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Myosin-I facilitates symmetry breaking and promotes the growth of actin comet tails

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Abstract:

Actin and myosin are molecular machines that convert free energy released from ATP hydrolysis into mechanical force. Polymerizing actin networks provide pushing force for a variety of cellular processes including cell motility, endocytosis and phagocytosis. Myosin-Is, as single-headed, membrane associated motors of the myosin superfamily, are commonly found alongside Arp2/3-medicated branched actin network at membrane interfaces, where they participate in actin organization and force generation. However, the fundamental question of 'how do forces generated by myosin-I motor activity couple with actin assembly for force generation?' remains unresolved. To investigate the role of myosin-I in actin-mediated force generation, we reconstituted an in vitro actin-based motility system. In this system, branched actin networks were nucleated by Arp2/3 complex from a micron-sized bead surface coated with Arp2/3 activating factors. Initially, actin filaments formed a symmetric shell around the bead, which then transitioned into a polarized comet tail after symmetry breaking, propelling the bead forward. We site-specifically coupled a range of densities of myosin-Is to the bead surface and assessed their effects on actin polymerization, network architecture, and symmetry breaking. We found that myosin-Is promoted force generation by regulating the dynamics and architecture of the actin comet tails through its force-generating power strokes, applying an effective repulsive force from the surface. These studies suggest synergy between myosin-I activity and branched actin assembly to drive morphological changes at the cell membrane.

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About the speaker:

Dr. Mengqi is a postdoctoral researcher working with Prof. Michael Ostap at the University of Pennsylvania, Perelman Medical School, Muscle Institute, studying cytoskeleton and molecular motors. She received her PhD in Physics with Prof. Jennifer Ross at Syracuse University, where she investigated the enhanced diffusion of active enzymes and built enzyme-powered micro-robots using DNA origami.

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