Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

How barotropic and stable are differential-rotation cylindrical flows?[1] GREGORY SHEARD, TONY VO, Department of Mechanical and Aerospace Engineering, Monash University, LUCA MONTABONE, Atmospheric, Oceanic and Planetary Physics, University of Oxford — In rotating cylindrical containers it is possible to generate a highly depth-independent vertical shear layer, akin to the layers studied by Stewartson theoretically in 1957, by driving the inner radial part of the fluid at a different speed through rotation of disks embedded in the top and base of a fluid-filled enclosure. This configuration finds laboratory application in the study of shear layers in rotating flows motivated by geophysical flows such as planetary polar vortices and terrestrial hurricanes. We combine high-order axisymmetric computations with a linear stability analysis and three-dimensional simulation to characterize regimes of depth-independent ("barotropic") flow, and the modes by which both axial (depth-dependent) and azimuthal symmetry are broken in the system. Azimuthal instability produces striking symmetrical polygonal patterns closely resembling patterns seen in atmospheric polar vortices.

[1]Supported by the Australian Research Council through Discovery Grant DP120100153

Gregory Sheard
Department of Mechanical and Aerospace Engineering, Monash University

Date submitted: 11 Aug 2013 Electronic form version 1.4