中央大學物理學系

Department of Physics, National Central University

Colloquium

Cellular mounds formation on defect topography

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Abstract : Collective motion plays a crucial role in morphogenesis, where cells coordinate and self-organize into complex and ordered structures essential for tissue development and function. In the past decade, dense cells have been reported to behave as active nematics due to their anisotropic cell shape and self-propelling nature, leading to the emergence of orientational order. Topological defects, which the orientational order is lost, play critical roles in morphogenesis and tissue developments. Previous studies have shown that half-integer defects serve distinct functions in biological processes, acting as hotspots for cell death, extrusion, and accumulation in cellular monolayers. In addition, integer defects are predominantly observed in tissue development, such as at the tips or head of Hydra during regeneration. However, how they affect collective cellular motion and tissue morphogenesis remains elusive. In this work, we investigate the impact of integer topological defects (+1) on collective cell motion using three-dimensional (3D) time-lapse confocal imaging. Our findings show that integer defects promote cellular extrusion in 2D cell monolayers, inducing largescale morphogenetic convergent flows which lead to multilayering and result in the formation of 3D nematic tissues. In short, by modulating tissue orientation through topological defect patterns, we can transform flat cell sheets into order 3D tissues.