Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Centrifugal instabilities in curved free shear layers: direct computations in the nonlinear regime OMAR ES-SAHLI, ADRIAN SESCU, Mississippi State University, USA, MOHAMMED AFSAR, University of Strathclyde,UK — Curved free shear layers abound in many engineering applications involving complex geometries, such as backward facing step flows, wall injection, the flow inside side-dump combustors, or flows around vertical axis wind turbines. Most of the previous studies involving centrifugal instabilities have been focused on wall-bounded flows, where the so-called Taylor vortices in enclosed geometries or Görtler vortices in boundary layer flows on concave surfaces are generated. Centrifugal instabilities in curved free shear layers, however, did not receive sufficient attention partly because these flows are mostly dominated by Kelvin-Helmholtz instabilities. Under certain conditions, however, longitudinal instabilities in the form of Görtler vortices can occur, which - alone or in combination with Kelvin-Helmholtz type instabilities - may be susceptible to secondary instabilities and ultimately to turbulence. We study the development and growth of nonlinear Görtler vortices evolving inside curved free shear layers in both incompressible and compressible regimes, using direct numerical solution to the Navier-Stokes equations. Results for different flow conditions are reported, along with discussions of challenges associated with simulating these types of flows.

Adrian Sescu
Mississippi State University

Date submitted: 30 Jul 2019 Electronic form version 1.4