INFERNOS

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Information is physical. During the last decade, this basic concept has led to a revolution in our understanding of quantum mechanics. Less attention has been paid so far to equally important implications of this principle in statistical mechanics of small systems, where statistical fluctuations are large and make their thermodynamic properties extremely dependent on the information available. The most basic process illustrating the importance of information to statistical systems is the information-to-energy conversion in the famous Maxwell's Demon (MD). Our primary goal is to study both experimentally and theoretically the statistics of fluctuations and the role of information in thermodynamics of nanoscale systems. The first milestone will be the experimental realization of the nanoscale MD. We will create an experimental set-up and develop the corresponding theory of the monitored statistical evolution with feedback that optimizes the information-to-energy conversion. Our vision is to develop the electronic and bio-molecular nanodevices that will allow us to systematically explore the limits of information-powered systems, in particular, to test the Szilárd's limit relating one bit of information to extracted energy. We will also study statistics of energy fluctuations as revealed via equilibrium and non-equilibrium fluctuations of temperature. Part of these fluctuations has a quantum mechanical origin, but identification of this contribution in practice poses a challenging problem. Another novel extension of the MD work will be the study of thermodynamic constraints on quantum detectors. Although MD is one of the cornerstones of theoretical statistical mechanics, little has been done about its definite experimental realization. The principal novelty of our project is to bring about a robust and rigorous experimental base for the field. Naturally, our experimental studies will be accompanied by relevant theoretical efforts.

- Quantum Engineering
- EC - FP7
- IP
- Quantum Metrology, Sensing and Imaging

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