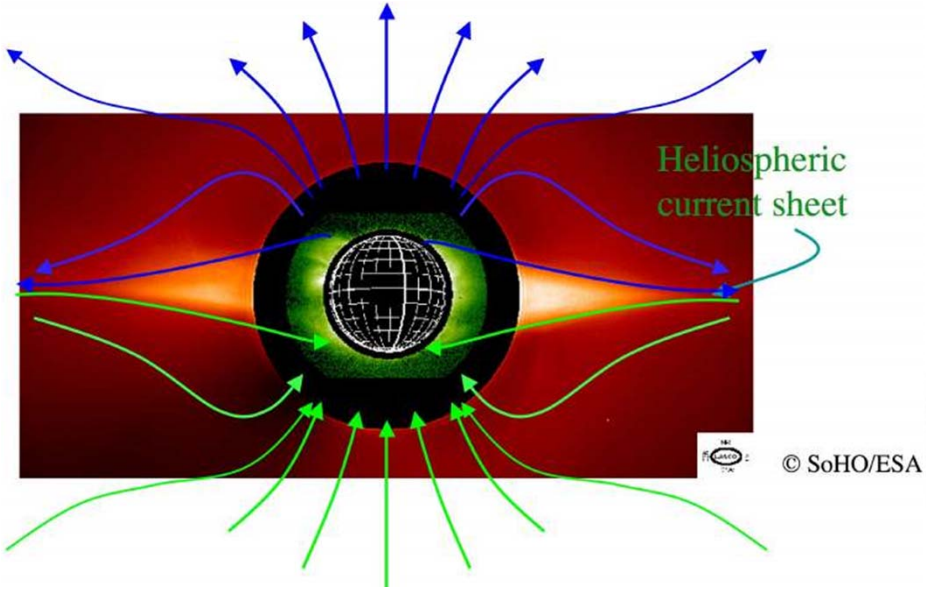
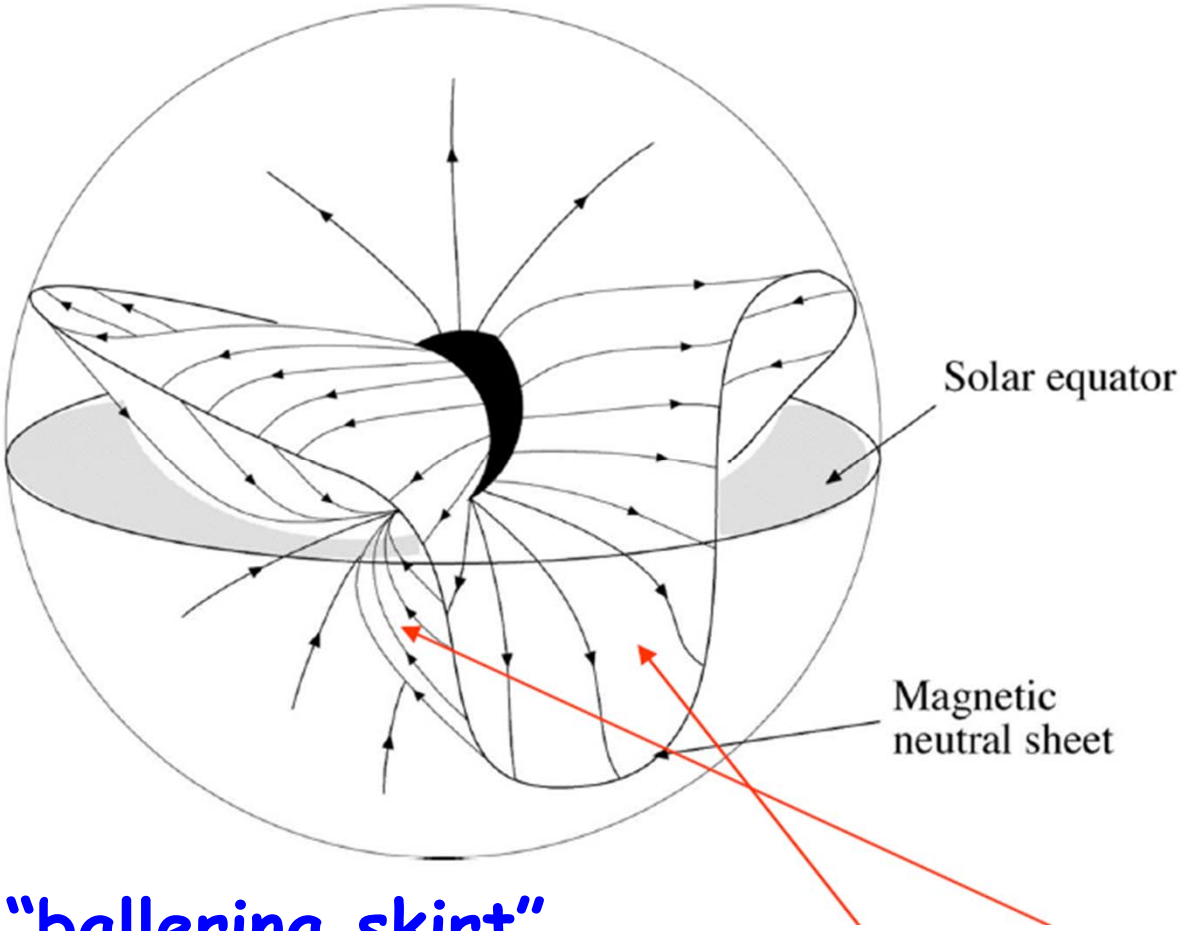
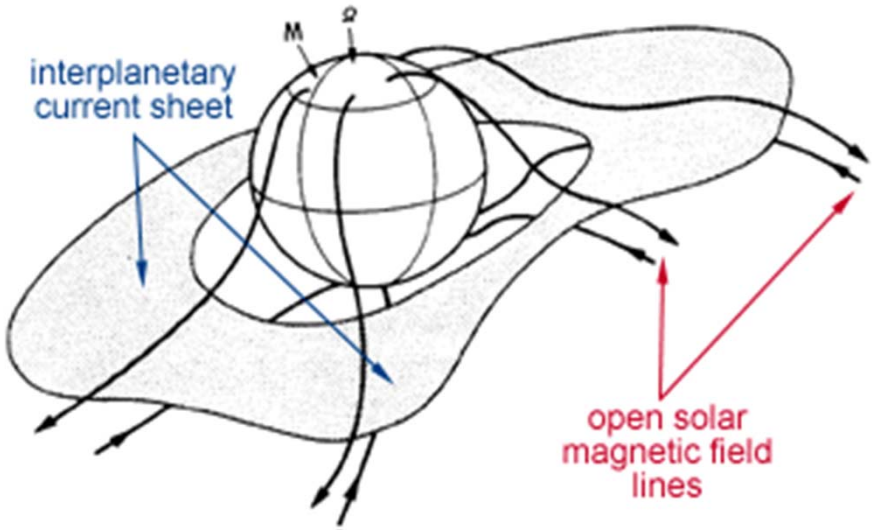
Heliospheric Current Sheet



http://www.nmdb.eu/?q=node/135





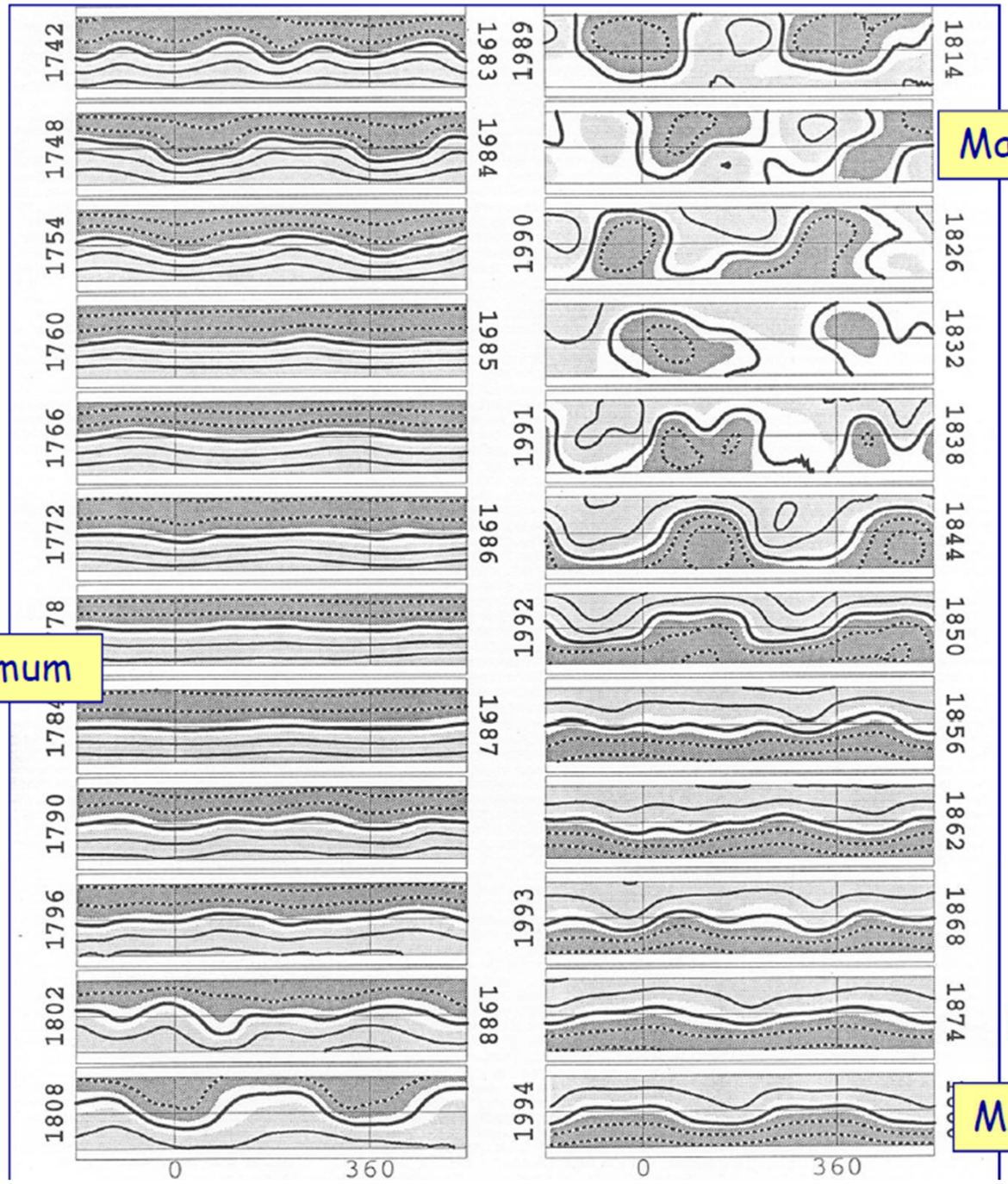
http://pluto.space.swri.edu/image/glossary/IMF.html

"ballerina skirt"

