Topology and dynamics of large scale solar magnetic field

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Course Outline

Observations of the large scale magnetic field in the photosphere taken at the Wilcox Solar Observatory since 1976 up to 2007 have been analyzed to deduce its latitudinal and longitudinal structures and asymmetry, its differential rotation, and their variability in time. New approach has been suggested to reveal the contribution of the weak and strong magnetic fields on the organizing of global topology and dynamics of solar magnetic field over last three cycles N 21, 22 and 23.

The latitudinal topology of the photospheric magnetic field is composed of

1) a four zonal 20-22-year periodical structure and

2) polarity's waves running from the equator to the poles with periods of 2-3-years about.

The boundaries of the four zones are located at the equator and at +/- 25 degrees (where the solar activity has the highest amplitude). The polarities of the near-equatorial zones coincide to the polarities of leading sunspots and have opposite signs in the Northern and Southern hemispheres. It is important to study whether the non-zero level of the magnetic field calculated as a mean around the Sun at different latitudes is a component of a basic background field or the result of the mis-balance of the strong magnetic field mainly concentrated in active regions.

The polarity's waves have different periods in the Northern and Southern hemispheres, but they are synchronized by solar activity cycle. The study of the origin of these waves was performed in view of their relationship with the presence of the differential rotation and torsional waves in the magnetic field of the Sun.

North-South asymmetry of solar magnetic field and its short and long term variability in time have been studied.The time of magnetic field emergence is discussed.

Extremely interesting quasi-stable over 30 years longitudinal structure has been found. Its relation to the latitudinal topology of the magnetic field was studied.

These results are fundamental for the understanding of the magnetic origin of the solar activity, dynamics,heliospheric structure and for the prediction of the solar wind and magnetospheric perturbations.