Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Compressibility Effects in High Speed Turbulent Shear Layers Revisited[1] KRISTEN MATSUNO[2], SANJIVA LELE, Stanford University — In the past few decades, several models have been proposed to capture the consequences of compressibility on turbulence in shear flows. However, current explanations of reduced growth rates and alterations to turbulence structure with increasing Mach number remain somewhat incomplete, and comprehensive theory and modeling is elusive. In this work, compressible mixing layers over a range of convective Mach numbers ($M_c \in [0.2, 2.0]$) and free-stream density ratios ($\frac{\rho_2}{\rho_1} = [\frac{1}{7}, 1, 7]$) are directly simulated and compared to previous work. Using this database, the effect of M_c on key mechanisms in the evolution of turbulent kinetic energy (TKE) such as the pressure-dilatation correlation and the baropycnal work term are presented. The well-known effects of increasing compressibility on turbulent lengthscales and anisotropy are also demonstrated. Fluctuating velocity fields are decomposed into solenoidal and dilatational components via a Helmholtz decomposition, and resulting Reynolds stress components display cancellations in the transverse direction. Pressure fluctuations are analyzed to characterize acoustic communication across vortical structures.

[1]This work is supported by the Department of Energy, Office of Science's INCITE program
[2]membership pending

Kristen Matsuno
Stanford University

Date submitted: 29 Jul 2019 Electronic form version 1.4