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The inefficacy of fluid turbulence to mix passive scalars when Schmidt numbers are large KATEPALLI R. SREENIVASAN, DHAWAL BUARIA, New York University, USA, MATTHEW P. CLAY, P. K. YEUNG, Georgia Institute of Technology, USA — A defining property of fluid turbulence is that it mixes substances extremely well. Thus, any circumstances leading to a loss of that property is of vital importance from both theoretical and practical perspectives. We demonstrate one such instance by considering the mixing of passive scalars advected in stationary isotropic turbulence, using state-of-the-art direct numerical simulations on up to grids of 8192^3 points. The microscale Reynolds number is in the range $1-650$ and the Schmidt number Sc is in the range $1-512$. First, we show that the mean scalar dissipation rate, when suitably non-dimensionalized, decreases as $1/\log Sc$, violating the principle of anomalous dissipation in the limit of large Sc. One-dimensional (1D) cuts through the scalar field indicate increasing density of sharp fronts on larger scales as Sc increases, which oscillate sharply between high and low scalar concentrations leading to reduced mixing. The scaling exponents of the scalar structure functions in the inertial-convective range saturate with respect to the moment order and the saturation exponent approaches unity as Sc increases, qualitatively consistent with 1D cuts of the scalar.

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