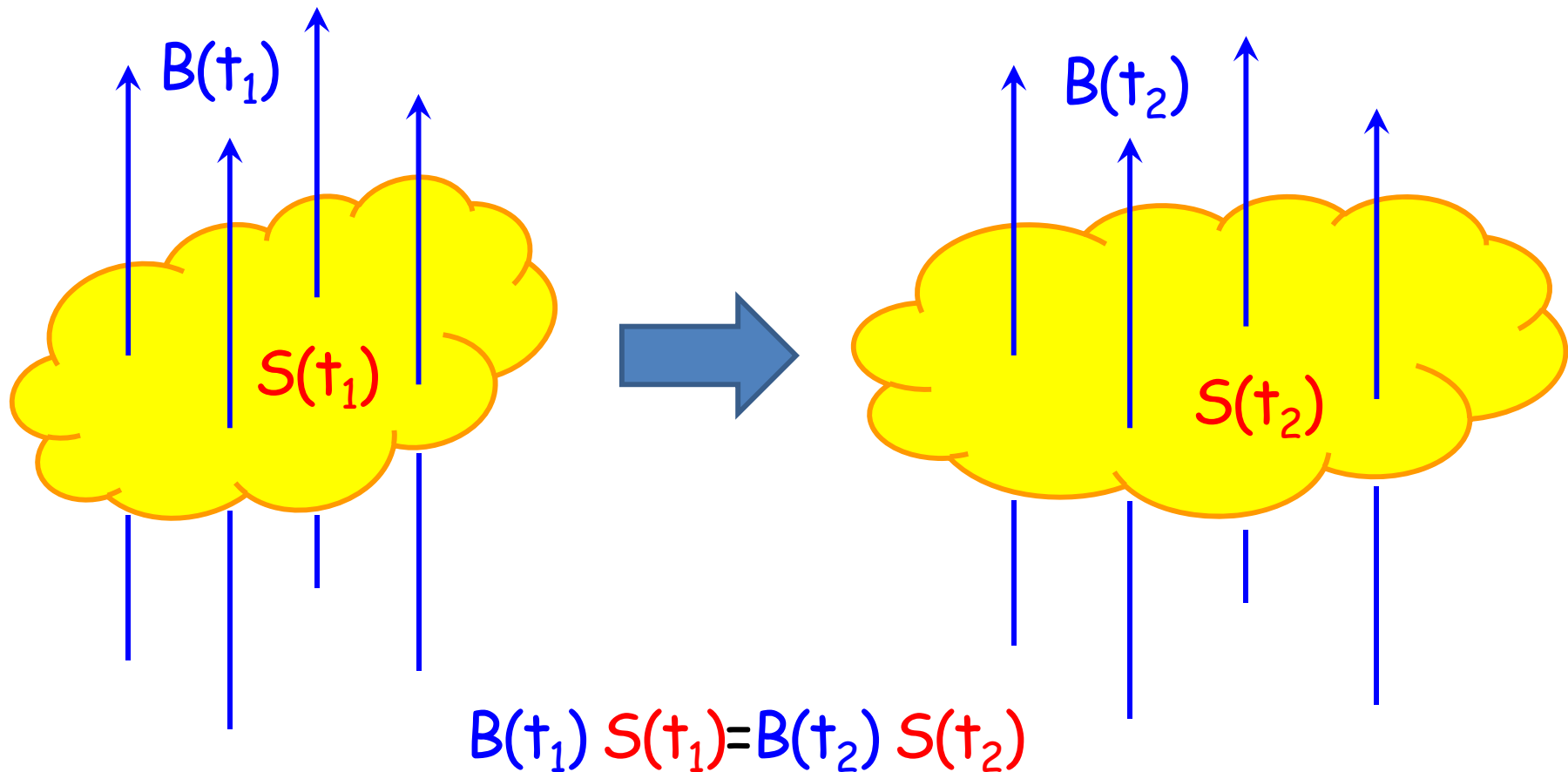


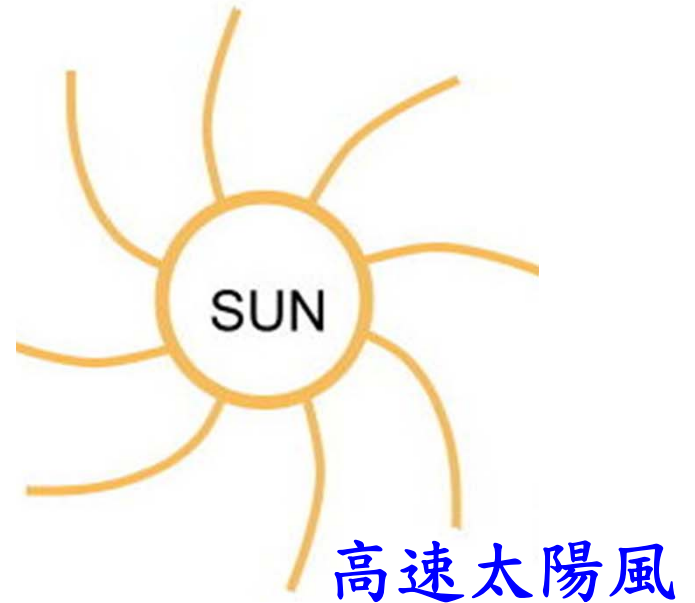
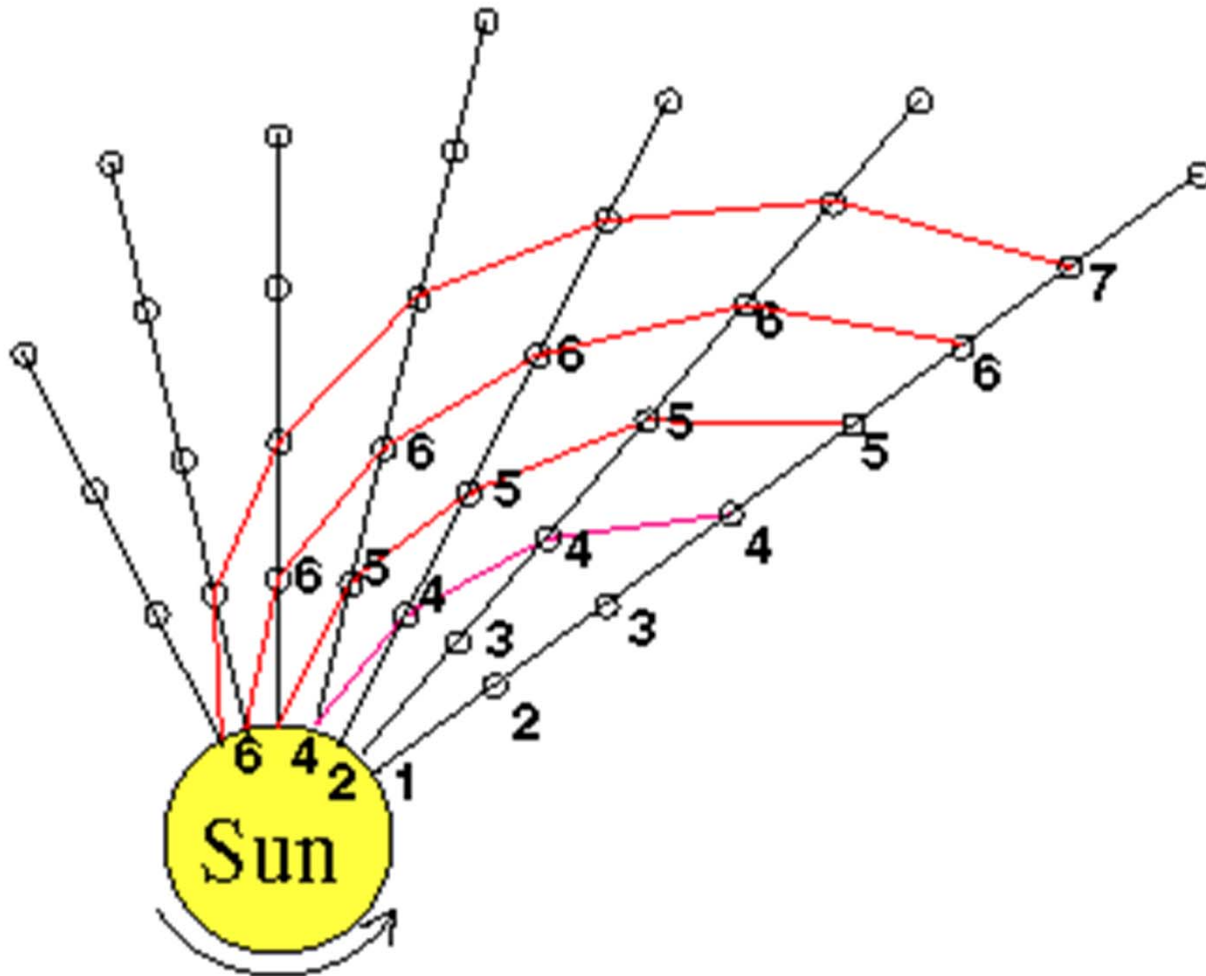
Frozen-in Magnetic Flux



