Extracting work from absence of correlations

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Abstract

As Landauer's Principle and Szilard's engine illustrate, the reduction of a system's entropy costs work, while its increase can be used to extract work from a heat bath. One consequence in standard thermodynamics is that correlations have work value: the total entropy of two correlated systems is less than the sum of their local entropies, and thus work can be extracted if this correlation is consumed. In the talk, we show that the situation is surprisingly different for microscopic and quantum systems far from the thermodynamic limit: quite the contrary, absence of correlations can be used to extract work. Recently, it has been shown that the possible state transitions in the microscopic regime are severely limited by an infinite family of "second laws". We show that stochastic independence, if consumed as a resource, allows to overcome these limitations, to extract additional work reliably, and to achieve all state transitions that are otherwise only possible in the thermodynamic limit. Our result also yields an operational non-asymptotic characterization of von Neumann (neg-)entropy in terms of a majorization relation which generalizes the trumping relation from entanglement theory.

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