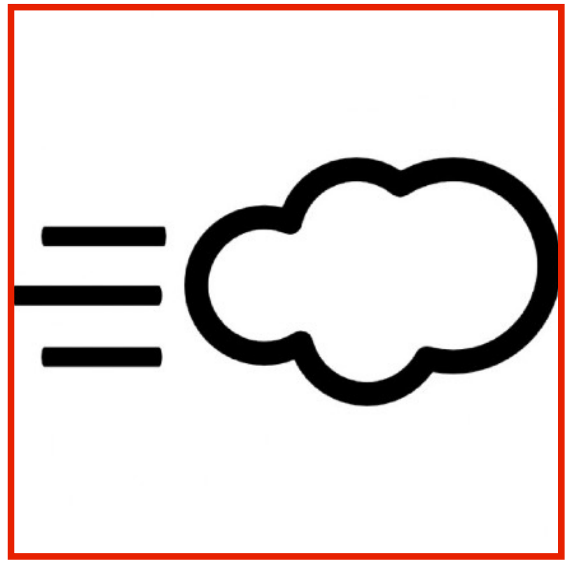
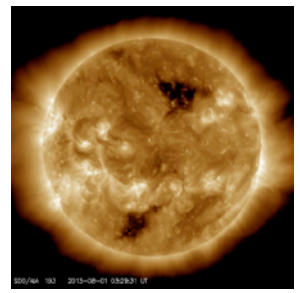
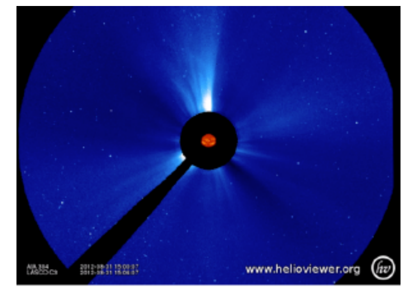


SOLAR WIND

SOLAR WIND VARIATIONS

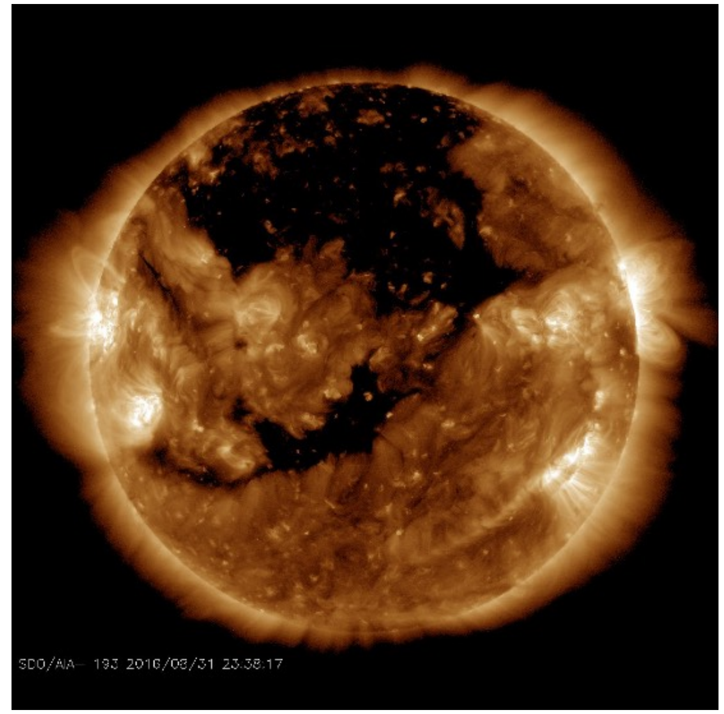
Non-eruptive No B reconnection	Eruptive B reconnection
Coronal Hole	Coronal Mass Ejection
	

The variations in the solar wind introduce space weather events.

