

Oscillations in the polarized solar radio emission at 1.76 cm wavelength in 1992-2003

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Abstract. We investigated variations of the radio emission of the whole Sun at 1.76 cm obtained and archived at the Nobeyama radio heliograph in 1992 - 2003. For this purpose the daily data of the intensity and also right/left circular polarization of the radio emission with one-second average were processed. It was found that 3 minutes oscillations are present at the different phases of solar activity, including the minimum of activity. Especially conspicuous these oscillations present in a difference between the right and the left circular polarization. Intensity of the oscillations changes with a level of the solar activity. As we register fluctuations from the full Sun that their source can be not only sunspots but also and chromosphere of the Sun. Spectral analysis of the presence of 3-minute oscillations in polarization of the solar radio emission shows that there exist modulation with the periods of 27 and 157 days.

In this paper we used daily averaged on the solar disk data. Files of the data contain series of values (with one second average) of the intensity and the right/left circular polarization. The total number of counts for each considering day was about 28000 - 29000 and it corresponds to 8 hours of observation. Thus method of the spectral analysis was applied to the values of the intensity and the polarization of the radio emission. The data of various days of observation were processed by one technique. For each day of observations we obtained the power spectrum. The longer period of the power spectrum were obtained by summing of their daily values.

Data from the Nobeyama radio heliograph allow us to make an analysis of the different components of the solar radio emission. Figure 1 shows the power spectrum at time interval 120-500 seconds, obtained with FFT (fast Fourier transform) method for the intensity and difference left and right circular polarization of the radio emission correspondingly. In a range 3 minutes (at the time axis) components of the polarized radiation have local maxima. More clearly 3-minute oscillations are visible in a difference between left and right circular polarizations. In this work we do not use any frequency filters were not used. Therefore the power spectrum increases to a low-frequency wing of a spectrum, reflecting a daily variation.

Figure 2 shows the sum of spectral power density of a range of 150-200 seconds (SSPD) index (for a noise reduction smoothing on 30 days was applied). It is possible to notice, that power of the 3-minute oscillations depends on phase of the solar activity cycle. In 1994-1997 (minimum of activity) the power of the 3-minutes oscillations about 2 times less than in period of the maximum. Also, in Fig. 2 we can see the cyclic variations of power of the 3-minutes oscillations.

The carried out analysis has shown that polarization radio emission from whole the Sun at 1.76 cm has the 3-minutes oscillations. This result confirms the results obtained on the data from the radio telescopes RT-22 on a wave 2.25 cm Abramenko & Tsvetkov (1985) and according to the Nobeyama radio heliograph Gelfreikh et al (1999), executed at the analysis of separate active regions. The analysis of these oscillations at different

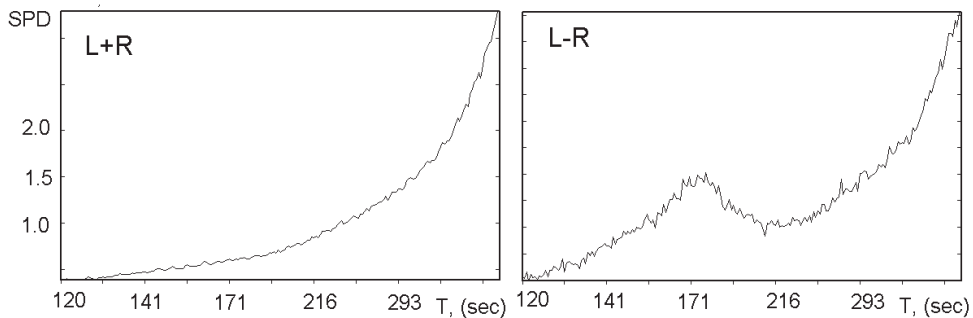


Figure 1. Summary power spectrum of the time series of the solar radio emission in 1992-2003 according to the Nobeyama radio heliograph at 1.76 cm in relative units: a) intensity of radio emission; b) differences between left and right circular polarization. The data were processed per every day of observation separately and then the spectral density was summarized.

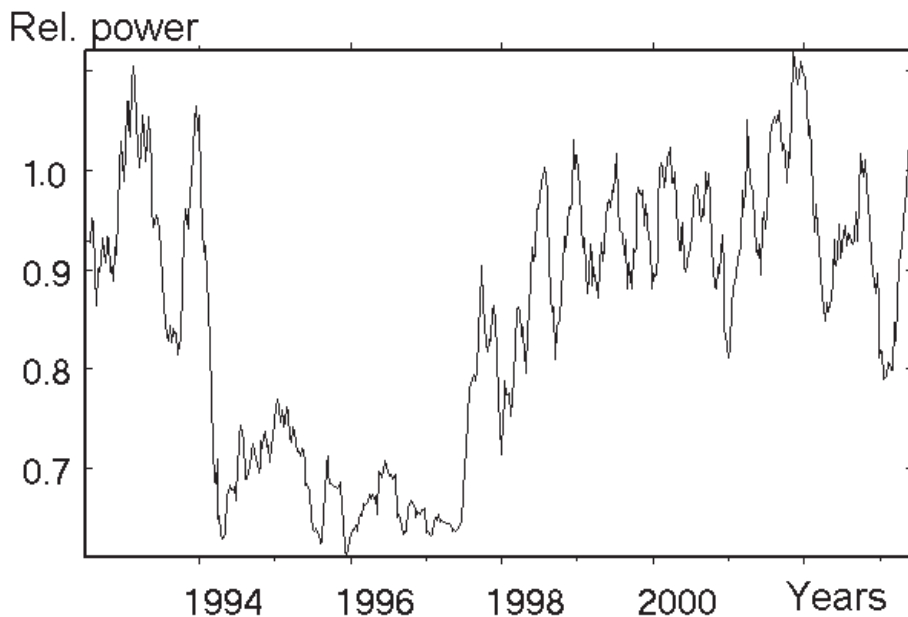


Figure 2. (on the right) Change of the relative power of the 3-minute oscillations over the range of periods of 150-200 seconds in 1992-2003. Smoothing on 30 days is carried out.

phases of solar activity has revealed, that 3-minute oscillations exist not only during a maximum of activity (in this time there are groups of sunspots with the large magnetic fields), but also at phase of a minimum.

References

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