SFB/TRR 21 - Colloquium

27. November 2015, Stuttgart

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The thermodynamics of quantum information processing

How much heat is dissipated in a quantum computer? Just how small can thermal engines be? When does a system act as a heat bath towards a quantum device? As technology miniaturizes, we find that some approaches of traditional thermodynamics are inadequate to study heat and work in the regime of the very small. There are several aspects to this change, such as finite-size effects, subjectivity of information, emergence of quantum effects, the growing importance of correlations between small systems, and the fact that we are normally interested in single-shot results, as opposed to averages over a large number of experiments. To tackle these challenges, a new theory of quantum thermodynamics is emerging, drawing from insights of quantum information theory. Quantum information theory has given us tools to model knowledge of quantum systems explicitly: we use it to analyse the security of cryptographic protocols, or how much information can be sent through a noisy channel, for example. In this talk, I will explore the connection between information theory and thermodynamics. We will start with the classic example of Maxwell's demon, and build up to the work cost of erasure of quantum information.

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