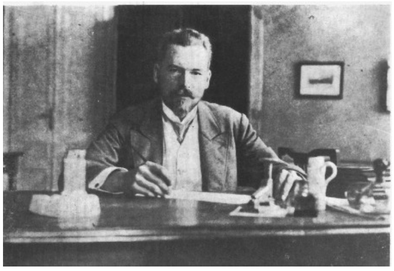

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Self-organization without self-attraction in quorum-sensing active matter: the interplay between nonreciprocity and motility

Monday, 25 September 2023 12:05 (25 minutes)

Over the past years, the generation of interactions breaking action-reaction symmetry has emerged as new paradigm for active matter. Such nonreciprocal interactions have in particular been argued to constitute a generic route for the emergence of steady states breaking time reversal symmetry. The generalization of the Cahn-Hilliard theory of phase separation to nonreciprocal mixtures predicts, for example, the emergence of traveling states when intra-species attraction leads to demixing while chasing inter-species interactions are present. Here, we study a minimal model of active phase separation involving two species of particles regulating their self-propulsion speed via quorum-sensing rules. Combining simulations of the microscopic model and linear stability analysis of the associated coarse-grained field theory, we identify a mechanism for dynamical pattern formation that does not rely on the standard route of intra-species effective attractive interactions. Instead, our results reveal a highly dynamical phase of chasing bands induced only by the combined effects of self-propulsion and nonreciprocity in the inter-species couplings. Turning on self-attraction, we find that the system may phase separate into a macroscopic domain of such chaotic chasing bands coexisting with a dilute gas. We show that the chaotic dynamics of bands at the interfaces of this phase-separated phase results in anomalously slow coarsening.

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