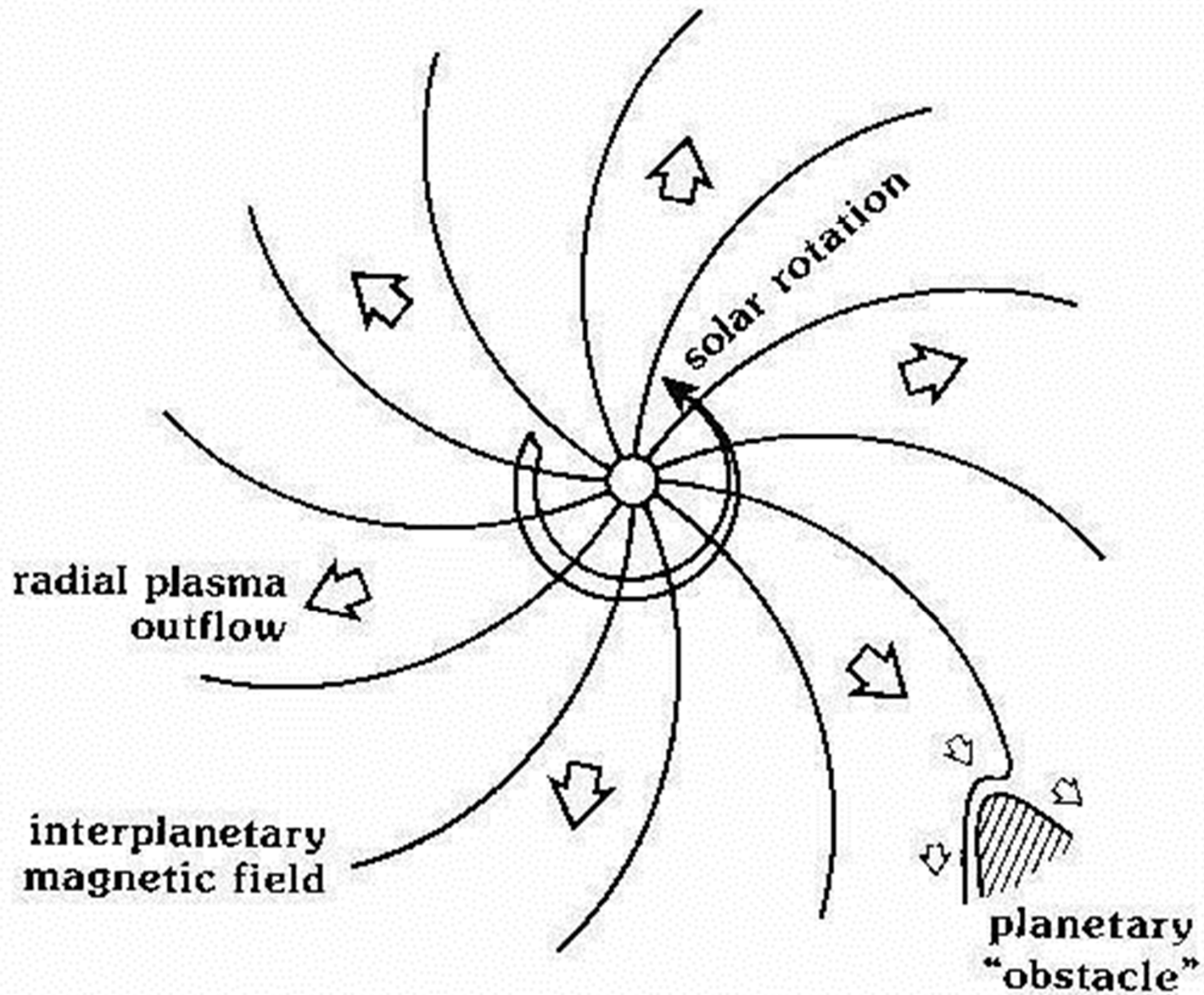
由不同fluid elements所圍繞的磁通量，雖然fluid elements在流動後，可能變形或圍繞的面積有很大的改變，但是所圍繞的磁通量不變，這就好像這些磁力線被凍結(frozen-in)在每個電漿團上。成立條件:導電率非常高的電漿。

