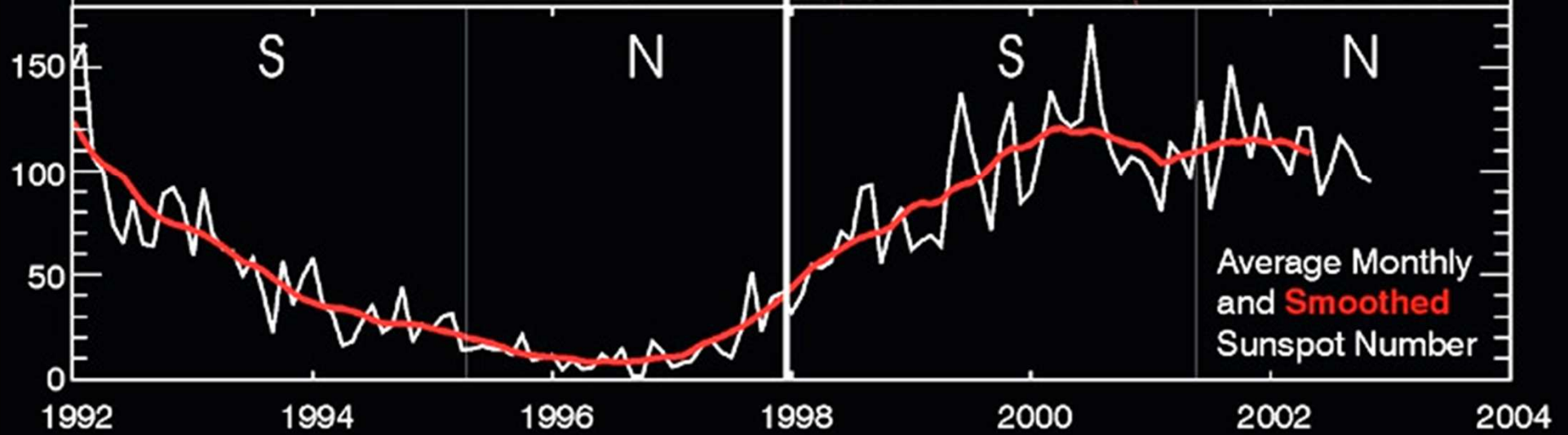
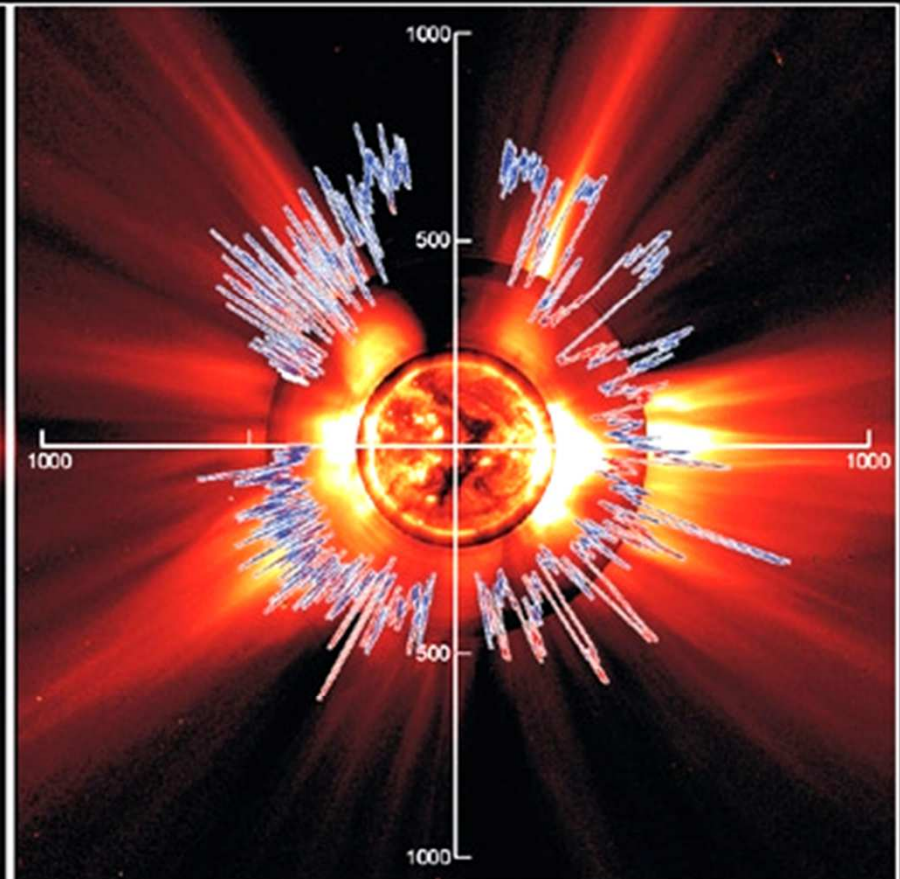