The Earth can be "toward" sector or in "away" sector

http://theory.physics.helsinki.fi~plasmainfo.html

The ballerina dancing through the solar cycle



Maximum

Minimum

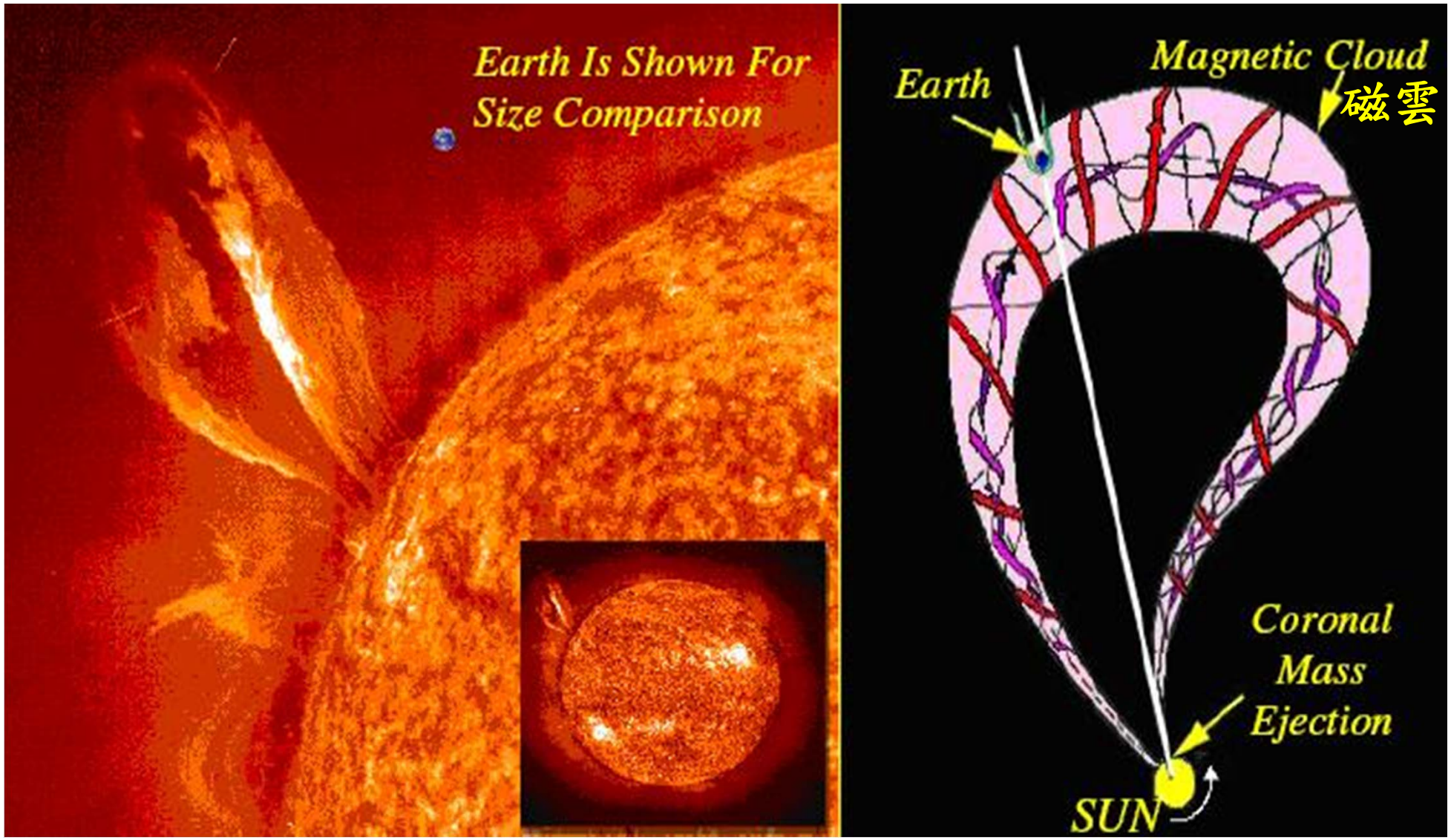
Minimum

The magnetic topology of the large-scale heliosphere

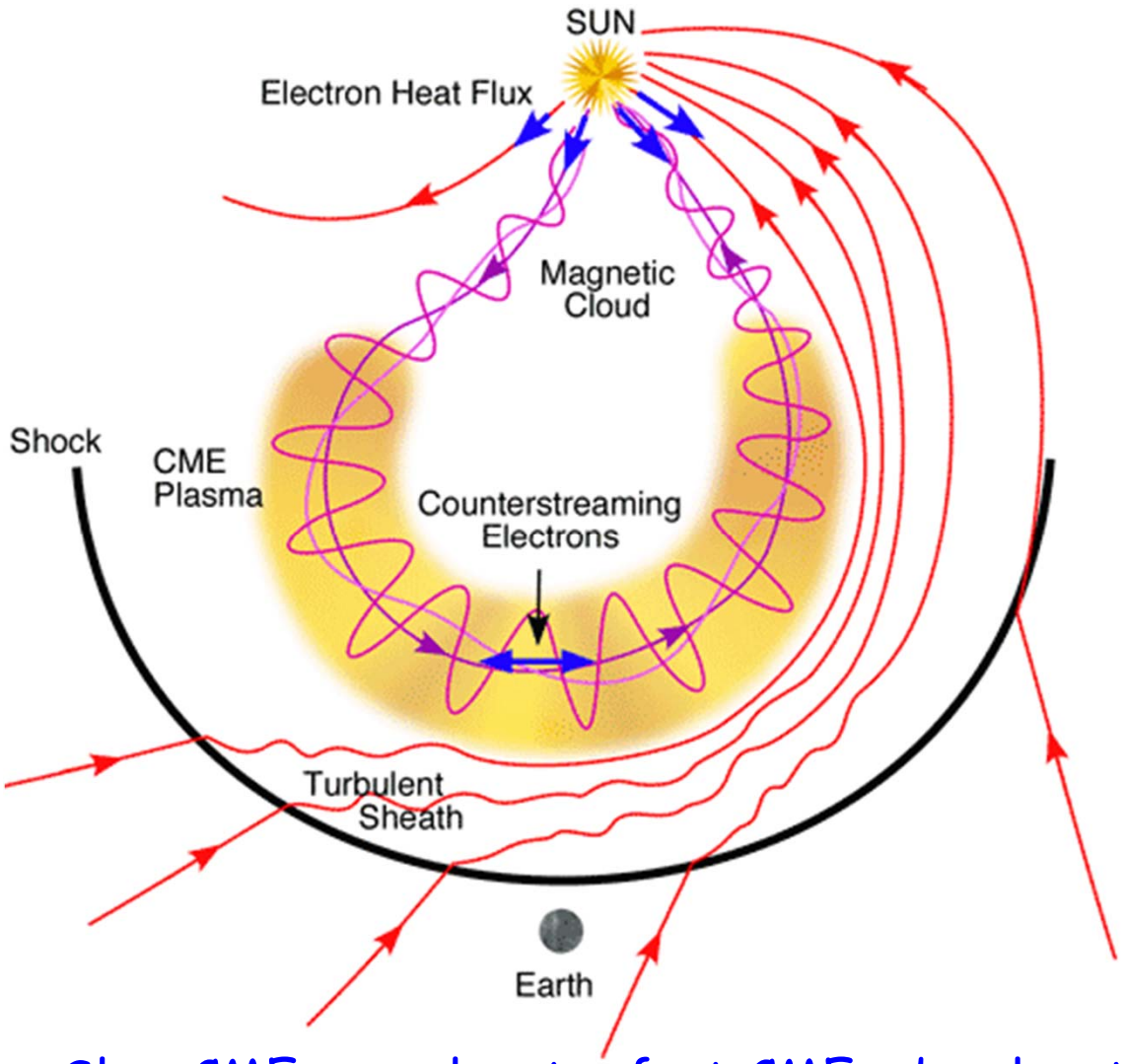
At activity maximum, the ballerina skirt flips over, and the magnetic polarity is then reversed at next minimum. Thus, the magnetic cycle of the sun (the "Hale-cycle") takes 22 years!

