Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Effects of magnetic fields on heat transfer in flowing liquid metals[1]

J. RHOADS, Princeton University, E. EDLUND, P. SLOBODA, PPPL, H. JI, Princeton University — The presence of a magnetic field can significantly change the dynamics of large and small scale features within conducting fluids. In particular, turbulent eddies with vorticity misaligned with the magnetic field are strongly damped via ohmic dissipation. Studying the anisotropic damping of the turbulence is critically important for understanding heat transport in flowing liquid metals. Experiments have been conducted in the Liquid Metal Experiment (LMX) using a GaInSn eutectic alloy as a working fluid to investigate these effects. These experiments considered free-surface, wide aspect-ratio flows with fluid velocities up to 20 cm/s and a uniform applied magnetic field strength up to 2 kG, corresponding to Reynolds numbers up to $Re \sim 10^4$ and interaction parameters up to $N \sim 10$. Heat was injected into the flow via a resistive heater placed on the free surface and the fluid temperature downstream was monitored by an array of thermocouples and an infrared camera, while an array of velocity probes provided measurements of vortical structures within the flow. The changes observed in both vortical structures and global heat transfer within the fluid will be presented.

[1]Work supported under contract DE-AC02-09CH11466.

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Date submitted: 02 Aug 2013 Electronic form version 1.4