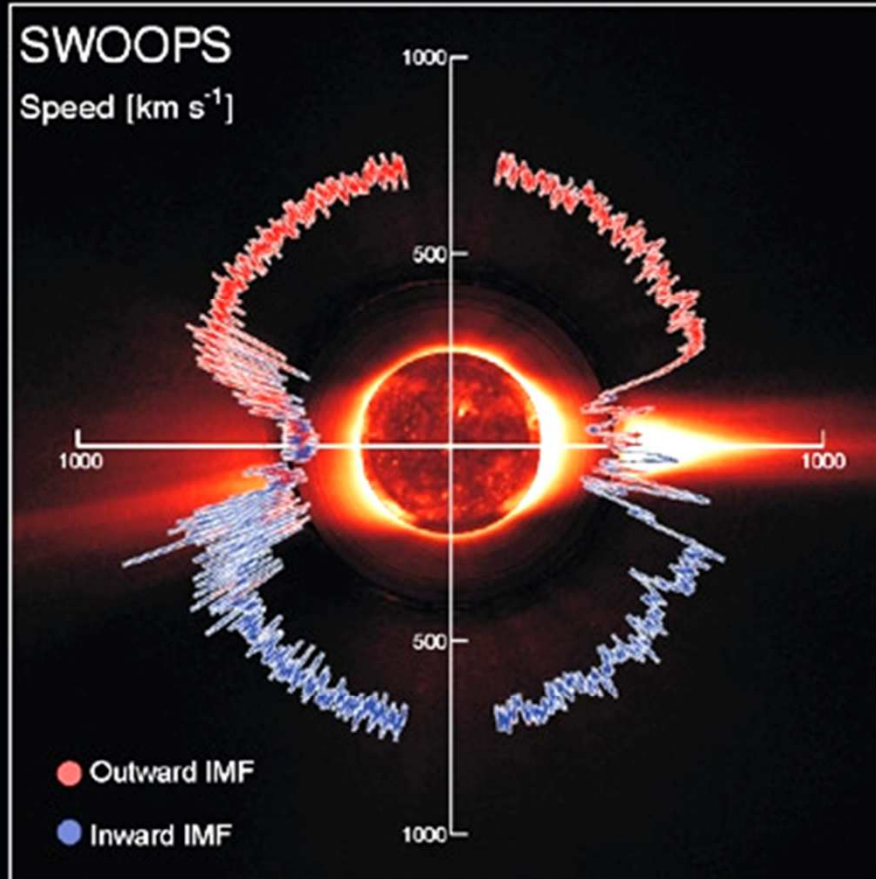


