SPECIFIC OF A ROTATION OF THE SOLAR MEAN MAGNETIC FIELD DURING CYCLE 21 AND 22

U. M. Leyko

Astronomical Observatory, Taras Shevchenko National University
3 Observatorna St., 04053 Kyiv-53, Ukraine
e-mail: leiko@aoku.freenet.kiev.ua

Taking into consideration Severny' idea on magnetic asymmetry the two time series for N(+) and S(−) components have been derived from time series of Stanford measurements of the solar mean magnetic field, cycle 21 and 22. Separative investigation of N(+) and S(−) component spectra furnishes more correct explanation of the origin of the spectrum peaks of time series of the solar mean magnetic field measurements and definition of the features of the largescale magnetic structures rotation. Pronounced differences of the power and form of the peaks in spectra of both cycles point out to the different space–time organization of the largescale magnetic structures during each cycle. The difference of N(+) and S(−) component spectra within each cycle is caused by magnetic asymmetry.

The rotation of the solar largescale magnetic field is a vital problem of present-day solar physics. The first investigations have revealed faster magnetic structure rotation than that of photospheric plasma at all latitudes except equator [1]. It was obtained two periods, 27^d and 28^d–29^d, of rotation of the largescale magnetic structures at latitude zone near equator [2]. Sun-as-a-star measurements of the solar magnetic field (the solar mean magnetic field, SMMF) were begun by Severny *et al.* in 1968 at the Crimean Astrophysical Observatory and two rotation periods $26\overset{d}{.}8$ and $27\overset{d}{.}6$ were obtained. These periods were interpreted by Syverny as rotation periods of N(+) and S(−) largescale magnetic structure [3].

Taking into consideration Severny' idea on magnetic asymmetry the curve of Stanford SMMF measurements, cycles 21 and 22, have been inspected and brought out its asymmetric about the line of zero value of the magnetic field. The SMMF time series seems to be a sum of two independent time series. These are series of the plus SMMF values (N(+) component of SMMF) and minus SMMF values (S(−) component of SMMF). Therefore, it is necessary to investigate each of these series separately. Two series of such a length as original one were formed as following. In original series the minus values were replaced by zero and derived the series of N(+) component. Replacing the plus values by zero the series of S(−) component are derived. For further investigation of series the spectral analysis method was applied. The results are shown in Fig. 1.

There are power spectra of SMMF, cycle 21 and 22, of whole (original) series (top panel), of S(−) component series (middle panel and N(+) component series (bottom panel) in 13^d–15^d and 25^d–31^d period range in Fig. 1. Significant distinctions between the spectra of whole series manifestate the features of SMMF rotation during each cycle. The 21 and 22 cycles spectra are different from each other by number of peaks, their power and form thus it points out to the different space–time organization of magnetic structures during timescale in each cycle. One can say that there were five latitude zones of the predominant concentration of the largescale magnetic structures for cycle 21 and three such zones for cycle 22.

It is known the higher latitude of the largescale magnetic structure the a magnetograf signal is smaller. For this reason and in consequence of differential rotation the power of rotation period decreases with the increasing of a value of its period. This rule is observed for spectrum peaks of the 22 cycle both for whole series and components series. But spectrum peaks of cycle 21 don't follow this rule. Two powerful peaks in spectrum of S(−) component point out to S(−) structures concentrated mainly at two latitude zones during 21 cycle. The powers of these peaks are approximately equal. This is an evidence of predominant S(−) magnetic structures concentration at the latitude zone rotated with $28\overset{d}{.}2$ period. In spectrum of N(+) component $26\overset{d}{.}93$ peak is exceptional one. Therefore, the zone of predominant concentration of N(+) structures had $26\overset{d}{.}93$ rotation period. These conclusions are in a good agreement with results of [4]. During the 22 cycle all three spectra are alike. The peaks of both component have the same periods, but their form is different. Magnetic asymmetry had another character during cycle 22.

