Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

A Stochastic Model for the Relative Motion of High Stokes Number Particles in Isotropic Turbulence ROHIT DHARIWAL, SARMA RANI, Univ of Alabama - Huntsville, DONALD KOCH, Cornell University — In the current study, a novel analytical closure for the diffusion current in the PDF equation is presented that is applicable to high-inertia particle pairs with Stokes numbers $St_r \gg 1$. Here St_r is a Stokes number based on the time-scale τ_r of eddies whose size scales with pair separation r. Using this closure, Langevin equations were solved to evolve particle-pair relative velocities and separations in stationary isotropic turbulence. The Langevin equation approach enables the simulation of the full PDF of pair relative motion, instead of only the first few moments of the PDF as is the case in a moments-based approach. Accordingly, PDFs $\Omega(U|r)$ and $\Omega(U_r|r)$ are computed for various separations r, where the former is the PDF of relative velocity U and the latter is the PDF of the radial component of relative velocity U_r, both conditioned upon the separation r. Consistent with the DNS study of Sundaram & Collins, the Langevin simulations capture the transition of $\Omega(U|r)$ from being Gaussian at integral-scale separations to an exponential PDF at Kolmogorov-scale separations. The radial distribution functions (RDFs) computed from these simulations also show reasonable quantitative agreement with those from the DNS of Fevrier et al.

Rohit Dhariwal
Univ of Alabama - Huntsville

Date submitted: 16 Jul 2014 Electronic form version 1.4