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Thermodynamic fluctuations in compressible homogeneous turbulence GUILLAUME BEARDSELL, GUILLAUME BLANQUART, Caltech — At its core, in incompressible turbulence, the velocity field is divergence-free, i.e., solenoidal, whereas it has both solenoidal and dilatational components in compressible turbulence. In incompressible turbulence, the pressure field has no impact on the density and temperature fields. On the other hand, in compressible turbulence, pressure fluctuations are coupled with the density and temperature fields through the energy equation and the equation of state. In this work, we explore these phenomena through numerical simulations of forced compressible subsonic turbulence (i.e, at turbulent Mach numbers less than unity). First, we derive how turbulence should be forced in compressible simulations. Using the proposed framework, we then analyze how compressibility effects arise when a compressible simulation is initialized with an incompressible turbulent field. We observe a non-isentropic transient behavior in which density fluctuations are small and temperature fluctuations are large, after which the isentropic behavior is recovered. Finally, we compare the solenoidal and dilatational components of the pressure fields, by looking at their respective magnitude and probability density functions as a function of the Mach number.

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