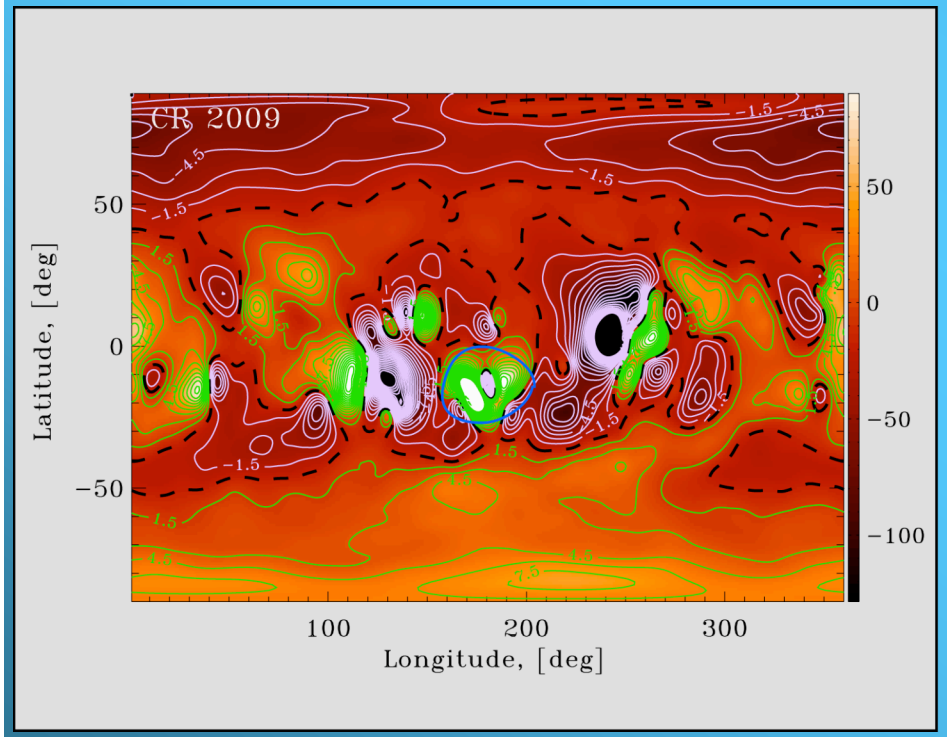
WG2 Topical Sessions

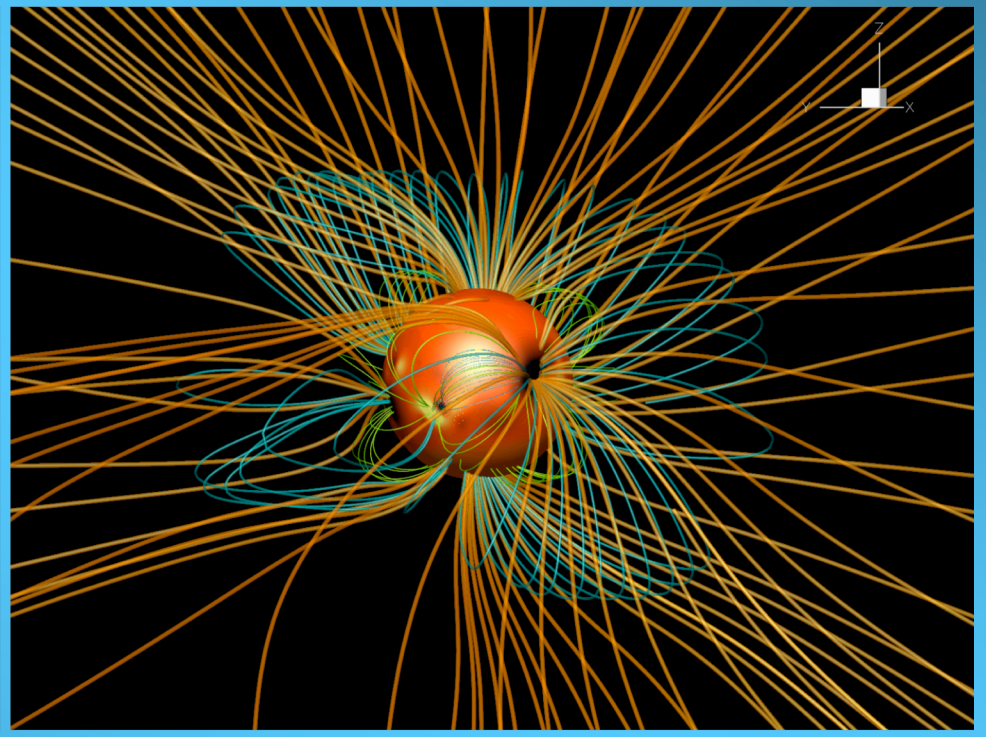
WG2 Session: Magnetic (and Other) Data Input into Global Models

