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# MANIFESTATION OF THE JUPITER'S SYNODIC PERIOD IN THE SOLAR WIND PARAMETERS AND GROUND PRESSURE

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## Abstract

On the basis of daily data ($n$ = 14038), a relevance of Jupiter's synodic period to the changes in the solar wind parameters and ground pressure has been found. The values of these changes obtained by superposed epoch technique are ≈ 0,5 $cm^{-3}$ for the solar wind density, ≈ 8000 K for the solar wind temperature, and 1 mb for the ground pressure.

The power spectrum determined from solar wind density data for the period of July 26, 1965 to December 31, 2002 (see OMNI database) is presented in Fig. 1. As seen from Fig. 1, the 399-day variation (equal to the synodic period of the Jupiter) has the greatest amplitude in the range of periods of 20-800 days. It is greater than for 27-day, half-year and annual variations and only is smaller compared to that for 11-year variations and their higher-order modes. The appearance of such a variation is, apparently, due to the injection of electrons and ions from the Jupiter ionosphere. In fact, the "open" field tubes can appear (e.g., due to the magnetic reconnection) at the frontal point of the Jupiter`s magnetosphere. As a result, a part of Jupiter`s ionospheric matter from the dayside can, by means of tubes, form "Jovian wind", which will propagate into the solar wind (by analogy with the polar wind near the Earth).

The Jupiter rotates rapidly and has a powerful magnetosphere. The subsolar region of its magnetopause stands off at considerable distance, where the tangential velocities of intersection of interplanetary matter by magnetic field lines can be high. According to the induction law, this promotes a rather strong electric field $E \sim -[VB]$ directed from the Jupiter. As a result, the effect of ion injection from open field tubes into the vicinity of the frontal point will be significantly intensified. More complicated and effective mechanisms, intensifying the ion injection from the open magnetospheric tubes, are also possible.

Two types of such an outflow are expected: high energy electrons ($E_e \cong 0.2$-40 MeV) and Jupiter`s ionospheric particles. The fact that the Jupiter is a powerful source of high-energy electrons has repeatedly been mentioned in literature (see, for example, [Lopate, 1991]). The second type (the outflow of ionospheric particles) is not widely known. The high-energy electrons will move to the Sun along the curved field lines of the IMF (Archimedes spirals) because of large Larmor radii [Timofeev et al., 2003]. The Larmor radii of ionospheric particles are very small, therefore, it should be expected that they will directly move to the Sun, creating hypothetical "Jovian wind".

The purpose of the present study is to determine a response of solar wind parameters and ground pressure to the influence of the Jupiter. We have used the superposed epoch technique near the times of opposition of the Earth and Jupiter. They are repeated every 399 days. The data were filtered with a probability band-pass filter with a transmission band of 100 to 700 days.

Fig. 2 demonstrates the results of the superposed epoch technique near Earth-Jupiter opposition (the solid vertical lines) for the density (panel *a*), temperature (*b*) and ground pressure (*c*). The feducial points of oppositions are taken from Astronomical Annals for the period of 1965 to 2002. As seen from Fig. 2, the amplitude of the effect is quite noticeable. It is ≈ 0.5 $cm^{-3}$ (≈ 6 %) for the density, 8000 K (≈ 2.5 %) for the temperature and ≈ 1 mb (≈ 0.1 %) for the ground pressure. The average values of the density, temperature and pressure for the indicated period are ≈ 7.45 $cm^{-3}$, 115790 K and 1008 mb, respectively. The errors in the determined values are calculated by special technique developed for superposed epoch analysis [Jamison, Regal, 1982]. Each point in Fig. 2 has, on the average, an error of ± 0.13 $cm^{-3}$, ± 2107 K and ± 0.013 mb, respectively, which corresponds to the significance level > 95 %.

## Brief conclusions

1. In the power spectrum in the range of the periods of 100-700 days, the effect of increase of the solar wind density with the period of 399 days has maximum amplitude.

2. The "response" of the solar wind density and temperature, as well as of the ground pressure, to the influence of the Jupiter corresponds to ≈ 0.5 $cm^{-3}$, ≈ 8000 K and ≈ 1 mb, respectively.

