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Change of the photospheric magnetic field structure in the course of 11-year solar cycle

E.S. Vernova (1), M.I. Tyasto (1), D.G. Baranov (2)

(1) IZMIRAN, SPb. Filial, St. Petersburg, Russia (helena@ev13934.spb.edu), (2) A.F. Ioffe Physical-Technical Institute, St. Petersburg, Russia

Long-term features of the solar activity distribution were considered in connection with changes of Sun's magnetic field structure. Longitudinal distributions of the photospheric magnetic field studied on the base of Wilcox Solar Observatory data (1976-2004) displayed two opposite types during different parts of the 11-year solar cycle. Heliolongitudinal distributions differed for the ascending phase and maximum of the solar cycle on one hand and for the declining phase and minimum on the other depicting maxima around two roughly opposite Carrington longitudes (180 deg. and 0/360 deg.). Thus the maximum of the distribution shifted its position by 180 deg. with the transition from one characteristic period to the other. The same peculiarities of the longitudinal distribution were observed for some manifestations of the solar activity (sunspots, sources of solar proton events, sources of X-ray flares).

Two characteristic periods correspond to different situations occurring in the 22-year magnetic cycle of the Sun, in the course of which both global magnetic field and the magnetic field of the leading sunspot in a group change their sign. In consequence, global magnetic field polarity and polarity of the leading sunspots may be the same (in a given solar hemisphere) or opposite. During ascending phase and maximum (active longitude 180 deg.) polarities of the global magnetic field and those of the leading sunspots coincide, whereas for the declining phase and minimum (active longitude 0/360 deg.) the polarities are opposite. These results show that the observed change of active longitudes is closely connected with the polarity changes of Sun's magnetic field in the course of 22-year magnetic cycle.