

The Fluctuation and NonEquilibrium Free Energy Theorems - Theory & Experiment

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We give a brief summary of the derivations of the Evans-Searles Fluctuation Theorems (FTs) and the NonEquilibrium Free Energy Theorems (Crooks and Jarzynski). The discussion is given for time reversible Newtonian dynamics. We emphasize the role played by thermostating. We also highlight the common themes inherent in the Fluctuation and Free Energy Theorems. We discuss a number of simple consequences of the Fluctuation Theorems including the Second Law Inequality, the Kawasaki Identity and the fact that the dissipation function which is the subject of the FT, is a nonlinear generalization of the spontaneous entropy production, that is so central to linear irreversible thermodynamics. Lastly we give a brief update on the latest experimental tests of the FTs (both steady state and transient) and the NonEquilibrium Free Energy Theorem, using optical tweezer apparatus.