta \dot{N}_{pm}| = (2-8) \cdot 10^{10}$ cm^{-2} sec^{-1}. In the period from 24 May through 31 May 1976, at $R = (25.6-18.5)R$, change changes at rates $|\Delta \dot{N}_p| = (1-2) \cdot 10^{11}$ cm^{-2} sec^{-1} were regularly present at observation times $\Delta t = 0.5-1.25$ min. This was accompanied by a particularly large increase of the intensity of the small-scale fluctuations with periods $\tau = 0.5-5$ sec.

The obtained data make it possible to construct the plasma-inhomogeneity spectra, which are shown in Figs. 1 and 2. $\Delta\Psi_m$ and ΔN_{pm} are respectively the changes of the relative phase difference of the coherent radio signals and of the integral electron density, due to inhomogeneities with a time scale $\Delta\tau$, and $f = 1/\Delta\tau$ is the frequency of the fluctuations. The values of the spectral density $\Delta\Psi_m^2/f$ (or $\Delta N_{pm}^2/f$) of the individual observed inhomogeneities, determined from the plots of $\Delta N_p(t)$, are marked on the figures with different symbols for the different runs. In the measurement cycle from 30 March to 5 April 1976, when the radio-signal paths approached the sun to line-of-sight distances $R = (76-71)R_\odot$, variations were registered with frequencies $1.6 \cdot 10^{-4} \leq f \leq 0.25$ (the corresponding experimental points are marked near the dashed line 1 of Fig. 1). The dependence of the spectral density on the fluctuation frequency is approximated quite well by a power-law function with an exponent $\beta = -2.75$ (dashed line 1). The rms approximation error is $\sigma\beta = 0.325$. A similar relation is observed also in the next measurement cycle from 18 April through 23 April 1976, at $R = (60-55.3)R_\odot$ (line 1 on Fig. 2). In this case $\beta = -2.725 \pm 0.33$. The runs

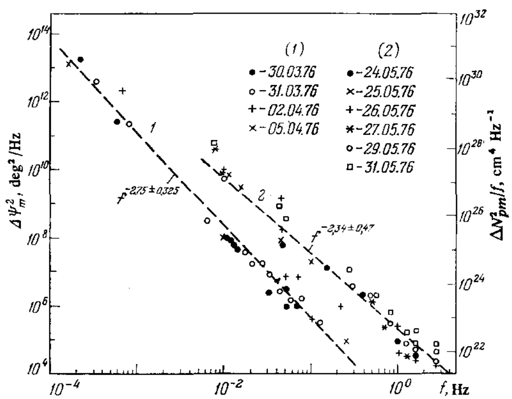

FIG. 1.

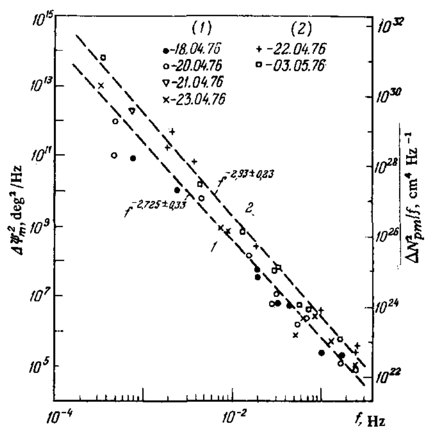

FIG. 2.

of 22 April 1976 ($R/R_\odot = 56.2$) and 3 May 1976 ($R/R_\odot = 46$), when intense large-scale inhomogeneities ($f = 2.5 \cdot 10^{-4} - 3.10^{-3}$ Hz) were observed, were considered separately. In these days, the spectral density was higher than in the other days, but the power-law dependence with $\beta = -2.93 \pm 0.23$ was preserved in the frequency range $2.5 \cdot 10^{-4} \leqslant f \leqslant 0.25$ Hz (dashed line 2 of Fig. 2), and if its high-frequency part $4 \cdot 10^{-3} \leqslant f \leqslant 0.25$ Hz is considered separately, then $\beta = -2.69 \pm 0.16$.

Finally in the measurement runs from 24 May through 31 May 1976 ($R/R_\odot = 25.6 - 18.5$), fluctuations with frequencies $f = 8 \times 10^{-3}$ to 2.5 Hz were registered. The spectral density of the inhomogeneities was much higher than in the considered cases, particularly in the $4 \cdot 10^{-2} \leqslant f \leqslant 2.5$ Hz band (dashed line 2 and the points near it on Fig. 1). The corresponding exponent of the polynomial is $\beta = -2.34 \pm 0.47$. In this measurement cycle, a tendency is noted for the spectral density of the high-frequency fluctuations to increase and for the coefficient β to decrease when the radio-communication path approached the sun. It is thus seen from Fig. 1 that all the experimental points obtained on 31 May 1976 lie near the line 1, which is the average for the entire cycle, and the corresponding value of the coefficient β for this run of observations is $\beta = -2.17 \pm 0.41$.

Thus, the results of our measurements show that the spectrum of the inhomogeneities of the near-solar plasma in the region $R = (76 - 18.5)R_\odot$ has a power-law variation in the frequency band $10^{-4} \leqslant f \leqslant 2.5$ Hz, with a spectral exponent $P = -\beta + 1 \approx 3 - 4$ close to the value $P_K = 11/3$ for the classical Kolmogorov spectrum. As the sun is approached, the spectral density of the inhomogeneities increases, particularly in the region of the high-frequency fluctuations.