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On Pair Diffusion and Preferential Concentration of High Stokes Number Particles in Isotropic Turbulence SARMA RANI, University of Alabama in Huntsville, DONALD KOCH, Cornell University — In this study, we derived the Fokker-Planck equation governing the PDF of pair separation and relative velocity vectors of high St particles. The PDF equation contains a particle-pair diffusion coefficient in relative velocity space. We developed an analytical theory to predict this relative velocity-space pair diffusion coefficient in the limit of high St. Using the diffusion coefficient, Langevin-equation-based stochastic simulations were performed to evolve pair separation and velocity vectors in isotropic turbulence for particle Stokes numbers, $St = 1,\ 2,\ 4,\ 10,$ and, 20 and a Taylor micro-scale Reynolds number, $Re_\lambda = 75$. The most significant finding from the Langevin simulations is that our pair diffusivity theory successfully captures the transition of relative velocity PDF from a Gaussian PDF at separations of the order of integral length scale to a non-Gaussian PDF at smaller separations. The pair radial distribution functions (RDFs) computed using our theory show that as the Stokes number increased, particles preferentially accumulate even at integral length scale separations. Another significant finding of our approach is that the slope of RDF at Kolmogorov length scale separations for higher St particles is not zero.

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