Ulysses First Orbit

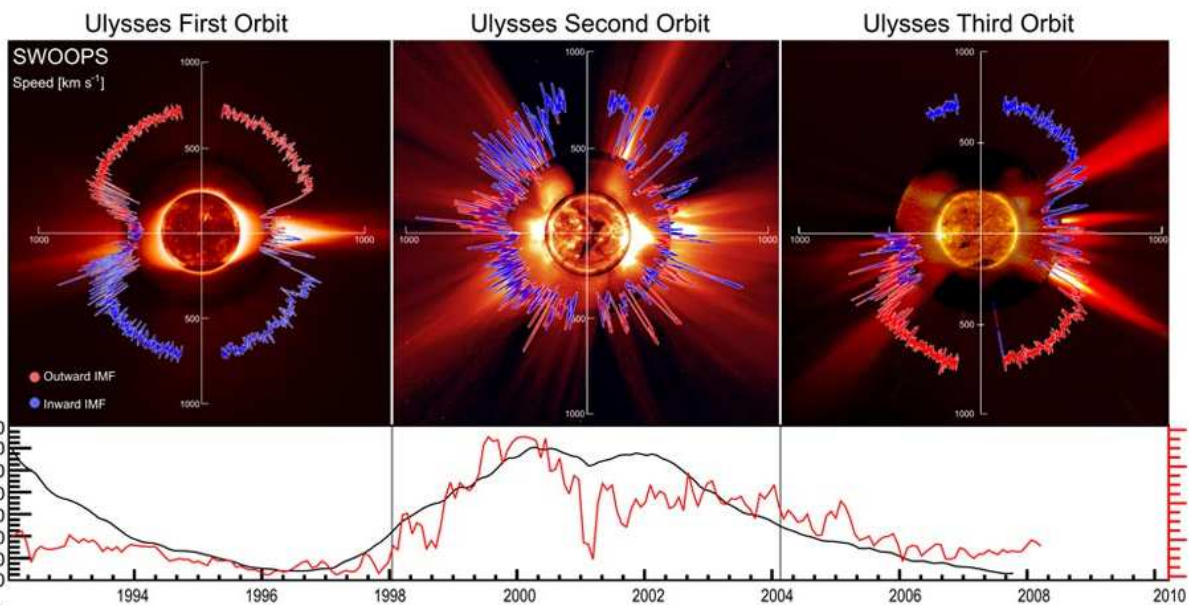
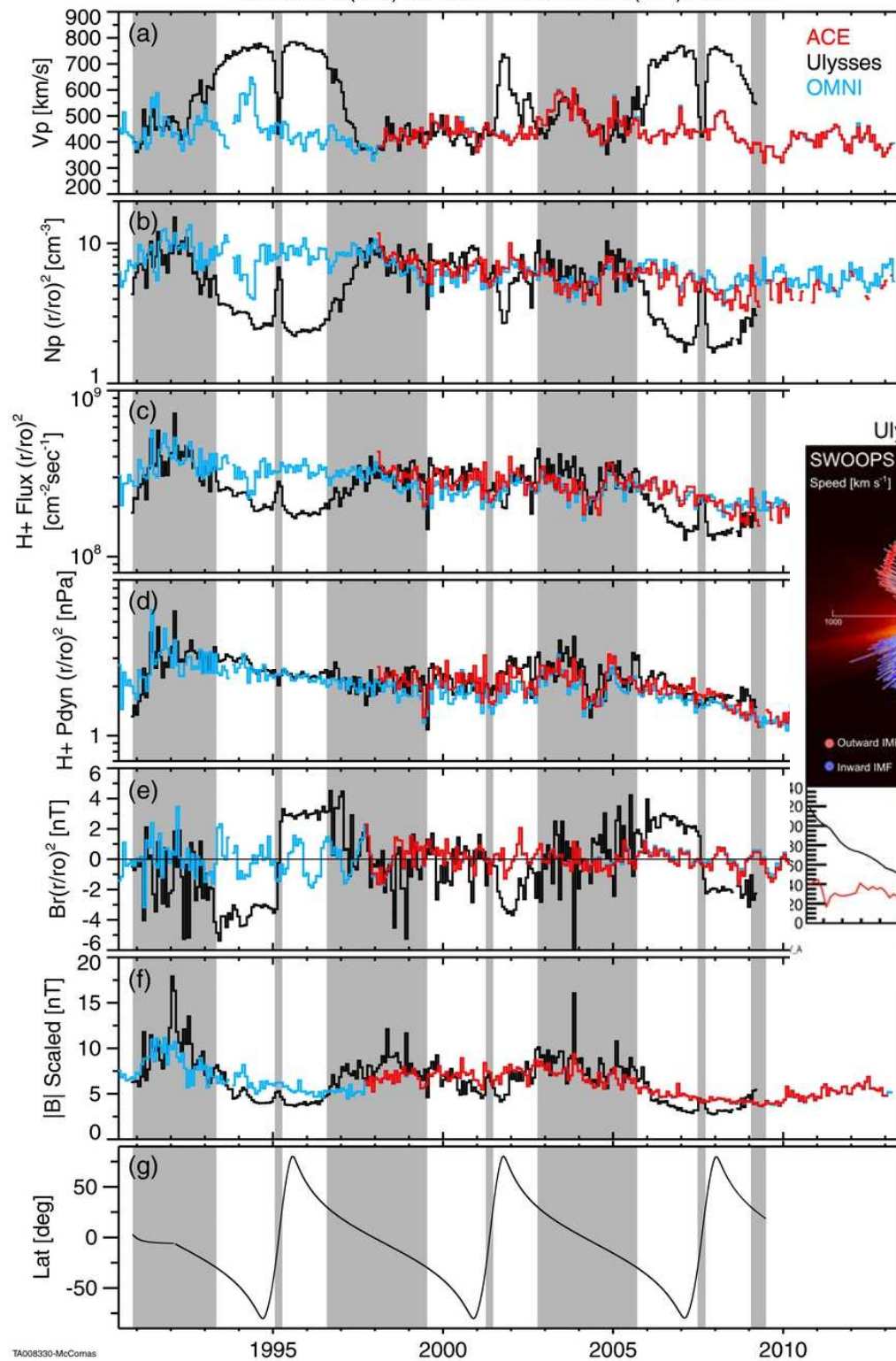
Ulysses Second Orbit



http://science.nasa.gov/media/medialibrary/2008/01/14/14jan_northpole_resources/swoops_wind.jpg

McComas et al., *Geophys. Res. Lett.*, 2003.