Chairs: Roussev and Arge

Date: Thu PM, Aug 3

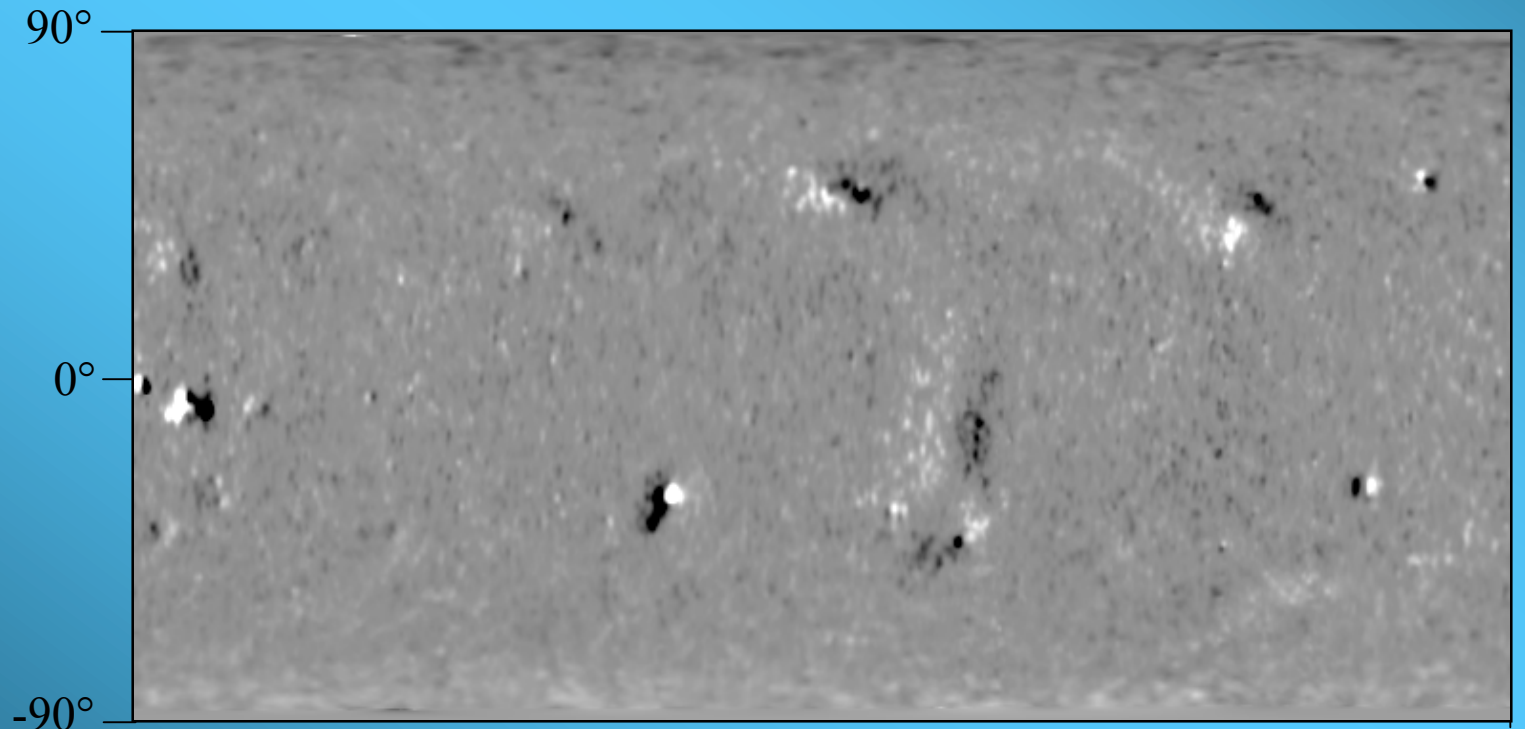
A: Magnetic Observations ⟶ **B:** 3D Global MHD Model of Solar Corona





This session is about how **A** is obtained, and how this (and other data) are incorporated into **B**.

