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Quantum Resource Theories: An overview and some recent results

IMAN MARVIAN, Duke University

If one looks at the scientific history of the theory of entanglement, the turning point is easily seen to occur in the mid-nineties, at the point when researchers in quantum information theory began to consider entanglement as "a resource as real as energy". It gradually became clear that the entanglement theory should be understood as a framework to study questions about manipulating resource states for performing certain tasks, similar to the theory of thermodynamics. From this point on, entangled states and entangling operations were defined as those states and operations that cannot be implemented when one only has access to Local Operations and Classical Communication. Researchers then began to systematically answer questions such as: under this kind of restriction when is it possible to convert one resource state into another? How do we quantify the resource? What is the resource cost of simulating an operation? Subsequently, motivated by the success of the resource theory approach to entanglement, many researchers started applying this approach to understand other properties of quantum systems, such as coherence, asymmetry and athermality in quantum thermodynamics. In this talk, I give an introduction to quantum resource theories, with more emphasis on the resource theories of entanglement, coherence and asymmetry. I also discuss some recent results on distillation of quantum coherence in the context of quantum thermodynamics.