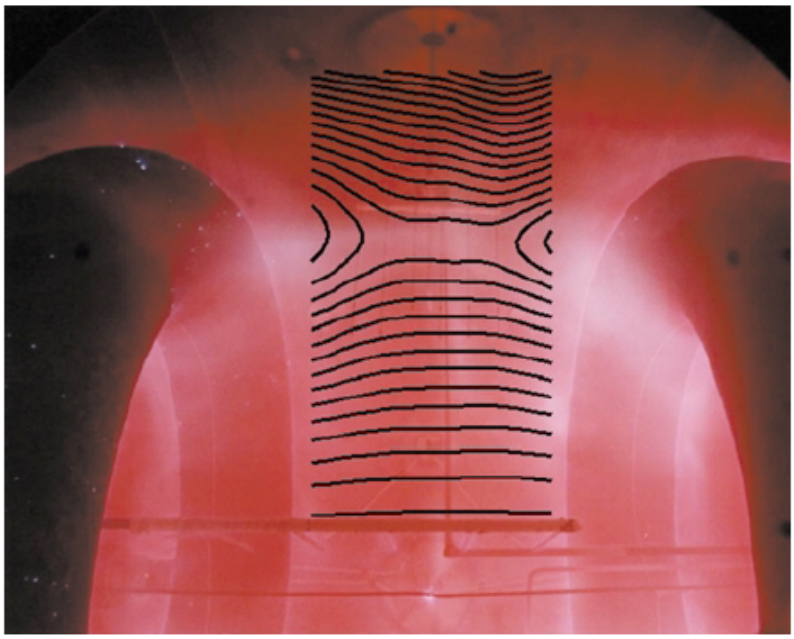
Plasmas self-organizing in the laboratory and Cosmos

Physicists studying plasmas in the lab and those studying plasmas in the cosmos both puzzle over observations of plasmas undergoing self-organization. This is particularly true for plasmas confined by magnetic fields. For example, plasmas can spontaneously generate magnetic fields in the lab, in the Sun, and throughout galaxies – a puzzle referred to as the "dynamo" problem. Or it is seen in the lab that the temperature of the positively charged particles in the plasma can suddenly double, from two million to four million degrees, in 100 microseconds – reminiscent of the mystery of why positive ions in the solar wind are much hotter than the electrons. It is also observed that rapidly rotating plasmas in the lab can suddenly and spontaneously slow down, a physics problem similar to the question of how a plasma disk surrounding a black hole loses its angular momentum. Or the sudden rearrangement of magnetic field lines – the phenomenon of magnetic reconnection - can lead to energy loss in fusion energy plasmas and flares on the surface of stars.

Recently, laboratory and astrophysical scientists have teamed up to attack these, and other, physics problems that they share. The National Science Foundation has established a Physics Frontier Center, entitled The Center for Magnetic Self-Organization in Laboratory and Astrophysical Plasmas, with the participation of six institutions (the University of Wisconsin, Princeton University, the University of Chicago, SAIC, Swarthmore College and the Lawrence Livermore National Laboratory). The Center is essentially a partnership between NSF and the Department of Energy since DOE supports the experimental facilities and computational tools. Plasmas investigated for application to fusion energy development will now also be employed for their relevance to astrophysics.

For a description of topics within the Center see the talks by R. Rosner (C11.001), M. Yamada (C11.002) and S. Prager (LM1.001). For more information, contact S. Prager (scprager@wisc.edu).



Measurement of magnetic field lines undergoing reconnection in the MRX experiment, Princeton University.