CMP Seminar

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Nonequilibrium thermodynamic limits to fluctuations and response

Thermodynamics is a remarkably successful theoretical framework, with wide ranging applications across the natural sciences. Unfortunately, thermodynamics is limited to equilibrium or near-equilibrium situations, whereas most of the natural world, especially life, operates very far from thermodynamic equilibrium. Research in nonequilibrium statistical thermodynamics is beginning to shed light on this domain. In this talk, I will present two such recent predictions. The first is a bound that quantifies how dissipation shapes fluctuations far from equilibrium. Besides its intrinsic allure as a universal relation, I will discuss how it can be used to offer energetic constraints on chemical clocks, and bound the dissipation in complex materials. The second is a collection of equalities and inequalities---akin to the Fluctuation-Dissipation theorem but valid arbitrarily far from equilibrium---that link a system's response to the strength of nonequilibrium driving. These results open new avenues for experimentally characterizing nonequilibrium response and suggest design-principles for high-sensitivity, low-noise devices. I will also discuss how they rationalize the energetic requirements of some common biochemical motifs.

Monday, February 24th, 2020 at 4:10 p.m.
Room: 1400 BPS Bldg.
Host: Matt Comstock