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Study of Magnetorotational Instability and Free-Surface MHD Flow H. JI, L. BERZAK, M. BURIN, E. FREDRICKSON, J. GOODMAN, N. KATZ, W. LIU, X. MA, K. MCMURTRY, E. SCHARTMAN, J. STONE, J. WAKSMAN, R. WOOLLEY, Princeton U., F. CATTANEO, A. OBABKO, R. ROSNER, U. Chicago, P. FISCHER, Argonne National Laboratory, A. KAGEYAMA, Earth Simulator Center, Japan, B.-F. FENG, U. Texas - PanAm, N. MORLEY, UCLA —
An overview is given on two laboratory experiments using liquid gallium to study basic physics problems with astrophysical importance. The first one concerns magnetorotational instability (MRI), which is regarded as a dominant mechanism for rapid angular momentum transport in magnetized accretion disks. Based on theoretical analyses, computer simulations, and prototype experiments, a short Couette flow apparatus has been constructed including two differentially rotating rings at both ends to minimize the Ekman effect. Current focus is to clearly demonstrate MRI and to study its nonlinear saturation. The second experiment is to study stability and turbulence in free-surface MHD flow, which is important in understanding X-ray bursts observed from neutron star surfaces, and also in implementing free-surface liquid metal flow across the magnetic field in fusion devices. Based on the results from a prototype experiment, a larger open- channel flow is built to achieve higher flow speeds and magnetic fields. Comparisons with state-of-art 3D MHD simulations are also planned. Work supported by DoE (DE-AC02-76-CH03073), NSF(AST-0205903, PHY-0215581), and NASA(ATP03-0084-0106, APRA04-0000-0152).

Hantao Ji
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