CME – suddenly, a mass is ejected into space. A CME is an eruptive event.
—> magnetic reconnection is involved

A CH is not eruptive. A CH is present, it doesn't pop up suddenly. A CH can of course slowly appear or disappear, become bigger, become smaller but not on time scale of a few minutes. It is also not the case that a CH ejects material and a little bit later, not any more. The solar wind continuously emanate from a CH.
—> no magnetic reconnection is involved

CORONAL HOLE



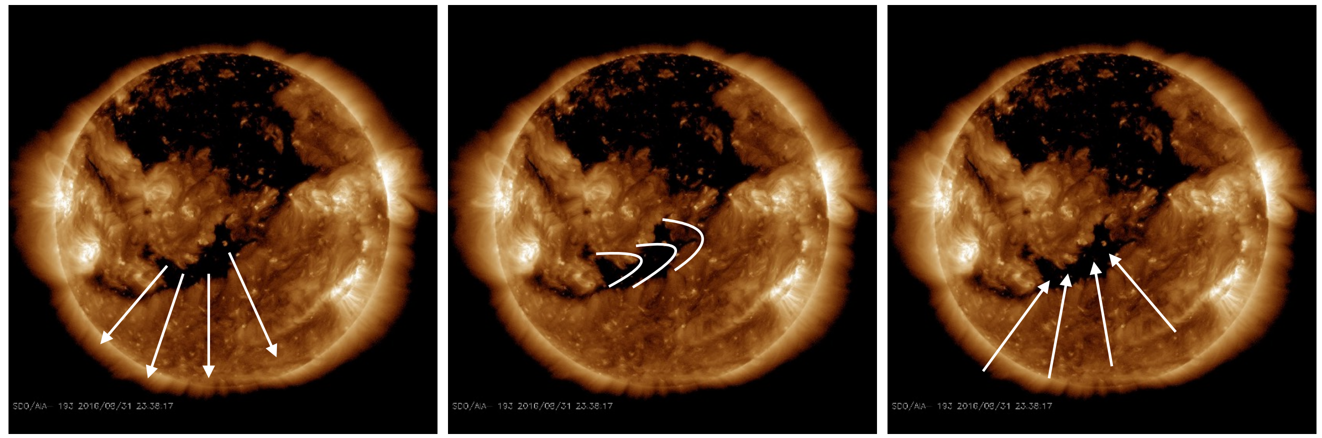
open field structure, source of fast solar wind
non eruptive
radial – plasma leaving when it is at the central meridian, reaches Earth

What is important determining when and how strong the impact of a CH will be:

- The heliographic latitude of earth
- The latitude of the CH on the solar disk: the part of a CH with a low latitude is important. Polar coronal holes have only an impact when they extent to lower latitudes.
- It is the material that leave at the central meridian that will reach earth. You have to guess how fast the solar wind is. Calculate the time the material needs to cross the distance 1AU and you have an estimate of the arrival time of the CH wind near Earth.

