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The conservative cascade of kinetic energy in compressible turbulence HUSSEIN ALUIE, SHENGTAI LI, HUI LI, Los Alamos National Laboratory — We use a coarse-graining approach to analyze inter-scale transfer of kinetic energy in compressible turbulence. We present the first direct evidence that mean kinetic energy cascades conservatively beyond a transitional "conversion" scale-range despite not being an invariant of the compressible flow dynamics. We use high-resolution three-dimensional simulations of compressible hydrodynamic turbulence on 512^3 and 1024^3 grids. We probe regimes of forced steady-state isothermal flows and of unforced decaying ideal gas flows. The key quantity we measure is pressure dilatation cospectrum, $E^{PD}(k)$, where we provide the first numerical evidence that it decays at a rate faster than k^{-1} as a function of wavenumber. This is sufficient to imply that mean pressure dilatation acts primarily at large-scales and that kinetic and internal energy budgets statistically decouple beyond a transitional scale-range. Our analysis establishes the existence of an ensuing inertial range over which mean SGS kinetic energy flux becomes constant, independent of scale. Over this inertial range, mean kinetic energy cascades locally and in a conservative fashion despite not being an invariant.

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