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Rotational Diffusion of Particles in Turbulence EVAN VARIANO, COLIN MEYER, MARGARET BYRON, University of California, Berkeley — We experimentally compare the rotation of spherical and ellipsoidal particles in homogeneous, isotropic turbulence. We find that the particle orientation is well described by a Gaussian diffusion process. This theoretical model would predict that the Lagrangian autocorrelation function for angular velocity is a negative exponential. We measure this Lagrangian autocorrelation function using stereoscopic particle image velocimetry (SPIV) applied to particles whose size is within the inertial subrange of the ambient turbulence. The SPIV resolves 3 velocity components in a nearly 2-dimensional planar volume, which we use as inputs for a nonlinear optimization to quantify the solid body rotation of the particles. This provides us the angular velocity timeseries for individual particles. Through ensemble statistics, we determine the Lagrangian autocorrelation function of angular velocity, from which we can quantify the turbulent rotational diffusivity and its behavior between the extremes of short-term non-Fickian transport and long-term Fickian diffusion.

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