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Photospheric magnetic field at different phases of the solar cycle

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Time and spatial dependencies of the photospheric magnetic field are studied using the synoptic maps data NSO (Kitt Peak) for 1976-2003. In our analysis the behavior of strong and weak magnetic fields was considered for low-latitude (equatorial) and high-latitude regions separately, the magnetic field polarity being taken into account. It is shown that both high-latitude and equatorial fields change in accordance with the 11-year solar cycle, however, they reach their maxima at different times: for the high-latitude magnetic fields the maximum occurs slightly earlier than the solar cycle maximum, whereas for equatorial magnetic fields the maximum lags behind the solar cycle maximum and almost coincides with the second Gnevyshev maximum.

It is shown that, for the equatorial magnetic fields, the time-dependencies of the strong ($|B| > 20$ G) and the weak ($|B| < 4$ G) magnetic fields are exactly in anti-phase, and the change from one pattern to the other occurs in the interval $4 \text{ G} < |B| < 6$ G.

Not only the time-dependence but also the longitudinal distribution of the strong magnetic fields is in anti-phase with the distribution of the weak magnetic fields. Strong and weak magnetic fields in different periods of the solar cycle are concentrated around the opposite heliolatitudes (0°/360° and 180°): these longitudes become dominating in turns with the transition from the ascent-maximum period of the cycle to the descent-minimum period of the cycle and vice versa.