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Biased and flow driven Brownian motion in periodic channels[1] S. MARTENS, A. STRAUBE, Humboldt-University Berlin, G. SCHMID, University Augsburg, L. SCHIMANSKY-GEIER, Humboldt-University Berlin, P. HÄNGGI, University Augsburg — In this talk we will present an expansion of the common Fick-Jacobs approximation to hydrodynamically as well as by external forces driven Brownian transport in two-dimensional channels exhibiting smoothly varying periodic cross-section. We employ an asymptotic analysis to the components of the flow field and to stationary probability density for finding the particles within the channel in a geometric parameter. We demonstrate that the problem of biased Brownian dynamics in a confined 2D geometry can be replaced by Brownian motion in an effective periodic one-dimensional potential $\Psi(x)$ which takes the external bias, the change of the local channel width, and the flow velocity component in longitudinal direction into account. In addition, we study the influence of the external force magnitude, respectively, the pressure drop of the fluid on the particle transport quantities like the averaged velocity and the effective diffusion coefficient. The critical ratio between the external force and pressure drop where the average velocity equals zero is identified and the dependence of the latter on the channel geometry is derived. Analytic findings are confirmed by numerical simulations of the particle dynamics in a reflection symmetric sinusoidal channel.

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