

JOURNAL CLUB: A quantum engine in the BEC-BCS crossover

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July 03, 2024

15:00 to 16:00

Seminar Room

Heat engines convert thermal energy into mechanical work both in the classical and quantum regimes¹. However, quantum theory offers genuine non-classical forms of energy, different from heat, which so far have not been exploited in cyclic engines. Here we experimentally realize a quantum many-body engine fuelled by the energy difference between fermionic and bosonic ensembles of ultracold particles that follows from the Pauli exclusion principle². We employ a harmonically trapped superfluid gas of 6Li atoms close to a magnetic Feshbach resonance³ that allows us to effectively change the quantum statistics from Bose-Einstein to Fermi-Dirac, by tuning the gas between a Bose-Einstein condensate of bosonic molecule and a unitary Fermi gas (and back) through a magnetic field^{4,5,6,7,8,9,10}. 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. We obtain a work output of several 10⁶ vibrational quanta per cycle with an efficiency of up to 25%. Our findings establish quantum statistics as a useful thermodynamic resource for work production.

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