at the central meridian

B OF CORONAL HOLE



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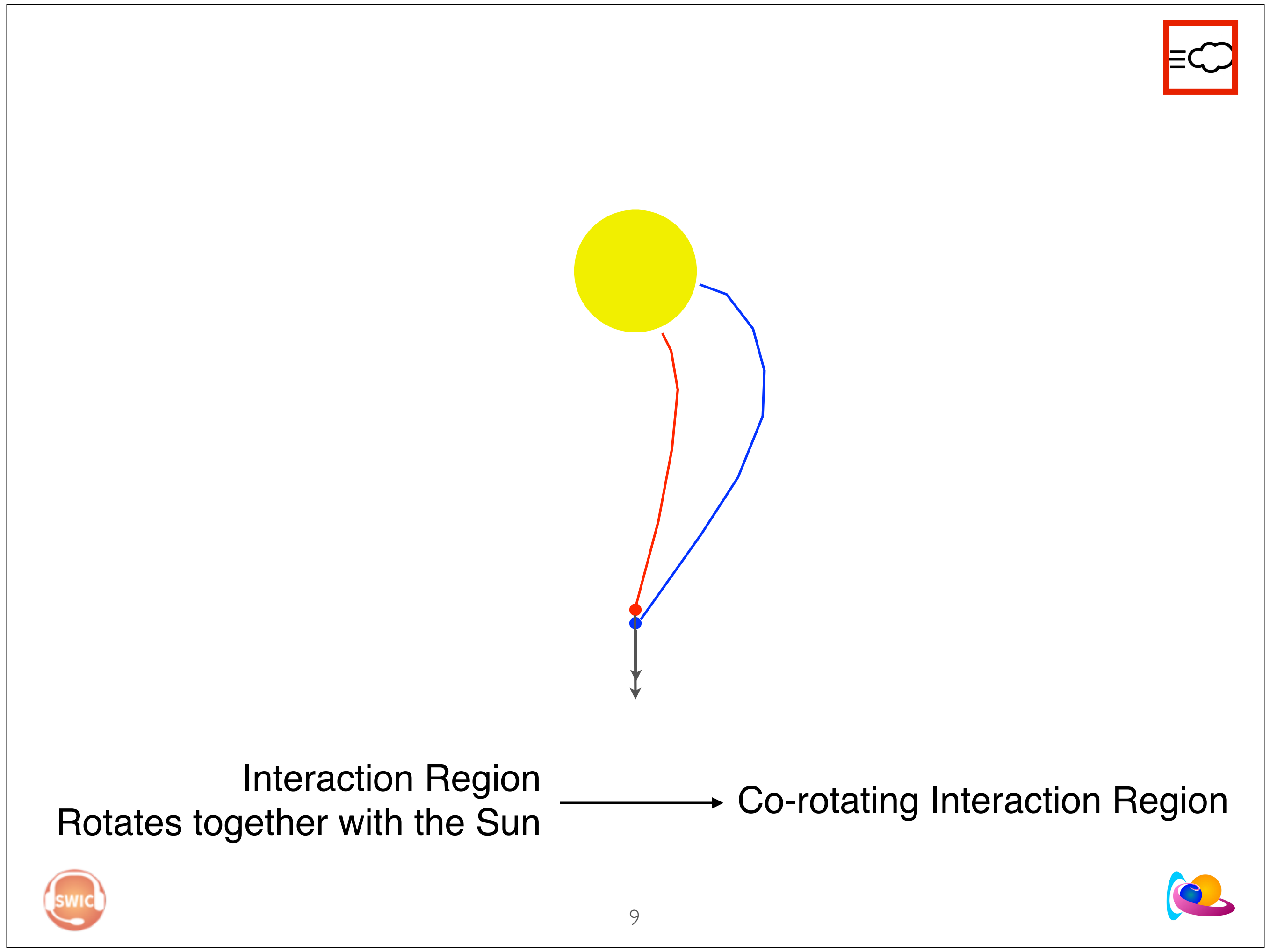
at the central meridian

WHAT HAPPENS WHEN FAST CATCHES SLOW?

Top View

What happens when fast catches slow solar wind material?



Continuous process – the source of the fast particles, i.e. stays present.

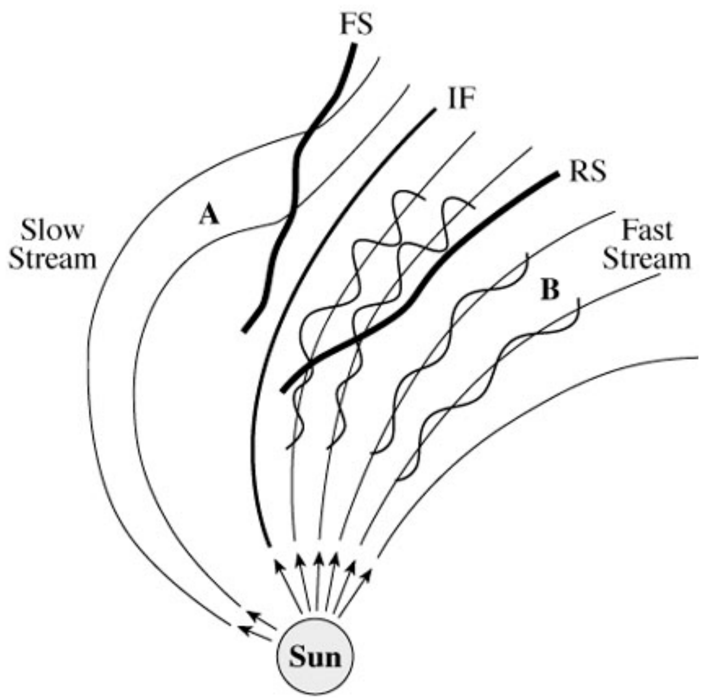
When fast solar-wind streams, emanating from coronal holes, interact with slow streams, they can produce Co-rotating Interaction Regions in interplanetary space. The magnetic fields of the slow streams in the solar wind are more curved due to the lower speeds, and the fields of the fast streams are more radial because of their higher speeds. Intense magnetic fields can be produced at the interface (IF) between the fast and slow streams in the solar wind. The Co-rotating Interaction Regions are bounded by a forward shock (FS) and a reverse shock (RS).