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。

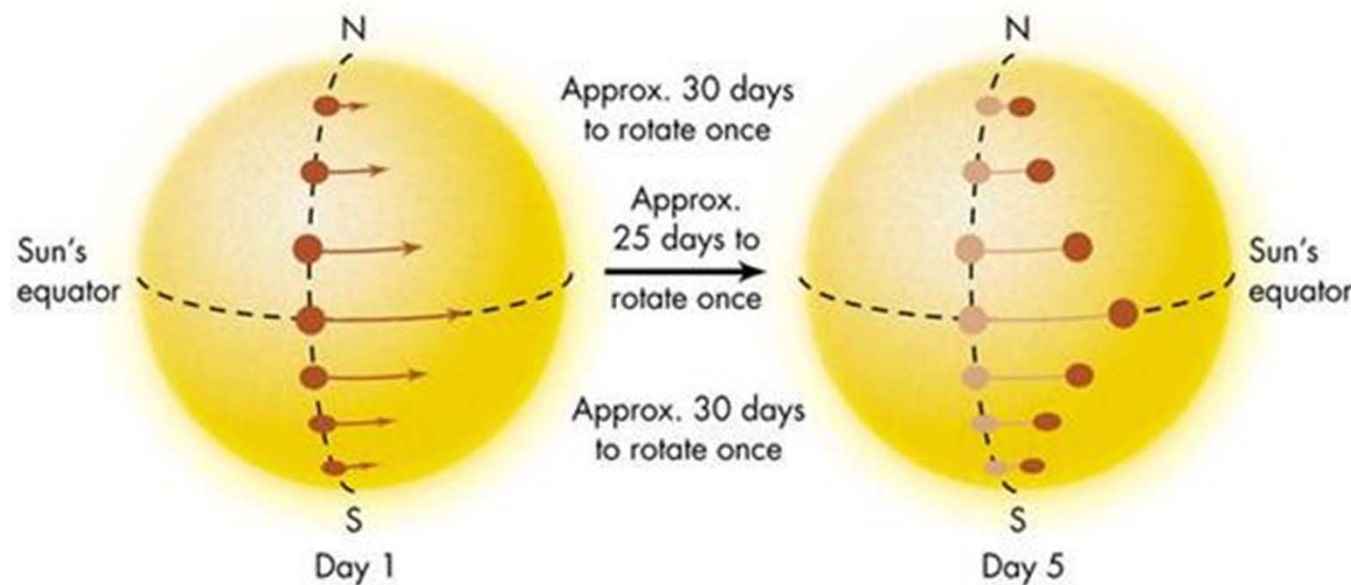


SOLAR WIND



太陽的差動自轉 (differential rotation)

