

Task Reconnection 2.

“EMHD and PIC simulations of turbulent reconnection, related micro-instabilities and role in experiments”

Subtask 2.1. MRX-MPS

Long term goal - Additional value of the interdisciplinary collaboration:

In astro and in particular in solar physics magnetic reconnection is supposed to be enhanced, even to be triggered by turbulence. Since turbulence observations are rather indirect or even impossible in astrophysical plasma turbulence is usually investigated by means of numerical simulations. The calibration of the resulting predictions on laboratory experiments is, therefore, very much desired. The long term goal is the investigation of the turbulence characteristics of collisionless plasmas and of its influence on magnetic reconnection in comparison with and verified by MRX experiments. In particular this concerns the rate of magnetic reconnection in turbulent plasmas, the mutual feedback of reconnection and turbulence, the role of micro instabilities e.g. in current disruption events in experiments.

1.5 year plan

Goals:

Theory and simulations:

- 2-D PIC and EMHD simulations of reconnection in a given turbulence
- 2-D PIC and EMHD simulations of reconnection in self-generated turbulence and mutual dependence
- EMHD and PIC simulations of current disruption events in MRX and relation to the micro instabilities

Laboratory:

- Conduct experiments in MRX to study flux rope dynamics with or without externally imposed gradient in the reconnection electric field direction

Interdisciplinary collaboration:

This work requires a close collaboration between basic laboratory experiments and basic astrophysical theory work

Personnel:

Theory: Büchner, Jain, Munoz (MPS): Theory, EMHD and later PIC code simulations

Experiment: Ji, Yamada, postdoc (PPPL): experiments on MRX

Possible Publications:

- EMHD simulations for turbulent reconnection in 2-D
- Kinetic (PIC simulation) turbulent reconnection in 2D
- Role of micro-instabilities and turbulence in current disruption events in MRX

Impulsive reconnection dynamics under externally imposed variations along reconnecting current direction

Approximate 4 year plan

Goals:

Theory and simulation:

- Massively parallel runs of the 3-D PIC code for reconnection in a given turbulence in two and three dimensional geometry.
- PIC simulations of reconnection in self generated turbulence in two and three dimensional geometry, mutual dependence of reconnection and turbulence
- 3D PIC code Simulations of current disruptions in MRX
- Estimation of turbulent dissipation and its effect on reconnection.
- Ion influence on the instabilities and turbulence by a 3-D PIC code.

Laboratory:

- Externally perturbed experiments in MRX with a finite guide field