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Turbulent Mixing due to Rayleigh-Taylor Instability

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Rayleigh-Taylor instability occurs when a dense fluid rests on top of a light fluid in a gravitational field. It also occurs in an equivalent situation (in the absence of gravity) when a pressure gradient accelerates an interface between fluids of different density. The latter is a major concern in Inertial Confinement Fusion Implosions (ICF). In the last decade, 3D simulation has made major advances in understanding turbulence arising from Rayleigh-Taylor instability. This will be the main focus of the talk, together with some recent key experimental advances. Results of 3D simulations are shown for three cases:- (a) mixing at a plane boundary, (b) break-up of a layer of dense fluid due to Rayleigh-Taylor instability and (c) mixing in a simple spherical implosion (a simplified ICF implosion). Engineering models (RANS models) are needed to model the effect of mixing in complex applications. However, it will be argued that 3D simulation currently plays an essential role in understanding the mixing process and calibration/validation of the engineering models. Of particular interest is the influence of initial conditions. It will be shown that for Rayleigh- Taylor turbulence in practical situations, loss of memory of the initial is unlikely to occur - this has important consequences for the engineering models.