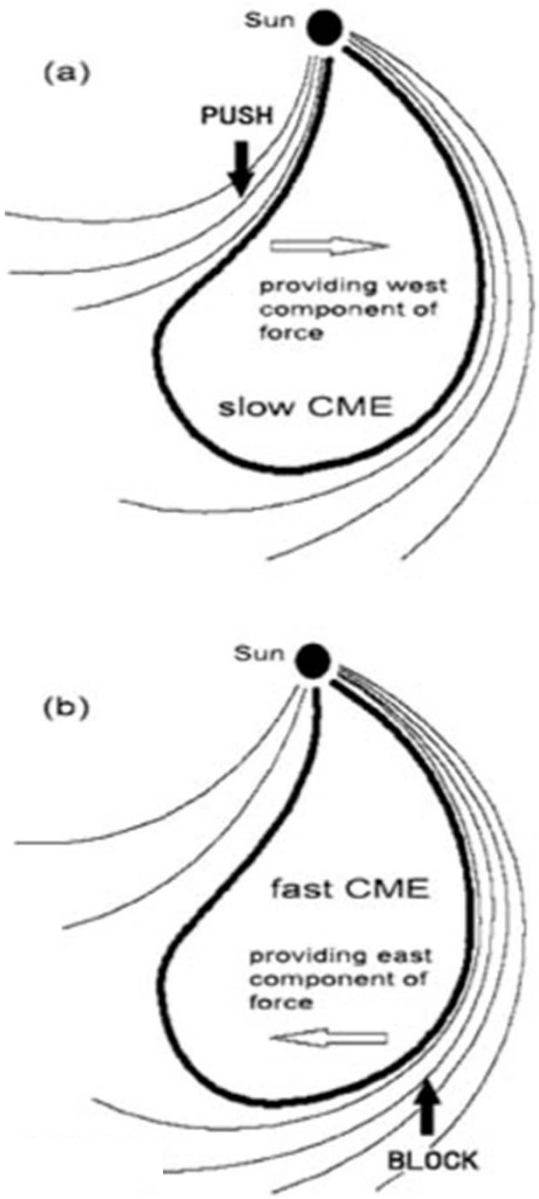
Hoeksema, 1995

http://theory.physics.helsinki.fi~plasmainfo.html



http://www.cac.cornell.edu/slantz/ECE5860/ECE586-Spr07/Images/magneticloud.jpg





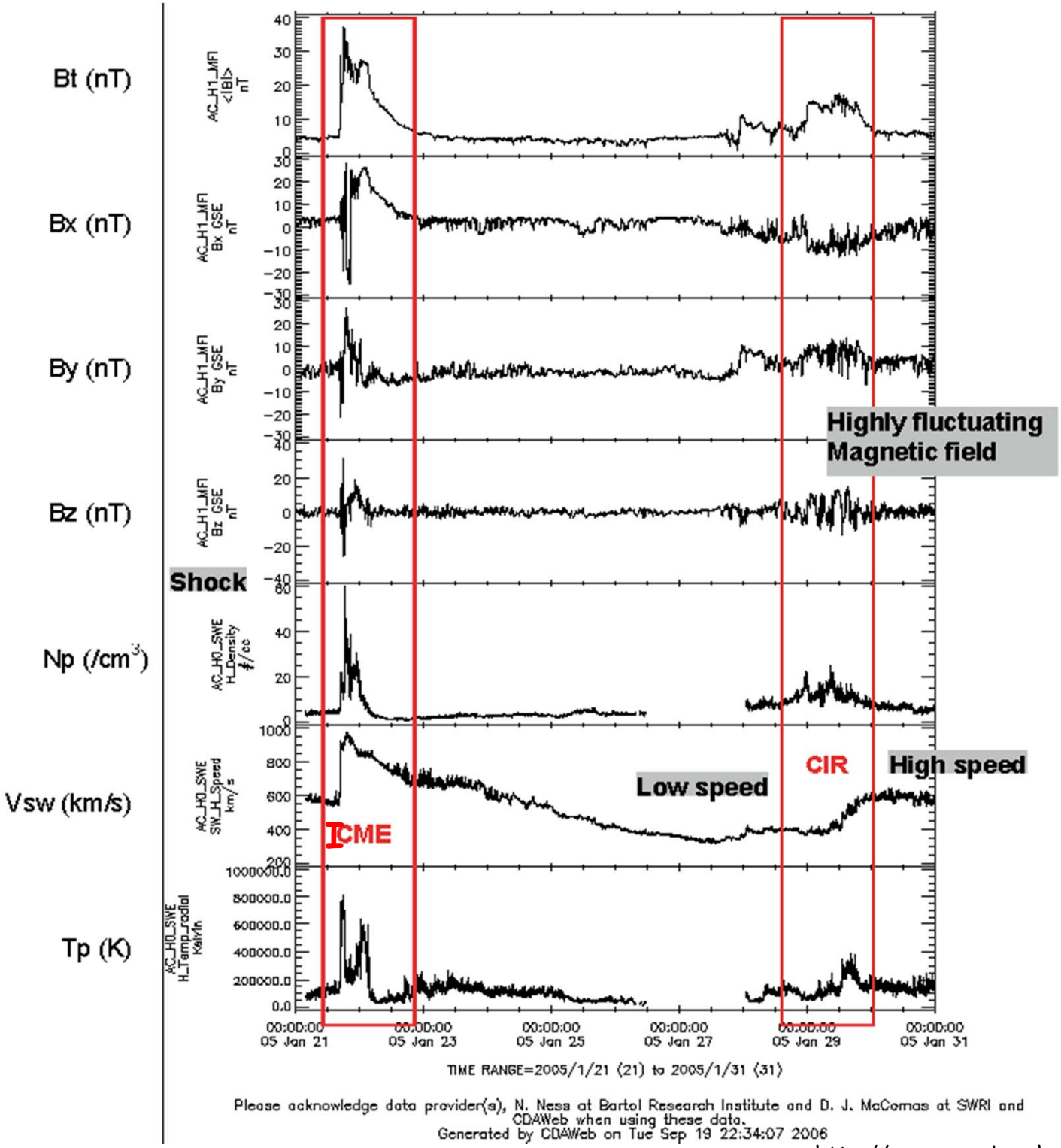
Slow CMEs accelerate, fast CMEs decelerate
→ towards the ambient SW speed

Forces acting on CMEs:
(i) Lorenz force (close to the Sun), (ii) Drag force (outer corona)

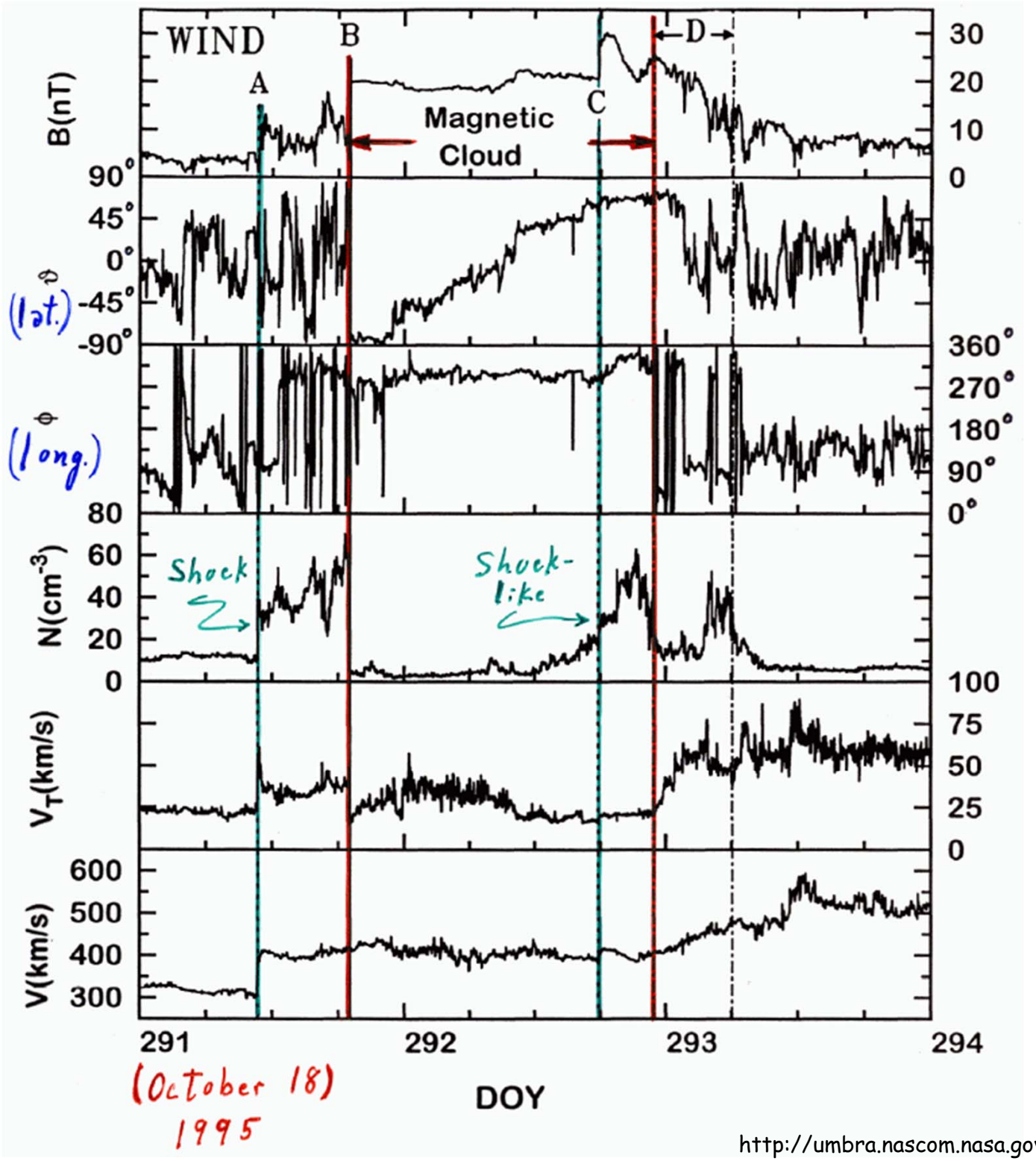
CMEs deformation:
interaction between (i) multiple CMEs, (ii) ambient solar wind