One reason why two shocks are eventually formed at a CIR is due to symmetry about the pressure enhancement caused by compression and entraining of the slow wind ahead of the fast stream (Figure 10.9 [Gosling, 1996]): shocks are driven away from the pressure increase in both directions, resulting in a so-called \Forward-Reverse shock pair" in which the forward shock propagates away from the Sun while the reverse shock propagates towards the Sun but is carried out with the solar wind flow.

http://www.boulder.swri.edu/~deforest/Movies.html

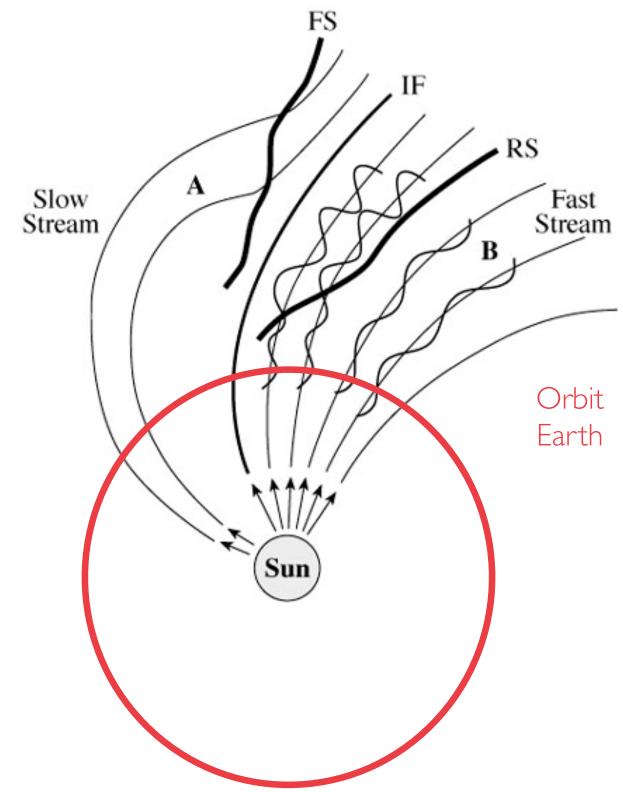
Coronal Hole

- Co-rotating structure
- Radial!
- No extra mass-flux



Coronal hole is not the source of more plasma, but of faster plasma.

