WINTER SEMESTER 2024 / 2025

RTG 2756 CYTAC SEMINAR SERIES

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RTG 2756

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SELF-ASSEMBLED ACTIVE ACTOMYOSIN GELS SPONTANEOUSLY CURVE AND WRINKLE SIMILAR TO BIOLOGICAL CELLS AND TISSUES

Living systems adopt a diversity of curved and highly dynamic shapes. These diverse morphologies appear on many length-scales, from cells to tissues and organismal scales. The common driving force for these dynamic shape changes are contractile stresses generated by myosin motors in the cell cytoskeleton, that converts chemical energy into mechanical work. A good understanding of how contractile stresses in the cytoskeleton arise into different 3D shapes and what are the shape selection rules that determine their final configurations is still lacking. To obtain insight into the relevant physical mechanisms, we recreate the actomyosin cytoskeleton in-vitro, with precisely controlled composition and initial geometry. A set of actomyosin gel discs, intrinsically identical but of variable initial geometry, dynamically self-organize into a family of 3D shapes, such as domes and wrinkled shapes, without the need for specific pre-programming or additional regulation. Shape deformation is driven by the spontaneous emergence of stress gradients driven by myosin and is encoded in the initial disc radius to thickness aspect ratio, which may indicate shaping scalability. Our results suggest that, while the dynamical pathways may depend on the detailed interactions between the different microscopic components within the gel, the final selected shapes obey the general theory of elastic deformations of thin sheets. Altogether, our results emphasize the importance for the emergence of active stress gradients for buckling driven shape deformations and provide novel insights on the mechanically induced spontaneous shape transitions in contractile active matter, revealing potential shared mechanisms with living systems across scales.