http://ase.tufts.edu/cosmos/pictures/Sept09/Fig8_7.MagCloud.gif

https://ccmc.gsfc.nasa.gov/images/dips-pic.jpg

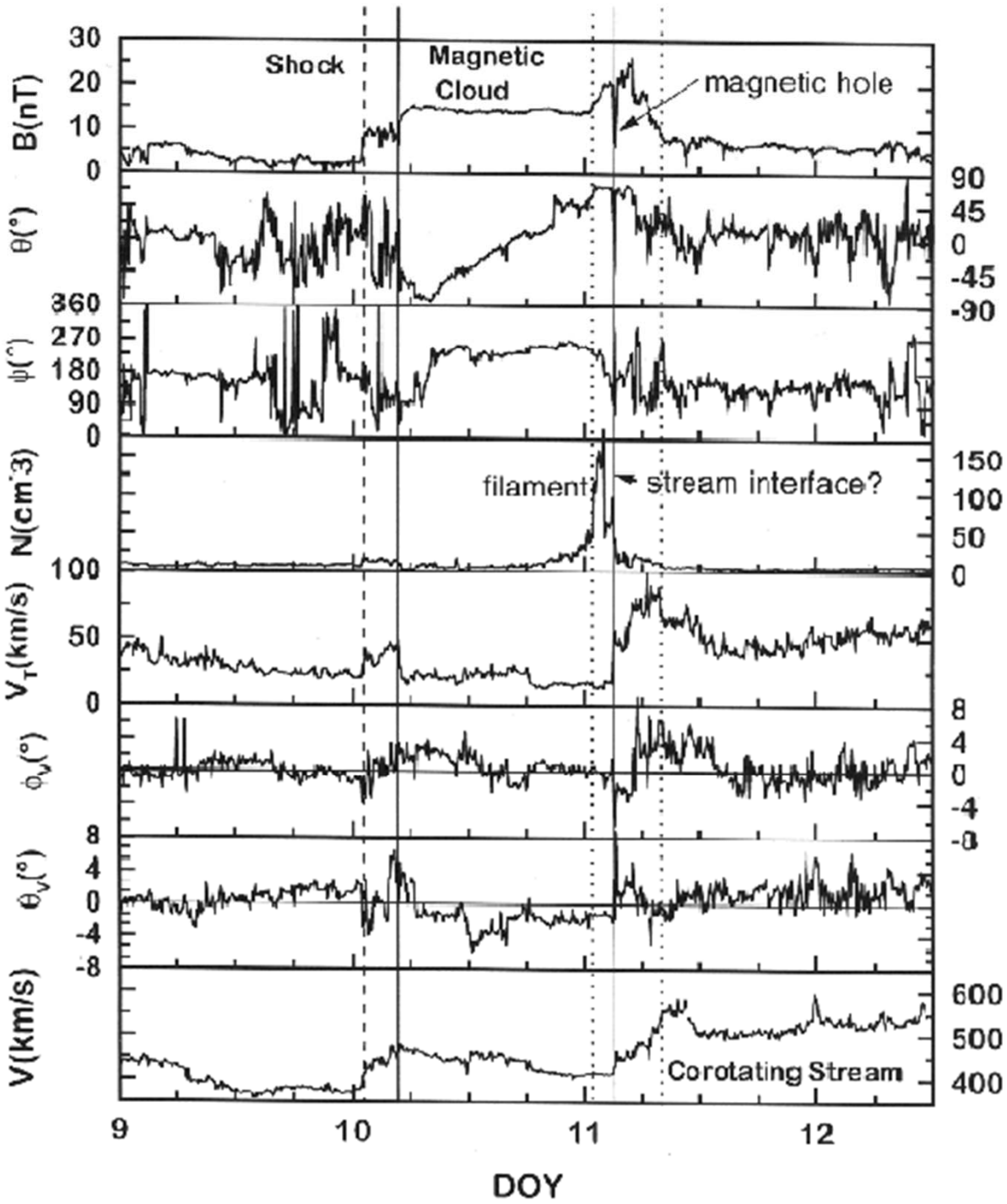


http://www.serc.kyushu-u.ac.jp/gaikyo/manual.pdf

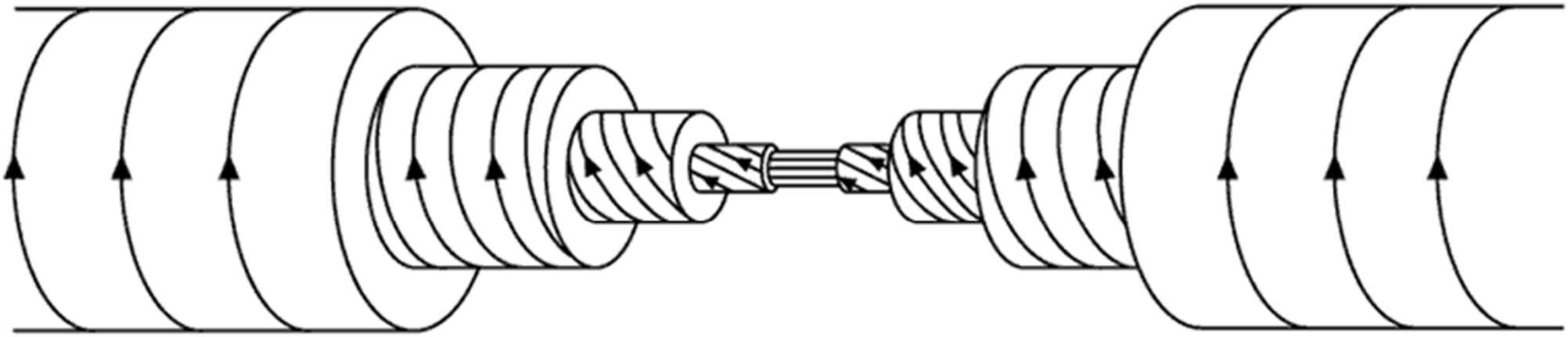


http://umbra.nascom.nasa.gov/istp/lepping-2.gif

WIND - January 1997



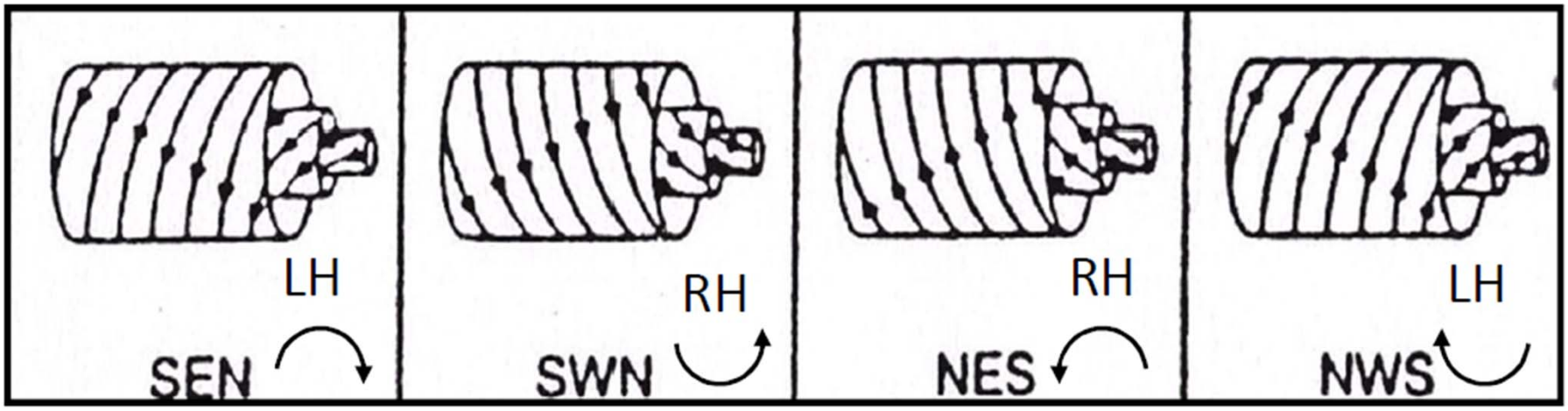
http://www-istp.gsfc.nasa.gov/istp/outreach/workshop/img/nicky/slide4.gif



Interior Structure of Flux Rope

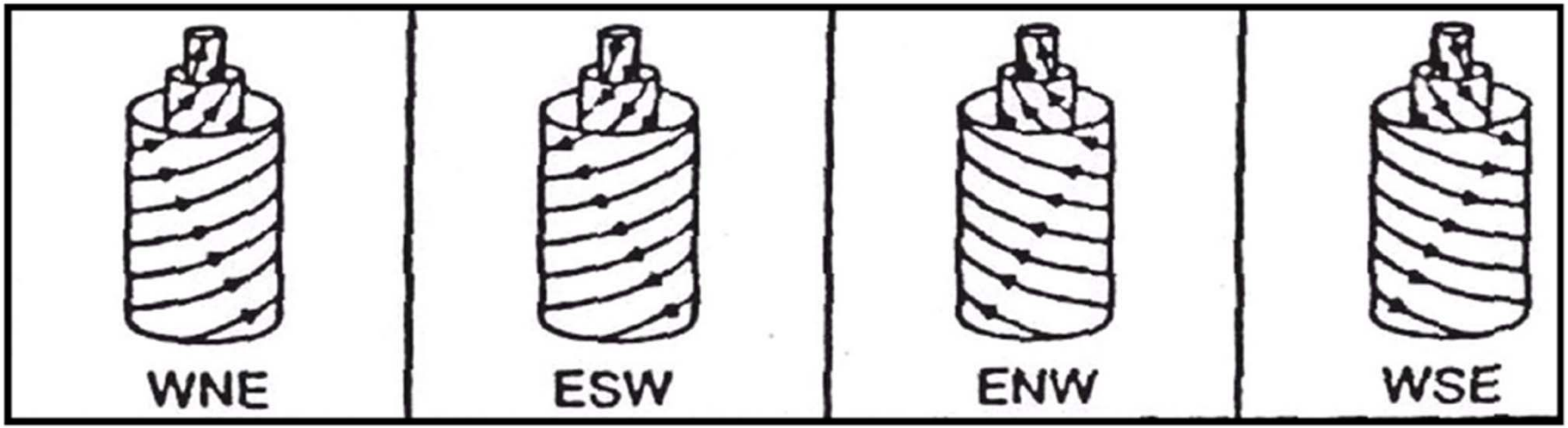
http://www-ssc.igpp.ucla.edu/personnel/russell/papers/896/fig6.gif

Low inclination flux ropes (bipolar): south-north (SN) or north-south(SN)



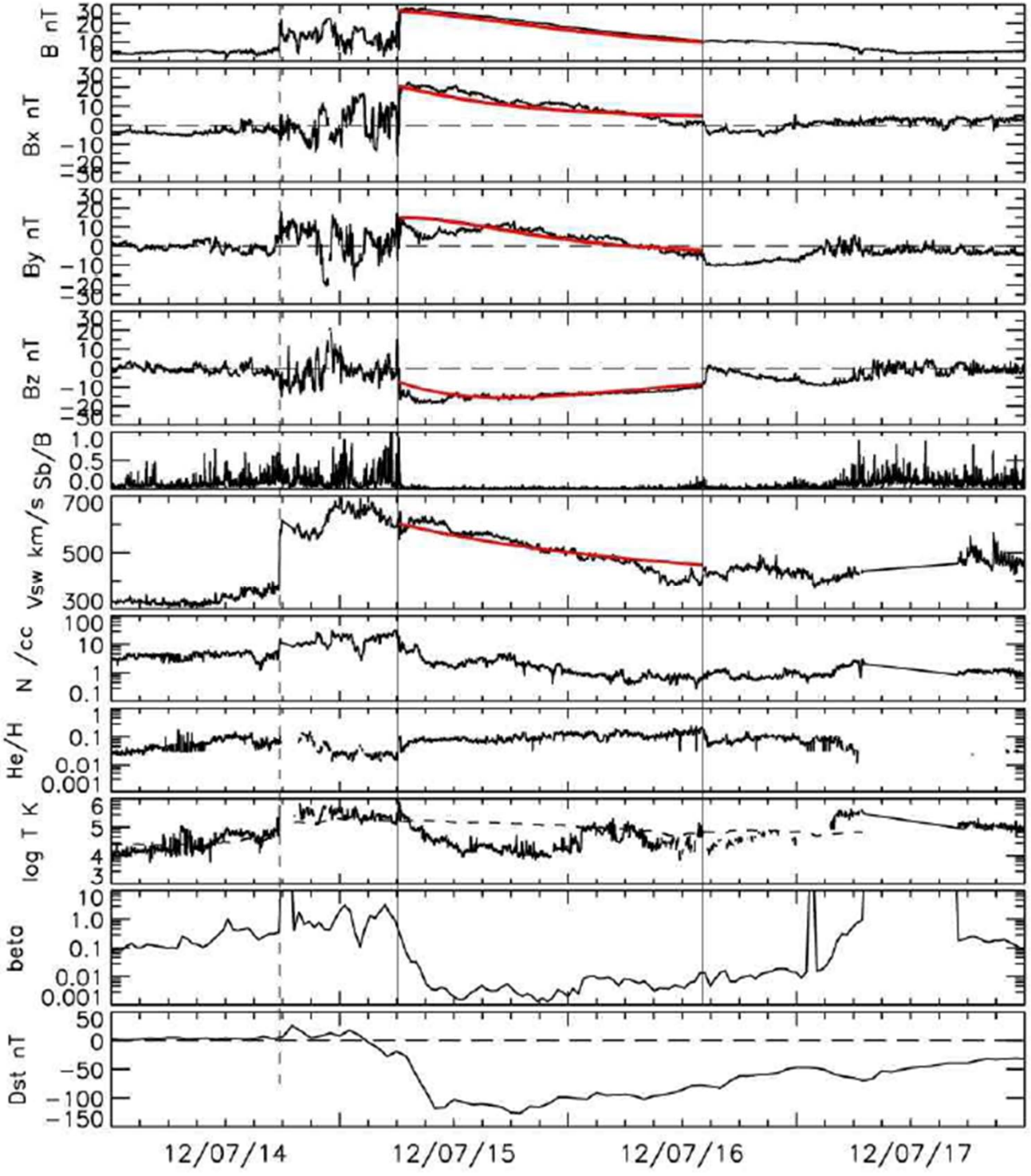
handedness: how B is observed to rotate as viewed by an observer looking towards the Sun
LH = clockwise; RH = counter clockwise

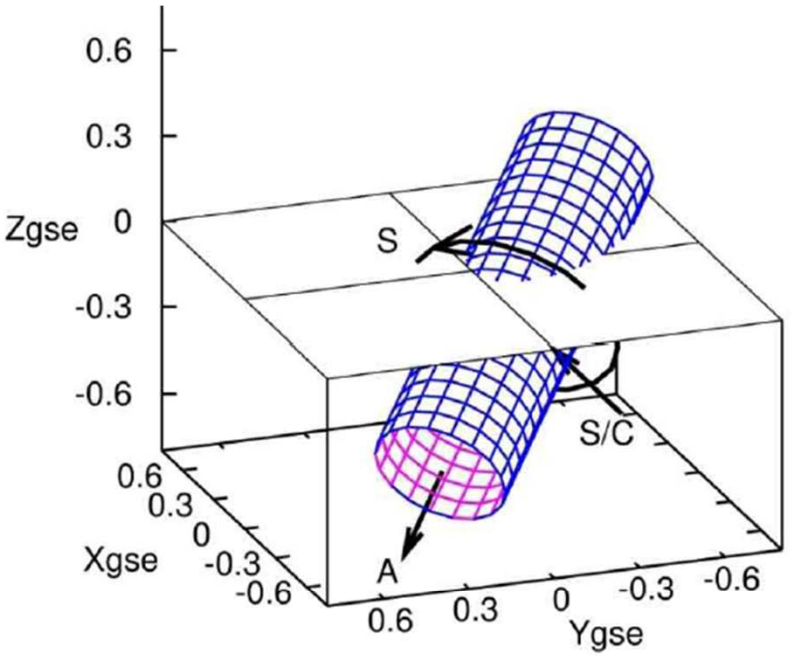
High inclination flux ropes (unipolar): north (N) or south (S)



