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报告

超冷强相互作用费米气体量子热机中量子耗散的抑制

Quantum Friction-free Superadiabatic Heat Engine with a Trapped Unitary Fermi Gas

武海斌教授 | 华东师范大学精密光谱科学与技术国家重点实验室教授

讲者介绍 Biography

武海斌，男，华东师范大学教授，博士生导师，国家青年千人和上海市优秀学术带头人。2009 年在美国阿肯色大学获得物理学博士学位；2010 年至 2012 年在美国杜克大学物理系从事博士后研究工作； 2012 年 10 月至今在华东师范大学精密光谱科学与技术国家重点实验室工作。主要从事量子光学、超冷费米原子气体的实验研究。在 Science、Phys. Rev. Lett.等物理学期刊上发表研究论文 40 余篇，SCI 收录的他人引用 900 多次。目前主持国家自然科学基金重点项目以及科技部重点专项等项目。

报告摘要 Abstract

During the last three decades, finite-time thermodynamics has been developed in the quest for the optimal performance of thermal machines and efficient use of energy resources. With the development of quantum technologies, the interest has shifted to the nanoscale and the quantum domain. A race has started to realize useful quantum heat engines and refrigerators. To implement such quantum devices requires extracting the maximum available work in the minimum possible time, and finding the minimum-time transition between quantum states. More importantly, the key goal in the thermodynamic cycles of the machines is to reduce the undesirable effects of the environment, which lead to dissipation and decoherence. Here we experimentally demonstrate friction-free superadiabatic strokes with a scale invariant trapped unitary Fermi gas as a working substance and establish the equivalence between the superadiabatic mean work and its adiabatic value. The far-from-equilibrium dynamics of quantum devices can be tailored by shortcuts to adiabaticity to suppress quantum friction. The ability to implement such manipulation in a unitary Fermi gas offers new avenues in quantum control for strongly-coupled many-body systems. It can be harnessed for the experimental test of predicted quantum anomalies in atomic clouds confined to two-dimensions and quantum supremacy of many-particle thermal machines.