Motile defects in contractile tissues: Insights from pulsating active matter

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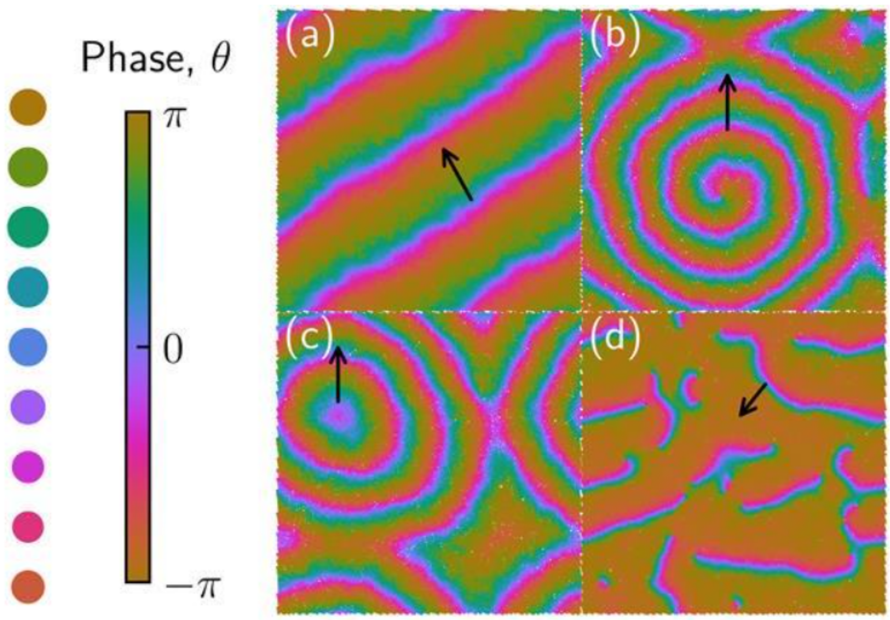
When heartbeats become irregular due to tachycardia or fibrillation, spiral waves and motile defects emerge at the surface of cardiac tissues [1]. Capturing the emergence of such defects in confluent tissues without any cellular flow is a theoretical challenge which has recently been tackled by models of actively deforming particles [2-5]. In dense assemblies where particles are subject to individual pulsation of their sizes, the interplay between synchronization and repulsion can produce deformation waves resembling those observed in cardiac tissues. Combining particle-based and hydrodynamic approaches, we examine the statistics of defects in the collective deformation of particles. We rationalize the emergence of defect motility as stemming from the breakdown of time-reversal and spatial symmetries. Specifically, we provide analytical predictions for the deformation profile near the defect core to quantify the angular and translational velocities of defects. These results lead to identifying the dominant mechanism underlying the crossover between various deformation patterns in contractile tissues, with broader implications for understanding similar phenomena in other active systems.



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