Solar Synoptic Map

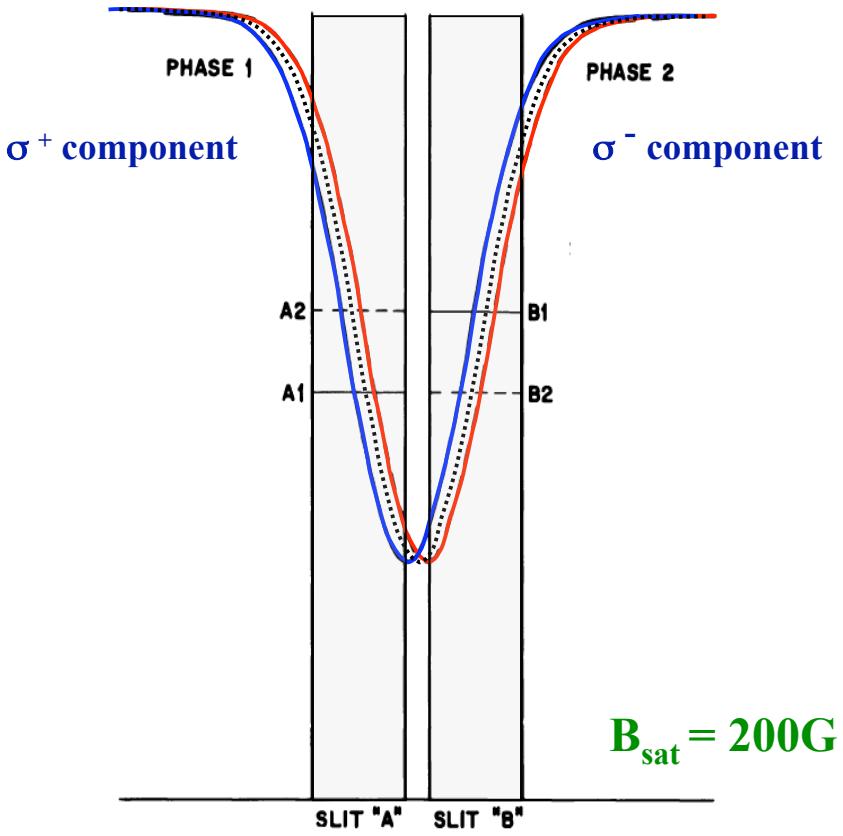


Time

Courtesy Mount Wilson Solar Observatory

Line Saturation Effects

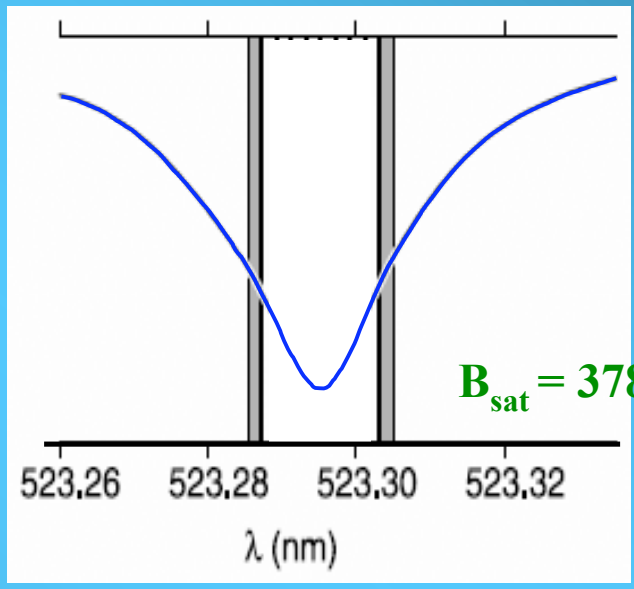
λ525.0nm



B_{sat} = 200G

Howard et al., Solar Physics 1983

λ523.3nm



B_{sat} = 3782G

Ulrich et al., ApJ 2002

Correction factor = 4.5-2.5sin²ρ
where ρ = center to limb distance

Session Summary

- We will discuss how to make a best use of solar magnetograms in global computational models of the solar corona and solar wind.
- We will talk about the advantages and limitations of the available magnetic data (NSO/SOLIS, MWO, WSO, MSO/IVM, SoHO/MDI, etc.) and numerical models.
  - Observers will discuss the standard and alternative approaches as well as reduction techniques of those data.
  - Numerical modelers will discuss what boundary conditions and observed data inputs are used in MHD calculations of the steady-state solar corona and solar wind as well as transient phenomena.

Speakers

1. Carl Henney (NSO): *"SOLIS-VSM Longitudinal Magnetic Synoptic Maps"*
2. Leif Svalgaard (ETK): *"How Good/Bad Are the Inner Boundary Conditions for Heliospheric Solar Wind Modeling?"*
3. Luca Bertello (UCLA): *"Modeling the Full Solar Magnetic Field Surface"*
4. Yang Liu (Stanford): *"Using MDI and WSO Synoptic Maps/Charts in Numerical Models"*
5. Jon Linker (SAIC): *"Boundary Conditions and Data Inputs Used for Both Ambient and Eruption Calculations"*
6. Igor Sokolov (UM): *"Semi-Empirical MHD Modeling of the Solar Corona and Solar Wind"*

We invite researchers who have worked, or presently work on these and other related topics to join us and contribute to the discussion.

WG2 Session: Origin and Evolution of the Solar Wind

Chairs: Roussev and Holzer
Date: Wed PM, Aug 2

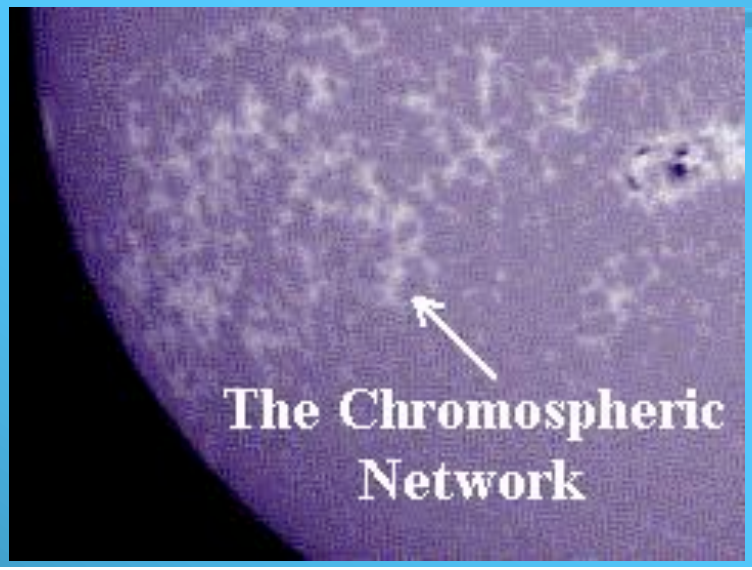
Session will focus on photosphere–solar corona–solar wind magnetic connectivity and energy transport from photosphere to solar corona.

Session Summary

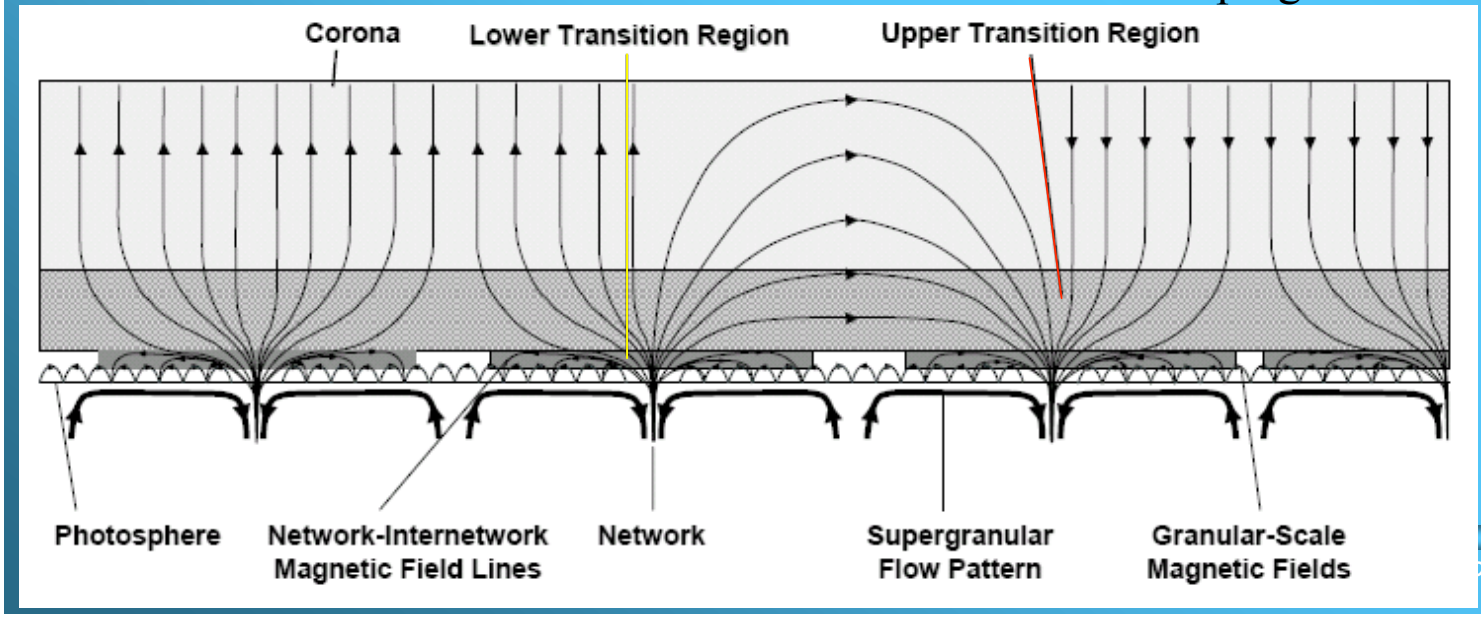
Fundamental questions to be addressed in the session include:

1. What fraction of network magnetic field closes below the corona in the network and internetwork?
2. How does the network (and internetwork) magnetic field map into the corona for a variety of different distributions of magnetic field elements throughout the network and internetwork?
3. How much magnetic energy dissipation is expected as a consequence of supergranular transport of internetwork fields into the network and of the consequent reconnection?
4. What fraction of the dissipated magnetic energy gets to the corona, in what form does it get there, and by what path?
5. Is most of the lower corona emission produced on recently reconnected field lines (and thus transiently heated field lines) connecting the network to the internetwork?
6. Session will also discuss the peculiar ion distributions that provide important clues to the specific mechanisms that heat and accelerate the solar wind in the low corona.

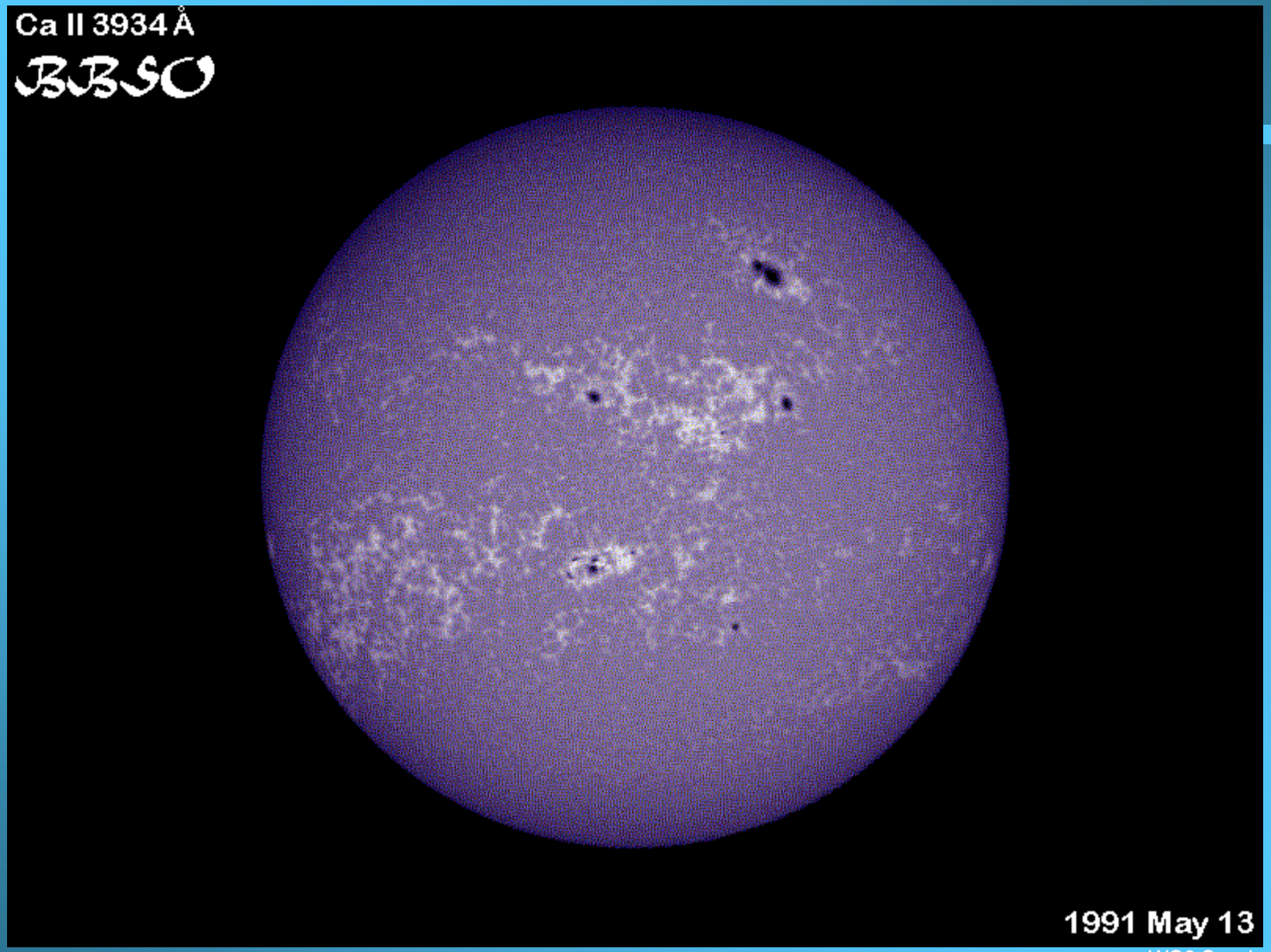
Chromospheric Network



The chromospheric network is a web-like pattern most easily seen in the emissions of the red line of hydrogen (H-alpha) and the ultraviolet line of calcium (Ca II K - from calcium atoms with one electron removed). The network outlines the supergranule cells and is due to the presence of bundles of magnetic field lines that are concentrated there by the fluid motions in the supergranules.