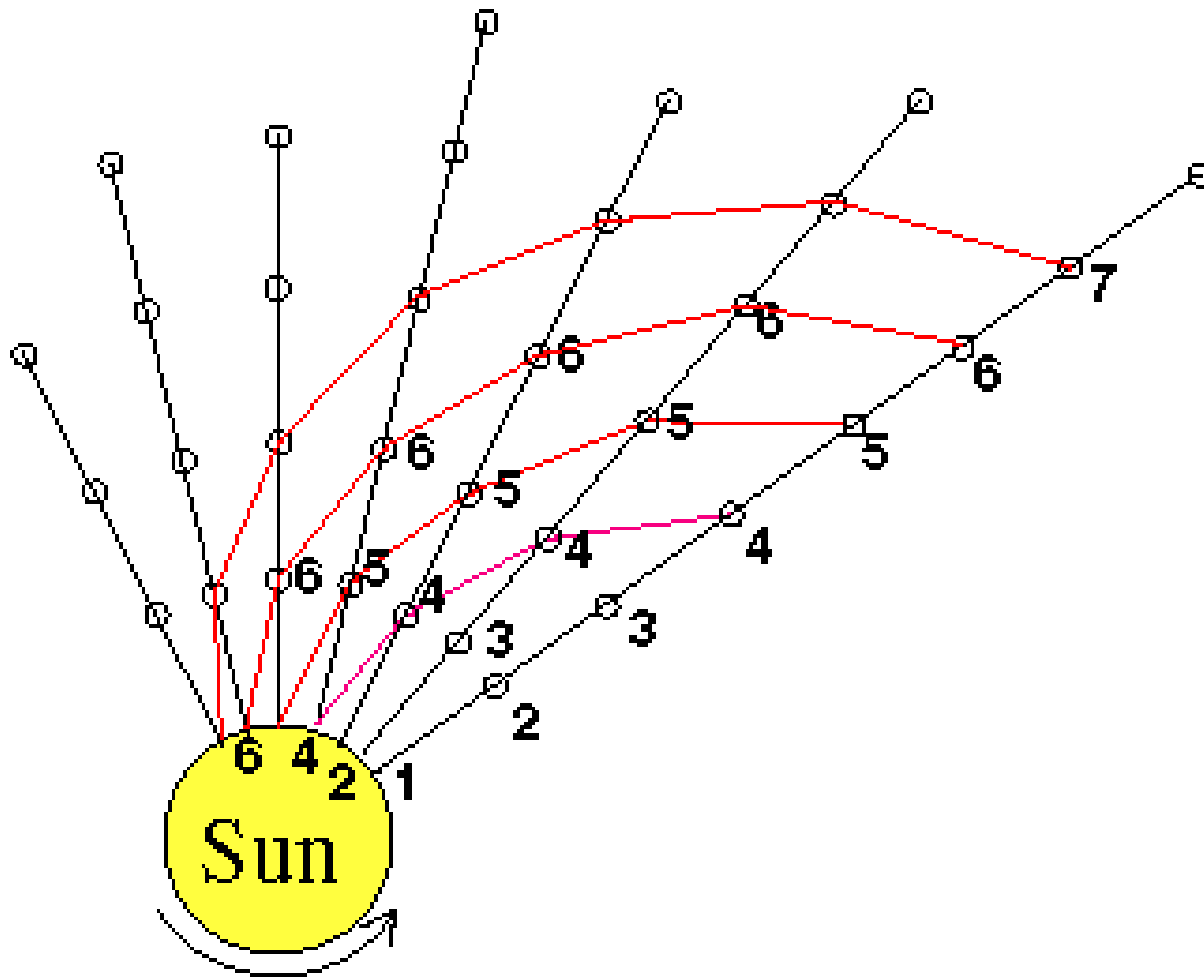
06/19/1990(170) 00:00 UT to 05/30/2013(150) 00:00 UT



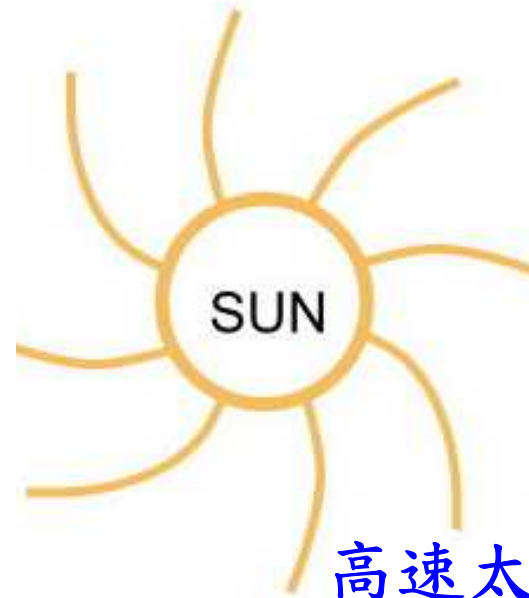
<http://iopscience.iop.org/0004-637X/779/1/2/downloadHRFigure/figure/apj486711f2>