Bothmer and Schwenn (1994); *Mulligan et al.* (1998)

http://theory.physics.helsinki.fi~plasmainfo.html


B nT
Bx nT
By nT
Bz nT
Sb/B
Vsw km/s
N /cc
He/H
log T K
beta
Dst nT
12/07/14
12/07/15
12/07/16
12/07/17


Zgse
Xgse
Ygse
S
S/C
A

A cylindrically symmetric force-free field model for magnetic cloud

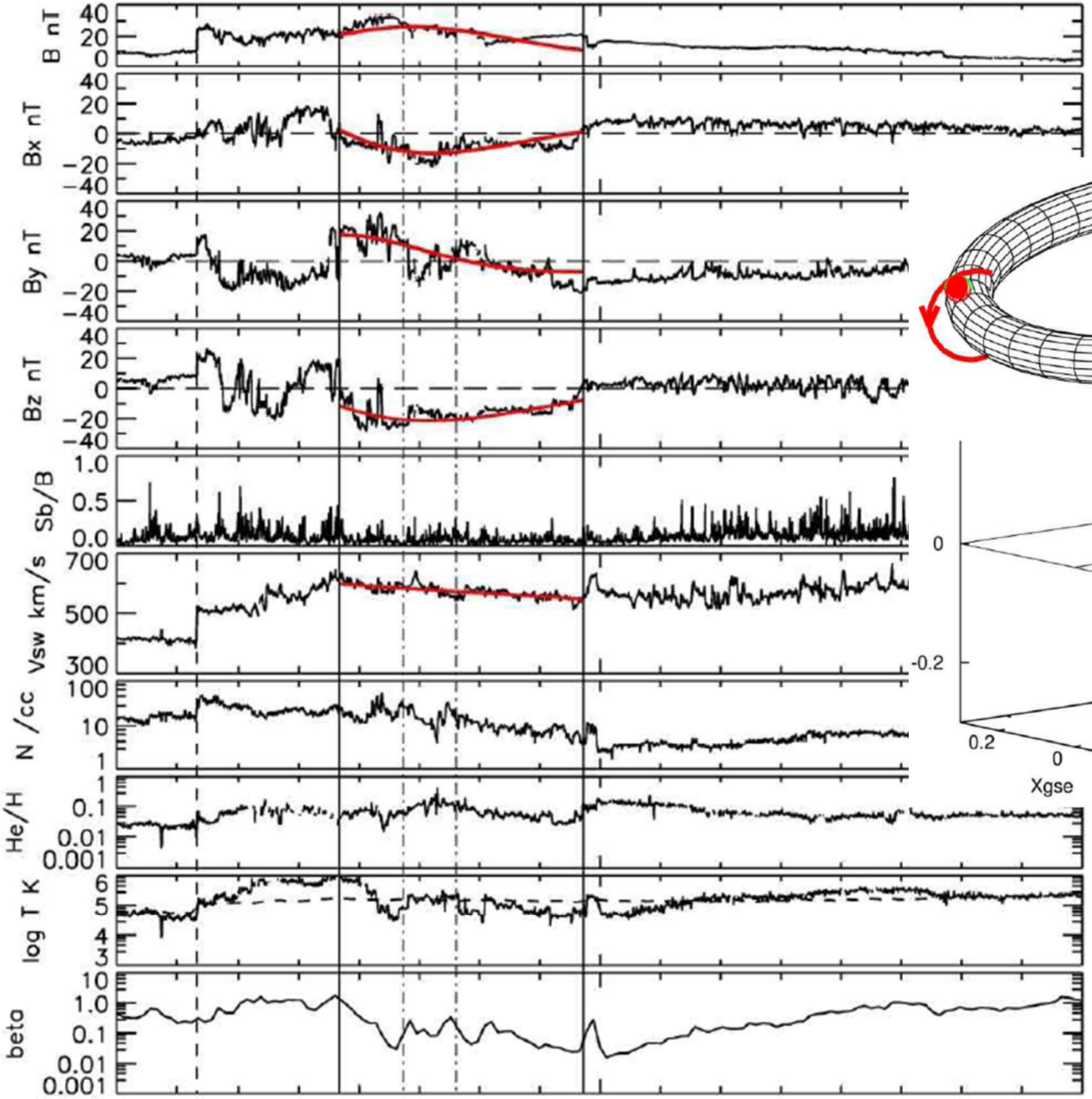
$$\nabla^2 \mathbf{B} = -\alpha^2 \mathbf{B}. \tag{3}$$

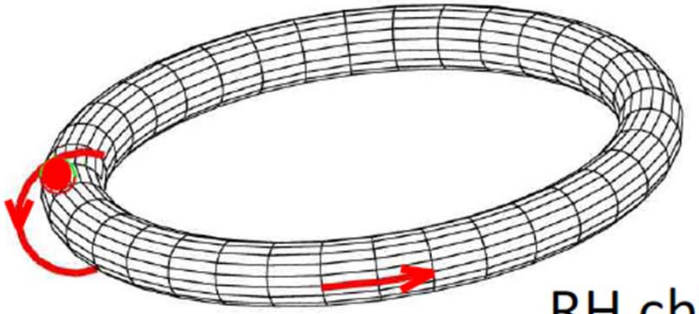
Lundquist [1950] has given the solution of equation (3) with the helical structure in the cylindrical geometry as follows:

$$\begin{cases} B_R = 0 & \text{radial component} \\ B_T = B_0 H J_1(\alpha R) & \text{tangential component} \\ B_A = B_0 J_0(\alpha R) & \text{axial component} \end{cases} \tag{4}$$

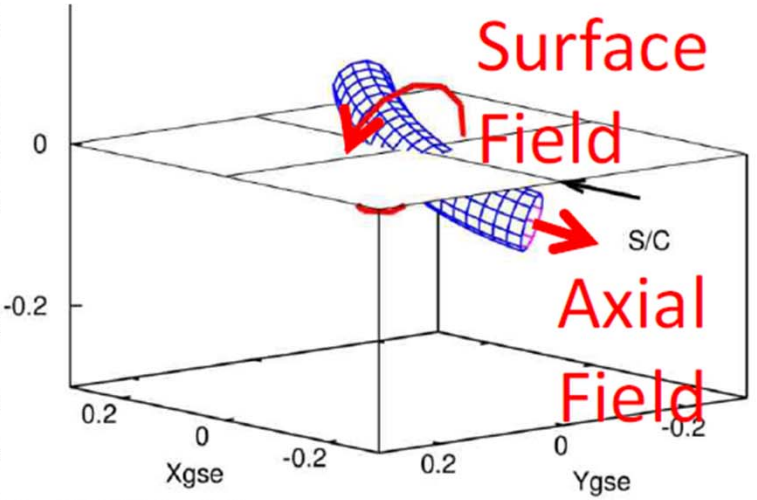
where J_n is the nth-order Bessel function, $H = \pm 1$ denotes the right- and left-handedness of the field twist, B_0 is the field intensity at the axis of the rope, and R is the radial distance from the axis.

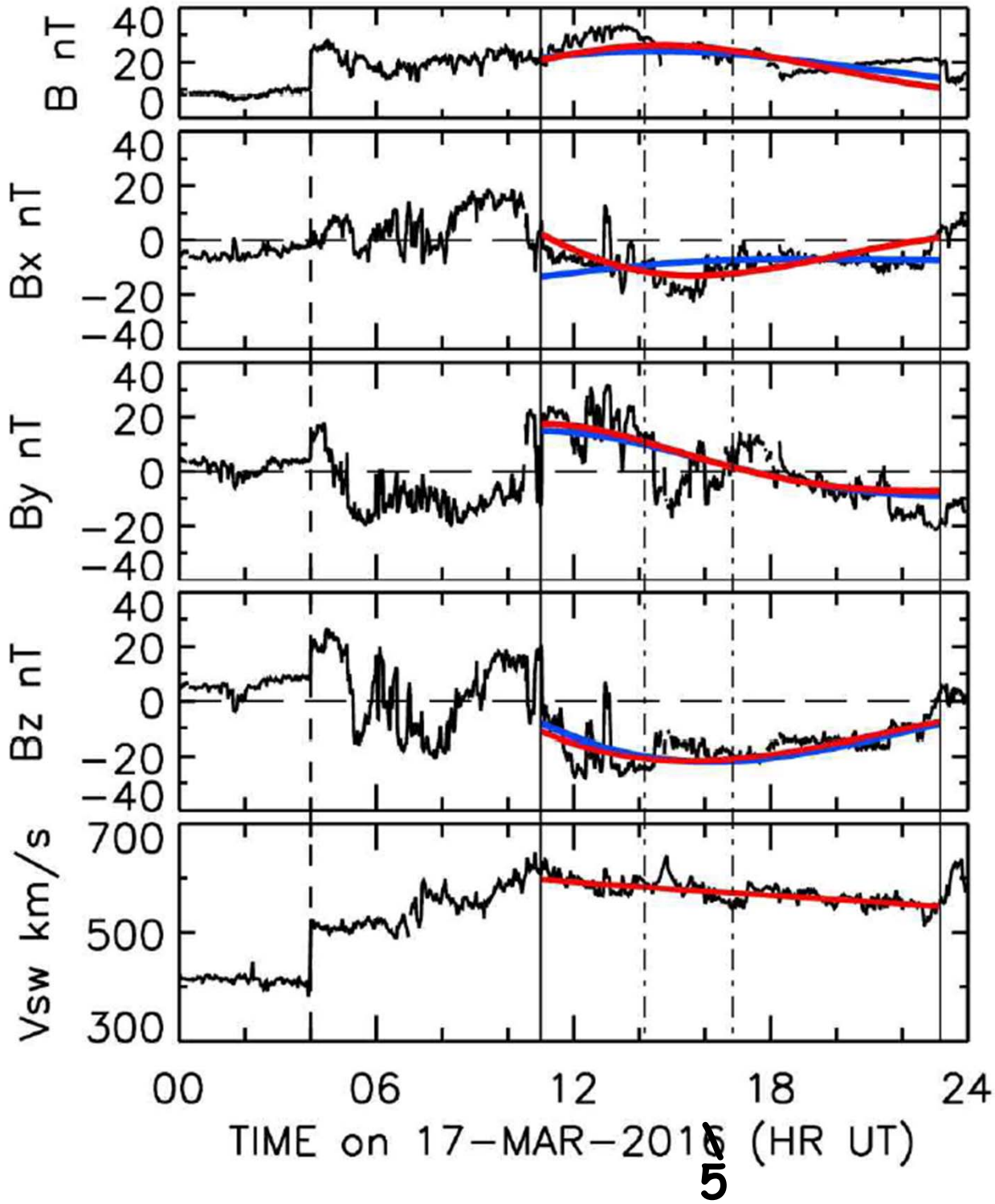
Feng et al. (2007)

