

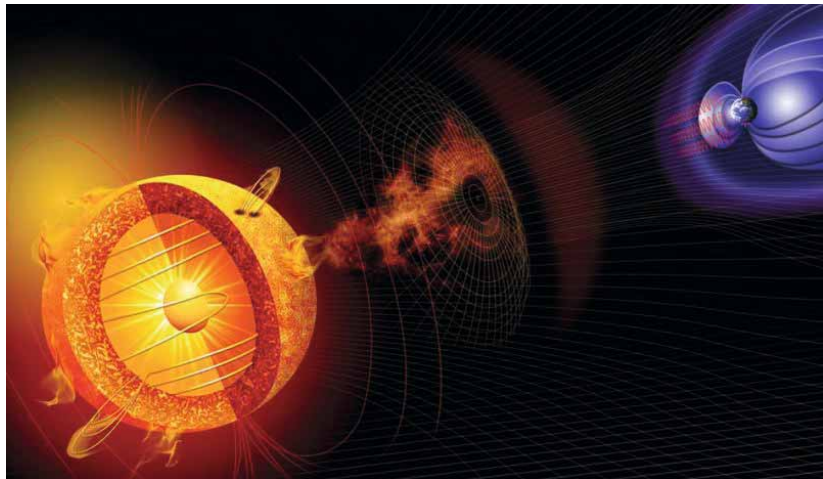
# Magnetic reconnection - the mechanism of the space weather changes

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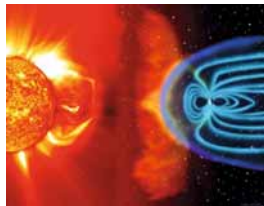
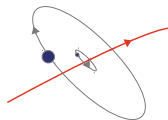
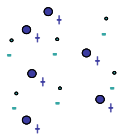
University of Graz

# Sun-Earth interaction

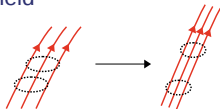


# Space Plasma

Scales

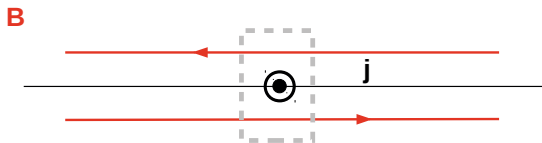


Frozen-in magnetic field



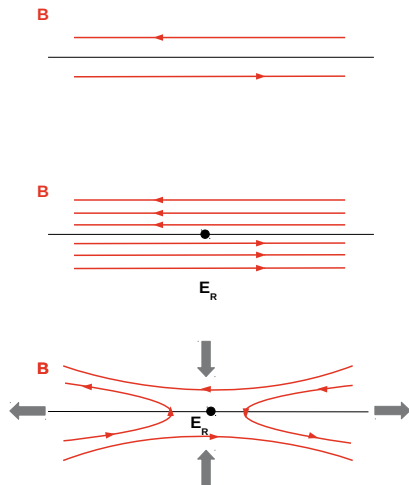
$$\frac{\partial B}{\partial t} = \nabla \times [V \times B] + \eta_m \nabla^2 B$$

# Current sheets



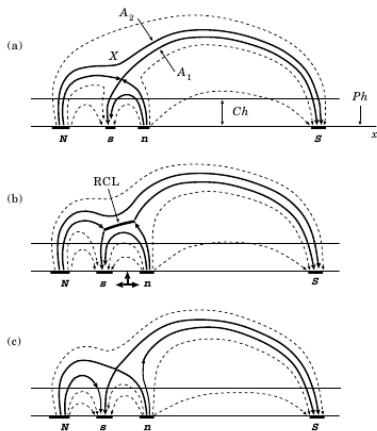
$$\nabla \times \mathbf{B} \sim \mathbf{j}$$

# Magnetic reconnection



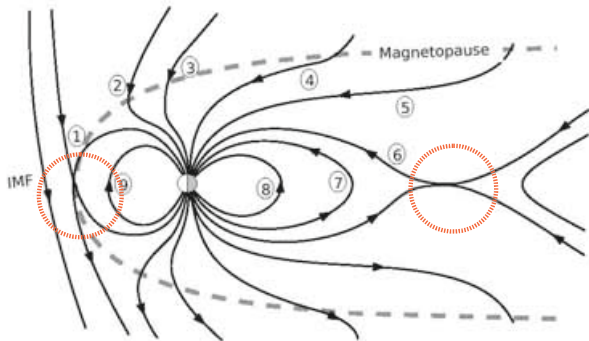
$$\frac{B_{in}^2}{2\mu_0} = \frac{\rho v_{out}^2}{2}$$

