OBSERVATIONS OF SOLAR GLOBAL OSCILLATIONS (1983-1985) AND POTENTIAL INFLUENCE OF TERRESTRIAL SOURCES OF ERRORS

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ABSTRACT. The Earth atmospheric pressure fluctuations in the 5-min range of periods are analysed and their influence on observations of solar 5-min oscillations are briefly discussed. New series of observations confirmed the oscillations of the Sun with period of 160.010 min.

Over last 12 years systematic observations of solar oscillations were made using differential technique: the difference of line-of-sight velocity between a central circular area on the solar disk and outer annular portion of the disk is measured (Severny et al., 1976). These observations showed that the Sun oscillates with a period of 160 min (Severny et al., 1984) which was independently detected in Doppler velocity measurements by Brookes et al. (1976), Scherrer et al. (1979), Grec et al. (1980) and recently in the solar diameter measurements by Hill et al. (1985).

A detailed analysis of the available data indicates that the 160-min oscillations may correspond to spherical harmonic l=3 (Kosovichev and Severny, 1986).

Our observations made in 1983-1985 fully confirm the presence of 160-min oscillations with stable initial phase. In accordance with earlier data, new observations show a progressive phase shift by about 35 min per year for the sinusoidal wave obtained with folding period of 160.0000 min, see Figure 1a. The regression line gives for the best value of period 160.0106 (±6) min. Contrary to such behaviour of the data taken in the solar spectral line (Fe I 512.4 nm), the results obtained for the telluric line (687.9 nm) reveal a random scatter of points near horizontal line (Figure 1b). One should also note that the telluric line power spectrum (PS) averaged for the last three years, 1983-1985, didn't show any substantial

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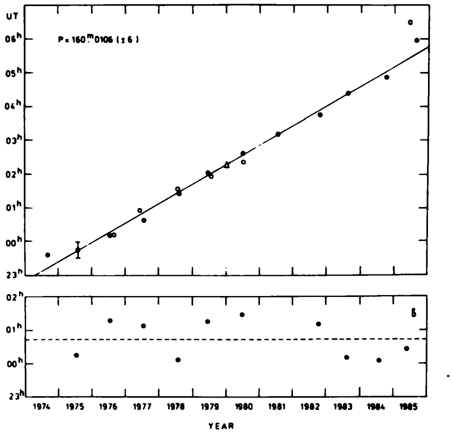

Figure 1. Time of maximum Doppler velocity for the solar (a) and telluric (b) lines (a superposed epoch analysis using a period of 1/9 of a day).

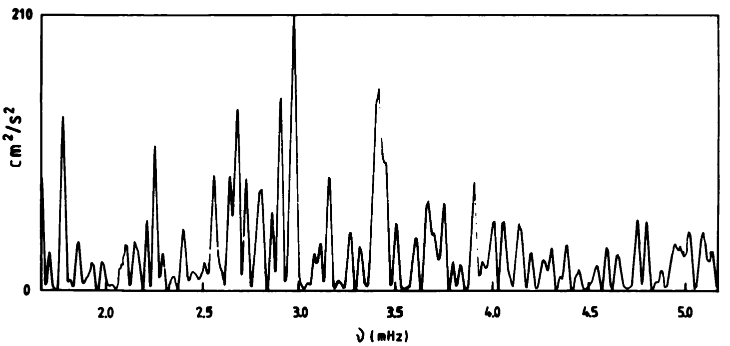

Figure 2. Power spectrum of the data obtained in the solar line 512.4 nm on 19 June 1981.

peak at the 160-min period.

The data obtained under the best observational conditions (observations during about 10 hs per day) were subjected to the PS analysis to search for discrete frequencies in the 5-min range (Claverie et al., 1979; Grec et al., 1980; Scherrer et al., 1983). An example of the PS presented in Figure 2 shows a pattern of discrete frequencies which agrees with the data of Scherrer et al. (1983) and Henning and Scherrer (1985).

Figure 3 shows the echelle-diagram of frequencies in the 2.2-4.2 mHz range according to three different sets of measurements. The agreement between Crimea and Stanford appears to be satisfactory again.

Starting from 1983 the registration of the Earth atmospheric pressure was carried out simultaneously with the patrol Doppler observations. The PS of these data for

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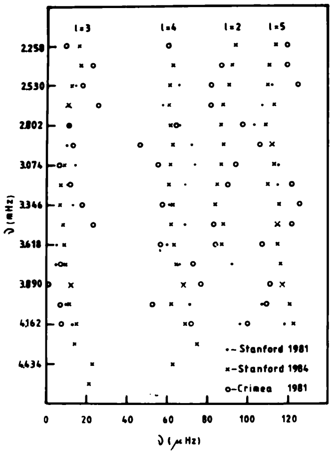

Figure 3. Comparison of crimean frequencies of solar acoustic oscillations (o; the 1981 year data) with the Stanford results for 1981 (.) and 1984 (x).

the 5-min range exhibits as usual an increase of power for longer periods, as opposed to the solar line PS (see, e.g., Figure 2) with evident concentration of power within relatively narrow frequency band.

A careful consideration of these PS showed that only 20% of peaks from both spectra coincide with the accuracy ±5 microHz; frequencies of the rest of the peaks differ by more than 30 microHz.

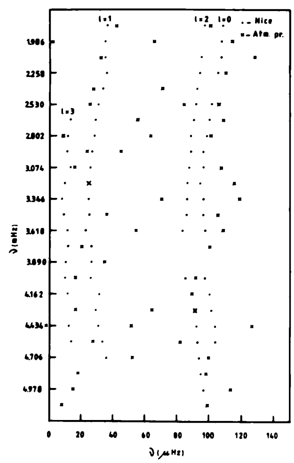

Figure 4. Echelle-diagram for the frequencies of solar oscillations (•; from Grec et al., 1980) and atmospheric pressure fluctuations (x).

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Keeping in mind that variations of the atmospheric pressure would be more serious for the "entire-disk" velocity measurements than for the differential method, we compared the PS of atmospheric pressure with the results of Grec et al. (1980), see Figure 4. Though there is no absolute coincidence of the individual frequencies, the overall structure of the frequencies forces us to suspect that the problem of atmospheric pressure fluctuations needs thorough investigation in future (see also Yerle's (1986) discussion of the atmospheric influences on observations of solar oscillations).

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