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Cascade of internal energy fluctuations in compressible isotropic turbulence with thermal nonequilibrium QINMIN ZHENG, JIANCHUN WANG, SHIYI CHEN, Southern University of Science and Technology, BERND R. NOACK, Harbin Institute of Technology (Shenzhen) — Inter-scale transfer of the internal energy fluctuations are investigated by numerical simulations of stationary compressible isotropic turbulence in vibrational nonequilibrium with large-scale thermal forcing. The attentions are mainly focused on statistical properties of turbulence, and inter-scale transfer of the translational-rotational and the vibrational energy fluctuations, with impacts of large-scale thermal forcing, compressibility and vibrational relaxation. Based on the Helmholtz decomposition, it is found that the solenoidal velocity component predominates over the dilatational component; fluctuations of the solenoidal velocity and pressure components are insensitive to the turbulence Mach number and the vibrational relaxation, while fluctuations of the dilatational velocity and pressure components depend closely on them. It is revealed that cascades of the translational-rotational and the vibrational energy fluctuations are mainly dominated by the solenoidal mode of filtered velocity. SGS fluxes of the translational-rotational and the vibrational energy fluctuations due to the solenoidal component of filtered velocity are insensitive to the local compressibility; SGS fluxes due to the dilatational component of filtered velocity are positive in the compression region, balanced by the reverse SGS fluxes in the expansion region.

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