Vibrational energy fluctuation in compressible isotropic turbulence with thermal non-equilibrium QINMIN ZHENG, JIANCHUN WANG, MINPING WAN, SHIYI CHEN, Department of Mechanics and Aerospace Engineering, Southern University of Science and Technolog, HUI LI, School of Power and Mechanical Engineering, Wuhan University — The vibrational energy fluctuation of compressible isotropic turbulent flows in vibrational non-equilibrium is investigated numerically at turbulent Mach numbers of 0.44 and 1.09, focusing on the effect of the characteristic vibrational relaxation time on statistical features of the dissipation/production components of vibrational energy fluctuation. The dissipation/production of vibrational energy fluctuation might result from effects of dilatation, thermal diffusion and vibrational relaxation. The dissipation component due to thermal diffusion always suppresses the vibrational energy fluctuation in both of compression and expansion regions for the weakly and highly compressible turbulences; but its effect is insignificant comparing to other two components. For the weakly compressible turbulence, the dissipation/production of vibrational energy fluctuation mainly comes from effects of dilatation and vibrational relaxation when the characteristic vibrational relaxation time is small; and the vibrational relaxation component loses its significance gradually with the increase of characteristic vibrational relaxation time. For the highly compressible turbulence, both of the dilatation and vibrational relaxation effects play an important role in the dissipation and production of vibrational energy fluctuation.

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