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Regularization mechanism of Rayleigh-Taylor turbulent mixing[1]

SNEZHANA I. ABARZHI, University of Chicago — Turbulent mixing induced by Rayleigh-Taylor instability plays an important role in a variety of natural and artificial phenomena spanning astrophysical and low to high energy density regimes. We apply group theory to analyze symmetries, invariants, scaling and spectra of turbulent mixing induced by the Rayleigh-Taylor instability. The properties of this statistically unsteady, anisotropic, and inhomogeneous turbulent process are found to depart from the canonical Kolmogorov scenario. Time- and scale-invariance of the rate of momentum loss leads to non-dissipative momentum transfer between the scales, to 1/2 and 3/2 power-law scale dependencies of the velocity and Reynolds number respectively, and to spectra distinct from Kolmogorov. Turbulent mixing exhibits more order compared to isotropic turbulence and its viscous and dissipation scales are set by the flow acceleration. To trigger relaminarization of RT mixing, few mechanisms are proposed, including highly coherent initial conditions and flow acceleration by high favorable pressure gradient.

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