



HAO Colloquium Series

(Refreshments served)

Speaker: Cary Forest, University of Wisconsin

Time: 1:30–2:30 pm

Date: Wednesday, December 14, 2011

Location: CG1-South Auditorium

Title: Magnetic Dynamos in the Lab: Progressing from Liquid Metal to Plasmas

Abstract:

Astrophysical dynamos are composed of highly conducting, turbulent, flowing plasma in which the flow energy is much larger than that of magnetic field energy. Creating a laboratory plasma dynamo is challenging since confinement is required to keep the plasma hot (and conducting), and this requires strong applied magnetic fields. For this reason, laboratory experiments using liquid metals have been addressing the dynamo process. This talk will begin by reviewing the past decade's main results from experimental studies of dynamos using liquid metals.

Recent experiments on a novel plasma device will then be described that establish the feasibility of creating a high R_m (large, steady-state, fast flowing, and hot plasma) that is weakly magnetized and therefore suitable for dynamo studies. Flow is driven by electromagnetic torques at the magnetized boundary of a 0.5 m radius multi-cusp plasma, and then the momentum is transported inward through viscosity and the entire plasma rotates as a rigid rotor at speeds up to 4 km/s when neutral charge exchange drag is minimized. Remarkably, by changing plasma composition and density, the viscosity (and therefore the fluid Reynolds number) can be independently controlled. A much larger device, the Madison Plasma Dynamo Experiment (the MPDX), is now under construction and to extend these experiments to larger parameters. Confinement projections show the experiment will be quite capable of studying a broad range of dynamos such as large scale slow dynamos, as well as small-scale, turbulent, fast dynamos with R_m at least an order of magnitude larger than in liquid metal experiment.

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