Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

The influence of compressibility on nonlinear spectral energy transfer - Part 2: Effect on hypersonic boundary layer transition ANKITA MITTAL, SHARATH GIRIMAJI, Texas AM Univ — We examine the effect of compressible spectral energy transfer in the nonlinear regime of transition to turbulence of hypersonic boundary layers. The nature of spectral energy transfer between perturbation modes is profoundly influenced by two compressibility mechanisms. First and foremost, the emergence of nonlinear pressure-dilatation mechanism leads to kinetic-internal energy exchange within the perturbation field. Such interchange is absent in incompressible flow as pressure merely reorients the perturbation amplitude vector while conserving kinetic energy. Secondly, the nature of triadic interactions also changes due to variability in density. In this work, we demonstrate that the efficiency of nonlinear spectral energy transfer is diminished in compressible boundary layers. Emergence of new perturbation modes or 'broad-banding' of the perturbation field is significantly delayed in comparison to incompressible boundary layer undergoing transition. A significant amount of perturbation energy is transformed to internal energy and thus unavailable for 'tripping' the flow into turbulent state. These factors profoundly change the nature of the nonlinear stage of transition in compressible boundary layer leading to delayed onset of full-fledged turbulence.

Ankita Mittal
Texas A
M Univ

Date submitted: 30 Jul 2017 Electronic form version 1.4