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Structure Functions in Isotropic Turbulence: DNS and Stochastic Models[1] S.B. POPE, A.G. LAMORGESE, Cornell University, P.K. YEUNG, Georgia Institute of Technology — Lagrangian velocity structure functions (up to tenth order) are extracted from direct numerical simulations (DNS) of isotropic turbulence and are compared to predictions from several stochastic models. The DNS are of statistically-stationary homogeneous isotropic turbulence for a range of Taylor-scale Reynolds numbers up to 650. As expected, the Lagrangian velocity structure functions extracted from the DNS reveal strong intermittency with the most pronounced non-Gaussian behavior in the dissipation range. The Langevin model for velocity and Sawford's 1991 model for acceleration are both Gaussian, and hence do not represent such behavior. The recently-developed conditionally cubic Gaussian (CCG) model for acceleration accounts (to some extent) for intermittency and non-Gaussianity. In this model, the pseudo-dissipation is taken to be log-normal, and the acceleration conditional on pseudo-dissipation is taken to be cubic Gaussian. Because this model accurately describes the one-time velocity and acceleration statistics, its predictions of the structure functions are accurate at small and large times. At intermediate times they exhibit strongly non-Gaussian behavior and anomalous scaling, in moderate agreement with the DNS data.

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