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Collective locomotion of non-swimmers ERIC LAUGA, University of California, San Diego (USA), DENIS BARTOLO, ESPCI (France) — To achieve propulsion at low Reynolds number, a swimmer (e.g. a biological cell such as a bacterium, or a spermatozoon) must deform its shape in time in a way that is not invariant under time-reversal symmetry (non-reciprocal); this is Purcell's scallop theorem. We show here explicitly that there is no many-scallop theorem. Two active bodies undergoing reciprocal deformations - and therefore incapable of swimming when considered separately - can exploit hydrodynamic interaction to swim. If the bodies are polar, we also show that they experience effective long-range interactions. We derive our results analytically for a minimal dimers model, and generalize them to more complex geometries on the basis of symmetry and scaling arguments. Furthermore, we explain how such cooperative locomotion can be realized experimentally by shaking a collection of soft particles with a homogeneous external field, thereby making non-swimmers swim.

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