Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Identifying mechanisms for superdiffusive dynamics in cell trajectories GIUSEPPE PASSUCCI, MEGAN BRASCH, JAMES HENDERSON, M LISA MANNING, Syracuse University — Self-propelled particle (SPP) models have been used to explore features of active matter such as motility-induced phase separation, jamming, and flocking, and are often used to model biological cells. However, many cells exhibit super-diffusive trajectories, where displacements scale faster than $t^{1/2}$ in all directions, and these are not captured by traditional SPP models. We extract cell trajectories from image stacks of mouse fibroblast cells moving on 2D substrates and find super-diffusive mean-squared displacements in all directions across varying densities. Two SPP model modifications have been proposed to capture super-diffusive dynamics: Levy walks and heterogeneous motility parameters. In mouse fibroblast cells displacement probability distributions collapse when time is rescaled by a power greater than $\frac{1}{2}$, which is consistent with Levy walks. We show that a simple SPP model with heterogeneous rotational noise can also generate a similar collapse. Furthermore, a close examination of statistics extracted directly from cell trajectories is consistent with a heterogeneous mobility SPP model and inconsistent with a Levy walk model. Our work demonstrates that a simple set of analyses can distinguish between mechanisms for anomalous diffusion in active matter.

Giuseppe Passucci
Syracuse University

Date submitted: 11 Nov 2016 Electronic form version 1.4