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Reducing dissipation in far-from-equilibrium biomolecular processes

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Biomolecular machines are central actors in a myriad of major cell biological process. It seems plausible that evolution has sculpted these machines to efficiently transduce free energy (thus reducing dissipation) in their natural contexts, where stochastic fluctuations are large, nonequilibrium driving forces are strong, and biological imperatives require rapid turnover. But what are the physical limits on such nonequilibrium efficiency, and what machine designs actually achieve these limits? In this talk, I discuss a theoretical framework predicting how to rapidly and efficiently drive such noisy systems from one state to another, and describe experiments demonstrating the utility of this framework for reducing dissipation when rapidly unfolding and refolding the 'hydrogen atom' of biophysics, a single DNA hairpin.

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