Abstract Submitted
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Propulsion of spherical microparticles through spontaneous symmetry breaking in mucus[1] HENRY FU, University of Utah, LOUIS ROGOWSKI, Southern Methodist University, JAMEL ALI, Florida Agricultural and Mechanical University-Florida State University, XIAO ZHANG, MINJUN KIM, Southern Methodist University — Symmetries have long been used to understand when propulsion is possible in microscale systems. For biological force- and torque-free swimmers the Scallop theorem applies kinematic reversibility of Stokes flow has been to understand which swimming strokes are asymmetric under time-reversal and capable of propulsion. Currently, artificially propelled magnetic micro- and nanoparticles are being utilized in a variety of techniques including hyperthermia, drug delivery, and magnetic resonance imaging. Rotation of rigid magnetic particles by an external magnetic field are a promising category of such artificial propulsion. So far it has been expected that spherical beads are too symmetric to be propelled in this fashion, but here we present experiments demonstrating that rotating spherical magnetic beads in a solution of mucin seem to display a spontaneous symmetry-breaking propulsion. We perform a perturbative analysis of a rotating sphere in a nonlinear polymeric fluid that elucidates the physical mechanism behind such a symmetry breaking.

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