T. E. Holzer, 2005, Solar Wind 11 Proceedings


Ca II 3934 Å
BBSO
1991 May 13

Speakers

Plenary: Steve Cranmer (CfA): *"Turbulent Origins of the Solar Wind"*

Session:

1. Phil Isenberg (UNH): *"Kinetic Mechanisms for Generation of the Fast Solar Wind"*
2. Scott McIntosh (SWRI): *"Magneto–Convection Driven Spicules: Fast Solar Wind Origins and the Potential Impact on CME Propagation"*
3. Uri Feldman (NRL): *"The Source of the Solar Wind in Quiet and Coronal Hole Regions"*
4. Tayeb Aiouaz (HAO): *"The Supergranular Magnetic Network, its Expansion and Effects through the Solar Atmosphere"*

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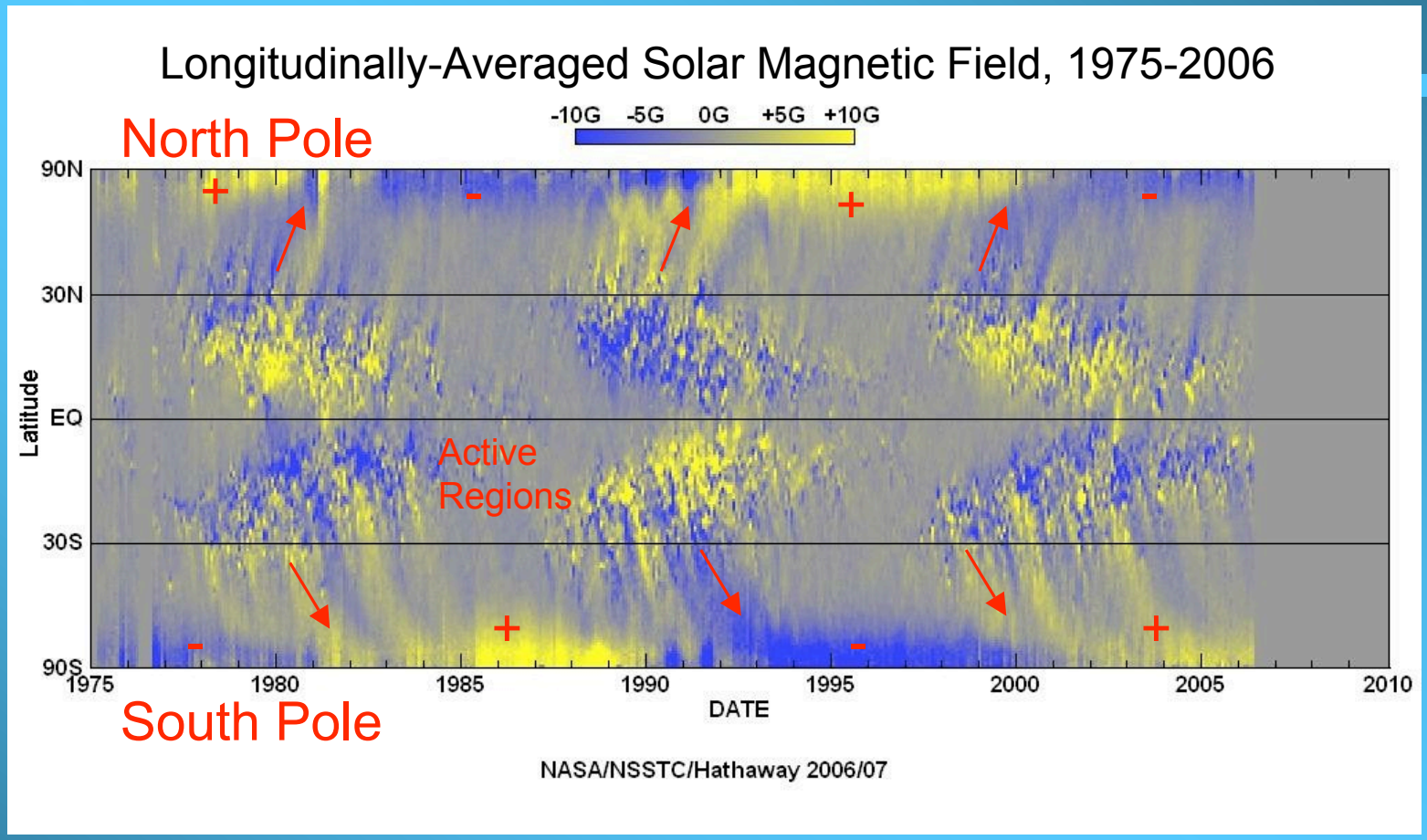
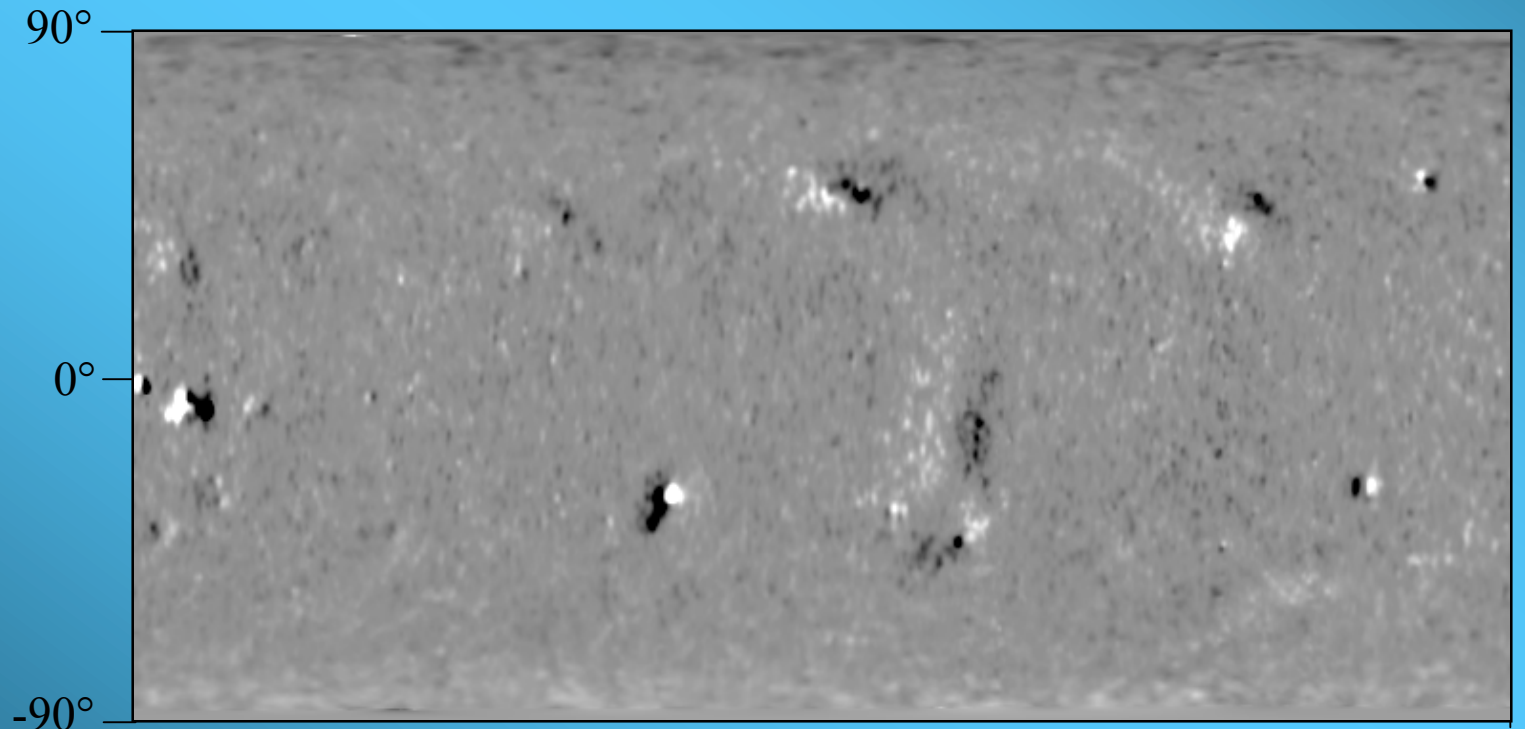
Reversal of the Solar Magnetic field and its Interplanetary Consequences