Parker Spiral

當太陽風吹出時，磁場會被太陽風拉著跑，由於太陽自轉，太陽磁場會以螺旋結構(稱之為Parker Spiral)分佈於太陽系中。



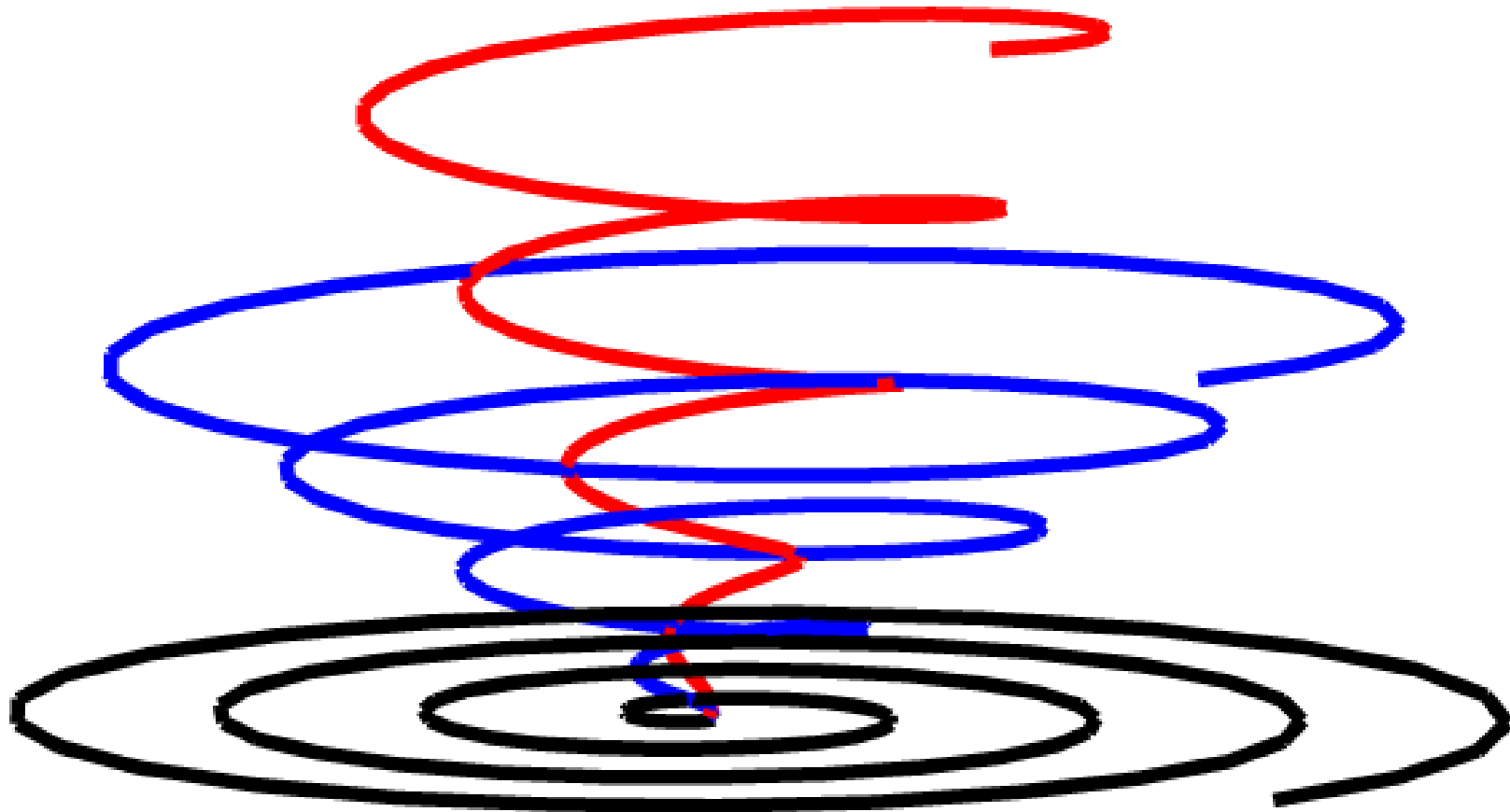
低速太陽風



高速太陽風

Parker Spiral

Ideal Parker spiral magnetic field lines between 0 and 25 AU for a solar wind speed of 450 km s^{-1} . Black, blue, and red lines show heliographic latitudes of 0, 30, and 60 degrees, respectively.



