Abstract Submitted
for the DFD15 Meeting of
The American Physical Society

Turbulent energy flux generated by shock/homogeneous-turbulence interaction KRISHNENDU SINHA, RUSSELL QUADROS, Department of Aerospace Engineering, Indian Institute of Technology Bombay, JOHAN LARSSON, Department of Mechanical Engineering, University of Maryland, College Park — High-speed turbulent flows with shock waves are characterized by high localized surface heat transfer rates. Computational predictions are often inaccurate due to the limitations in modeling of the unclosed turbulent energy flux in the highly non-equilibrium regions of shock interaction. In this paper, we investigate the turbulent energy flux generated when homogeneous isotropic turbulence passes through a nominally normal shock wave. We use linear interaction analysis where the incoming turbulence is idealized as being composed of a collection of two-dimensional planar vorticity waves, and the shock wave is taken to be a discontinuity. The nature of the post-shock turbulent energy flux is predicted to be strongly dependent on the incidence angle of the incoming waves. The energy flux correlation is also decomposed into its vortical, entropy and acoustic contributions to understand its rapid non-monotonic variation behind the shock. Three-dimensional statistics, calculated by integrating two-dimensional results over a prescribed upstream energy spectrum, are compared with available direct numerical simulation data. A detailed budget of the governing equation is also considered in order to gain insight into the underlying physics.

Krishnendu Sinha
Department of Aerospace Engineering, Indian Institute of Technology Bombay

Date submitted: 28 Jul 2015 Electronic form version 1.4