Self-contained measurement driven engine

S. Seah[a], S. Nimmrichter[c], and V. Scarani[a,b]

[a]Department of Physics, National University of Singapore, 2 Science Drive 3, Singapore 117542, Singapore
[b]Centre for Quantum Technologies, National University of Singapore, 3 Science Drive 2, Singapore 117543, Singapore
[c]Max Planck Institute for the Science of Light, Staudtstraße 2, 91058 Erlangen, Germany

There has been growing interest in understanding the role of measurement in quantum thermodynamics. Previous works[1, 2, 3] exploit the stochasticity induced by quantum measurements – more commonly termed as "quantum heat"– to design engines with efficiencies approaching unity. However, a more recent study [4] suggests that the energy change due to "quantum heat" should rather be interpreted as work. Here we adopt a bottom-up approach and propose a self-contained heat engine driven by a continuous measurement-feedback protocol, where the engine system acts as the working medium and is coupled to a hot bath and to a measurement pointer that thermalises with a cold bath. The measurement cost is associated to the interaction Hamiltonian between the system and pointer and vanishes for a gapless pointer. We show that when operated in ideal cycles of distinct measurement, feedback, and erasure strokes, the engine attains Otto efficiency. In a practical scenario of continuous finite-time operation, the efficiency will be lower as the interplay between the thermalisation rates to individual baths, the measurement-feedback rate, and the coupling rate between the system and pointer will then affect the engine performance.

References

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