Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Oscillatory Convection in Rotating Liquid Metals[1] VINCENT BERTIN[2], ENS Paris, ALEX GRANNAN, JONATHAN AURNOU, UCLA Earth and Space Sciences — We have performed laboratory experiments in a aspect ratio $\Gamma \simeq 2$ cylinder using liquid gallium ($Pr \simeq 0.023$) as the working fluid. The Ekman number varies from $E = 4 \times 10^{-5}$ to 4×10^{-6} and the Rayleigh number varies from $Ra = 3 \times 10^5$ to 2×10^7. Using heat transfer and temperature measurements within the fluid, we characterize the different styles of low Pr rotating convective flow. The convection threshold is first overcome in the form of a container scale inertial oscillatory mode. At stronger forcing, wall-localized modes develop, coexisting with the inertial oscillatory modes in the bulk. When the strength of the buoyancy increases further, the bulk flow becomes turbulent while the wall modes remain. Our results imply that rotating convective flows in liquid metals do not develop in the form of quasi-steady columns, as in $Pr \simeq 1$ planetary and stellar dynamo models, but in the form of oscillatory motions. Therefore, convection driven dynamo action in low Pr fluids can differ substantively than that occurring in typical $Pr \simeq 1$ numerical models. Our results also suggest that low wavenumber, wall modes may be dynamically and observationally important in liquid metal dynamo systems.

[1]We thank the NSF Geophysics Program for support of this project.
[2]VB will be in France during DFD, so one of the other authors will present this paper.

Jonathan Aurnou
UCLA Earth
Space Sciences

Date submitted: 02 Aug 2016 Electronic form version 1.4