Single-ion heat engine

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Abstract

Laser-cooling, manipulating and observing of single ions in Paul traps has reached an impressive perfection. We use such techniques for realizing a single-ion heat engine. A special linear Paul trap allows for coupling radial and axial modes of oscillation. Periodic heating and cooling of the radial degree of freedom results in a coherent excitation of the axial motion realizing a thermodynamic Otto cycle [1,2]. In the experiment we use a high speed camera imaging the ion motion to determine the output power of the engine. In order to compare the experimental data with theoretical predictions we rely on a novel temperature measurement technique [3]. The method features measurement times of a few microseconds and works in the relevant temperature range of 0.1 – 100 mK.

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