Highlights

Activity F - Electronic and thermal transport from the nanoscale to the macroscale - 2021

Optimal energy conversion through anti-adiabatic driving breaking time-reversal symmetry

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Starting with Carnot engine, the ideal efficiency of a heat engine has been associated with quasi-static transformations and vanishingly small output power. In this work, we exactly calculate the thermodynamic properties of an isothermal heat engine, in which the working medium is a periodically driven underdamped harmonic oscillator as sketched in the figure, focusing instead on the opposite, anti-adiabatic limit, where the period of a cycle is much shorter than the system's timescales.
We show that in that limit it is possible to approach the ideal energy conversion efficiency η=1, with finite output power and vanishingly small relative power fluctuations. The simultaneous realization of all the three desiderata of a heat engine is possible thanks to the breaking of time-reversal symmetry. We also show that non-Markovian dynamics can further improve the power-efficiency trade-off.