

Abstract Submitted
for the DFD17 Meeting of
The American Physical Society

New insights on compressible turbulent mixing in spectral space¹

JOHN PANICKACHERIL JOHN, DIEGO DONZIS, Texas A&M University, KATEPALLI SREENIVASAN, New York University — Previous studies have shown that dilatational forcing has an effect in the dynamics of the velocity field in compressible turbulence. However, there has virtually been no studies of these effects on scalar mixing, the specific mechanisms responsible for compressibility effects and the scaling with governing parameters. Using a large DNS database, generated with different ratios of solenoidal to dilatational forcing, we find that the commonly used turbulent Mach number (M_t) fails to parametrize mixing efficiency. Instead, the dilatational Mach number (M_{td}) is a better scaling parameter to observe non-monotonic trends. We observe an accumulation of energy at large scales when compressibility is high; this has an effect on the energy and scalar cascade. We analyze both budgets to assess changes in global and inter-scale statistics for each mode and their interactions. For moderate compressibility levels, the normalized spectra of both modes do not collapse even when their own dissipation rates are used. Furthermore, a dilatational cascade is formed at high compressibility levels with advection terms scaling with χ , the ratio of dilatational to total kinetic energy. Results on scalar dissipation and their relation to thermodynamic variables are also presented.

¹Support from NSF is gratefully acknowledged.

John Panickacheril John
Texas A&M University

Date submitted: 01 Aug 2017

Electronic form version 1.4