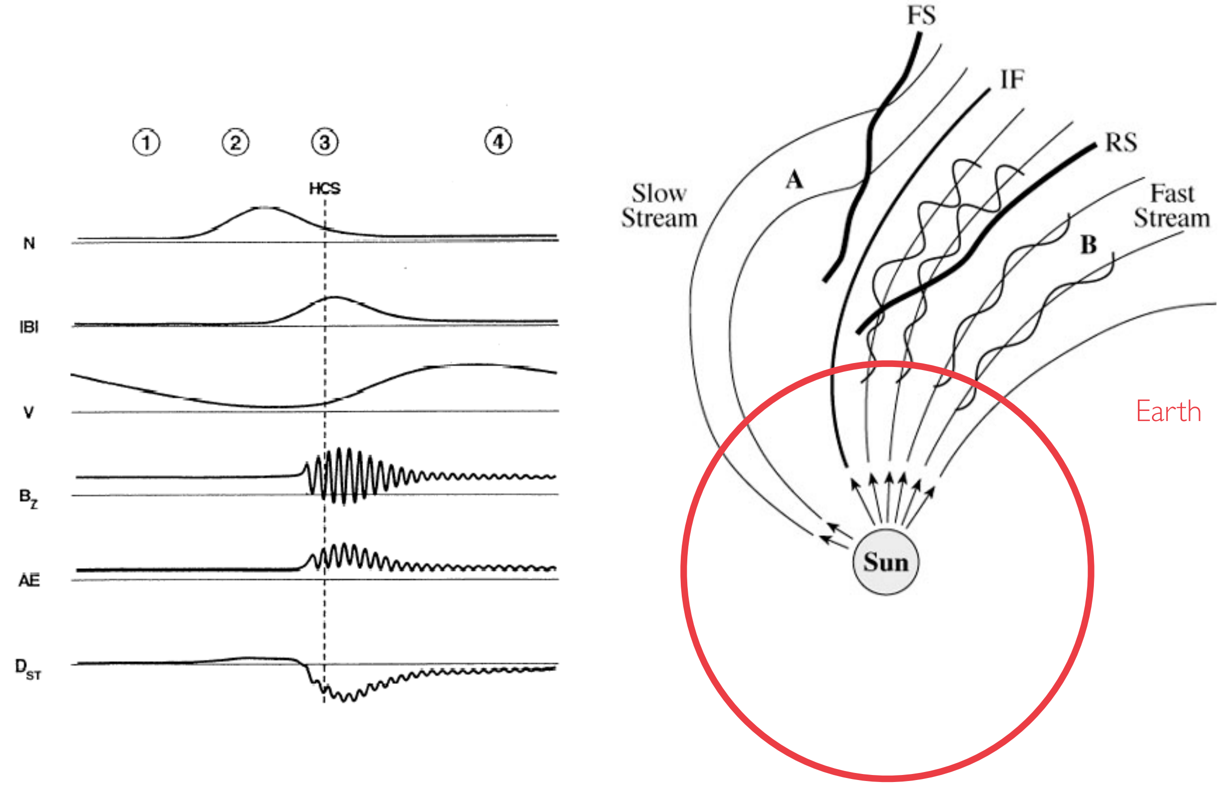
Coronal Hole



At a point in space: the total flux of mass is the same
—> v high, density low
—> v low, density high

When your plasma is more dense, the closer the magnetic field lines.

