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The Forward-Backward Time Asymmetry in Shape Deformation of Tetrahedra in Fully Developed Turbulence JENNIFER MUTSCHALL, HAITAO XU, Max Planck Institute for Dynamics and Self-Organization, ALAIN PUMIR, Ecole Nationale Superieure de Lyon, EBERHARD BODENSCHATZ, Max Planck Institute for Dynamics and Self-Organization — The analysis of shape deformations of multi-particle clusters can serve as an important tool for gaining insights in turbulent mixing. Recent experiments and numerical simulations on clusters of four particles (i.e. tetrahedra) observe a tendency for initially isotropic tetrahedra to deform into coplanar structures and thereby to enhance the mixing process. A quantitative understanding was to date missing. Further, the understanding of the forward-backward time asymmetry in shape deformation can elucidate the time-irreversibility of fully developed turbulence. Here we present an explanation of the observations and extend the analysis to the dynamics of tetrahedra backwards in time. We report our analytical results and compare them with our particle tracking experiments in a von Karman swirling flow and with direct numerical simulations of homogeneous isotropic turbulence in a periodic box.

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