Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Anisotropy turbulent Rayleigh–Bénard convection in spherical shell due to shifting of gravity center[1] GUIQUAN WANG, Univ of Twente, LUCA SANTELLI, Gran Sasso Science Institut, ROBERTO VERZICCO, University of Rome Tor Vergata, DETLEF LOHSE, RICHARD STEVENS, Univ of Twente
— we use direct numerical simulation to simulate the thermal convection for a fluid with Prandtl number of unity in spherical shells with an aspect ratio of 0.3 between the inner and outer sphere radius. We study the influence of the gravity center location by shifting it from the geometrical center to 0.8 of inner sphere radius, for Rayleigh number up to 3E+7. When the gravity center is moved to the south, a convective jet is generated in the opposite northern direction. Besides, a large-scale vortex is formed, while the flow in the southern hemisphere becomes stratified. However, surprisingly, the global heat transfer seems relatively insensitive to the shifting gravity center, even though the flow pattern is completely changed. On the outer sphere, the heat transfer is highest near the north pole while on the inner sphere, it is highest around the south pole. We use quadrant analysis and model analysis to investigate the inhomogeneous flow structures when the gravity center is not located at the geometrical center. Our results indicate that it is essential to consider density heterogeneities when modeling convection in the Earth's outer core.

[1]ERC (the European Research Council) Starting Grant No. 804283 UltimateRB

Guiquan WANG
Univ of Twente

Date submitted: 03 Aug 2020 Electronic form version 1.4