Quantum engines based on entanglement and continuous measurement

Andrew N. Jordan

Chapman University, 1 University Drive, Orange, California 92866, USA
University of Rochester, Rochester, New York 14627, USA

Quantum measurement engines are enabled by combining the physics of quantum measurement with feedback and work extraction based on the information obtained. I will present several new designs of this principle. The first uses continuous measurements of the joint momentum and position of a quantum oscillator together with feedback on the origin of the oscillator potential to extract work from the measurements as a continuous stochastic process [1]. The second uses coupled quantum systems and the entanglement between them to run a measurement engine with local measurements to upconvert energy from one system to another [2]. I will present new research adapting the entanglement-fueled engine to work in the deep strong coupling limit, where vacuum fluctuations of ground state entanglement are rectified with local measurements and energy extraction pulses in order to run an engine cycle on a many-body chain of quantum systems. The work scales linearly with the number of sub-systems in the chain [3].

[1] Sreenath K. Manikandan, Cyril Elouard, Kater W. Murch, Alexia Auffèves, Andrew N. Jordan, Efficiently Fuelling a Quantum Engine with Incompatible Measurements, arXiv:2107.13234

[2] Léa Bresque, Patrice A. Camati, Spencer Rogers, Kater Murch, Andrew N. Jordan, Alexia Auffèves, A two-qubit engine fueled by entangling operations and local measurements, Phys. Rev. Lett. 126, 120605 – Published 24 March 2021 (editor's suggestion).

[3] Étienne Jussiau, Léa Bresque, Alexia Auffèves, Andrew N. Jordan, in preparation.