Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Three-dimensional instabilities in a rapidly counter-rotating split cylinder[1] PALOMA GUTIERREZ-CASTILLO, JUAN M. LOPEZ, Arizona State University — The three-dimensional flow in a counter-rotating cylinder that is split at its mid-plane is studied numerically via spectral methods. The cylinder of radius a and length h is completely filled with fluid of kinematic viscosity ν. The top half rotates with angular speed ω and the bottom half with angular speed $-\omega$. There are two nondimensional parameters governing the flow, $Re = \omega a^2/\nu$ and $\Gamma = h/a$. For small values of Re and Γ the flow is steady, axisymmmetric and reflection symmetric about the mid-height (with appropriate changes of sign for some flow components). In this regime the interior flow in each half of the cylinder rotate as solid-body rotation of opposite senses. Apart from the boundary layers on the cylinder walls, there is also an internal shear layer separating the two counter-rotating halves. Above a critical Re that depends on Γ, this internal shear layer becomes unstable to low frequency instabilities that break both the axisymmetry and the reflection symmetry. For these cases there exist rotating waves associated with the shear-layer instability. The variation of the critical Re and the azimuthal wavenumbers of the instability as a function of Γ is studied, along with the nonlinear dynamics.

[1]U.S. National Science Foundation grant CBET-1336410

Paloma Gutierrez-Castillo
Arizona State University

Date submitted: 30 Jul 2015

Electronic form version 1.4