Task Reconnection 5.
"Magnetic field in 3D and its dissipation

Subtask 5.2. Plasmoids and Supra-Arcade Downflows (SADs): Comparison between solar observations and MHD simulations

Goal

The primary goal is to investigate, from solar observations, the structure and statistics of plasmoids and supra-arcade downflows (SAD's) forming in the aftermath of solar coronal mass ejections (CMEs), and to compare with MHD simulations. There appears to be significant evidence that plasmoids observed in a post-CME current sheet is the manifestation of a secondary tearing instability that produces magnetic islands copiously in a high-Lundquist-number plasma studied by, for example, by Bhattacharjee et al. (Phys, Plasmas 2009, 16, 112102), and Huang & Bhattacharjee (Phys. Rev. Lett. 2012, 109, 265002).

1.5 year goal

Using recent high-resolution images from the Solar Dynamic Observatory (SDO) we plan to compare predicted island distributions with solar observations.
We also plan to study SADs which are thought to form in post-CME current sheets. These SADs appear as dark plasma voids descending through faint, hot halos of emission above the main soft X-ray flare arcades at the time of large CMEs (e.g. Innes et al., Solar Phys. 2003,217,247; Savage et al, ApJ 2012, 747, L40). We plan to analyze SDO images of super-arcade downflows from a sample of events. It is likely that SADs are not plasmoids, but manifestations of a 3D ideal instability of extended current sheets. We plan to carry out MHD simulations of SADs, and compare simulation results with observations.

MP/Princeton collaboration:
Amitava Bhattacharjee, Lijia Guo, and Yi-Min Huang (Princeton University) – MHD simulations of thin current sheet dynamics
Davina Innes (MP), Lijia Guo, and Donald Schmit (MP) – Analysis of the supra-arcade downflows