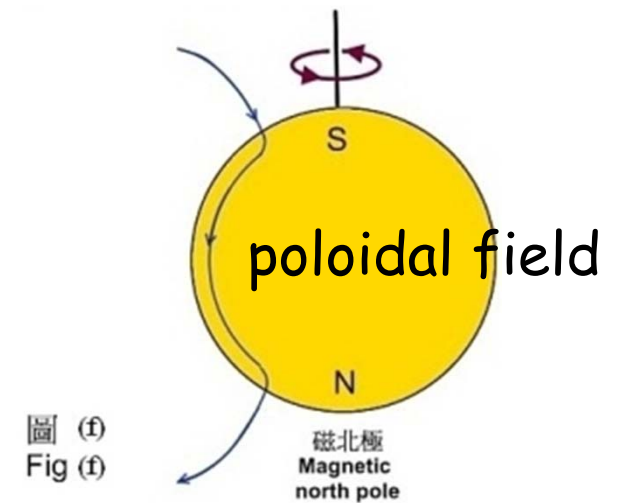
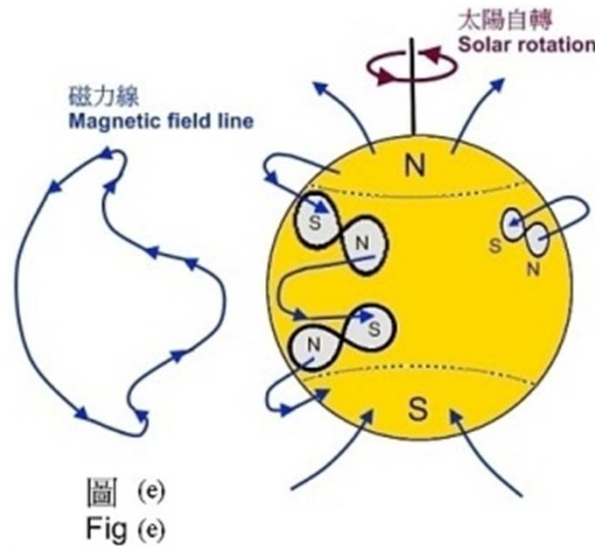
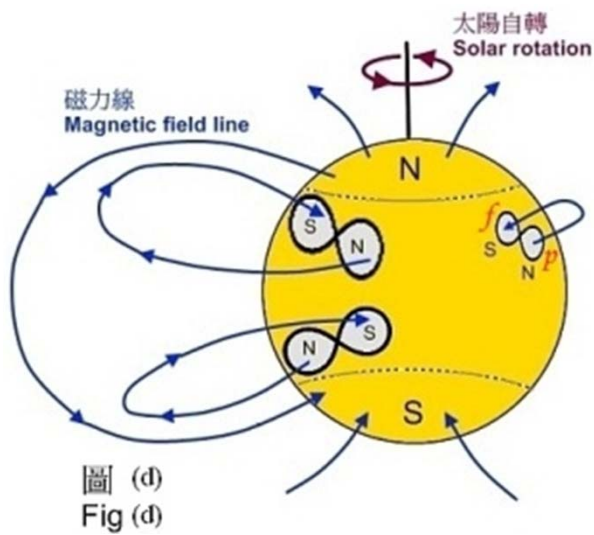
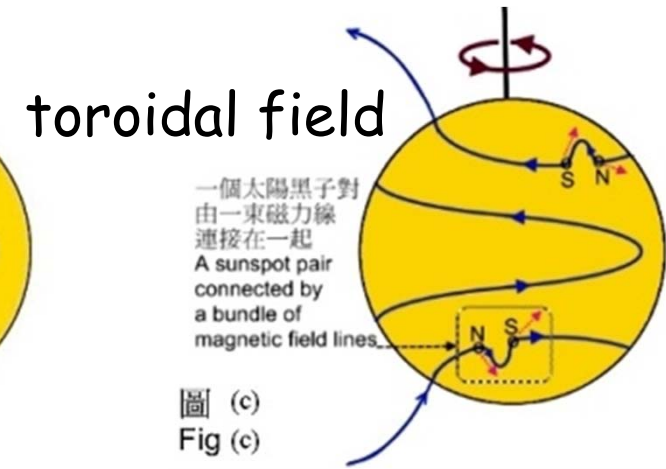
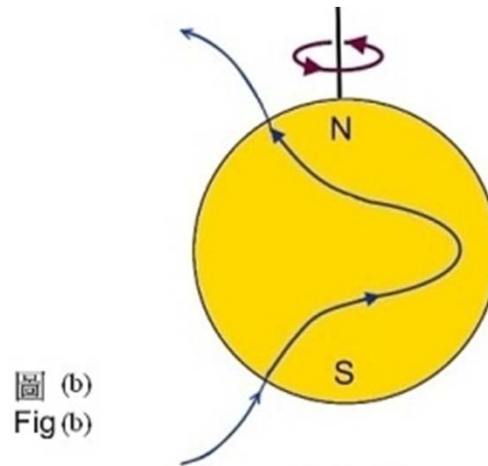
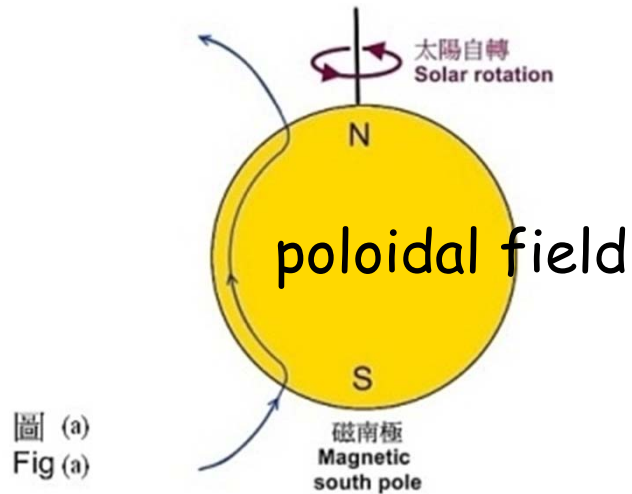
太陽平均約**27**天自轉一周，赤道區自轉速率較快，自轉一周約需**25**天，而高緯區自轉速率較慢約需**30**天。太陽的核心和輻射層並無差動自轉。



