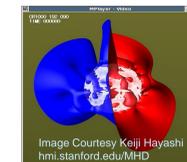
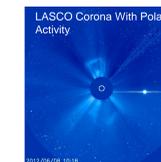


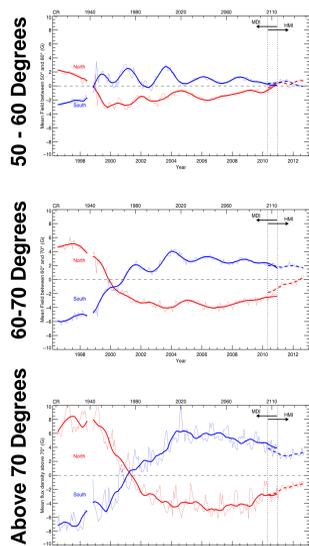
The Asymmetric Polar Field Reversal – Long-Term Observations from WSO

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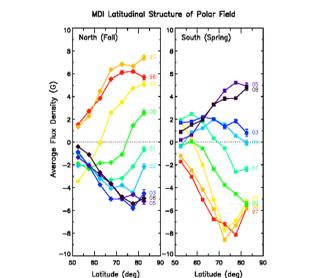
The Sun's polar field above 55° in the northern hemisphere has reversed and the southern field is beginning to weaken. The polarity reversal proceeds from lower latitude to higher latitude. The asymmetry is not unusual and is related to the poleward transport of flux that emerged in the active region bands earlier in the cycle. During the declining phase of Cycle 23 the poles were fairly equal, but the northern field began to decay in early 2009. Prior cycles have behaved differently, as observed at the Wilcox Solar Observatory and elsewhere.



The Polar Field Reverses Direction Progressively, From Lower to Higher Latitudes.

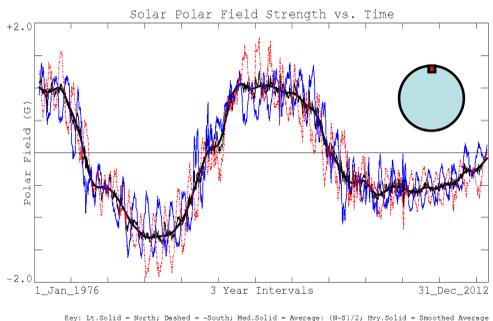


Smoothed Polar Field for Different Polar Cap Sizes Observed with MDI and HMI During Cycle 23 and the early Cycle 24. Reversal is Delayed for Higher Latitudes / Smaller Caps



Avg. Polar Field in 5° Latitude Bins 4CR MDI Averages for 1996–2008 North at left; South at Right

WSO Polar Field – Polemost Aperture Covers 55 degrees to the Pole



WSO Observations of the Sun's Polar Field from 1976-2012

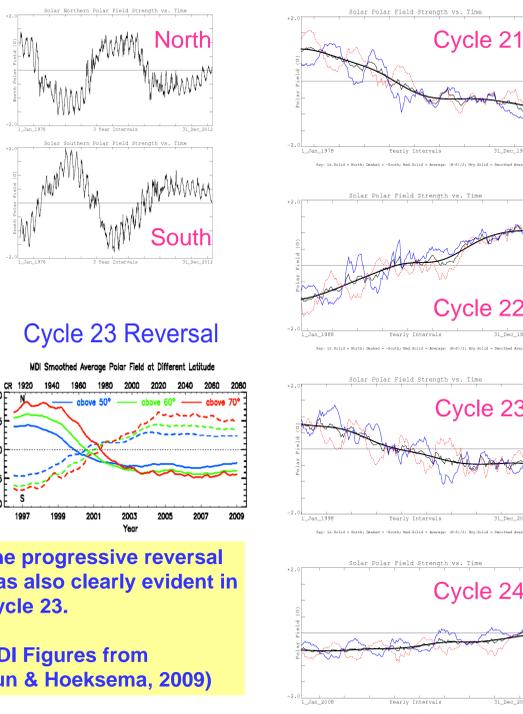
The northern magnetic field strength is shown in blue. The negative of the south is shown in red. The average of +North and -South is shown in black. The heavy black line is smoothed. N and S are shown separately in the panels below and to the left.

