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Geometric Features of High-Schmidt Number Scalar Mixing

Jörg Schumacher[(1)], Katepalli R. Sreenivasan[(2)]

(1) *Dept. of Physics, Philipps University, Marburg, Germany*
(2) *ICTP, Trieste, Italy*

The mixing of passive scalars of decreasing diffusivity, advected in each case by the same three-dimensional Navier–Stokes turbulence, is studied within high-resolution direct numerical simulations. The mixing becomes more isotropic with decreasing diffusivity, as is manifest in the increasing symmetry of the probability density function of the scalar gradient and in approach to equality of box-counting results of level sets of scalar gradients of opposite sign. The local flow in the vicinity of steepest negative and positive scalar gradients are in general different, and its behavior is studied for various values of the scalar diffusivity. Mixing approaches monofractal properties with diminishing diffusivity. We consider these results in the context of possible singularities of scalar dissipation.

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