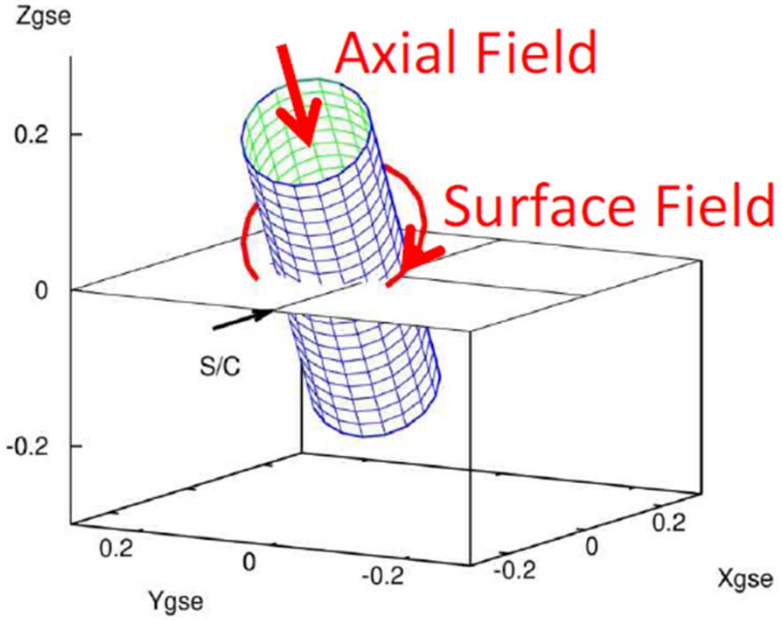




RH chirality

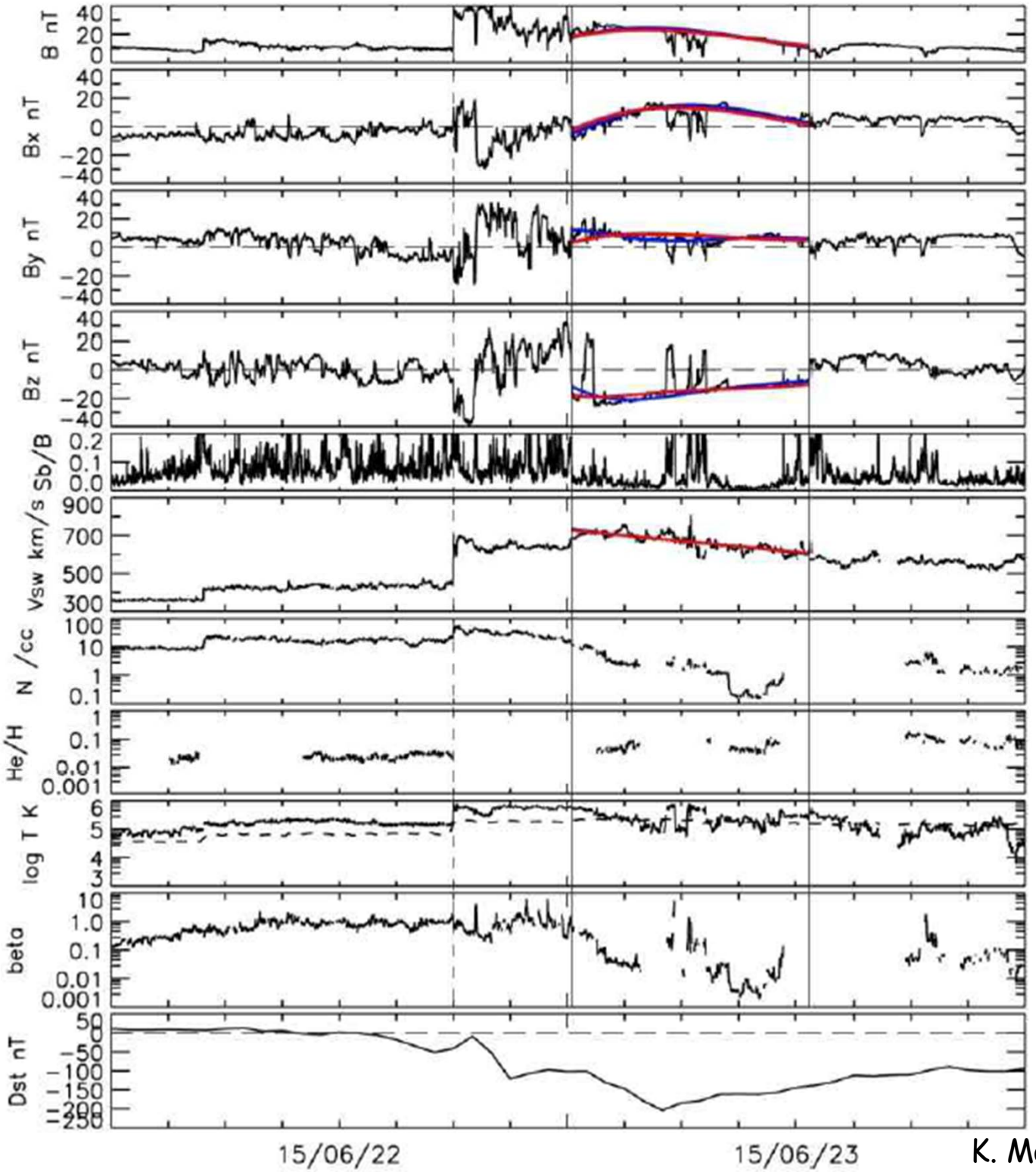






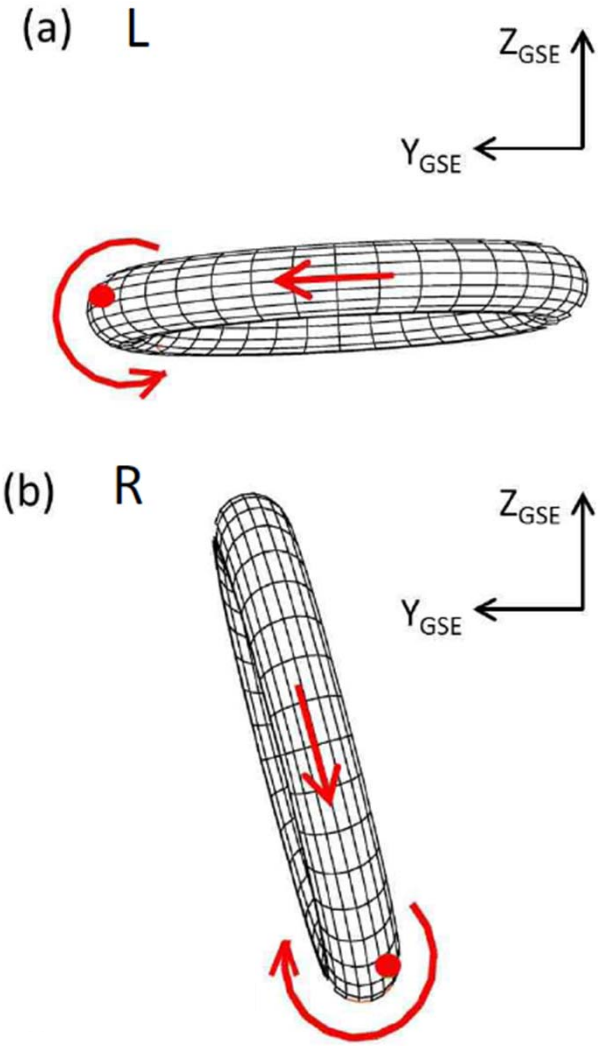
Cylinder-fit

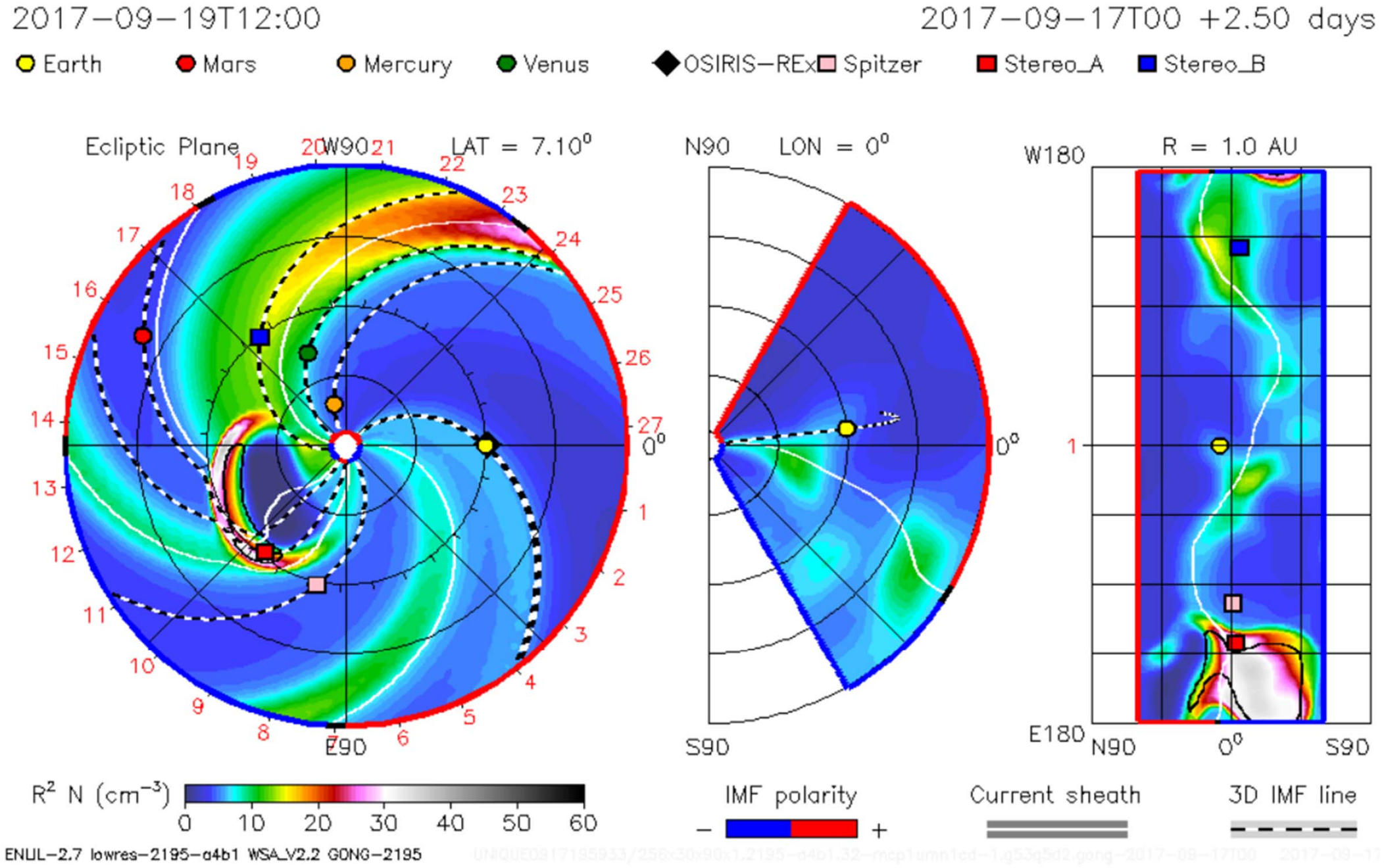
Torus-fit



