Curvature-guided motility of microalgae in geometrically confined environments

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The natural habitats of many living microorganisms are complex geometric environments, rather than bulk situations. The confinement and, in particular, the exposure to solid/liquid interfaces is playing an important role with regard to the adhesion of cell populations and, subsequently, the formation of biofilms. The influence of interfaces on the dynamics was recognized as an important factor, and there are differences in the way that pusher- and puller-type swimmers behave close to interfaces. Using microfluidic experiments and molecular dynamics simulations, we report on the motility of single *Chlamydomonas* microalgae in 2D circular compartments. We find that the radial probability distributions of trajectories display a characteristic wall hugging effect, where swimmers remain trapped at the concave interface. This effect becomes strongly amplified upon decreasing the size of the circular compartment; in fact, its significance is found to scale as the curvature of the compartment walls. For trajectories in the vicinity of the concave wall, an alignment of the local swimming direction with the local wall tangent is observed. Based on geometric arguments involving the swimmer's persistence length and the size of the compartment, we explain this entrapment effect at concave interfaces.