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Mechanical output of myosin II motors is regulated by myosin filament size and actin network mechanics SAMANTHA STAM, Biophysics Graduate Program, University of Chicago, Chicago, IL, JONATHAN ALBERTS, Center for Cell Dynamics, University of Washington, Friday Harbor, Washington, MARGARET GARDEL, Department of Physics, University of Chicago, Chicago, IL, EDWIN MUNRO, Department of Molecular Genetics and Cell Biology, University of Chicago, Chicago, IL — The interactions of bipolar myosin II filaments with actin arrays are a predominate means of generating forces in numerous physiological processes including muscle contraction and cell migration. However, how the spatiotemporal regulation of these forces depends on motor mechanochemistry, bipolar filament size, and local actin mechanics is unknown. Here, we simulate myosin II motors with an agent-based model in which the motors have been benchmarked against experimental measurements. Force generation occurs in two distinct regimes characterized either by stable tension maintenance or by stochastic buildup and release; transitions between these regimes occur by changes to duty ratio and myosin filament size. The time required for building force to stall scales inversely with the stiffness of a network and the actin gliding speed of a motor. Finally, myosin motors are predicted to contract a network toward stiffer regions, which is consistent with experimental observations. Our representation of myosin motors can be used to understand how their mechanical and biochemical properties influence their observed behavior in a variety of in vitro and in vivo contexts.

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