Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Differential diffusion and spectral transfer in turbulent mixing at high Schmidt numbers[1] KIRAN RAVIKUMAR, P.K YEUNG, M.P. CLAY, Georgia Tech — Many applications of turbulent mixing involve differential diffusion between scalars of different molecular diffusivities. We study this phenomenon using direct numerical simulation, employing a dual-grid computational approach to meet stringent resolution requirements for scalars of low diffusivity (high Schmidt number, Sc). The largest Schmidt number ratio considered is 64, occurring between two scalars of $Sc = 4$ and 256, whose fluctuations are produced by velocity fluctuations acting upon a uniform mean scalar gradient. Spectral transfer characteristics examined individually for each scalar show robust evidence of a forward cascade, where local transfer by nonlocal interactions modulated by low-wavenumber velocity modes is readily observed at the small scales. Contributions to the coherency spectra from moderately non-local velocity-scalar triads were found to produce a net decorrelating effect at small scales which is balanced by the coherent mean gradient forward cascade leading to a stationary state. The scalings of the two-scalar difference spectrum and joint dissipation rate are investigated in detail. The role of differential diffusion in double-diffusive convection is briefly addressed.

[1]Supported by DOE INCITE program at Oak Ridge National Laboratory

Pui Kuen Yeung
Georgia Institute of Technology

Date submitted: 02 Aug 2019 Electronic form version 1.4