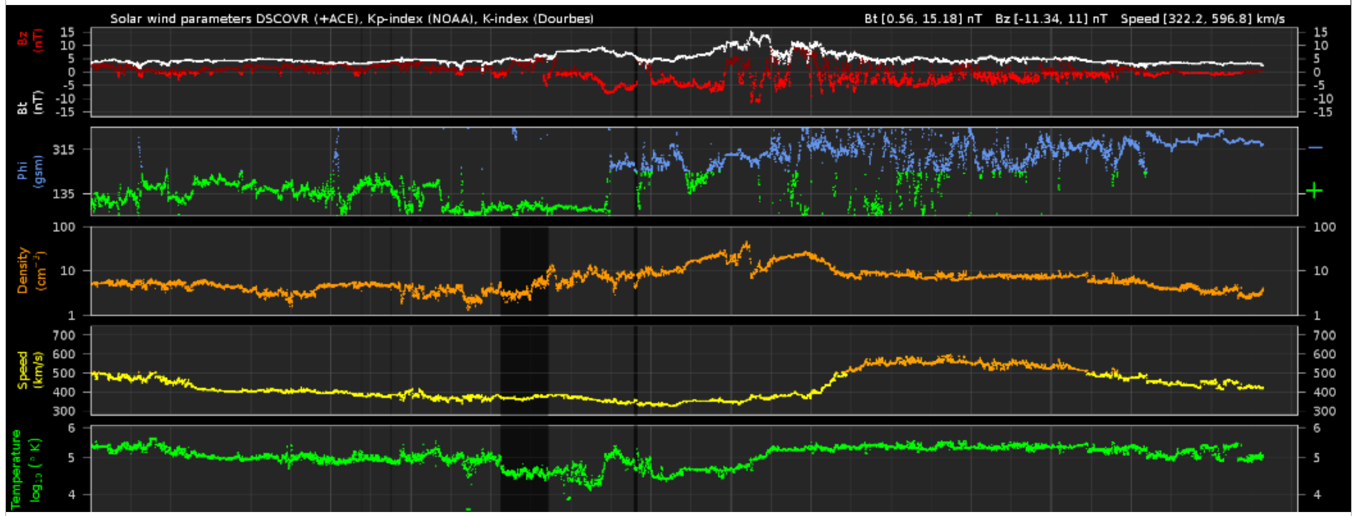
Coronal Hole



At a point in space: the total flux of mass is the same
—> v high, density low
—> v low, density high

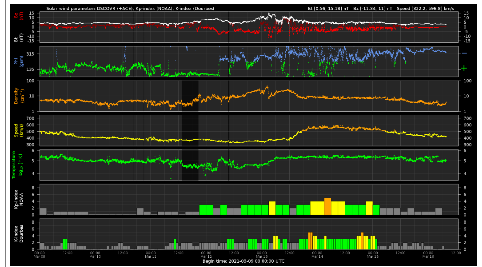
When your plasma is more dense, the closer the magnetic field lines.

X-axis refers to where you are on the red circle (time). This changes because the sun rotates.

