Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Shock-Capturing Simulations of Multi-Fluid Shock-Turbulence Interactions YIFENG TIAN, FARHAD JABERI, Michigan State University, DANIEL LIVESCU, Los Alamos National Laboratory, ZHAORUI LI, Texas AM University — The interaction between an isotropic multi-fluid turbulence with a planar shock wave is studied using turbulence resolved shock-capturing simulations. This problem is an extension of the canonical Shock-Turbulence Interaction (STI), with the effects of strong density variations (from compositional changes) taken into consideration. To establish shock-capturing simulation as a reliable method for studying STI, LIA convergence tests are conducted. These tests are consistent with previous DNS studies and indicate that LIA limits can be approximated at relatively high Reynolds numbers and low turbulent Mach numbers when the separation between numerical shock thickness and turbulent length scales is adequate. When variable density effects are introduced, turbulence structure is modified more by the normal shock, with a differential distribution of turbulent statistics in regions with different densities, resulting in a strong mixing asymmetry in the post-shock region. Turbulence achieves similar axisymmetric two-dimensional local state right after the shock wave in the multi-fluid case, but has a faster return to three-dimensional isotropic structure when compared to the single-fluid case. The characteristics of post-shock thermodynamic fluctuations are also affected and are dominated by shock strength fluctuations that result from the compositional changes.

Yifeng Tian
Michigan State Univ

Date submitted: 31 Jul 2016 Electronic form version 1.4