Abstract Submitted
for the 4CS21 Meeting of
The American Physical Society

Expressing the Dynamics of a Quantum Szilard Engine Using Quantum Information[1] SERGIO DIAZ, University of Maryland, Baltimore County, JEAN-FRANÇOIS VAN HUELE, Brigham Young University — Quantum information offers the possibility of advancing computation, communication, and cryptography. Quantum circuits combine qubits and quantum gates to perform informational tasks. Quantum resources allow quantum computers to perform certain tasks faster than classical computers. Szilard expanded on Maxwell's demon to design a single-temperature engine that challenges the second law of thermodynamics by extracting work from information. In doing so, Szilard brought together thermodynamics, information theory, and computation. We are interested in the quantum version of the Szilard engine, which we model following Zurek [2] and Davies [3]. By considering a box containing a single particle, partitioning the box, measuring occupancy, and moving the boundaries of the box, we reproduce the steps of the Szilard engine as a quantum mechanical problem. We analyze the dependence of the solutions on the parameters of the boxes. We also determine thermodynamic quantities describing the evolution of our quantum system during one cycle of the Szilard engine, demonstrating how the demon violates the second law of thermodynamics and how it must be treated as its own quantum system.

[1]This project was funded by the National Science Foundation under grant 2051129.
[2]W. H. Zurek, Physics Reports 755, 1 (2018)
[3]P. Davies et al., (2020), arXiv:2011.01180 [quant-ph]

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Date submitted: 10 Sep 2021 Electronic form version 1.4