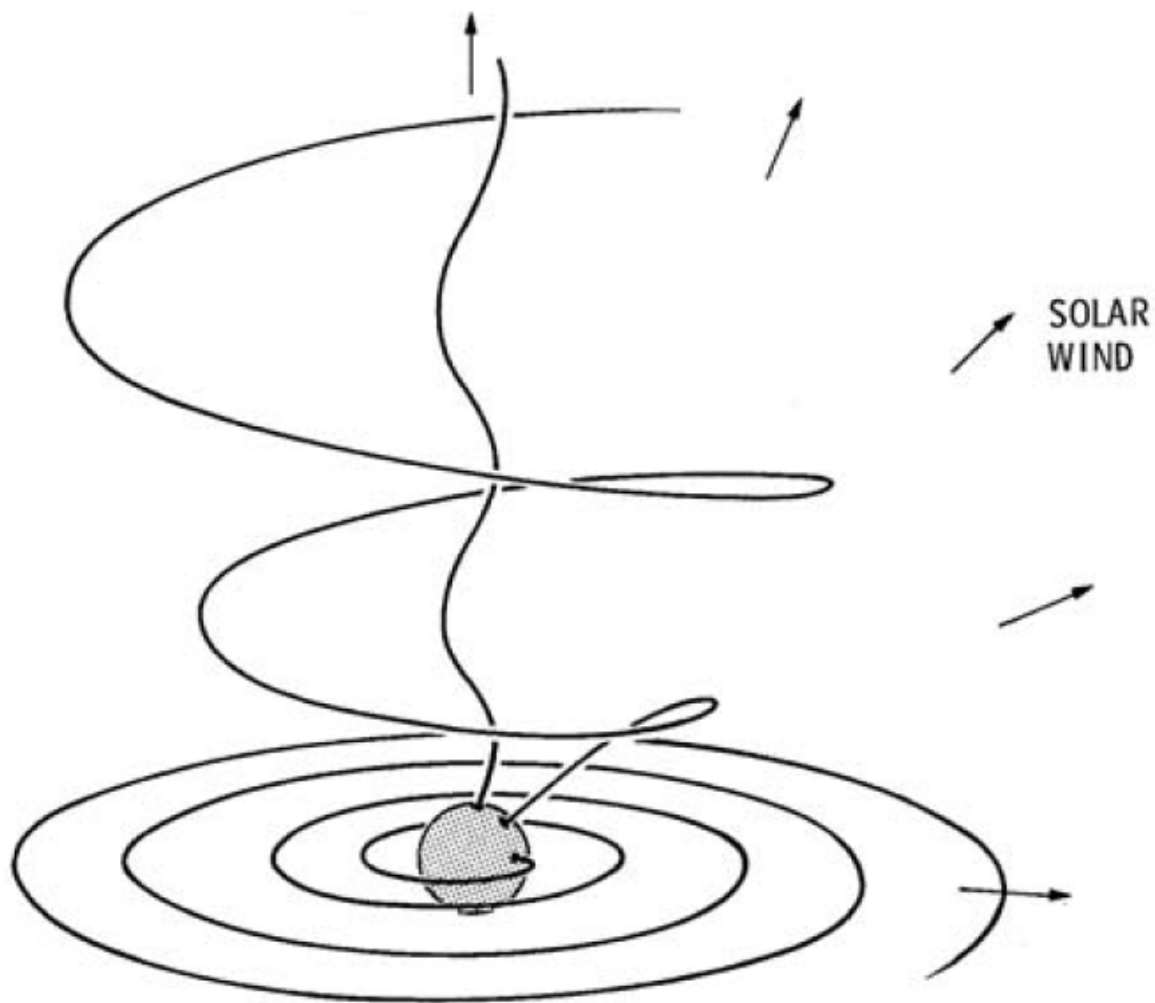
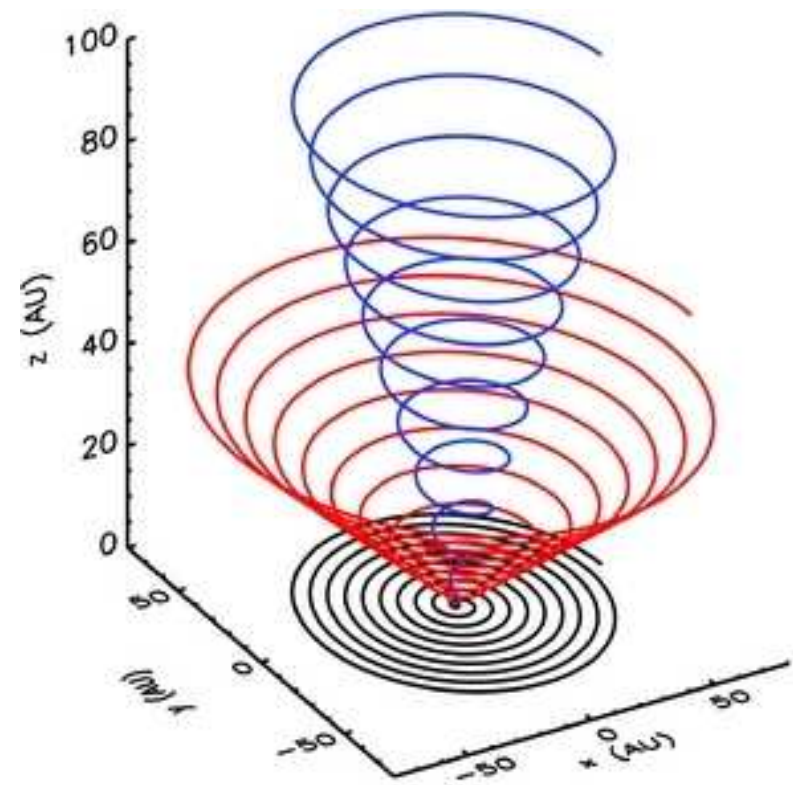


