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*Resource theory of quantum thermodynamics: State convertibility from qubit cooling and heating*

Thermodynamics plays an important role both in the foundations of physics and in technological applications. An operational perspective adopted in recent years is to formulate it as a quantum resource theory. I will begin with a quick introduction to the general framework of quantum resource theories, in particular motivating it and explaining why the convertibility of resourceful states is at its core. I will then specialize to the resource theory of quantum thermodynamics and present recent results that I found in collaboration with Elia Zanoni, Carlo Maria Scandolo, and Gilad Gour: We solved the question of how in the quantum limit, thermal non-equilibrium can be used to heat and cool other quantum systems that are initially at thermal equilibrium. We then showed that the convertibility between quasi-classical resources (resources that do not exhibit coherence between different energy eigenstates) is fully characterized by their ability to cool and heat qubits, i.e., by two of the most fundamental thermodynamical tasks on the simplest quantum systems. We, therefore, characterized the core problem of the resource theory of thermodynamics with operationally relevant tasks.