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Rheology of active suspensions: from individual to collective effort

ERIC CLEMENT, PMMH-ESPCI-University Pierre et Marie Curie

Future developments in bio-technologies involving micro-organisms, demand a fundamental understanding of the emerging hydrodynamics properties of suspensions laden with swimming bacteria. We are currently interested in the fluid properties modified by the presence of active microscopic swimmers such as E.coli. In such a context, due to individual or collective organization, one may observe properties significantly at odd with their classical passive counterpart. One may quote for example activated Brownian motion [1], anomalous transport in confined flows [2] or non-standard rheological response [3]. In order to provide a consistent physical and mechanical picture from the microscopic swimming properties, up to the macroscopic level, we developed various experimental tools microfluidic channels or specific rheological devices) to monitor either the individual 3D Lagrangian trajectories or the outcome of collective effects. We will discuss in particular, recent results probing the role of the swimming organization on the effective suspension rheology. [1] Mino et al. Phys.Rev.Lett. 106, 048102 (2011). [2] Altshuler et al., Soft-Matter, 9 , 1864 (2013) ; Figueroa-Morales et al. Soft Matter 11, 6284 (2015). [3] Lopez et al.,Phys. Rev. Lett. 115, 028301 (2015).