

Abstract Submitted
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Turbulent Particle Pair Diffusion Using Kinematic Simulations¹

NADEEM MALIK, King Fahd University of Petroleum and Minerals — Sweeping errors in Kinematic Simulations (KS) [1] have been shown to be negligible in turbulent flows with extended inertial subranges up to at least $1 < k < 10^6$ (k is the wavenumber) [2]. The departure from locality scaling observed in the pair diffusivity $K = \langle \Delta \cdot v \rangle$ in KS may therefore be a genuine effect, challenging previous assumptions [3] that in turbulence with generalized power-law energy spectra, $E(k) \sim k^{-p}$ for $1 < p \leq 3$, locality would lead to, $K \sim \sigma_{\Delta}^{\gamma}$, where $\sigma_{\Delta} = [\langle \Delta^2 \rangle]^{1/2}$, Δ is the pair separation, v is the pair relative velocity, $\langle \rangle$ is the ensemble average, and $\gamma = (1+p)/2$. For Kolmogorov turbulence this gives, $K \sim \sigma_{\Delta}^{4/3}$. A new analysis, supported by KS [4] confirms that both local and non-local effects govern the pair diffusion process, leading to, $K \sim \sigma_{\Delta}^{\gamma_p}$, where now $\gamma_p > \gamma$; for Kolmogorov turbulence, $K \sim \sigma_{\Delta}^{1.53}$. Thus non-local diffusional processes cannot be neglected, and this may have important consequences for the general theory of turbulence. REFERENCES: [1] Fung, J. C. H., Hunt, J. C. R., Malik, N. A., & Perkins, R. J. *J. Fluid Mech.* 236, 281 (1992). [2] Malik, N. A. *Under Review, Physics of Fluids* (2015). [3] Richardson, L. F. *Proc. Roy. Soc. Lond. A* 100, 709 (1926). [4] Malik, N. A. On Turbulent Particle Pair Diffusion. *Under review, Physics of Fluids* (2015).

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