太陽磁場每**11**年反轉一次，反轉時太陽黑子數目最多。

太陽差動自轉造成太陽黑子數目有**11**年的週期變化，而磁場極性有**22**年的週期變化。

Solar Dynamo---Babcock Model

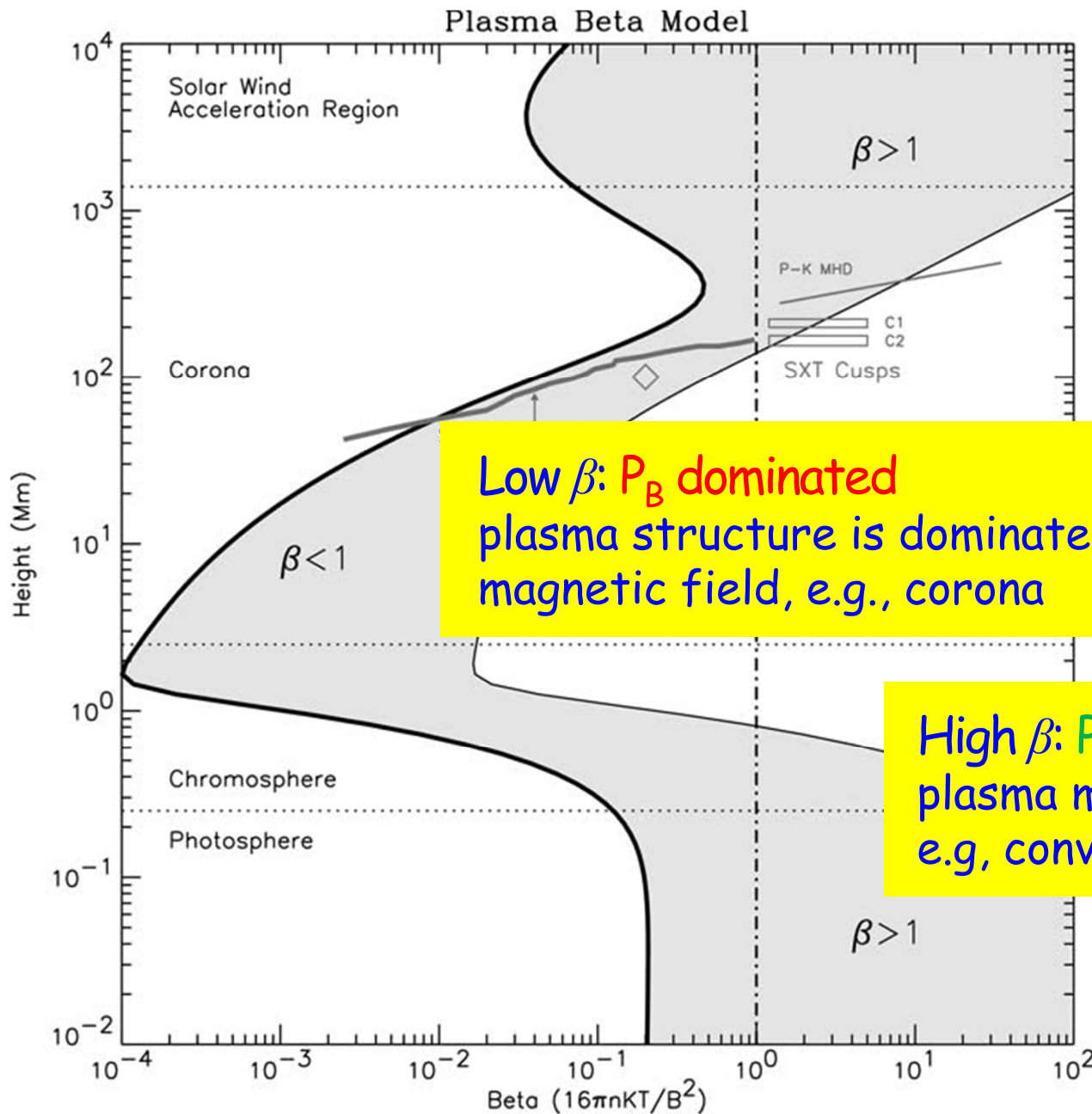


Plasma Beta

plasma thermal pressure P_g

$$\beta = \frac{nkT}{\frac{B^2}{2\mu_0}}$$

magnetic pressure P_B

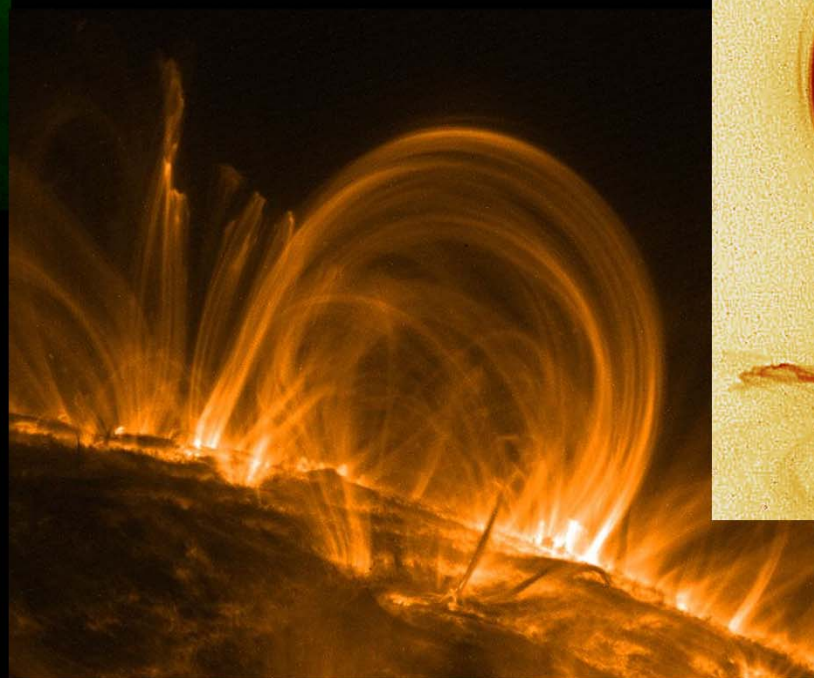
