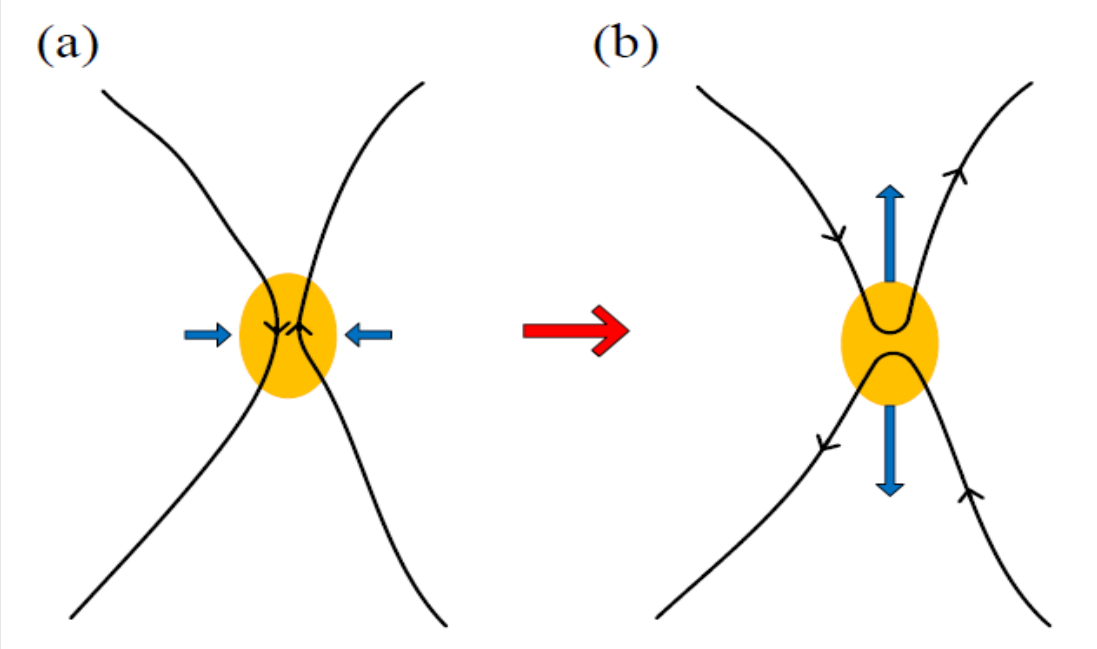
Magnetic reconnection (in 2D)



Dissertation
Page 2

Plasma connection changes in a "diffusion" region

- **What is the size (and shape) of this region?**
- **How much power enters?**
- **Where does it go?**

Fast / powerful reconnection

- **Resistive time (very long)** $\tau_D = L^2\mu_0/\eta$
- **Alfvén time (very short)** τ_A is L/V_A
- **Lundquist number (>>>1)** $S \equiv \mu_0 V_A L/\eta$
- **Sweet-Parker time (long-narrow diffusion region, D.14)** $\tau_{SP} = \sqrt{S}\tau_A$
- **"Fast" means faster than S-P**
- **Faster implies more entering power than ohmic dissipation: reconnection becomes dynamically relevant.**

What is new

- Magnetic Reconnection eXperiment (not new): Presentation_Yoo 4, 5, 8
- Collisionless regime (is it true?)
- Full 2-D measurements
  - Fields by magnetic probes: Dissertation p. 50
  - Electron temperature, density: Diss. 54
  - Ion flow by Mach probes: Diss. 57
  - Ion temperature by spectroscopy: Diss. 59
  - Plasma potential by floating probe: Diss 63
- Power inventory: Diss. 115

Results

- Open outflow (not S-P) fig.2 and D. 14
- Electron diffusion region >> d_e (to be explained)
- Electron heating >> ohmic input
- Hall dynamics:
  - Magnetized electrons and demagn. ions (figs 1, 2, 3)
  - Quadrupolar out-of plane magnetic field (D. 117)
  - In-plane electric field (→ ion acceleration) D. 76-78
- Input power >> S-P (fast reconnection)
- Output power:
  - 50% electromagnetic
  - 50%: 1/3 to electrons, 2/3 to ions
- Broad region of energy conversion

Weak spots

- Hall dynamics does not work in pair plasmas nor with guide field (as it requires heavy demangnetized ions)
- The Lundquist number is not really large (<1.E3)
- Is the plasma modified by diagnostics?
- No information on the trigger problem
- No information on energetic particles