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Superdiffusive cell motility on 2D substrates modeled as a persistent Lvy walk GIUSEPPE PASSUCCI, MEGAN E. BRASCH, Syracuse University, NICHOLAS O. DEAKIN, CHRISTOPHER E. TURNER, SUNY Upstate Medical University, JAMES H. HENDERSON, M. LISA MANNING, Syracuse University — Cell motility is an essential part of many biological processes such as morphogenesis, wound healing and tumorigenesis. We quantified cell motility by tracking mouse fibroblast and human breast carcinoma nuclei to construct cell trajectories. The mean-squared displacement of these trajectories reveals that cell motion is super diffusive, where displacements scale faster than $t^{1/2}$ in all directions. Existing self-propelled particle (SPP) models that do not explicitly incorporate ensemble heterogeneity are unable to predict this super-diffusive behavior. Therefore we developed a run-and-tumble SPP model with Levy distributed run times that captures observed super-diffusive behavior in the mean-squared displacement as well as scaling collapse exponents of displacement probability distributions which match those of mouse fibroblast and human breast carcinoma cell trajectories. We additionally introduced small fluctuations in particle orientation during runs, which generates a crossover from super-diffusive to diffusive dynamics at a very long times. This timescale can be extracted in experiments from the velocity auto-correlation function, allowing us to explicitly test this model prediction.

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