Solar polar magnetic fields reverse direction at each cycle maximum, producing a ~22-year magnetic solar cycle. How does this happen? The pole-ward transport of opposite-polarity weak magnetic fields from low latitude active regions is an important part of the process.

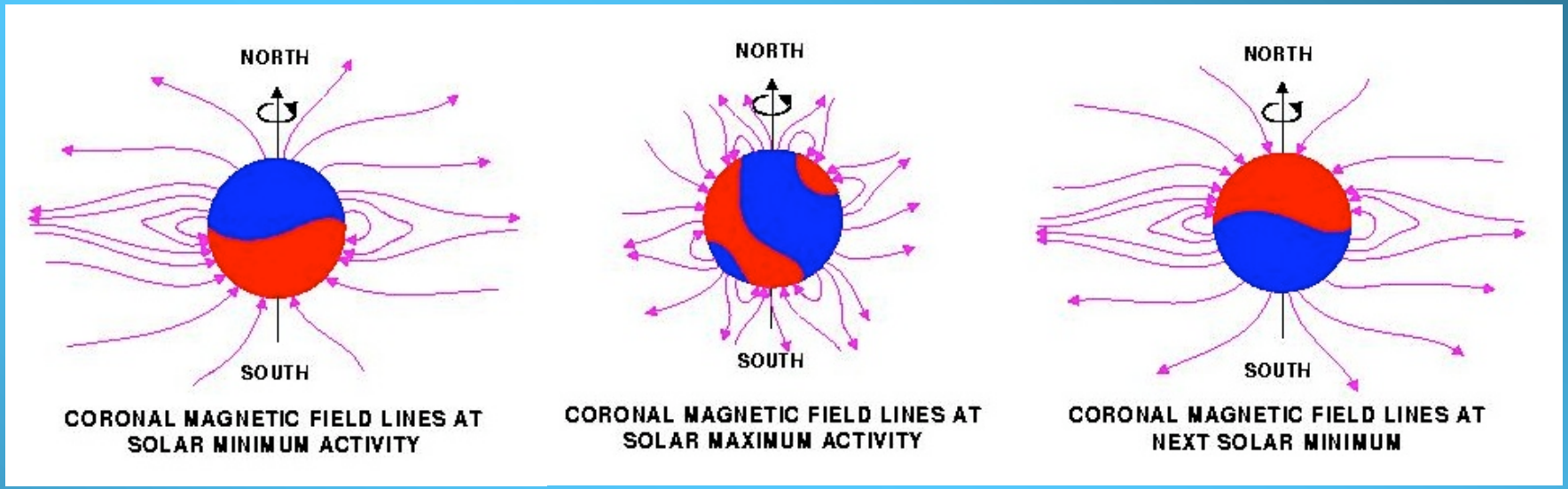
Solar Synoptic Map



Time

Courtesy Mount Wilson Solar Observatory

How is the field reversal manifested in the solar wind?
Ulysses Observations of the Magnetic Field Reversal in Cycle 23

