Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

What a resolvent analysis for low speed cylinder flow reveals about turbulent flows SEAN SYMON, BEVERLEY J. MCKEON, California Institute of Technology — A resolvent analysis using global modes is performed for the mean wake around a circular cylinder at a Reynolds number of $Re = 100$. Significant amplification resulting in a large resolvent norm occurs at a temporal frequency matching that of the vortex shedding. Moreover, the mode shapes identify the large-scale structures in the flow, which in this case is the vortex street. Rewriting the resolvent operator at this frequency as outer products of the forward and adjoint eigenvectors of the linear Navier-Stokes (LNS) operator reveals a close match between stability and resolvent modes. While resonance dominates the resolvent norm for the cylinder, high mean shear, which results in the LNS operator being non-normal, can also result in high amplification. In such cases a mean flow stability analysis does not identify the underlying structure at that temporal frequency and the perturbation energy is distributed in different velocity components for the optimal forcing and response modes. The implications of mean flow convection, which results in the non self-adjoint nature of the LNS operator, are discussed as well as extensions to canonical turbulence where wall-normal height influences whether stability outweighs non-normality.

Sean Symon
California Institute of Technology

Date submitted: 26 Jul 2017 Electronic form version 1.4