DPP11-2011-000862

Abstract for an Invited Paper
for the DPP11 Meeting of
the American Physical Society

A Magnetically Induced Spiral Instability in the Princeton MRI Experiment[1]

ERIK SPENCE, Princeton Plasma Physics Laboratory

The rapid angular momentum transport commonly observed in astrophysical disks and stars is a topic of intense theoretical and numerical study. It is widely believed that this transport is facilitated by MHD instabilities, especially the magnetorotational instability (MRI), which can be destabilized when an electrically conducting fluid has a radially-decreasing azimuthal velocity profile and is exposed to a magnetic field. This and other shear-flow instabilities are studied using the Princeton MRI experiment, a Taylor-Couette device with independently-rotating split endcaps, which uses the gallium eutectic GaInSn as its working fluid. Here we report the observation of a new magnetic-field-induced shear-flow instability. The fluid's velocity field is measured using an ultrasonic Doppler velocimetry system, which has indicated a dramatic destabilization of the background flow when there is sufficiently large applied magnetic field and differential rotation of the endcaps. The saturated state is a coherent, vertically independent, large-amplitude m=1 azimuthal mode, with a distinct spiral structure. Though the instability requires an applied magnetic field, it also exists as the magnetic Reynolds number approaches zero, indicating an inductionless mechanism. Characterization of the instability will be presented and compared with 3D numerical simulations. The relationship of this instability to the MRI and other shear-flow instabilities, as well as the resultant angular momentum transport and its possible astrophysical and geophysical applications, will be discussed.

[1]This work is supported by DOE contract number DE-AC02-09CH11466.