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Interplay between crosslinkers and dynamic molecular motor-induced instabilities in the moderation of biopolymer organization
DAVID SMITH, University of Leipzig, Institute for Soft Matter Physics, DAVID HUMPHREY, Center for Nonlinear Dynamics, University of Texas at Austin, FALKO ZIEBERT, WALTER ZIMMERMANN, Physikalisches Institut, Universität Bayreuth, JOSEF KÄS, University of Leipzig, Institute for Soft Matter Physics —
Structure and function of biological cells rely on the highly-dynamic self-organization of protein filaments to an intracellular cytoskeleton responsive to mechanical and chemical stimuli. While dissolving these complex cellular structures through Brownian motion is inherently slow (tens of minutes), changes in the activity of the molecular motor myosin II cause rapid order-disorder transitions within 1-2 minutes in reconstituted cytoskeletal actin networks. When motor-induced filament sliding decreases, actin network structure rapidly and reversibly self-organizes into various assemblies triggered by a nonlinear instability. Modulation of static crosslinker concentrations allow for a wide phase space of order ranging from nematics to compact asters & dense packing of motor-filament clusters. The observed isothermal transitions between disorder and self-organization illustrate that molecular motors can substantially contribute to dynamic cellular organization.

David Smith
University of Leipzig, Institute for Soft Matter Physics

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