The very powerful peaks of $10\overset{y}{.}27$ (21 cycle) and $8\overset{y}{.}7$ appeared in long period range of the spectrum of N(+) and S(−) components. The value of this peaks is the same for both component during one cycle, but their

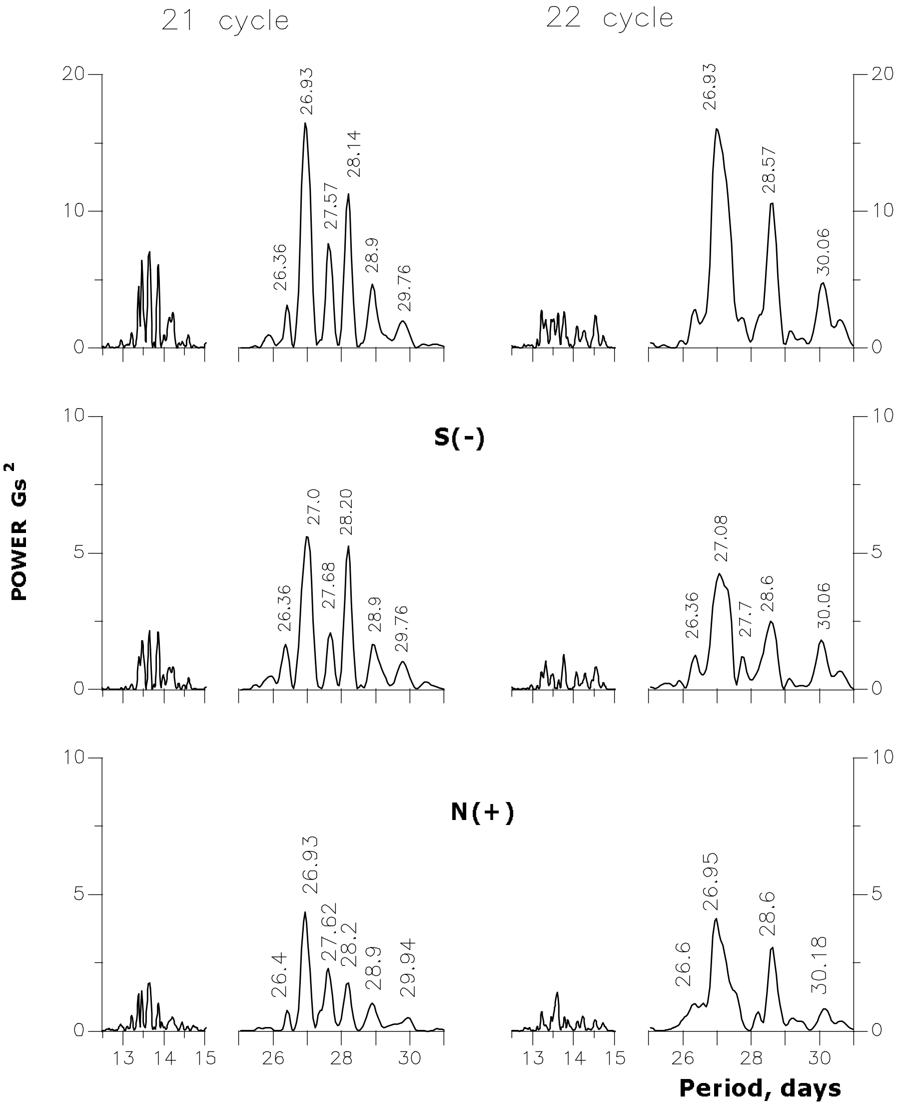

Figure 1: The spectrums of the solar mean magnetic field, 21 and 22 cycle

powers are different. These peaks are very weak in the spectra of whole series of both cycles.

Separative investigation of N(+) and S(−) component spectra furnishes more correct explanation of an origin of the spectrum peaks of time series of SMMF measurements and defines the features of the magnetic field rotation.The number and form of the spectrum peaks are caused by space-time organization of the largescale magnetic structures. Both cycles spectra are characteristically different in number of peaks, their power, a form and value of the rotation period pointing to the different space–time organization of largescale magnetic structures during each cycle. The difference of N(+) and S(−) component spectra within each cycle is caused by magnetic asymmetry.

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