Fig. 4.2 (p.83) in Balogh et al. (2008)

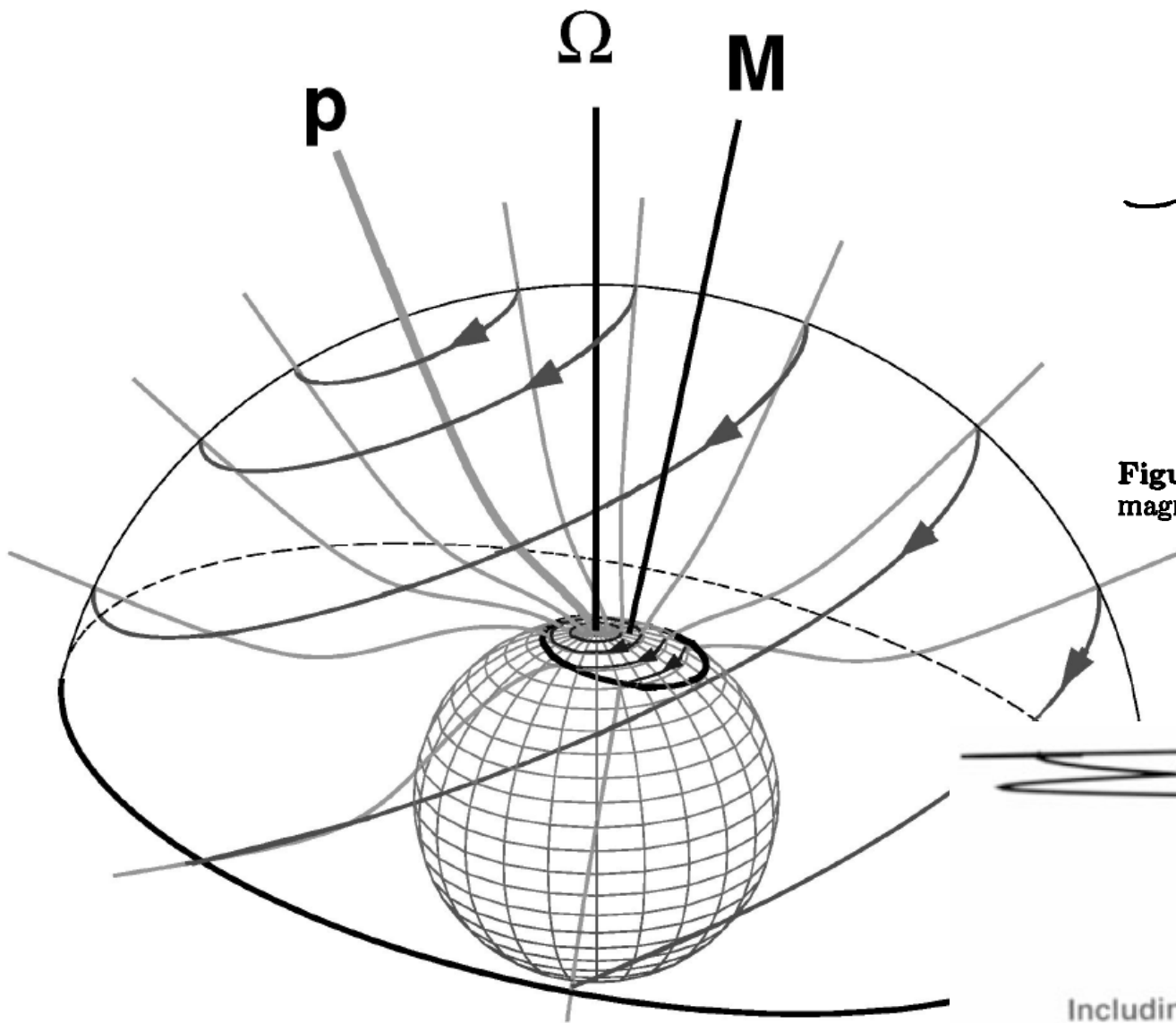


<http://iopscience.iop.org/article/10.1088/0004-637X/741/1/23>

Without
Footpoint Motion



Fig. 6.12 (p.134) in Simnett et al. (2017)



Fisk et al. (1999)

