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THE UNIVERSITY of WISCONSIN MADISON

PHYSICS COLLOQUIUM

D.W. Kerst Lecture

Studying Astrophysics in the Laboratory

How Is Angular Momentum Rapidly Transported in Accretion Disks?

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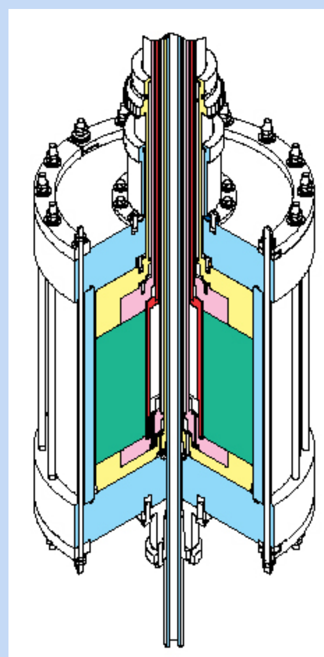
Host: Forest

Abstract: Rapid angular momentum transport in accretion disk plasmas has been a longstanding astrophysical puzzle. Since Keplerian flows are linearly stable in hydrodynamics, there exist only two viable mechanisms for the required turbulence: nonlinear hydrodynamic instability or linear magnetorotational instability (MRI). The latter is considered operating in hot disks ranging from quasars and X-ray binaries to cataclysmic variables. The former has been proposed mainly for cooler protoplanetary disk plasmas, whose Reynolds numbers are enormous. Despite their popularity, however, both candidate mechanisms have been rarely demonstrated and studied in the laboratory. In this talk, I will describe a novel laboratory experiment in a short Taylor-Couette flow geometry intended for such purposes. The experiments in water have shown, rather surprisingly, that quasi-Keplerian flows at Reynolds numbers as large as two millions are essentially laminar, effectively ruling out hydrodynamic turbulence as a candidate mechanism. The experiments in liquid gallium eutectic by imposing an axial magnetic field have shown the emergence of nonaxisymmetric modes identified as magnetocoriolis waves, one branch of which should become the MRI at higher speeds.



2241 Chamberlin Hall • Monday, November 24, 2008 • 4:00 P.M.

cookies & coffee served at 3:30 p.m.