Measurement-assisted quantum cooling

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Cooling a quantum system to its ground state is important for the characterization of non-trivial interacting systems, and in the context of a variety of quantum information platforms. In principle, this can be achieved by employing measurement-based passive steering protocols, where the steering steps are predetermined and are not based on measurement readouts. However, measurements, i.e., coupling the system to auxiliary quantum degrees of freedom, is rather costly, and protocols in which the number of measurements scales with system size will have limited practical applicability. We have identified conditions under which measurement-based cooling protocols can be taken to the dilute limit. For two examples of frustration-free one-dimensional spin chains, we show that steering on a single link is sufficient to cool these systems into their unique ground states. We corroborate our analytical arguments with finite-size numerical simulations and discuss further applications.