

PHYSICS AND ASTRONOMY COLLOQUIUM

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Irreversibility and the Second Law of Thermodynamics at the Nanoscale

What do the laws of thermodynamics look like, when applied to microscopic systems such as optically trapped colloids, single molecules manipulated with laser tweezers, and biomolecular machines? In recent years there has been considerable interest and progress in addressing this question, and it has become apparent that the fluctuations of small systems far from thermal equilibrium satisfy strong, useful, and unexpected laws. In particular, a proper accounting of fluctuations allows us to rewrite familiar inequalities of macroscopic thermodynamics as equalities. I will describe some of this progress, and will argue that it has refined our understanding of irreversibility, the second law, and the thermodynamic arrow of time.



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