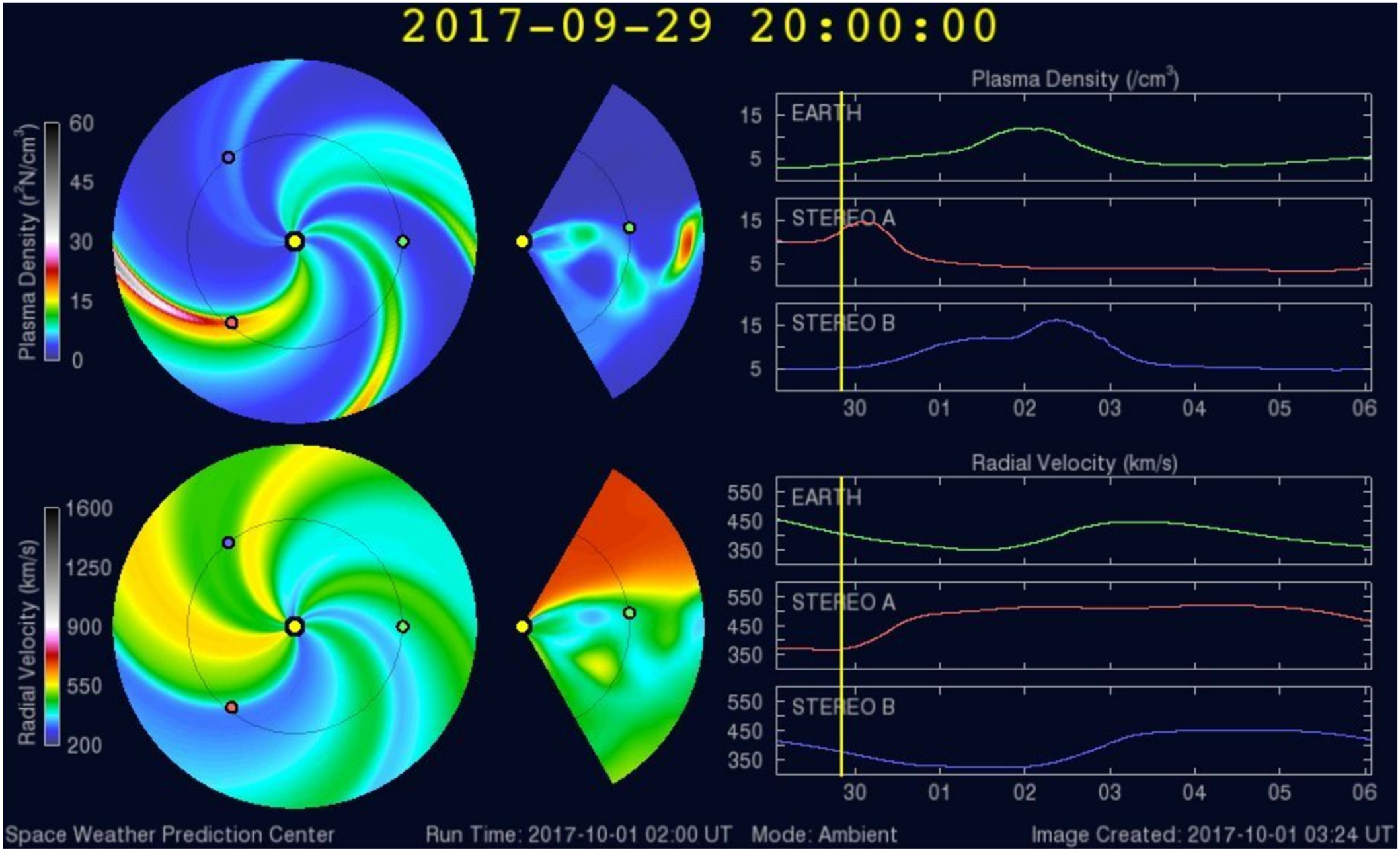
Left-handed

Right-handed



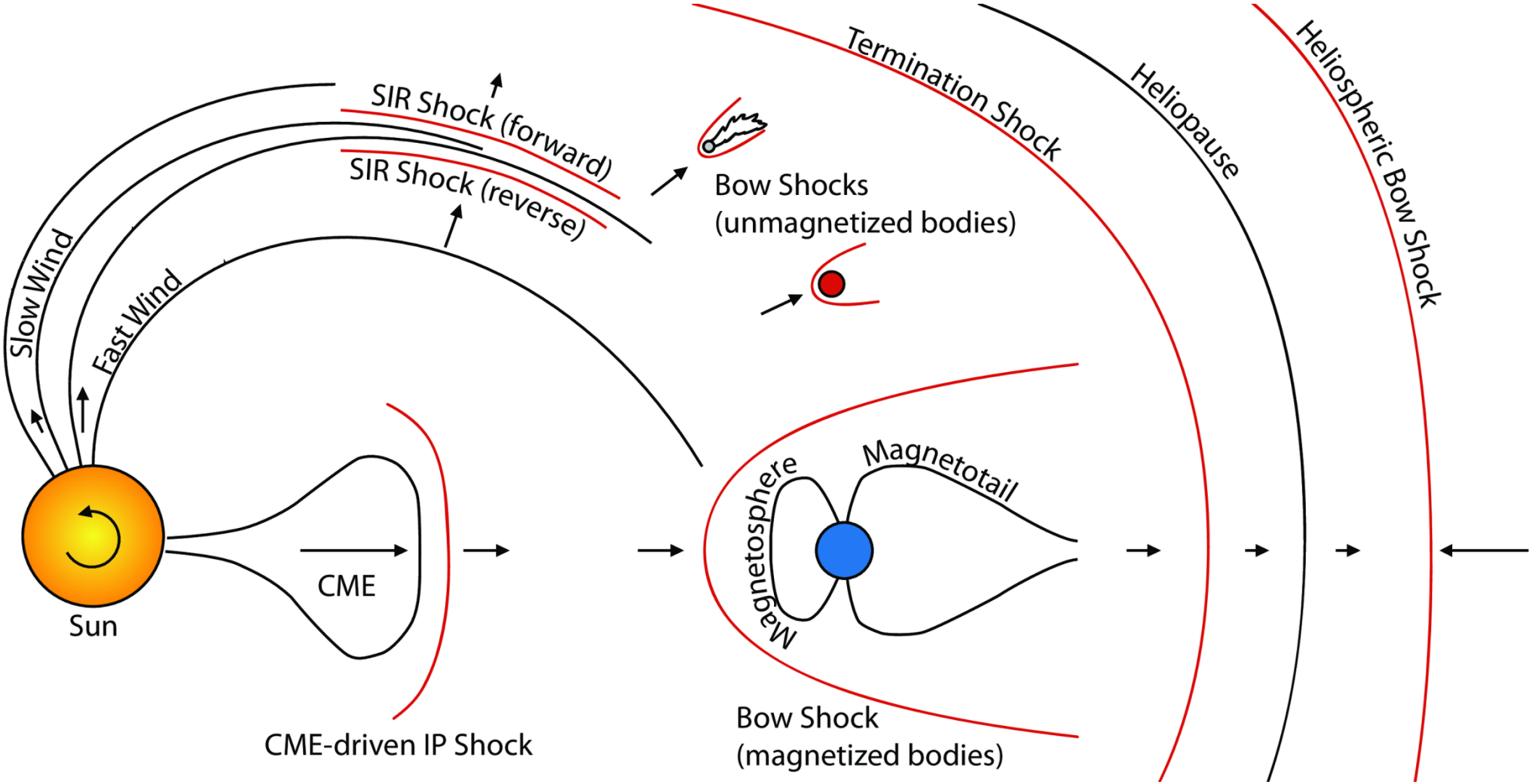


https://iswa.gsfc.nasa.gov/IswaSystemWebApp/iSWACygnetStreamer?timestamp=2038-01-23+00%3A44%3A00&window=-1&cygnetId=261



