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Collective dynamics of biomimetic run-and-turn microswimmers[1]
HAMID KARANI, GERARDO PRADILLO, PETIA VLAHOVSKA, Northwestern University — Suspensions of active living and artificial micro-particles exhibit diverse out-of-equilibrium phenomena. Here, we report the emergence of complex collective behaviors in a population of motile colloids externally energized by a modulated electric field. While most of previous works on collective behaviors of colloidal systems are based on active Brownian particles, we build on our previous findings on colloidal runners-and-tumblers and demonstrate that the random-walks of individual colloids transition into plethora of collective states similar to the ones observed in bacterial systems; ranging from swarms and jets to dynamic clusters and vortices. We elucidate the role of complex physical interactions between colloidal particles and show that different emergent states are identified by competing characteristic time and length scales. More specifically, we show that the time scales during the run and tumbling phases play a major role in establishing different stable collective states. Our findings show the potential for dynamic transitioning between states at constant concentration and activity (speed) of active particles by solely tuning the kinematic time and length scales of individual random walkers.

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