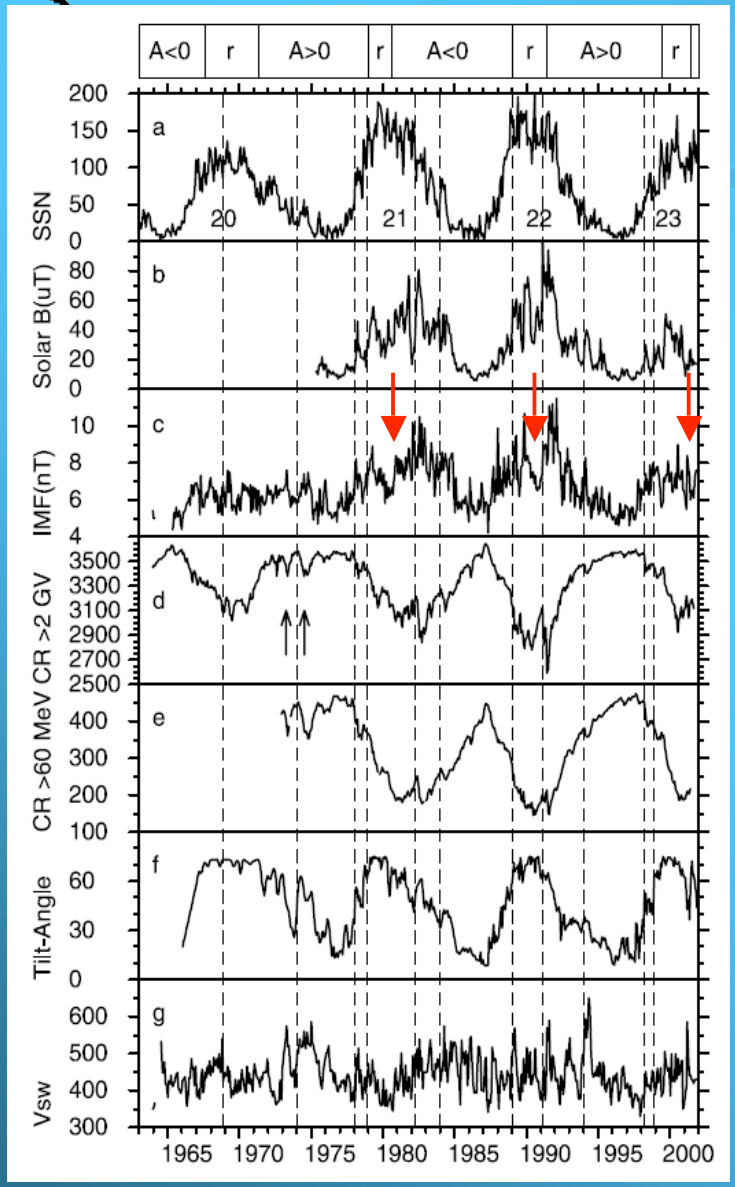


[Ed Smith, JPL; Bob Forsyth, IC]

A single current sheet separates two hemispheres of opposite field direction at solar minimum,

At maximum, the interplanetary magnetic field is more complex, with multiple current sheets. The dipole field axis does not simply turn smoothly through 180° in latitude.

How do the evolving interplanetary field structures relate to the developing solar magnetic field?



Wibberenz et al., 2002

Examples of the interplanetary consequences of the solar magnetic field cycle (A>0 = +ve North Pole):

<= Variations in solar magnetic field strength ~ correlated with:

<= Variations in IMF strength (note local minimum at solar maximum)

<= Variations in galactic cosmic ray intensity – flat profiles in A>0 epochs, pointed in A<0; consequence of particle drifts in the heliosphere

<= Variations in the tilt-angle of the heliospheric current sheet.

Speakers include:

Karel Schrijver(Lockheed Martin Advanced Technology Center) “The reversing solar polar field to test flux transport models and validate near-surface flows”

Yang Liu (Stanford) “The Reversal of Solar Magnetic Field Observed With SOHO/MDI and Its Expression in the Corona and Heliosphere”

Justin Kasper (MIT) “Connecting the Corona and Interplanetary Space with the Mileura Wide-Field Array”. This will discuss a new technique to monitor heliospheric magnetic fields using radio scintillation methods.

Deviations From the Parker Spiral

Parker's 1958 theory of the solar wind has been remarkably well confirmed by subsequent observations;

Field lines are Archimedean Spirals along cones of constant latitude.
However, there are occasions where the IMF clearly deviates from the Parker Spiral:

1) Ulysses observations at high helio-latitudes show deviations from the Parker spiral. What is the nature of these deviations, and their implications? Neil Murphy (JPL) will discuss.

2) Near radial fields can be produced in association with abrupt decreases in solar wind speed streams. Jack Gosling (U. of Colorado, Boulder) will report on these structures

3) Nathan Schwadron (Boston U.) will discuss how motions of the magnetic field line footpoints at the Sun can offer an explanation for the non-Parker fields observed by Ulysses.

Other sources of non-Parker fields that may be discussed include waves and interplanetary coronal mass ejections/magnetic clouds.