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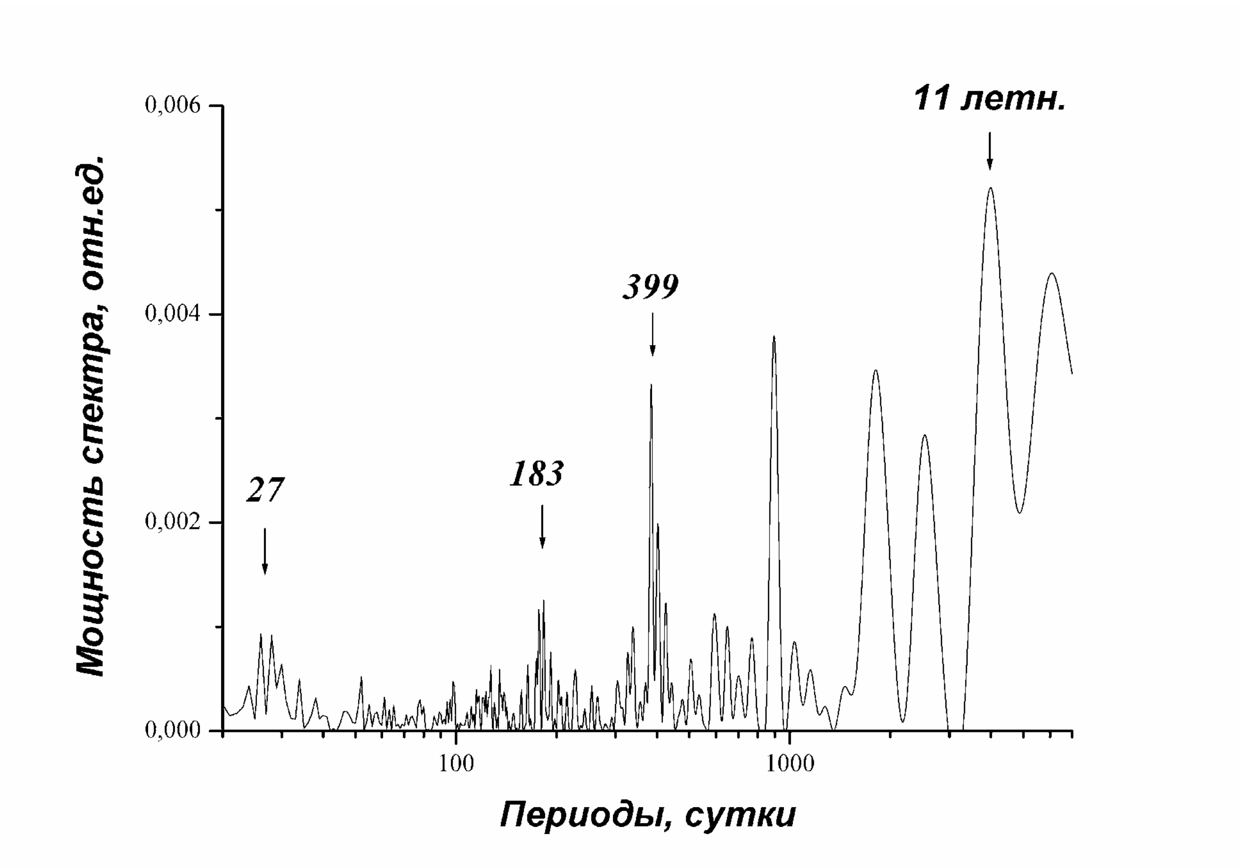


**Fig. 1.** Fluctuation power spectrum for the solar wind density in arbitrary units (the periods in days are shown at the bottom).

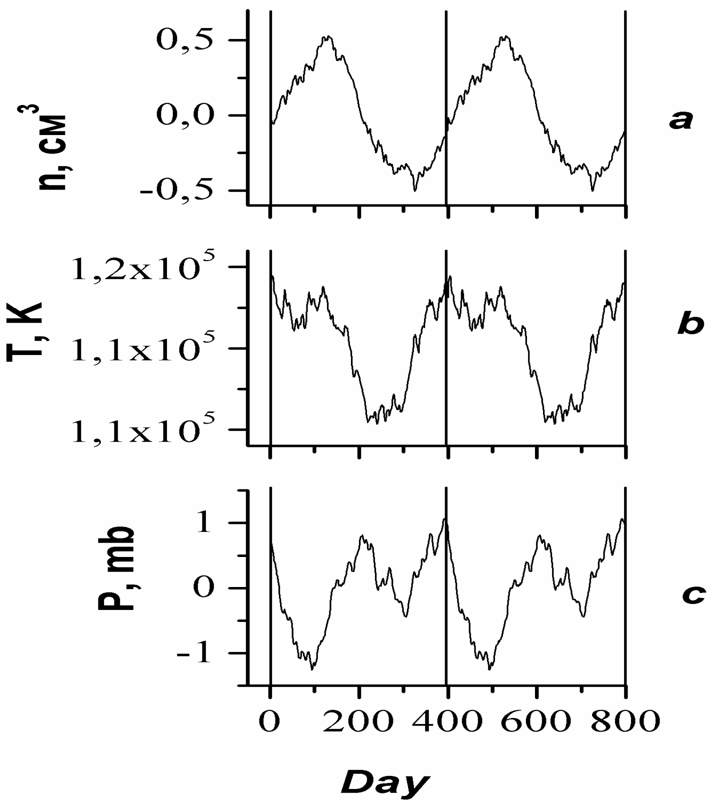


**Fig. 2.** The results obtained by superposed epoch technique: the Jovian wind particle density (*a*), the average temperature of particles in the Jovian and solar winds (*b*), the ground pressure (*c*).