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Statistical mechanics of an ideal active fluid confined in a channel CALEB WAGNER, APARNA BASKARAN, MICHAEL HAGAN, Brandeis University — The statistical mechanics of ideal active Brownian particles (ABPs) confined in a channel is studied by obtaining the exact solution of the steady-state Smoluchowski equation for the 1-particle distribution function. The solution is derived using results from the theory of two-way diffusion equations, combined with an iterative procedure that is justified by numerical results. Using this solution, we quantify the effects of confinement on the spatial and orientational order of the ensemble. Moreover, we rigorously show that both the bulk density and the fraction of particles on the channel walls obey simple scaling relations as a function of channel width. By considering a constant-flux steady state, an effective diffusivity for ABPs is derived which shows signatures of the persistent motion that characterizes ABP trajectories. Finally, we discuss how our techniques generalize to other active models, including systems whose activity is modeled in terms of an Ornstein-Uhlenbeck process.

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