Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

A liquid sodium model of the Earth's core[1] DANIEL LATHROP, MATTHEW ADAMS, DOUGLAS STONE, MINH DOAN, University of Maryland
— We present results from the three meter liquid sodium spherical Couette experiment at full speed (4 Hz outer sphere rotation rate and a range of inner sphere rates). The experiment is geometrically similar with the earth's core. We study hydrodynamic and hydromagnetic phenomena in rapidly rotating turbulence, as well as magnetic field induction by those flows. Two external electromagnets apply dipole or quadrupole magnetic fields, while an array of 31 external Hall sensors measure the resulting induced magnetic field. This allows us to study dynamo gain (as we yet have no self-generating magnetic dynamo) and broader range of rotating turbulence phenomena. We report substantial magnetic field gain for a variety of flow states. One of these states exhibits bistability in the hydrodynamic flow with magnetic field gain only in one of the two states. Zonal flow shear drives large azimuthal magnetic fields, prompting a need to measure the zonal flows. This has prompted us to develop acoustic mode velocimetry measurements adapted from helioseismology. Prior to measurements in the larger experiment, we develop this technique in our 60 cm diameter spherical Couette experiment in nitrogen gas. There, we compare acoustic mode frequency splittings with theoretical predictions for solid body flow and turbulent flow, and obtain excellent agreement. We also use this technique to estimate the zonal shear in those experiments.

[1]NSF EAR 1417148

Daniel Lathrop
University of Maryland

Date submitted: 01 Aug 2016 Electronic form version 1.4