Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Identifying instability mechanisms in swirling shear flows by using all components of the structural sensitivity[1] MATTHEW JUNIPER, UBAID QADRI, University of Cambridge — Four different physical mechanisms can cause or support instability in swirling shear flows (Gallaire and Chomaz 2003, PoF 15(9) 2622-2639). These are: axial shear, inertial waves, centrifugal instabilities, and azimuthal shear. In relatively simple flows, such as a Rankine vortex with plug axial flow, analytical methods can identify the physical mechanisms active in each region of the flow. In more complex flows, such as a vortex breakdown bubble, analytical methods cannot be applied and, in any case, regions of the flow are not easily delineated. When considering the stability of perturbations on top of a base flow, the structural sensitivity quantifies the effect of altering the feedback between the perturbation velocity vector and the perturbation momentum equation. We examine the nine components of this structural sensitivity, firstly for simple flows such as solid body rotation, secondly for complex swirling flows. The first analysis identifies the signature of each physical mechanism, such as the Kelvin-Helmholtz instability and the Coriolis mechanism. The second analysis compares these signatures with those found in different regions of the complex swirling flows. In this way, we identify the physical mechanisms that are active in each region of the more complex flow.

[1]Supported by the European Research Council and by Trinity College Cambridge

Matthew Juniper
University of Cambridge

Date submitted: 03 Aug 2012 Electronic form version 1.4