I. Current Sheet Dynamics

Simulation:

- Study effects due to probe
- Study wave characteristics and impact on reconnection, w/ and w/o collisions, in 3D symmetric and asymmetric reconnection
- Flux rope dynamics
- Measure the thickness as a function of the distance from the X-line in the outflow direction, in both 2D and 3D simulations

MRX:

- Study probe effects by measurements with and without a second probe nearby
- Obtain profiles by fast sweeping current sheet across probes
- Re-measure wave dispersion and compare to simulation
- Improve diagnostics for current sheet dynamics, including flux ropes
- Identified 3D current sheet disruption due to flux rope ejection as a cause of impulsive reconnection
- Flux rope dynamics
- Revisit electrostatic fluctuation measurements
- Explore high-f fluctuation measurements

Space:

- Determine dependence of wave characteristics on local parameters, including reconnection electric field
- ~~Geotail's best case: E_nongyrotropic can support E_reconnection?~~
- Wait/search for lucky events for satellites crossing current sheet near the X-line; flux rope dynamics?

Resolution 1: Waves identified as long wavelength EM LHDI
Resolution 2: Waves can't support Ey and can't explain CS thickening

Hypothesis 1: Flux rope dynamics explain CS thickening
Hypothesis 2: "X-line spreading" + flux ropes explain impulsive rec.

II. Electron and Ion Heating

Simulation:

- Include collisions; analyze data

MRX:

- Improve Te measurements by revised Langmuir probes
- Spectroscopic measurements of neutral particle energy
- Improve Ti by revised IDSP and flow measurements by Mach probe
- Electron heating vs VA^2 vs beta_e
- Electron energetic tail measurement
- Explore Te measurements by UV/EUV measurements

Space:

- Ion and electron heating
- Systematically determine the dependence of electron and ion heating/ acceleration on local parameters during reconnection

Hypothesis 1: waves important for (electron) heating
Hypothesis 2: potential structure important for ion heating

III. Guide Field Effects

Simulation:

- In a small system in MRX geometry
- Guide field enhancement in H. Karimabadi et al (1999)
- Guide field enhancement simulated by Huang and Bhattacharjee (2011)

MRX:

- Establish systematic dependence of reconnection rate, diffusion region structure, on guide field strength.
- Guide field enhancement detected
- Global dynamics
- Dependence of waves, heating/acceleration on guide field

Space:

- Guide field enhancement detected but with density depletion
- Systematically determine the dependence of reconnection rate, waves, electron and ion heating/acceleration on guide field strength

Resolution: guide field slows down reconnection
Hypothesis: global dynamics explain guide field enhancement