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MBL-mobile: Quantum engine based on many-body localization NICOLE YUNGER HALPERN, Harvard-Smithsonian ITAMP (Institute for Theoretical Atomic, Molecular, and Optical Physics), Harvard University, CHRISTOPHER WHITE, California Institute of Technology, SARANG GOPALAKRISHNAN[1], College of Staten Island, City University of New York — Many-body-localized (MBL) systems do not thermalize under their intrinsic dynamics. The athermality of MBL, we propose, can be harnessed for thermodynamic tasks. We illustrate this ability by formulating an Otto engine cycle for a quantum many-body system. The system is ramped between a strongly localized MBL regime and a thermal (or weakly localized) regime. The difference between the energy-level correlations of MBL systems and of thermal systems enables mesoscale engines to run in parallel in the thermodynamic limit, enhances the engine's reliability, and suppresses worst-case trials. We estimate analytically and calculate numerically the engine's efficiency and per-cycle power. The efficiency mirrors the efficiency of the conventional thermodynamic Otto engine. The per-cycle power scales linearly with the system size and inverse-exponentially with a localization length. The engine can be realized, e.g., with ultracold atoms in an optical lattice. This work introduces a thermodynamic lens onto MBL, which, having been studied much recently, can now be considered for use in thermodynamic tasks.

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