Abstract Submitted
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Rotation of rigid fibers in wall shear turbulence[1] CRISTIAN MARCHIOLI, ALFREDO SOLDATI, University of Udine — In this paper we examine the rotation of rigid fibers with different elongation and inertia in turbulent channel flow, focusing on the effect of local shear and turbulence anisotropy. Statistics of the fiber angular velocity, Ω, are extracted from DNS of turbulence at shear Reynolds number $Re_\tau = 150$ coupled with Lagrangian tracking of prolate ellipsoidal fibers with Stokes number $1 < St < 100$, and aspect ratio $1 < \lambda < 50$. Results for mean and fluctuating angular velocities show that elongation is important for fibers with small inertia ($St \leq 5$ in the present study). At larger inertia, elongation has an impact on rotation only in the streamwise and wall-normal directions. In the channel center, the Lagrangian autocorrelation coefficients of Ω and corresponding rotational turbulent diffusivities match the exponential behavior predicted by the theory of homogeneous dispersion. Also, the PDF of fiber angular velocities is generally close to Gaussian, indicating that fiber rotation away from solid walls can be modeled as a Ornstein-Uhlenbeck diffusion process at stationary state. In the strong shear region, fiber anisotropy adds to flow anisotropy to induce strong deviations on fiber rotational dynamics with respect to spherical particles.

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