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Spectral transfer and scale locality characteristics in turbulent mixing over a wide range of Schmidt numbers[1] DHAWAL BUARIA, P.K. YEUNG, Georgia Tech, J.A. DOMARADZKI, Univ of Southern Calif. — A classical picture of turbulent mixing is that advective transport by the velocity field causes blobs of scalar fluctuations to be broken down into smaller and smaller scales, where the fluctuations are ultimately dissipated by molecular diffusivity. In Fourier space this corresponds to a spectral cascade, which is generally understood to be local in nature (i.e., occurring among scales similar in size). However, recent numerical simulations show that at very low values of the Schmidt number (Sc) the spectral cascade is strongly suppressed. To understand this observation we examine the detailed spectral transfer characteristics of scalar fields with Sc ranging from 1/2048 to 64 in isotropic turbulence with Taylor-scale Reynolds number 140. We also compute so-called scale locality functions which measure contributions from "resolved" and "subgrid" scales to the transfer flux across a specified cutoff scale. Our results suggest that the classical cascade scenario holds well at $Sc \geq 1$. However, in the limit $Sc \ll 1$ transfer is dominated by nonlocal triadic interactions involving low wavenumber scalar modes and high wavenumber scalar modes, modulated by a high wavenumber velocity mode, corresponding to advection by the small-scale velocity field in physical space.

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