Seminar/Talk

Numerical Modeling of Nematic Membranes with Active Curved Anisotropic Inclusions

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Biological membranes are active, multicomponent systems whose shape emerges from a complex interplay between curvature-inducing inclusions, in-plane ordering, and cytoskeletal forces. In this talk, I present a numerical framework for modeling closed membranes populated by curved anisotropic components that interact via nematic alignment and couple to active forces. Our simulations reveal a rich landscape of membrane morphologies arising from the competition between intrinsic curvature, nematic interactions, and active stresses. We show how nematic alignment organizes curved inclusions into defect structures that localize in regions of high curvature, thereby guiding membrane remodeling and stabilizing complex shapes such as tubules, necks, and pearled structures . Active forces further drive the system out of equilibrium, enabling transitions to morphologies that are inaccessible in passive systems, including flattened, protrusive, and dynamically fluctuating states. These results provide a unified physical picture of how curvature, orientational order, and active forces cooperate to control membrane shape, with implications for processes ranging from endocytosis and phagocytosis to cell spreading and motility.

Thursday, May 28, 2026 11:00am - 12:00pm
Office Bldg West / Ground floor / Heinzel Seminar Room (I21.EG.101)

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