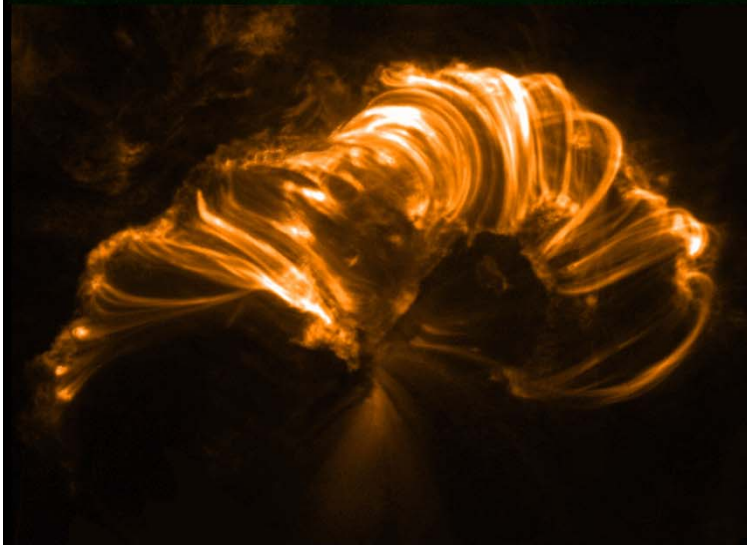
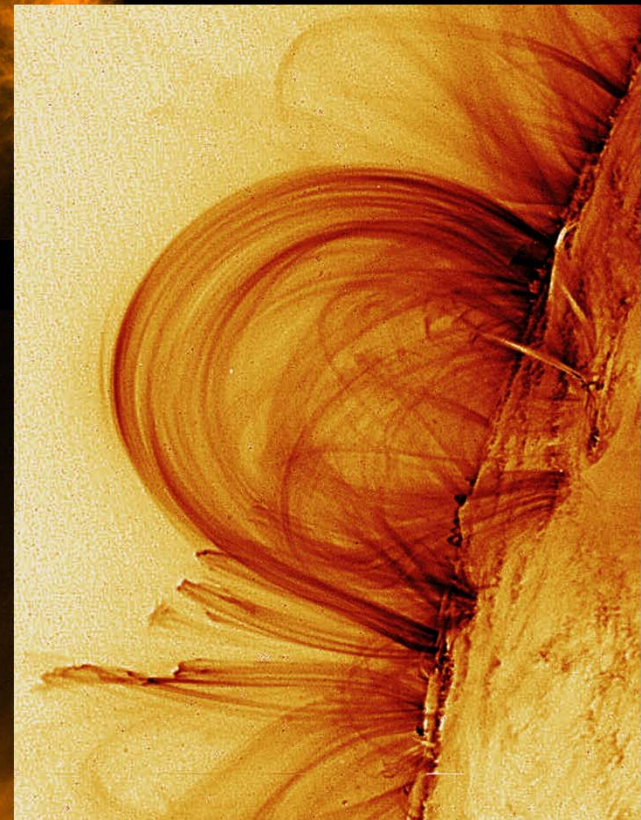
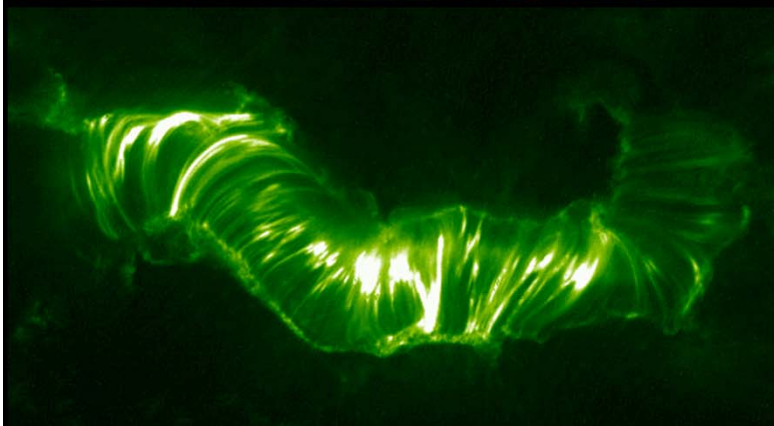
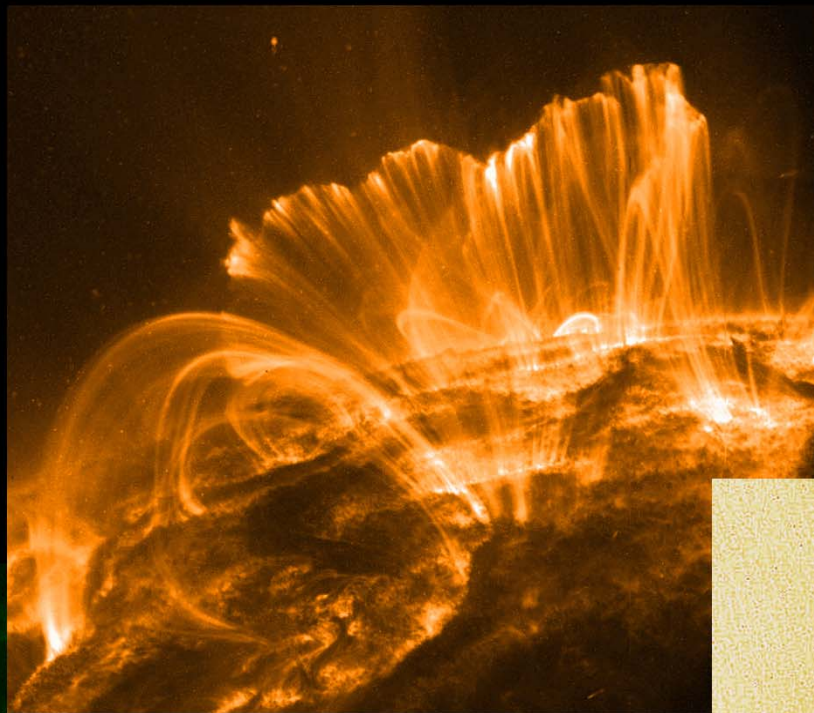
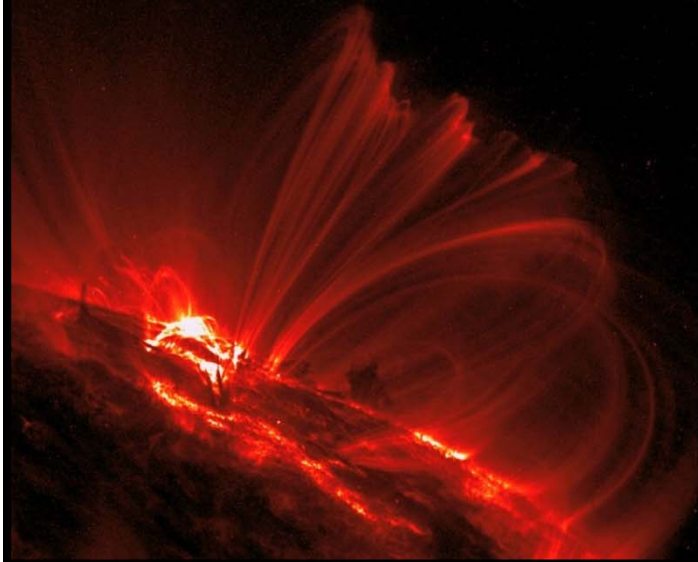


Low β : P_B dominated
 plasma structure is dominated by the topology of
 magnetic field, e.g., corona