http://www.swpc.noaa.gov/products/wsa-enlil-solar-wind-prediction

Heliospheric Shocks



http://sprg.ssl.berkeley.edu/~pulupa/illustrations/helioshocks/helioshocks.png

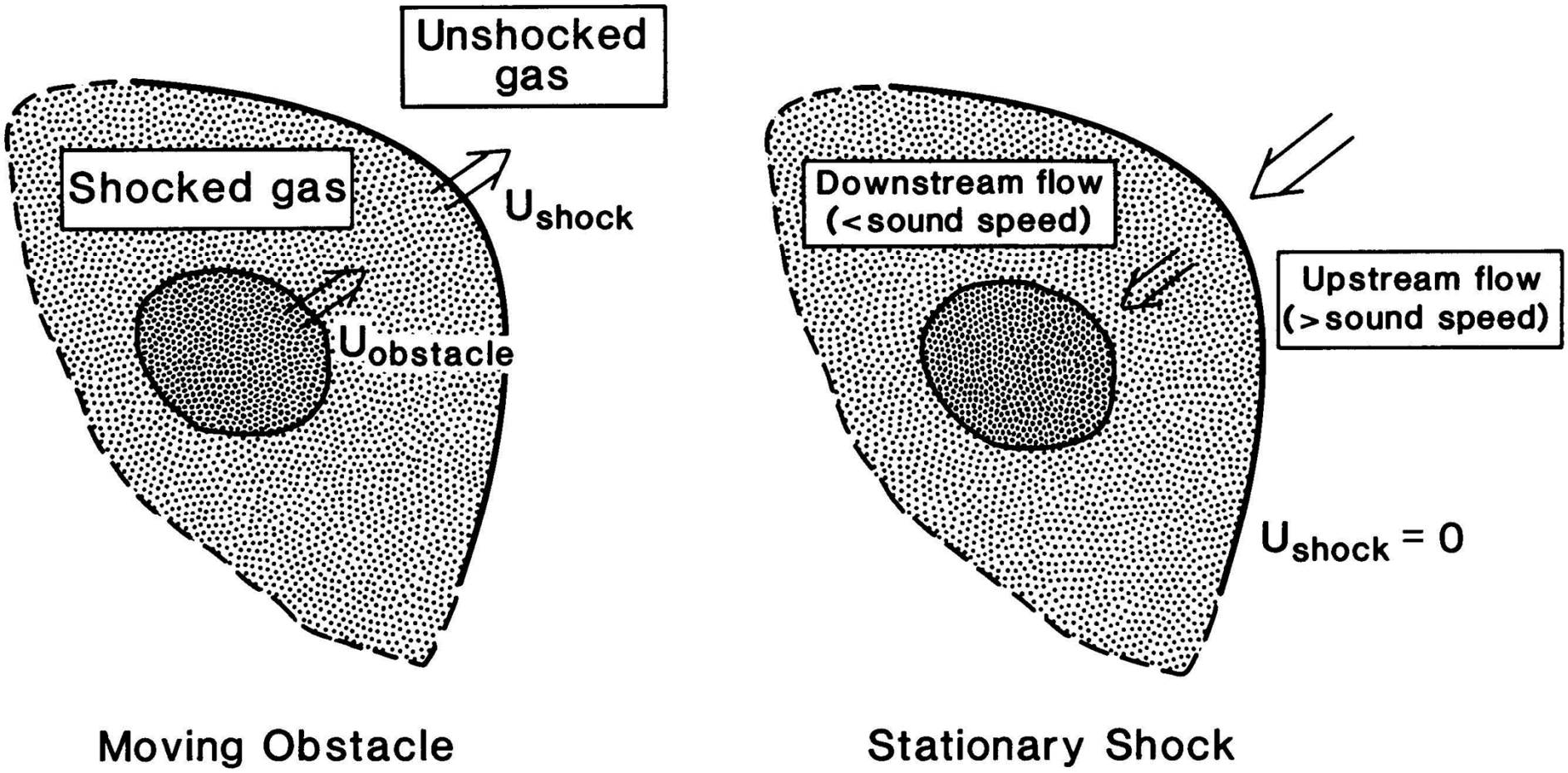
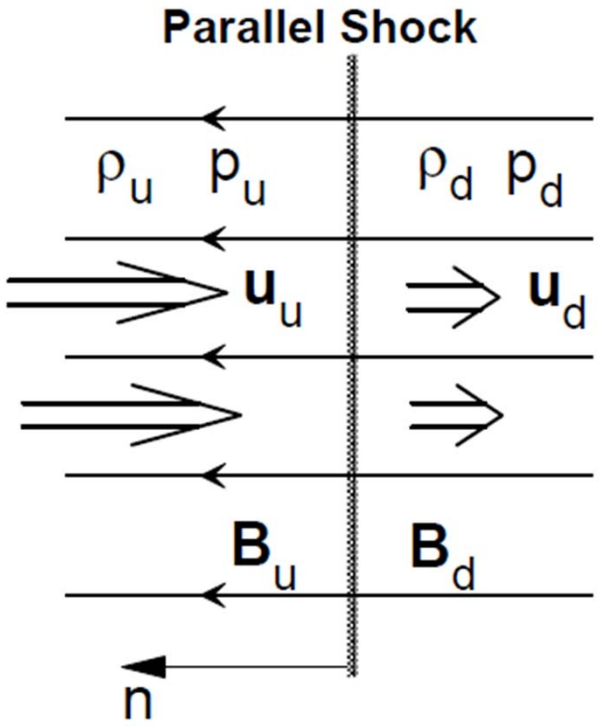
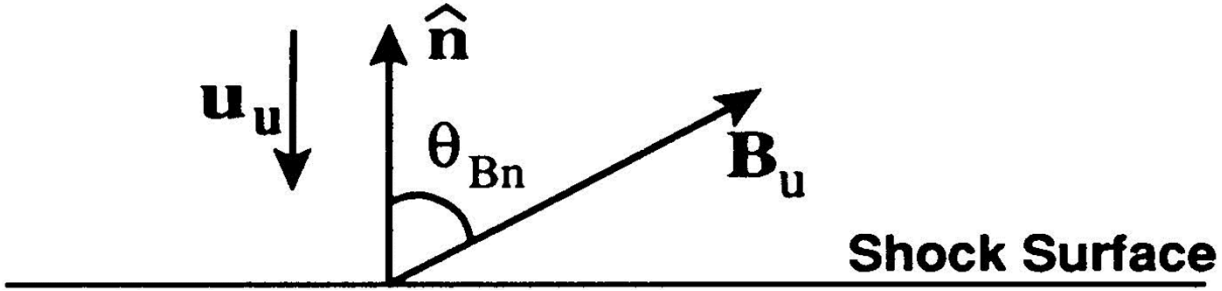
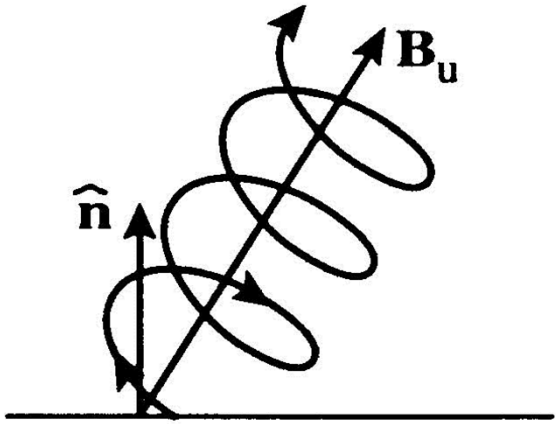


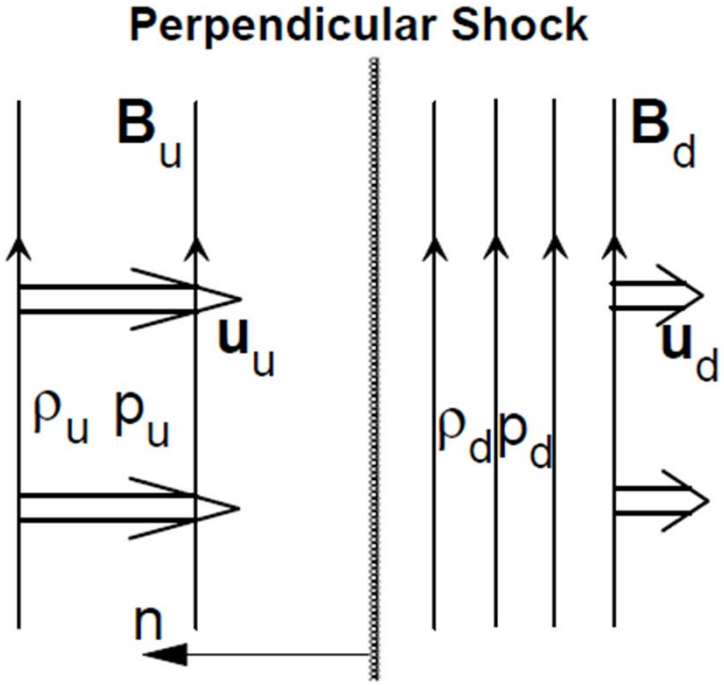
Fig. 5.1 in M. G. Kivelson and C. T. Russell (1995)

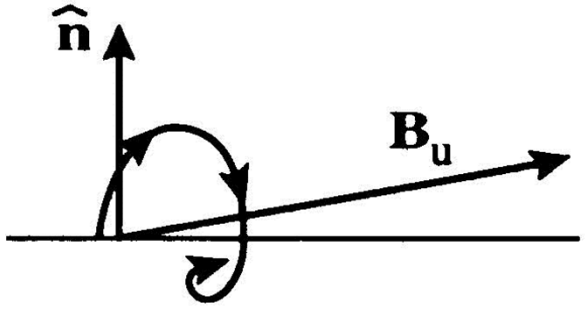






Quasi-Parallel





Quasi-Perpendicular

Fig. 6.5 in A. Otto (2006)

Fig. 5.5 in M. G. Kivelson and C. T. Russell (1995)

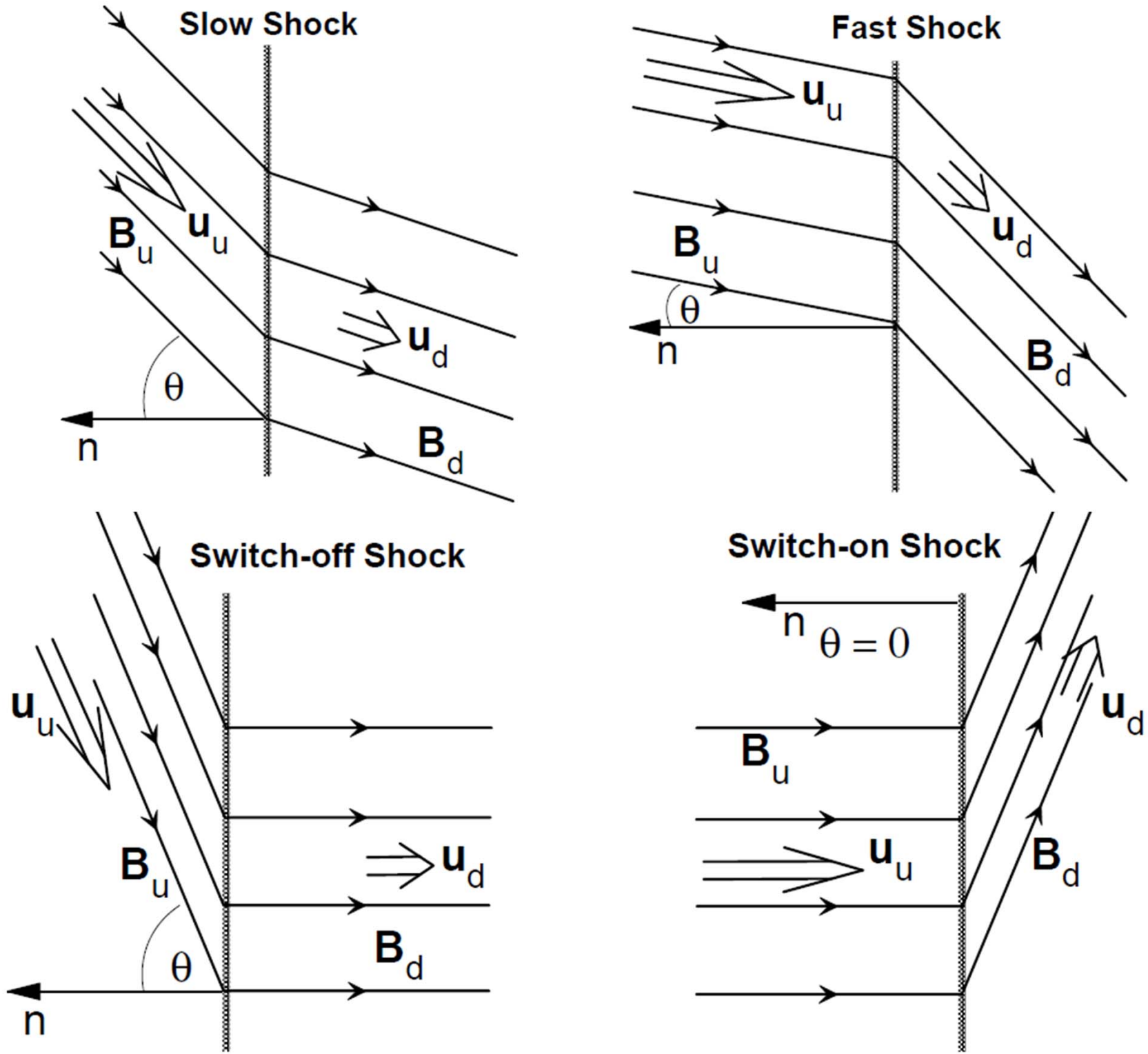


Fig. 6.7 & 6.8 in *A. Otto* (2006)