# Magnetic reconnection on Sun

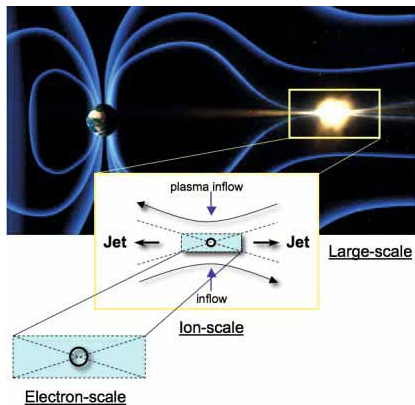


( from B.V.Somov, 2006 )

# Magnetic reconnection in magnetosphere

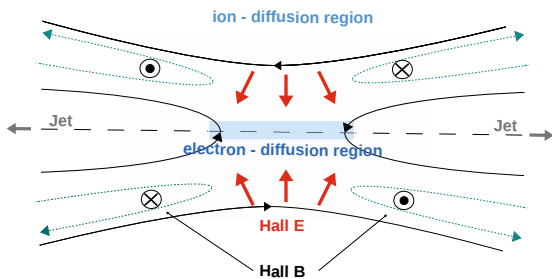


# Reconnection scales





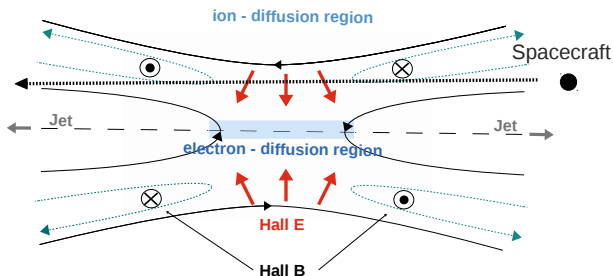
# Ion diffusion region



Zoom-in to the ion inertial length  $\frac{c}{\omega_{pi}}$ .

Ions decouple from magnetic field. Electrons are still frozen-in.

# Ion diffusion region *in-situ* measurements

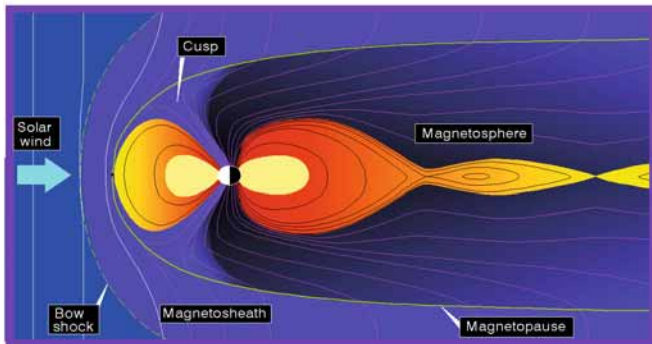


Spacecraft observes

- ▶ Plasma flow reversal
- ▶ Normal component of magnetic field reversal
- ▶ Hall fields

# Reconnection region motion

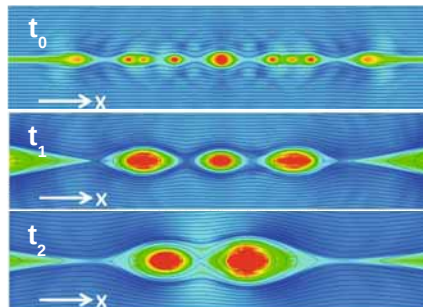
1



X-line propagates tailward due to the interaction of the earthward outflow with the Earth's dipole field

## Reconnection region motion

2



(from T.K.M. Nakamura et al., 2010)

Several X-lines are active in the current sheet, which leads to the plasma outflow coupling and X-line motions.

# Summary

Magnetic reconnection is a universal mechanism of the energy conversion in plasma, acting as a driver for the space weather changes.