High β : P_g dominated
 plasma motion drags the magnetic field,
 e.g., convection zone, solar wind

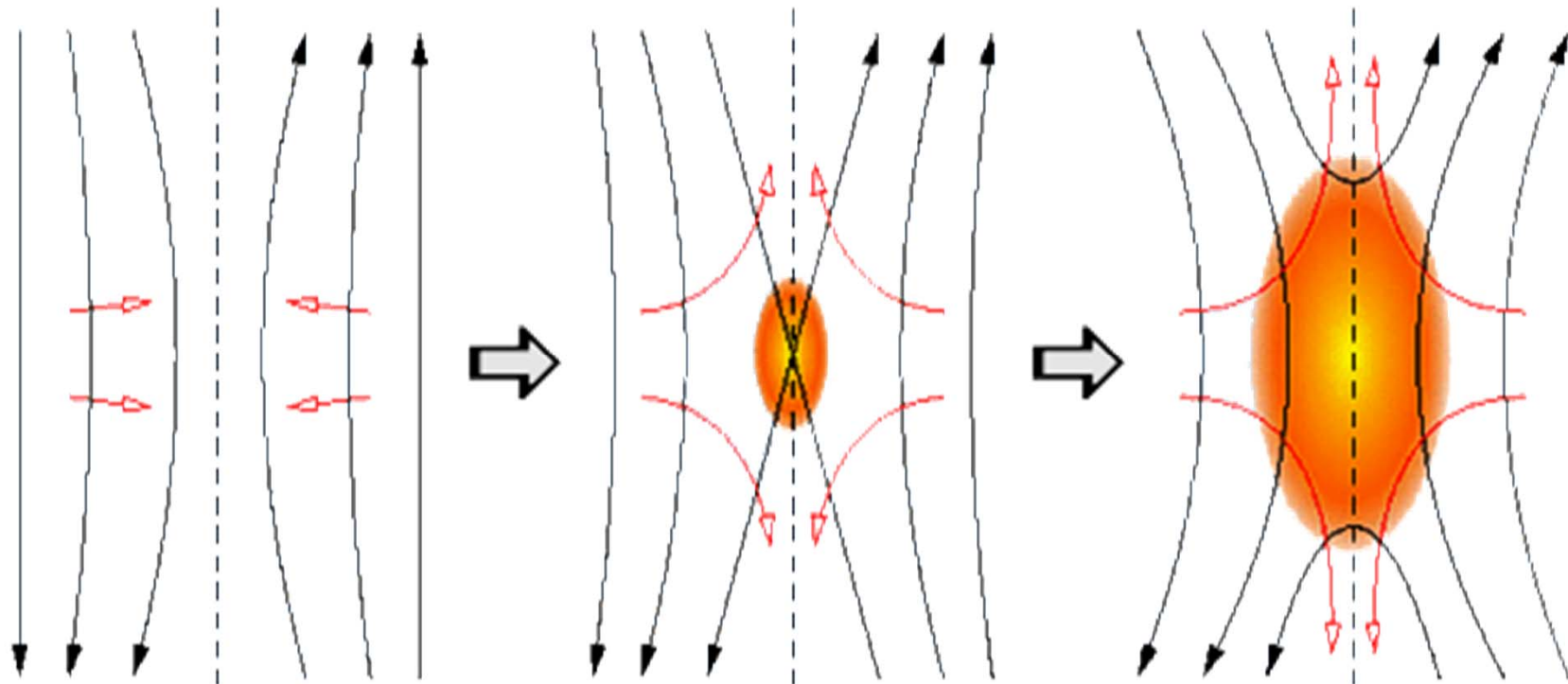
$\beta \ll 1$: cold plasma

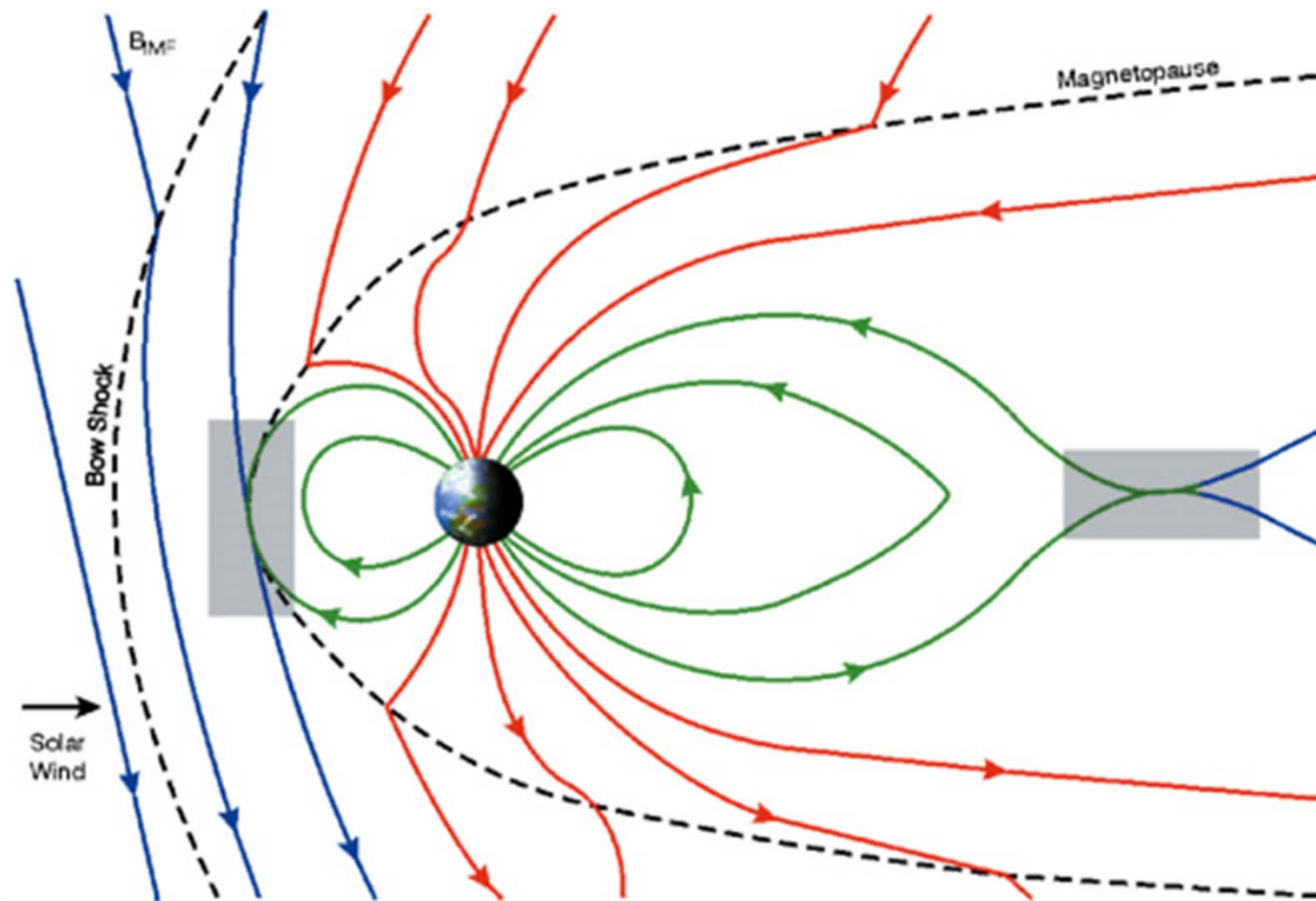
$\beta \geq 1$: warm plasma



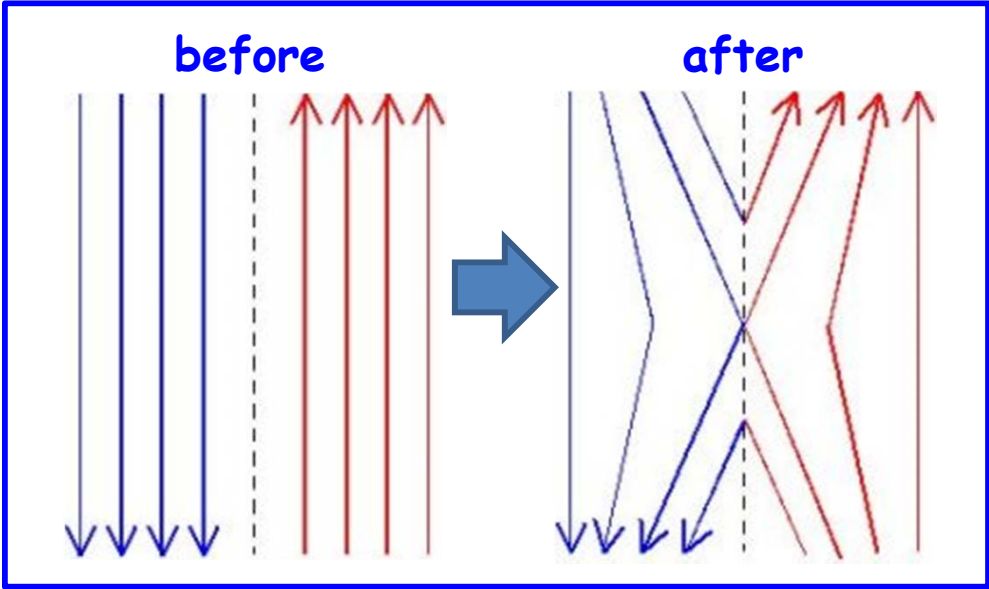
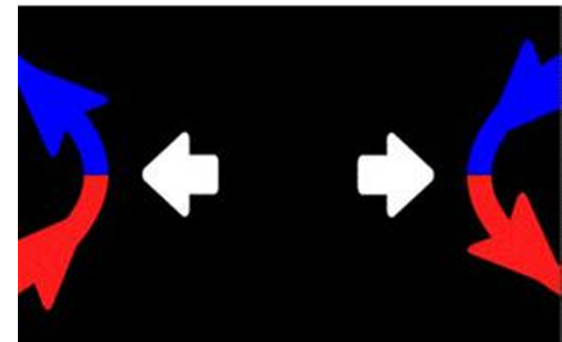
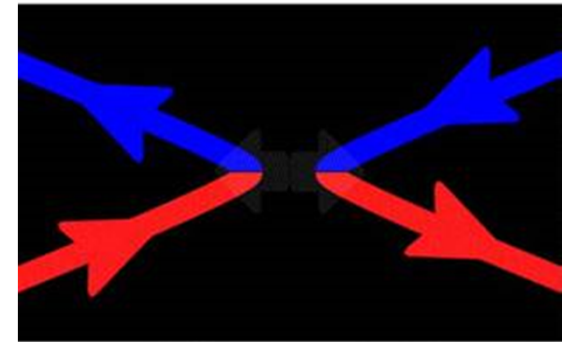
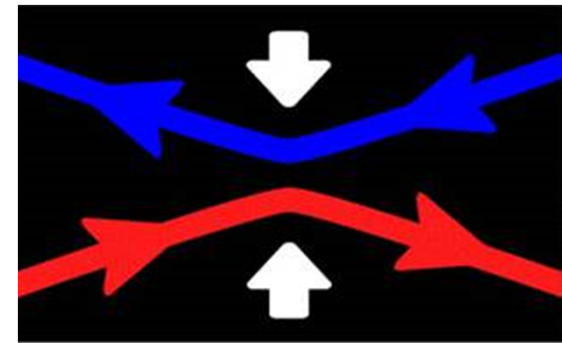
Magnetic Reconnection (磁重聯)

magnetic free energy \longrightarrow particle kinetic energy





southward IMF



<http://www.nap.edu/books/0309092159/xhtml/images/p2000a12bg23001.jpg>

http://msnbcmedia3.msn.com/j/msnbc/Components/Photo_StoryLevel/080206/080206-magneticreconnection-hmed-10a.grid-4x2.jpg

Solar wind's magnetic field

Earth's magnetic field

1

2

3