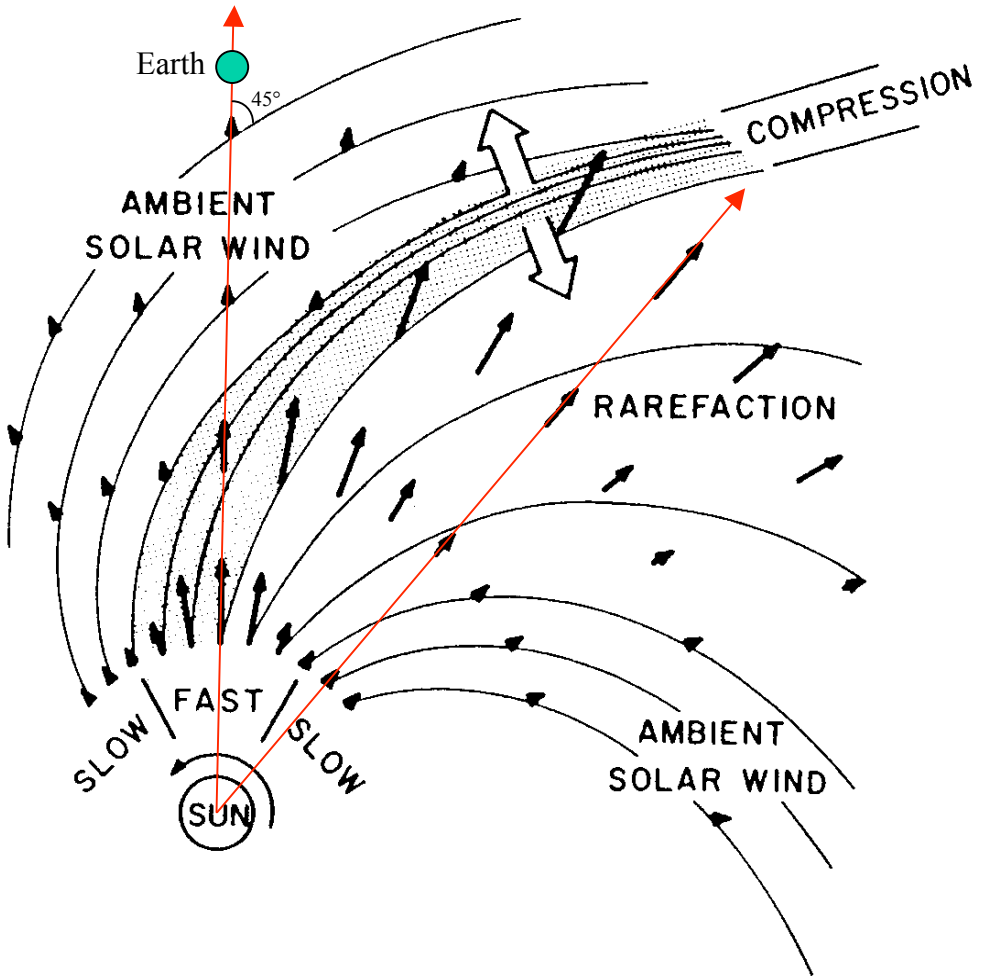
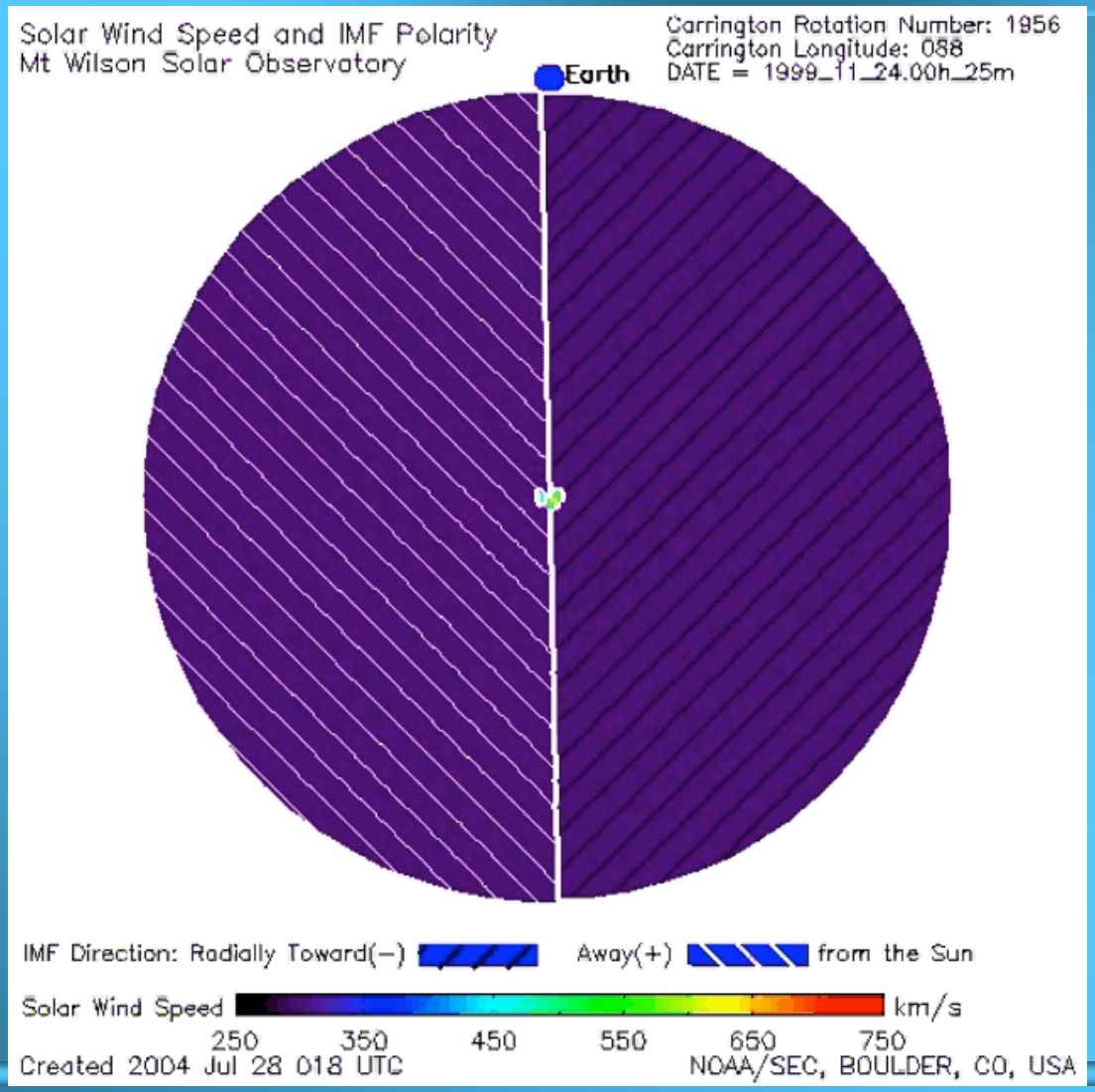


FIG. 4.13. Geometry of the interaction between fast solar wind (on less tightly wound spiral streamlines) and ambient solar wind (on more tightly wound spiral streamlines). The plasma is compressed where streamlines converge. (From Pizzo, 1985.)

Gosling, Annu. Rev. Astron. Astrophy.,1996, 34:35-73

Solar Wind Speed and IMF Polarity in the Ecliptic Driven by Daily Updated Photospheric Field Maps



IMF directed radially *away* from Sun.

IMF directed radially *toward* from Sun.