Nonequilibrium Semiflexible Networks: Aging, Ripping, and Motor-driven Fluctuations

(Talk #4)

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Networks of semiflexible filaments make up the cytoskeleton, the major structural component of cells, and form the prototypical example of an active gel. Two features of these networks are particularly intriguing either separately or in combination: (1) cross linker unbinding and rebinding and (2) nonequilibrium stress states created by endogenous molecular motor activity. Due to the motion of labile cross linkers, the networks' topology is dynamic, leading to new rheological features with e.g., dissipative mechanisms associated with cross linker breakage and rebinding under applied load. In addition, these networks are typically driven into nonequilibrium stress states by the action of molecular motors. The combination of the inherent elastic nonlinearities of semiflexible filaments with the motor-induced nonequilibrium stresses allows motor activity to tune the mechanical moduli of these active gels over orders of magnitude. In this talk, I report on numerical and analytic results exploring the effect of labile cross linkers on the rheology and structural evolution of semiflexible networks. I discuss the nonlinear elasticity and plastic deformation of such networks due to cross linker mobility, and I examine the nonequilibrium stiffening and strain fluctuation spectrum of semiflexible networks due to motor activity.