Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Compressible homogeneous turbulence: universality classes and scaling DIEGO DONZIS, JOHN PANICKACHERIL JOHN, Texas A&M University — A critical element in studying complex systems such as turbulence is the concept of universal scaling laws which provide fundamental as well as practical information about their spatio-temporal behavior. Universality in compressible flows, however, has proven to be elusive as no unifying set of parameters have been found to yield universal scaling laws. This severely limits our understanding of these flows and the successful development of theoretically sound models. Using a massive new DNS database of compressible isotropic turbulence with different driving mechanisms along with more than 15 studies of homogeneous flows in the literature, we show that universality is indeed observed when the parameter space is extended to include dilatational motions. Collapse of a number of statistics is observed across flows with solenoidal, dilatational and/or thermal forcing as well as shear flows, resolving some discrepancies in the literature. We postulate the existence of universality classes which bundle the evolution of flows in the new parameter space. An ultimate asymptotic regime predicted by renormalization group theories and statistical mechanics is also assessed with available data.

Diego Donzis
Texas A&M University

Date submitted: 10 Aug 2020 Electronic form version 1.4