

Abstract Submitted
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Shape matters: A Brownian microswimmer in a channel

HONGFEI CHEN, JEAN-LUC THIFFEAULT, UW-Madison — We consider the active Brownian particle model for a two-dimensional microswimmer with fixed speed, whose direction of swimming changes according to a Brownian process. The probability density for the swimmer evolves according to a Fokker–Planck equation defined on the configuration space, whose structure depends on the swimmer’s shape, center of rotation, and domain of swimming. We enforce zero probability flux at the boundaries of configuration space. We derive a reduced equation for a swimmer in an infinite channel, in the limit of small rotational diffusivity, and find that the invariant density depends strongly on the swimmer’s precise shape and center of rotation. We also give a formula for the mean reversal time (MRT) : the expected time taken for a swimmer to completely reverse direction in the channel. Using homogenization theory, we find an expression for the effective longitudinal diffusivity of a swimmer in the channel, and show that it is bounded by the MRT ¹. A novelty in our work is to include the center of rotation as a parameter, which changes a swimmer’s tendency to align with walls.

¹arXiv:2006.07714 [cond-mat.soft]

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