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Self-organized cell motility XINXIN DU, KONSTANTIN DOUBROVINSKI, Princeton University — Cell migration plays a key role in a wide range of biological phenomena, such as morphogenesis, chemotaxis, and wound healing. Cell locomotion relies on the cytoskeleton, a meshwork of filamentous proteins, intrinsically out of thermodynamic equilibrium and cross-linked by molecular motors, proteins that turn chemical energy into mechanical work. In the course of locomotion, cells remain polarized, i.e. they retain a single direction of motion in the absence of external cues. Traditionally, polarization has been attributed to intracellular signaling. However, recent experiments show that polarization may be a consequence of self-organized cytoskeletal dynamics. Our aim is to elucidate the mechanisms by which persistent unidirectional locomotion may arise through simple mechanical interactions of the cytoskeletal proteins. To this end, we develop a simple physical description of cytoskeletal dynamics. We find that the proposed description accounts for a range of phenomena associated with cell motility, including spontaneous polarization, persistent unidirectional motion, and the co-existence of motile and non-motile states.

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