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An autonomous single-piston engine with a quantum rotor

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Pistons are elementary components of a wide variety of thermal engines, allowing to convert input fuel into rotational motion. Here, we propose a single-piston engine where the rotational degree of freedom is effectively realized by the flux of a Josephson loop-a quantum rotor-while the working volume corresponds to the effective length of a superconducting resonator. Our autonomous design implements a Carnot cycle, relies solely on standard thermal baths and can be implemented with circuit quantum electrodynamics. We demonstrate how the engine is able to extract a net positive work via its built-in synchronicity using a filter cavity as an effective valve, eliminating the need for external control.

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