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Numerical Prediction of the Onset of the Magnetorotational Instability in the Princeton MRI Apparatus[1] ERIK GILSON, KYLE CASPARY, FATIMA EBRAHIMI, Princeton Plasma Physics Laboratory, JEREMY GOODMAN, Princeton University, HANTAO JI, Princeton Plasma Physics Laboratory, Princeton University, TAHIRI NUÑEZ, Hudson County Community College , XING WEI, Shanghai Jiao Tong University — The liquid metal magnetorotational instability experiment at PPPL is designed to search for the MRI in a controlled laboratory setup. MRI is thought to be the primary mechanism behind turbulence in accretion disks, leading to an enhanced effective viscosity that can explain observed fast accretion rates. The apparatus has several key differences from an accretion disk. The top and bottom surfaces of the vessel exert stresses on the surfaces of the working fluid. There are no surface stresses on an accretion disk, but rather a free-surface. To interpret experimental results, the Spectral Finite Element Maxwell and Navier Stokes (SFEMaNS) code (Guermond et al., 2009) has been used to simulate experiments in the MRI apparatus and study MRI onset in the presence of residual flows induced by the boundaries. These Ekman flows lead to the generation of radial magnetic fields that can obfuscate the MRI signal. Simulation results are presented that show the full spatial distribution of the velocity field and the magnetic field over a range of experimental operating parameters, including both above and below the expected MRI threshold. Both the residual flow and the radial magnetic field at the location of the diagnostics are computed for comparisons with experimental results.

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Erik Gilson
Princeton Plasma Physics Laboratory

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