The two poles show a strong annual periodicity due to the inclination of the Sun's rotation axis to the ecliptic.

The polar field at minimum was asymmetric after Cycles 21 and 22, but fairly symmetric after 20 and 23.

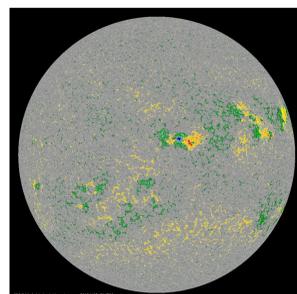
The polar field was weak in Cycle 23 and is weakening gradually and quite early, particularly in the north.

Polar reversals over 5 years around maximum for Cycles 21, 22, 23, and leading up to 24 are shown below right. The reversal this cycle seems more asymmetric. The North has already reversed sign.

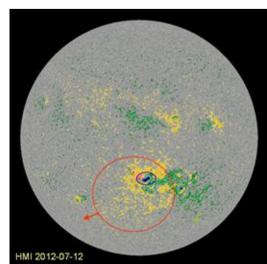


The progressive reversal was also clearly evident in Cycle 23.

MDI Figures from Sun & Hoeksema, 2009)



The current magnetogram (above) and radial field synoptic map (right) from HMI show an extended surge of weak negative (yellow) polarity that is making its way toward the south pole. The north below 70° has already reversed. The surge originated in the summer of 2012.



The extensive blue/yellow positive magnetic field region shown in this HMI magnetogram from 12 July 2012 has expanded and merged with left-over flux from other decaying active regions and is being carried poleward by meridional flows to reverse the southern cap.

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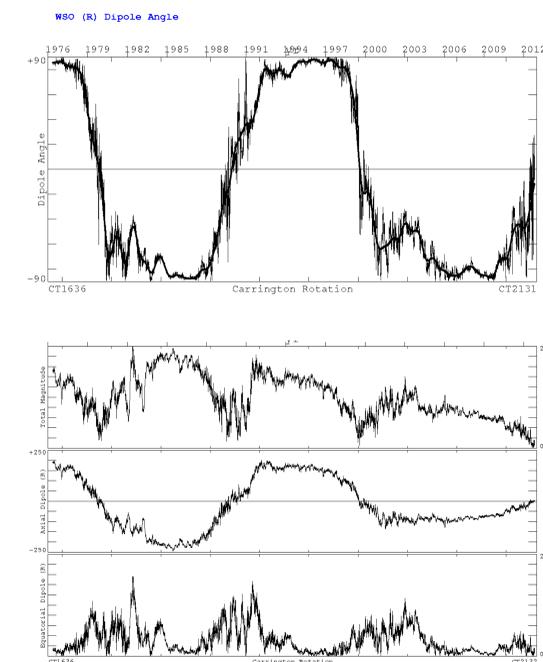
The five frames at right show large-scale features of the solar and coronal field over 36 years. The top frame shows the angle of the solar dipole field.

The second frame has three panels showing the total dipole, axial dipole and equatorial dipole.

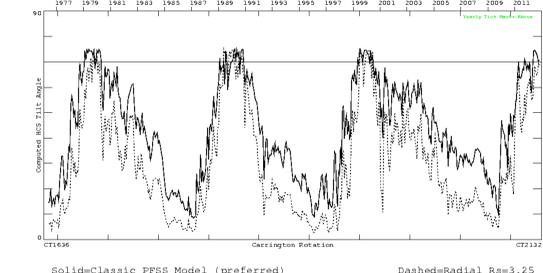
The third frame shows the inclination of the heliospheric current sheet computed with two models.

