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Universality and scaling in compressible turbulence[1] DIEGO DONZIS, SHRIRAM JAGANNATHAN, Texas AM University — A large database of Direct Numerical Simulations (DNS) of stationary compressible isotropic turbulence at a range of Taylor Reynolds numbers ($R_\lambda \approx 38 - 450$) and turbulent Mach numbers ($M_t \approx 0.1 - 0.6$) is used to explore universality. While in incompressible turbulence self-similarity analysis leads to a single scaling parameter (R_λ), compressible turbulence expands the parameter space due to the coupling between hydrodynamics and thermodynamics, and the dependence on the mode of external forcing. While for the former it is common to use M_t as a scaling parameter, the effects of the latter are harder to quantify, and their consequences may have been attributed to a certain lack of universality. For instance, when the dilatational mode is forced, the variance and skewness of pressure shows significant scatter when plotted against M_t. Using a Helmholtz decomposition, we split the velocity field into solenoidal and dilatational modes, and propose scaling parameters that include the contribution from both modes. When expressed against these parameters, we observe a universal scaling regime regardless of the mode of excitation of forcing. Other quantities that follow this behavior are also discussed.

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