Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Identification of dominant flow structures in rapidly rotating convection of liquid metals using Dynamic Mode Decomposition SUSANNE HORN, Department of Mathematics, Imperial College London, JONATHAN M. AURNOU, Department of Earth, Planetary, and Space Sciences, University of California, Los Angeles, PETER J. SCHMID, Department of Mathematics, Imperial College London — We will present results from direct numerical simulations of rapidly rotating convection in a fluid with $Pr \approx 0.025$ in cylindrical containers and Ekman numbers as low as 5×10^{-6}. In this system, the Coriolis force is the source of two types of inertial modes, the so-called wall modes, that also exist at moderate Prandtl numbers, and cylinder-filling oscillatory modes, that are a unique feature of small Prandtl number convection. The obtained flow fields were analyzed using the Dynamic Mode Decomposition (DMD). This technique allows to extract and identify the structures that govern the dynamics of the system as well as their corresponding frequencies. We have investigated both the regime where the flow is purely oscillatory and the regime where wall modes and oscillatory modes co-exist. In the purely oscillatory regime, high and low frequency oscillatory modes characterize the flow. When both types of modes are present, the DMD reveals that the wall-attached modes dominate the flow dynamics. They precess with a relatively low frequency in retrograde direction. Nonetheless, also in this case, high frequency oscillations have a significant contribution.

Susanne Horn
Department of Mathematics, Imperial College London

Date submitted: 01 Aug 2016 Electronic form version 1.4