Abstract Submitted
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Linear Response Theory of Single Particle Diffusion in Turbulence YUKIO KANEDA, Graduate School of Mathematics, Nagoya University — A theory is proposed for the statistics of single particle diffusion in stationary homogenous isotropic turbulence of incompressible fluid. The theory is based on a generalization of the idea of linear response theory that is known in the statistical mechanics for systems at or near the thermal equilibrium state. The theory gives $< |\Delta \mathbf{v}(t)|^2 > /(\epsilon t) = C_0 + B_1 + \cdots$, for the inertial time interval t such that $T \gg t \gg \tau$, where $\Delta \mathbf{v}(t)$ is the velocity increment of a particle during the time interval t, ϵ is the kinetic-energy dissipation rate per unit mass, T is the integral time scale, τ is the Kolmogorov micro-time-scale, $B_1 = C_{1T}(t/T) + C_{1\tau}(\tau/t)$, and $C_0, C_{1T}, C_{1\tau}$ are non-dimensional universal constants. B_1 represents the effect of small but finite t/T and τ/t. An examination of the theory by comparison with the data of direct numerical simulation (DNS) [B. L. Sawford and P. K. Yeung, Phys. Fluids 23, 091704 (2011)] suggests that the theory is in good agreement with the DNS.

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