Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Near free-fall oscillatory velocities in liquid metal rotating convection TOBIAS VOGT, HZDR, SUSANNE HORN, Coventry University, JONATHAN AURNOU, UCLA, HELMHOLTZ-ZENTRUM DRESDEN-ROSSENDORF TEAM, UNIVERSITY OF CALIFORNIA, LOS ANGELES TEAM, COVENTRY UNIVERSITY TEAM — The geomagnetic field is induced by liquid metal flow inside Earths outer core as a self-excited dynamo. Buoyancy drives the liquid metal flow because the iron rich core is cooling from its primordial state through heat loss to the mantle. The rotation of the Earth and Lorentz forces alter the resulting convective flow. However, the detailed flow topology is largely unknown. Here we will investigate the effect of rotation on a low Prandtl number thermal convection by means of laboratory experiments and DNS. Therefore, we consider a rotating Rayleigh-Bénard convection setup in an upright cylindrical vessel of aspect ratio $\Gamma = D/H = 2$. We investigate supercriticalities in the range of $1 \leq \widetilde{Ra} < 20$ and Ekman numbers $4 \times 10^{-5} \leq Ek \leq 5 \times 10^{-6}$ in liquid gallium at $Pr = 0.03$. By means of ultrasound-Doppler velocity measurements, we find that oscillatory convection generates velocities approaching the freefall velocity. Multimodal bulk oscillations dominate the vertical velocity field over the whole range of supercriticalities investigated. Additionally, coherent mean zonal flows and time-mean helicity suggesting that these oscillatory flows can be relevant for dynamo action.

Tobias Vogt
HZDR

Date submitted: 26 Jul 2019 Electronic form version 1.4