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Defect-mediated dynamics of coherent structures in active nematics MATTIA SERRA, Harvard University, LINNEA LEMMA, University of California at Santa Barbara, Santa Barbara, LUCA GIOMI, Instituut-Lorentz, Universiteit Leiden, ZVONIMIR DOGIC, University of California at Santa Barbara, Santa Barbara, LAKSHMINARAYANAN MAHADEVAN, Harvard University —
Cytoskeleton biopolymers, bacterial colonies, epithelial tissues and cell monolayers are examples of active nematics that display coordinated motion. Coherent motion in these systems is measured in terms of the global spatiotemporal organization of the orientational order parameter, and the local dynamics of nematic defects. But how are these coupled to the ambient velocity field that characterizes positional coherence? We combine dynamical systems theory, experiments on two-dimensional motor protein mixtures, and simulations of nematodynamic models to show that active nematics also possess positional coherence. The presence of these can be measured using Coherent Structures (CSs) - Lagrangian attractors and repellers, invisible to Eulerian techniques and trajectory plots, and thus serve as the organizing skeletons of the underlying chaotic motion. To understand the interaction of positional and orientational coherence on the dynamics of defects, we then analyzed observations and simulations and see that $+1/2$ defects move and deform the attractors, which in turn shape particle motion. Additionally, we find that regions of $+1/2$ defects undergo high bending and low stretching/shearing deformations. We conclude with some consequences of our framework for multicellular tissues.

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