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22nd RQC Colloquium

Converting quantum statistics into work

Prof. Eric Lutz

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Mar. 19, 2024(Tue) **16:00–17:00**(JST)

This colloquium will be held in HYBRID format.

On-site Venue: Wako C61 Wako Welfare and Conf. 2F Large Meeting Room

Online Venue: Zoom. To receive the link, register in advance at https://krs2.riken.jp/m/rqc_registration_form

Heat engines convert thermal energy into mechanical work both in the classical and quantum regimes. However, quantum theory offers genuine non-classical forms of energy, different from heat, which so far have not been exploited in cyclic engines. I will present an experimental realization a quantum many-body engine fuelled by the energy difference between fermionic and bosonic ensembles of ultracold particles that follows from the Pauli exclusion principle. Employing a harmonically trapped superfluid gas of Li atoms close to a magnetic Feshbach resonance allows one of effectively change the quantum statistics from Bose–Einstein to Fermi–Dirac, by tuning the gas between a Bose–Einstein condensate of bosonic molecules and a unitary Fermi gas (and back) through a magnetic field. The quantum nature of such a Pauli engine is revealed by contrasting it with an engine in the classical thermal regime and with a purely interaction-driven device. These results establish quantum statistics as a useful thermodynamic resource for work production [1].

[1] Koch et al., A quantum engine in the BEC–BCS crossover, Nature 621, 723-727 (2023).