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Self-consistent viscous heating of rapidly compressed turbulence[1]

ALEJANDRO CAMPOS, BRANDON MORGAN, Lawrence Livermore National Laboratory — Given turbulence subjected to infinitely rapid deformations, linear terms representing interactions between the mean flow and the turbulence dictate the evolution of the flow, whereas non-linear terms corresponding to turbulence-turbulence interactions are safely ignored. For rapidly deformed flows where the turbulence Reynolds number is not sufficiently large, viscous effects can't be neglected and tend to play a prominent role, as shown in the study of Davidovits & Fisch (2016). For such a case, the rapid increase of viscosity in a plasma–as compared to the weaker scaling of viscosity in a fluid—leads to the sudden viscous dissipation of turbulent kinetic energy. As shown in Davidovits & Fisch, increases in temperature caused by the direct compression of the plasma drive sufficiently large values of viscosity. We report on numerical simulations of turbulence where the increase in temperature is the result of both the direct compression (an inviscid mechanism) and the self-consistent viscous transfer of energy from the turbulent scales towards the thermal energy. A comparison between implicit large-eddy simulations against well-resolved direct numerical simulations is included to asses the effect of the numerical and subgrid-scale dissipation on the self-consistent viscous

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