MAR15-2014-020417

Abstract for an Invited Paper
for the MAR15 Meeting of
the American Physical Society

A synthetic playground for non-equilibrium error correction and information processing

ARVIND MURUGAN, Harvard

Biological proofreading mechanisms can lower error rates well below Boltzmann statistics by consuming free energy. By abstracting the principles behind these biochemical mechanisms, we discuss the central ingredients needed for any complex reaction network to perform error correction and the inherent energy-error tradeoffs. We propose that such abstract principles can be implemented and tested in synthetic systems using DNA strand displacement reactions. Such DNA circuits can mimic biochemical models of proofreading because of two central features: 1. exquisite control over reaction kinetics, 2. a DNA analog of ATP hydrolysis. Indeed, such DNA circuits may be used to mimic any non-equilibrium information processing scheme seen in biochemistry, such as adaption and ultra-sensitivity in addition to error correction. We discuss the conceptual and practical benefits from having a well-controlled synthetic playground for non-equilibrium ideas.