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Cytoskeletal Polymers Under Confinement: Insights into Active Matter Dynamics

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Cellular motility is driven by myosin motor proteins, which act on actin filaments to convert chemical energy into kinetic energy via ATP hydrolysis. In combination with a variety of other actin-binding proteins modifying actin architecture, this results in actin network contraction, directed motion events, and the emergence of intracellular flow. However, dissecting the individual contributions of these actin-binding proteins to actin architecture and dynamics is challenging within the complex cellular environment. Moreover, the role of physical confinement by the cell membrane in shaping actin networks and generating intracellular flow remains unclear. To address these questions, we encapsulate actin filaments together with selected actin-binding proteins in Giant Unilamellar Vesicles (GUVs), isolating them from the cellular environment while maintaining physical confinement. While previous studies involving such artificial cell systems have primarily focussed on visual comparison of the differently modified actin networks, we aim to also investigate their dynamic behaviour. Using time-resolved imaging techniques, we capture changes in the network structure and analyse the network heterogeneity and reorganization rate. Examining how confinement influences actin network dynamics will elucidate the factors driving internal flow and its consequences for self-propulsion.