Passive scalar diffusion through a turbulent energy gradient

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In this paper we numerically investigate the diffusion of a passive scalar across an interface which separates two homogeneous and isotropic decaying turbulent fields with different kinetic energy in the absence of a mean shear in two and three dimensions. The capability of the passive scalartransport to overcome the kinetic energy jump is discussed. The velocity field has been found to be highly intermittent and exhibits intense bursts of vorticity and strain, resulting in high values of derivative skewness and kurtosis and strongly non Gaussian statistics[1,2]. In all the investigated configurations, the mixing process leads to non-symmetric, anisotropic and highly intermittent scalar distributions, as shown by the probability density function and by the scalar derivative statistics. We will discuss the difference between the time asymptotic diffusion rates in the two- and three-dimensional configurations and how these compare with the turbulent intermittent penetration of the velocity fields. The direct numerical simulations have been carried out by means of a Fourier-Galerkin pseudospectral method coupled with an explicit Runge-Kutta time integration[3].

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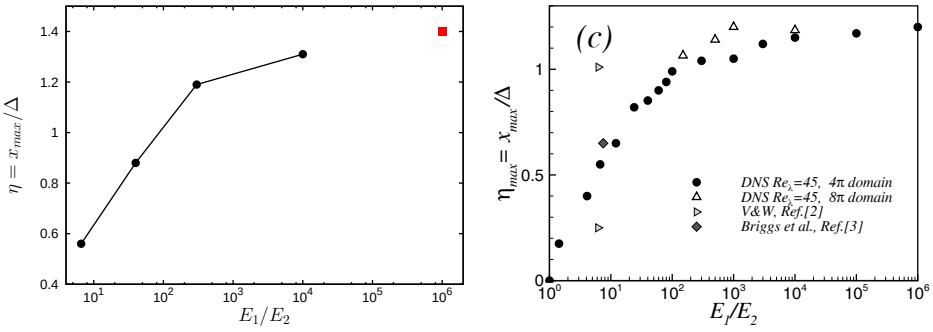

Figure 1: Intermittent penetration as function of the kinetic energy ratio, as measured by the position of the maxiumum of skewness: (a) two-dimensional mixing, (b) three-dimensional mixing.