Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

Transient Growth on a High-Reynolds-number Oseen Vortex Leading to Breakup ERIC STOUT, FAZLE HUSSAIN, Texas Tech University — Incompressible vortex-turbulence interaction and vortex perturbation transient growth are explored at Reynolds numbers (Re≡vortex circulation/viscosity) much higher than the current computational maximum of Re=10,000, via Large Eddy Simulation (LES) using the Smagorinsky model. At Re=10,000, LES results agree closely with Direct Numerical Simulation (DNS) results for the perturbation energy, peak azimuthal velocity, and core radius (radius of peak azimuthal velocity) - thus validating the LES scheme. Our previous studies have shown that turbulence, strained into external spiral filaments, induces axial flow on an initially rectilinear Oseen vortex column. Axial flow comparable to the swirl destabilizes a vortex; however, at Re=10000, viscous decay of the filaments limits the axial flow. We study a vortex column at Re=50,000 using LES to achieve stronger axial flow, thus triggering instability and transition of the vortex into turbulence. This transition is compared with DNS of an unstable vortex at Re=10000 - both simulations showing transition of the vortex column into a bundle of numerous spiraling axial vortex threads. Details of the initial transient growth, transition process and turbulence evolution will be explained.

Eric Stout
Texas Tech University

Date submitted: 01 Aug 2017 Electronic form version 1.4