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

Subtask 5.1. Field-aligned flows on the Sun and in the laboratory

The million degrees hot solar corona built but by coronal loops. In these loops ionized plasma is confined by the magnetic field and by this forms bright arcs that are aligned with the magnetic field. The feeding of mass and energy into these loops is still poorly understood. Usually the buzzword "coronal heating" is identified with the major problem, but the process that provides the mass to form the loops in the first place is closely related to the heating problem. If the heat input into the solar corona is constant in space, heat conduction back to the Sun and evaporation of cooler material would be the main source of plasma in the loops. If the heat is concentrated towards the loop footpoints, as other models suggest, then the mass supply would be through brief injections of cool material that is subsequently heated. Thus clarifying the actual process of the mass supply would put string constraints on the heating mechanism.

Solar observations alone might not be sufficient to decide which mass supply process is dominant, because on the Sun we cannot set up a controlled experiment. Here laboratory experiments can provide pivotal information on our understanding of the mass supply to and thus the heating of stellar coronae.

1.5 year goal

The first step towards the above-mentioned goal is to independently push the solar observations and the laboratory experiments and then compare and interpret the results.
In the case of the solar observations the new NASA mission IRIS, a spectrograph for extreme UV observations, will be the prime instrumental too. Being a Co-I institution MPS will have early access to the unique data to be acquired by IRIS after its launch in late spring 2013. The unprecedented spectral resolution together with the increased spatial resolution will allow us to study the mass supply to coronal loops in in much greater detail that so far.
The new experiments at PPPL with MRX, in particular the ones with new electrodes with holes, will enable to study the injection of the plasma into the lab loop in a way that was not possible before.
Once we have the solar and the laboratory data, we can directly compare the results and look for similarities and differences of the mass supply to the loops on the Sun and in the lab. In particular we can compare the velocity of the mass supply with respect to the sound and Alfvén speed and the typical time scales for the mass supply.

Approximate 4 year goal

Depending of the first comparisons between solar observations and laboratory experiments, there might be some motivations to improve and adjust the setup of the laboratory experiment. In particular, the solar observations might provide some new information on the boundary conditions that could be implemented in the laboratory experiment in order to improve the comparability between Sun and laboratory. Just as in the first part of this task, this would be a close interaction between laboratory and astrophysics

In a further step, the comparison between solar observations and laboratory experiments should be complemented with modeling of the structures on the Sun and in the laboratory. The 3D magnetohydrodynamics models that are performed at MPS for solar coronal features should be adapted to represent the model experiments, at least to some extent. In particular simplified models that allow to follow the build-up of magnetic energy during the laboratory experiment at PPPL would be of high interest for an advanced comparison between lab and sun. These models should act as a tool to understand the similarities and differences identified by the comparative studies

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