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Measurement and Simulation of Hindered Diffusion and the Implications for Near-Wall Velocimetry PETER HUANG, Brown University, KENNETH BREUER — The dynamics of hindered diffusion of near-wall colloidal particles is measured using Frustrated-Total Internal Reflection Fluorescent Microscopy and simulated using Brownian Dynamics. Particles can be experimentally tracked in three dimensions with an accuracy of 32 nm. The experimental and numerical results are in excellent agreement, and demonstrate the anisotropy of hindered diffusion, in good agreement to the classical theoretical results of Goldman and Brenner. The effect of shear on the diffusion dynamics is also explored, and it is found that the particle displacement distribution changes significantly as the Peclet number rises, reaching an equilibrium shear-dominated distribution for Pe $>$ 3. These results have significant implications for near wall velocimetry experiments in which an estimation of velocity is derived from the observed motion of tracer particles. We identify the errors that can arise due to Brownian motion, hindered diffusion and shear and discuss how these errors are affected by the various flow conditions as well as the time between adjacent observations of particles.

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