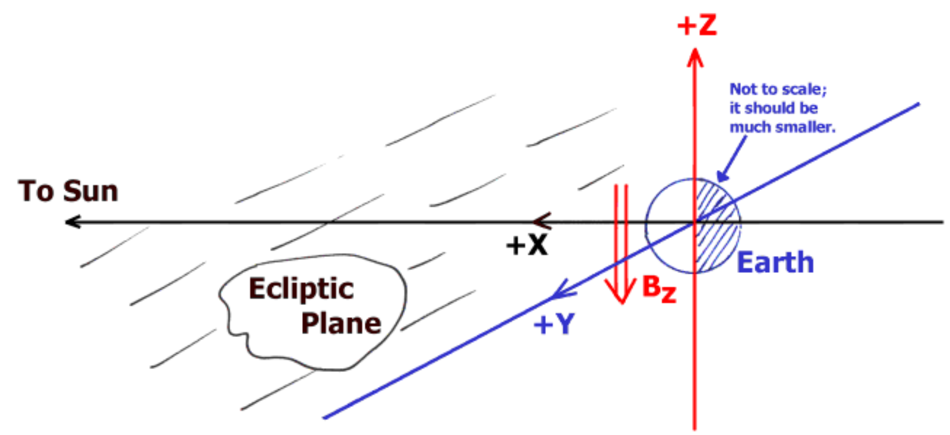


DSCOVR

Introduction to the exercise

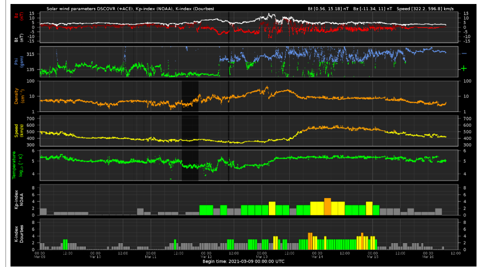


COORDINATE SYSTEM

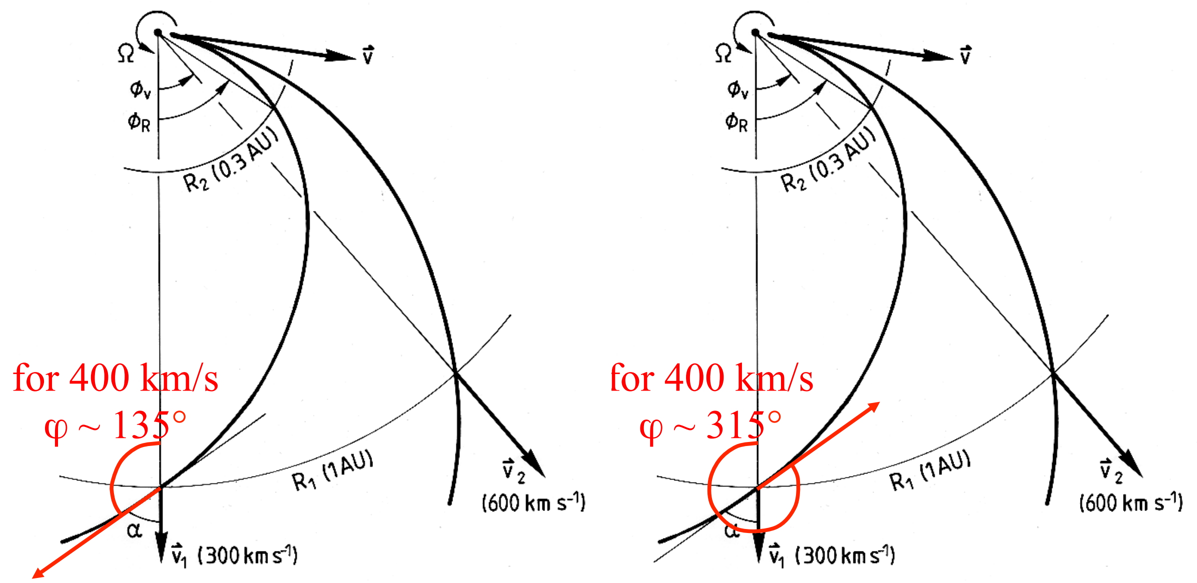


+Z is perpendicular to the Ecliptic Plane.

GSM: Geocentric Solar Magnetospheric System. This has its X-axis pointing from the Earth toward the Sun and its Y-axis is chosen to be in the ecliptic plane pointing towards dusk (thus opposing planetary motion). Its Z-axis is parallel to the ecliptic pole. Relative to an inertial system this system has a yearly rotation.

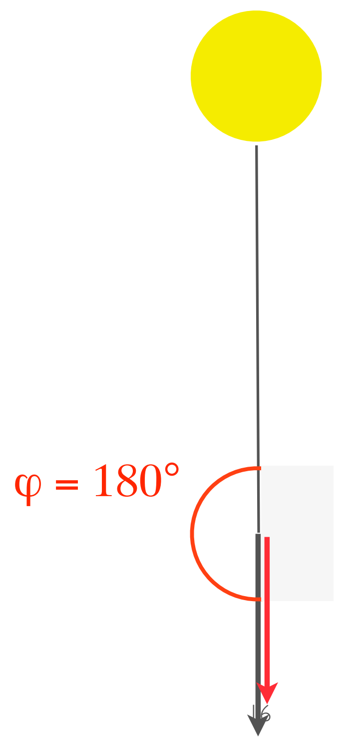


IMF POLARITY

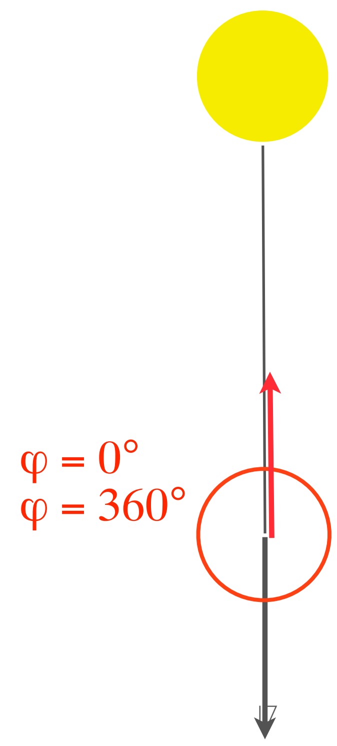


This is the IMF in the XY plane of the GSM coordinate system – not in the solar equatorial plane, ecliptic plane.
Phi is a value between
90° and 180°
270° and 360°

EXTREME FAST



EXTREME FAST



EXTREME SLOW