The fourth frame shows the total strength of the first three multipole components of the solar field: dipole, quadrupole and octupole.

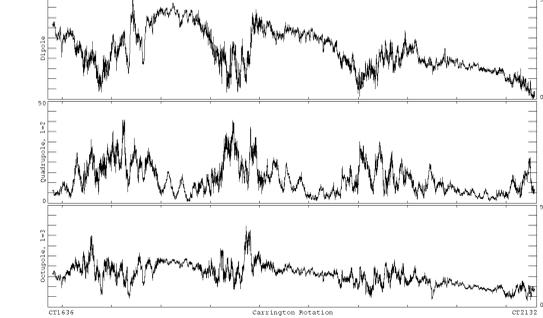
The fifth panel shows the relative magnitude of the m=0 (zonal) components of the first 8 harmonic components (l=1-8)



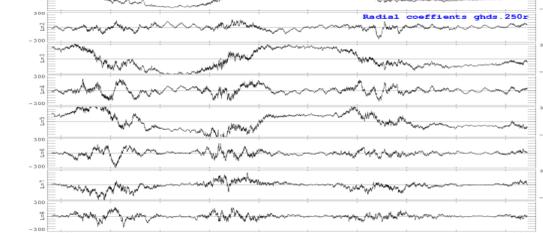
Maximum Inclination of the Current Sheet (N-S Mean): 1976-2012



Multipoles from WSO Radial: ghds.250R.power.ds



m=0 Multipoles from WSO



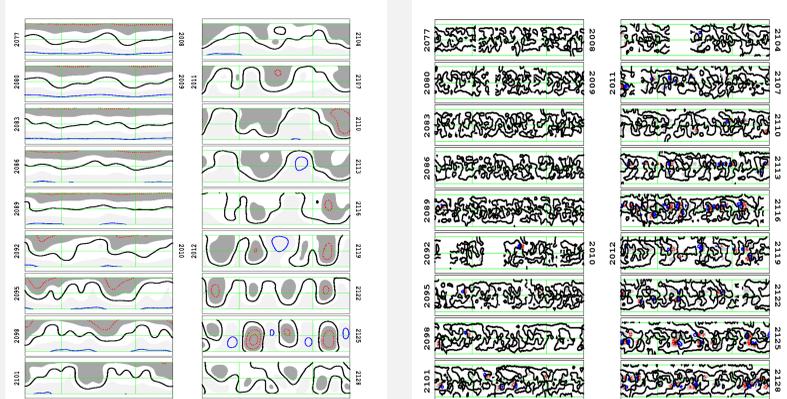
Cycle 24 has developed slowly, first in the northern hemisphere (2010) and then in the south (see synoptic maps on the right.)

The heliospheric current sheet (left panels) was not very flat even at minimum in 2009. The north was weaker, so the neutral line expanded to the north earlier. The negative north polar cap decayed through 2011 and by mid-2012 was absent as far as the heliosphere was concerned.

The southern cap remains positive, but is decaying slowly. Thus the asymmetry of the photospheric is carried out into the heliosphere.

Coronal and Photospheric Synoptic Maps During the Rise of Cycle 24

Each panel is two rotations wide and centered every 3rd CR from late 2008 through late 2012.



WSO Zonal Maps of the line-of-sight magnetic field for 3.5 Solar Cycles.

Full Sun maps are averaged over 360° and then plotted versus time to show the evolution of the largest scale features.

The figure shows in the fourth panel the net flux versus time – the familiar butterfly diagram.

The 3rd panel shows the net flux versus latitude over 3.5 solar cycles. Flux emerges in the active belts and moves poleward, causing polar field reversals at the time of solar maximum in 1979, 1990, 2000, and soon. Red, dashed contours are for negative field.

The top two panels show the symmetric and antisymmetric components of the net flux. There was much less flux in Cycle 23 and very little of the symmetric flux pattern. The polar fields, shown most prominently in the antisymmetric component, were weak in Cycle 23.

