Abstract Submitted
for the DPP06 Meeting of
The American Physical Society

Laboratory Study of MHD Effects on Stability of Free-surface Liquid Metal Flow M.J. BURIN, H. JI, K. MCMURTRY, L. PETERSON, Princeton U., D. GIANNAKIS, R. ROSNER, U. Chicago, P. FISCHER, Argonne National Laboratory — The dynamics of free-surface MHD shear flows is potentially important to both astrophysics (e.g. in the mixing of dense plasma accreted upon neutron star surfaces) and fusion reactors (e.g. in liquid metal first walls). To date however few relevant experiments exist. In order to study the fundamental physics of such flows, a small-scale laboratory experiment is being built using a liquid gallium alloy flowing in an open- channel geometry. The flow dimensions are nominally 10cm wide, 1cm deep, and 70cm long under an imposed magnetic field up to 7kG, leading to maximum Hartman number of 2000 and maximum Reynolds number of 4×10^5. Two basic physics issues will ultimately be addressed: (1) How do MHD effects modify the stability of the free surface? For example, is the flow more stable (through the suppression of cross-field motions), or less stable (through the introduction of new boundary layers)? We also investigate whether internal shear layers and imposed electric currents can control the surface stability. (2) How do MHD effects modify free-surface convection driven by a vertical and/or horizontal temperature gradient? We discuss aspects of both of these issues, along with detailed descriptions of the experimental device. Pertinent theoretical stability analyses and initial hydrodynamic results are presented in companion posters. This work is supported by DoE under contract #DE-AC02-76-CH03073.

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Date submitted: 21 Jul 2006 Electronic form version 1.4