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Coupling stochastic kinetics and mechanics uncovers new dynamics induced by focal adhesions in filopodia MARIA MINAKOVA, GAREGIN PAPOIAN, University of Maryland at College Park — Cell motility recently became a target for physical chemists and biophysicists. It is generally understood that in real biological systems, chemical and mechanical processes are coupled, sometimes in a very complex manner. Focal adhesions (FAs) represent a biologically relevant example of multi molecular assemblies that serve a mechanical function and have intriguing biochemical properties. FAs and their role in filopodial dynamics have been extensively studied experimentally from a biological standpoint. Although there are many biochemical studies of FAs kinetics in the literature, only a few works study FA dynamics from a physical perspective. In our work we developed a robust stochastic model of the filopodia coupled to mechanical properties of FAs, retrograde flow and the substrate. We carried out extensive simulations of the filopodial stochastic growth on the timescales of minutes, as well as a detailed theoretical description of a steady state, mapping multi dimensional phase space of mechanical and kinetic parameters onto various dynamics regimes. The combination of mean field analyses with detailed microscopic simulations provides a united platform for treating mechanochemical processes underlying complex behavior of the filopodial system.

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