Brownian motion in near-surface hydrodynamic flows

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Abstract

A pressure driven flow of water in a microfluidic channel can be closely observed using total internal reflection fluorescence. The associated evanescent field decays over a few hundred nanometres into the channel. The exponential decay allows for a direct determination of the particle altitude within these first few hundred nanometres. Combined with particle tracking, this distance measurement allows for the experimental determination of the velocity profile and local velocity distributions. Several researchers have made such measurements in the context of the average flow velocity. However, the near-surface character of the measurement suggests that the particle velocities may be rather small compared to typical diffusive motions. Here we will present a detailed look at the statistics around the mean of near-surface particle flows. As expected, the distribution of displacements transverse to the flow and in the plane is Gaussian as for normal diffusion. However, significant deviations are observed for both of the other spatial dimensions. An overview of our most recent experimental results will be presented.

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