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A minimal physical model for crawling cells ADRIANO TIRIBOCCHI, Department of Physics - University of Padua, ELSEN TJHUNG, Damtp - University of Cambridge, DAVIDE MARENDUZZO, School of Physics and Astronomy - University of Edinburgh, MICHAEL E. CATES, Damtp - University of Cambridge
— Cell motility in higher organisms (eukaryotes) is fundamental to biological functions such as wound healing or immune response, and is also implicated in diseases such as cancer. For cells crawling on solid surfaces, considerable insights into motility have been gained from experiments replicating such motion in vitro. Such experiments show that crawling uses a combination of actin treadmilling (polymerization), which pushes the front of a cell forward, and myosin-induced stress (contractility), which retracts the rear. We present a simplified physical model of a crawling cell, consisting of a droplet of active polar fluid with contractility throughout, but treadmilling connected to a thin layer near the supporting wall. The model shows a variety of shapes and/or motility regimes, some closely resembling cases seen experimentally. Our work supports the view that cellular motility exploits autonomous physical mechanisms whose operation does not need continuous regulatory effort.

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