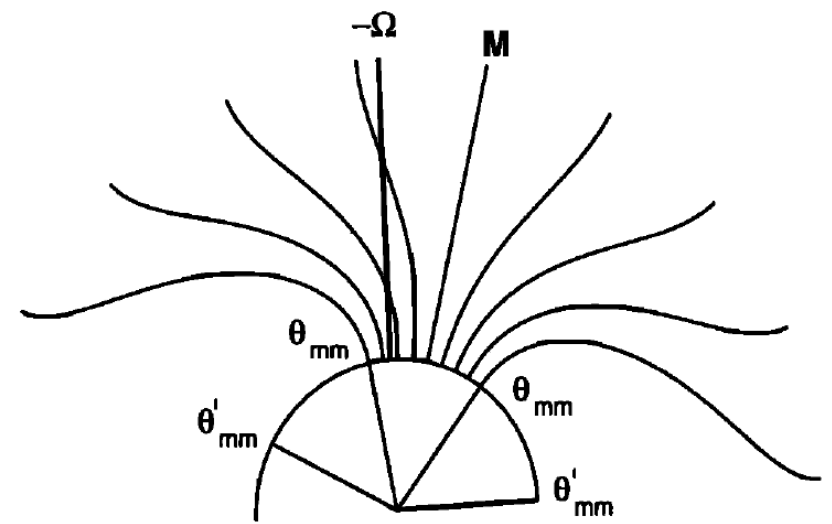
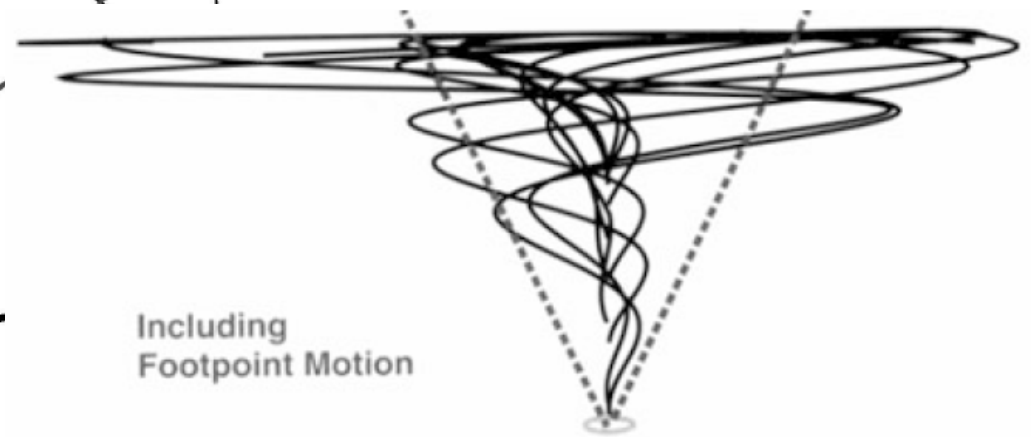


Figure 2. A schematic illustration of the expansion of magnetic field lines from a polar coronal hole.



Including
Footpoint Motion

Fisk (1996)

Fig. 6.12 (p.134) in Simnett et al. (2017)

FIG. 1.—An illustration of the motions of the magnetic field in the corona, in the polar coronal hole, as predicted by the model of Fisk (1996, after Zurbuchen et al. 1997). The outer surface, which is defined in the text, is penetrated only by field lines which open into the heliosphere and which have essentially constant magnetic pressure. The figure is drawn in the frame corotating with the equatorial rotation rate. The M -axis is the axis of symmetry for the expansion of the magnetic field from a polar coronal hole. The Ω -axis is the solar rotation axis. The open lines are field lines, with p marking the field line that connects to the solar pole. The curves with arrows are the trajectories of the field lines, the motion of which is driven by differential rotation of the photosphere.

The Fisk model leads to equations for the field components that differ significantly from the Parker equations:

$$B_R = B_o \left(\frac{r_o}{r} \right)^2$$

$$B_\theta = \left(\frac{B_o r_o^2}{r V_R} \right) \omega \sin \beta \sin \left(\phi + \frac{\Omega r}{V_R} - \phi_o \right)$$

$$B_\phi = \left(\frac{B_o r_o^2}{r V_R} \right) \left[\omega \left(\cos \beta \sin \theta + \sin \beta \cos \theta \left(\phi + \frac{\Omega r}{V_R} - \phi_o \right) \right) - \Omega \sin \theta \right]$$

The field strength at the source surface located at r_0 is B_0 . The co-latitude and longitude in heliographic coordinates are θ and ϕ , and ϕ_o is the longitude of the magnetic pole. The differential rate of rotation, $\omega = \Omega - \Omega(\theta)$ —that is, the difference between the angular velocity at the equator and at high latitudes (not the angular velocity at high latitudes).

When $\beta = 0$, the equations reduce to the Parker equations:

$$B_\theta = 0$$

$$B_\phi = \left(\frac{B_o r_o^2}{r V_R} \right) [(\omega - \Omega) \sin \theta]$$