Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Analytical Model for Pair Dispersion in Gaussian Models of Eulerian Turbulence GREGORY EYINK, DAMIEN BENVENISTE, The Johns Hopkins University — Synthetic models of Eulerian turbulence are often used as computational shortcuts for studying Lagrangian properties of turbulence (e.g. Elliott & Majda, 1996). These models have been criticized by Thomson & Devenish (2005), who argued on physical grounds that their sweeping effects are very different from true turbulence. We give analytical results for Eulerian turbulence modeled by Gaussian fields. Our starting point is an exact integrodifferential equation for the particle pair separation distribution obtained from Gaussian integration-by-parts. When velocity correlation times are short, a Markovian approximation leads to a Richardson-type diffusion model. We obtain a time-dependent pair diffusivity tensor of the form $K_{ij}(\mathbf{r},t) = S_{ij}(\mathbf{r})\tau(r,t)$ where $S_{ij}(\mathbf{r})$ is the structure-function tensor and $\tau(r,t)$ is an effective correlation time of velocity increments. Crucially, this is found to be the minimum value of three times: the intrinsic turnover time $\tau_{eddy}(r)$ at separation r, the overall evolution time t, and the sweeping time r/v_0 with v_0 the rms velocity. We thus verify the main argument of Thomson & Devenish (2005), but we predict scaling laws for pair dispersion different from theirs for zero-mean velocity ensembles.

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Date submitted: 02 Aug 2012 Electronic form version 1.4