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Stochastic thermodynamics and fluctuation theorems of active Brownian dynamics DIBYENDU MANDAL, KATHERINE KLYMKO, Univ. of California - Berkeley — Active biological systems reside far from equilibrium, dissipating heat even in their steady state, and thus requiring an extension of the conventional equilibrium thermodynamics and statistical mechanics. In this study, we have extended the emerging framework of stochastic thermodynamics to active Brownian particles. In particular, for the active Ornstein-Uhlenbeck model, we have provided consistent definitions of thermodynamic quantities like work, energy, and entropy at the level of single, stochastic trajectories and derived all the major integral fluctuation relations, for total entropy production, excess entropy production, and housekeeping heat. We have developed the equivalent of the Clausius inequality and it reflects the underlying non-Hamiltonian nature of the dynamics. For this active, overdamped model, we have also discovered some subtleties in the detailed fluctuation theorems for the excess and the housekeeping heat that are absent in passive overdamped dynamics. We have illustrated our results with explicit numerical studies. These studies will ultimately reflect on the thermodynamic efficiency of active, biological processes.

Dibyendu Mandal
Univ. of California - Berkeley

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