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Dynamics of Strongly Compressible Turbulence COLIN TOWERY, Univ of Colorado - Boulder, ALEXEI POLUDNENKO, Naval Research Laboratory, PETER HAMLINGTON, Univ of Colorado - Boulder — Strongly compressible turbulence, wherein the turbulent velocity fluctuations directly generate compression effects, plays a critical role in many important scientific and engineering problems of interest today, for instance in the processes of stellar formation and also hypersonic vehicle design. This turbulence is very unusual in comparison to “normal,” weakly compressible and incompressible turbulence, which is relatively well understood. Strongly compressible turbulence is characterized by large variations in the thermodynamic state of the fluid in space and time, including excited acoustic modes, strong, localized shock and rarefaction structures, and rapid heating due to viscous dissipation. The exact nature of these thermo-fluid dynamics has yet to be discerned, which greatly limits the ability of current computational engineering models to successfully treat these problems. New direct numerical simulation (DNS) results of strongly compressible isotropic turbulence will be presented along with a framework for characterizing and evaluating compressible turbulence dynamics and a connection will be made between the present diagnostic analysis and the validation of engineering turbulence models.

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