Quantum Measurement Cooling

Lorenzo Buffoni, Andrea Solfanelli, Paola Verrucchi, Alessandro Cuccoli, Michele Campisi

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Invasiveness of quantum measurements is a genuinely quantum mechanical feature that is not necessarily detrimental: Here we show how quantum measurements can be used to fuel a cooling engine. We illustrate quantum measurement cooling (QMC) by means of a prototypical two-stroke two-qubit engine which interacts with a measurement apparatus and two heat reservoirs at different temperatures. Optimal cooling efficiency is reached when the post measurement state is not entangled. We quantify the probability that QMC occurs when the measurement basis is chosen randomly, and find that it can be very large as compared to the probability of extracting energy (heat engine operation), while remaining always smaller than the most useless operation, namely dumping heat in both baths. Besides shedding new light on many facets of the second law of thermodynamics, the results show that QMC can be very robust to experimental noise. A possible low-temperature solid-state implementation that integrates circuit QED tools with circuit QTD (quantum thermodynamics) elements and methods is presented.

[1] arXiv:1806.07814