

Colloidal Microworms Propelling via a Cooperative Hydrodynamic Conveyor Belt

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We study propulsion arising from microscopic colloidal rotors [1,2] dynamically assembled and driven in a viscous fluid upon application of an elliptically polarized rotating magnetic field. Close to a confining plate, the motion of this self-assembled microscopic "worm" results from the cooperative flow generated by the spinning particles such as an hydrodynamic "conveyor-belt" effect. Chains of rotors propels faster than individual ones, until reaching a saturation speed at distances where flow additivity vanishes. By combining experiments with theoretical arguments, we elucidate the underlying mechanism of motion and fully characterize the propulsion speed in terms of the external field parameters.

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[1] P. Tierno, R. Golestanian, I. Pagonabarraga, and F. Sagués, *Phys. Rev. Letters*, 2008, **101**, 218304.

[2] P. Tierno, S. Schreiber, W. Zimmermann, and T. M. Fischer, *J. Am. Chem. Soc.*, 2009, **131**, 5366