MANIFESTATION OF THE 160-min SOLAR OSCILLATIONS
IN VELOCITY AND BRIGHTNESS
(OPTICAL AND RADIO OBSERVATIONS)*

(Invited Review)

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Abstract. All evidence of the solar origin of 160-min period oscillations is collected, and the present state of observations of this oscillation in optical and radio-ranges is considered. The main results are summarized: (a) the 160-min oscillation was observed in 1981 as well as before, (b) an attempt to find a nonradial component with \( l = 2 \) has failed, (c) the intensity and circular polarization of radioemission show with statistical significance the presence of this 160-min periodicity.

1. On the Solar Origin of 160-min Oscillations

The 160-min periodicity has the same phase at different sites of the Earth's globe: Crimea, Stanford, and South Pole (see Figure 1); the last observations lasting for about 5 days without interruptions caused by night-time intervals as is inevitable in usual ground-based observations show also that the 1-day sampling effect does not play any role. Moreover, the 160-min peak in the power spectrum (computed for 1974–1980) is the highest (see Figure 2). A possible influence of the differential transparency of the terrestrial atmosphere (difference in transparency between east and west limbs) can, in principle, bring some modulation, but this effect, on average, was reported to be at least 10 times smaller than the observed one (see Severny et al., 1980) and does not produce the systematic shift of the phase from year to year. Besides that, the changes of transparency do not show the 160-min variations, as follows from the work by Clarke (1980). The apparent absence of the 160-min oscillations in velocity when one uses a telluric line, as well as the indication for the 27.2-day periodicity in the variations of an amplitude of this 160-min oscillation (Kotov et al., 1982), are also worth noticing. One should also note that the synchronous, in parallel with the line-of-sight velocity, variations in the intensity and circular polarization of radioemission from the Sun are observed (see below), which can not be ascribed to fluctuations in the ionosphere of the Earth. The 160-min variations in IR limb-darkening were observed by Koutchmy's and Kotov (1980). A full analysis of possible non-solar sources and errors is in Kotov et al. (1982).


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A summary of the Crimean measurements of solar velocity is presented in Table I. The results of superposed epoch analysis for the Crimea, Stanford, and South Pole are illustrated by Figure 1 showing good agreement in phases of mean line-of-sight velocity curves; some difference in amplitudes can be easily ascribed to the differences in methods of measurements (different areas for averaging of velocity over the solar disk) and, in some part, – to difference in calibration. There is also a good agreement between the dependences of the moments of observed maximum (of outward velocity) upon the time (year) of observation (Figure 3); both Crimea and Stanford clearly show a year-to-year progressive drift of this moment provided that the period of the oscillations, in superposed epoch plots, is precisely 160,000 min; this phase drift is found to be in quite a good agreement with South Pole result too (see label N on Figure 3). This drift of the velocity maximum, determined for each individual year with exactly 160,000 min period, points to a true period of 160.010 min, corresponding to a yearly shift of the phase by about 32 min, on average.