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Turbulent mixing of highly diffusive substances in the presence of a uniform mean gradient[1] P.K. YEUNG, K.P. IYER, Georgia Tech, K.R. SREENIVASAN, New York Univ. — In the preceding talk, we verified the basic physical content and general validity of the theory of Batchelor, Howells & Townsend (J. Fluid Mech. **5**, 134 (1959)) in the case of passive scalar fields decaying in the absence of any production mechanism. In this study we consider results from direct numerical simulations on passive scalars of very strong diffusivity (low Schmidt number), in a presence of a uniform mean gradient, which leads to production of scalar fluctuations at the large scales. Our results show that the presence of the mean gradient alters the physics of mixing fundamentally. While the spectrum of scalar fluctuations still follows a -17/3 power law in the so-called diffusive-inertial range, the constant is found to be non-universal and dependent on the magnitude of the mean scalar gradient. Spectral transfer activity is greatly reduced compared with that for moderately and weakly diffusive scalars. The resulting weakening of spectral cascade at high wavenumber leads to many distinctive features, including the failure of dissipative anomaly, and a new balance of terms in the spectral transfer equation for the scalar variance, different from the case of no gradient. We also present an alternative explanation for the scaling behaviors actually observed.

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