Early Reversal of the Sun’s Polar Field – Is Solar Cycle 24 Already Peaking?

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Long-term measurements of the Sun’s poles show that reversal of the dominant magnetic polarity generally occurs within a year of solar maximum.

Current observations suggest that the northern polar field above 55 degrees may reverse in early 2012. The southern pole will reverse a few months later.

If a smaller polar cap is considered, the reversal will be observed to occur later, since the flux that reverses the field comes from lower latitude.

Because the polar field was so weak during the last minimum, a smaller amount of flux is required to accomplish the reversal this cycle.

If the historic relationship holds, the current weak solar cycle may already be near its maximum.

Streams of Flux Migrate Poleward to Reverse the Polar Caps Fields

The field reverses polarity progressively from lower to higher latitudes; this was highly evident in Cycle 23. (Figures from Sun & Hoeksema, 2009)

Decay of the Polar Fields

The negative northern pole is weakening quickly at the beginning of Cycle 24 because the field was so weak in Cycle 23. Streams of positive flux from the more active north are moving poleward to reverse the field direction, perhaps by mid 2012. These can be seen in the zonal maps, synoptic maps and magnetograms.

The southern field has not been weakened by negative polarity streams and is not weakening as quickly. The blue lines show a 23Hz low pass filter of the annually varying polar field. The green line is a by-eye extrapolation of the polar field trend.

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Potential

Radial

Acute

Angle

Aperture

Smoothed Polar Field for Different Polar Cap Sizes Observed with MDI During Cycle 23.

Reversal Is Delayed for Higher Latitudes/Smaller Caps

Average Polar Field in 5° Latitude Bins

4CR MDI Averages for 1996–2008

North at left; South at Right

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Radial

Aperture

Close-up of Small-Scale HMI Radial Field Elements

Different Methods of Disambiguation are Illustrated

Polar Views of MDI Magnetic Field near reversal in 1995/2000. The spiral-shaped streams of flux led to the reversal of the polar field. The four frames on the left are CR 1953 and 1954 and show a negative stream (N1) in 1999 at mid latitude. The leftmost column shows 30° to the pole; a close-up of 60° poleward is next to it. A second stream (N2) about a year later in 2000, shown on the right, is about to arrive and reverse the polarity in the north.

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