量子信息科技学术研讨会 (2018.9.17-21)

报告

受激拉曼绝热通道的量子绝热捷径

TShortcuts to Adiabaticity for Stimulated Raman Adiabatic Passages

颜辉教授 | 华南师范大学物理与电信工程学院教授

讲者介绍 Biography

颜辉，教授、博士生导师，2004 年本科毕业于武汉大学，2009 年博士毕业于中科院武汉物理与数学研究所，华南师范大学和香港科技大学博士后。广东省自然科学基金杰出青年基金获得者、广东省“特支计划”科技创新青年拔尖人才、广东省高校优秀青年教师、广州市珠江科技新星，广东省量子调控工程与材料重点实验室副主任。主要从事冷原子量子调控实验研究，具体研究方向包括：(1) 量子网络与量子存储；(2) 量子计算与量子模拟；(3) 量子精密测量。已发表 SCI 论文 40 余篇，其中 Nature Commun.1 篇，Phys. Rev. Lett.4 篇，Phys. Rev. A 17 篇。多个工作被广泛关注，包括 2018 年 PRL 编辑推荐、2016 年“中国光学重要成果”、2015 年美国《Science News》杂志研究新闻、2014 年《Nature Photonics》杂志研究热点等。申请国家发明专利 10 项，授权国家发明专利 6 项。

报告摘要 Abstract

The technique of “shortcuts to adiabaticity” plays an increasingly important role in quantum computation and other novel quantum technologies being fundamentally based on quantum operations, such as quantum simulation and quantum thermodynamics. In this talk, I will present our recently experimental results of stimulated Raman shortcut-to-adiabatic passage and theoretical scheme of universal shortcut-to-adiabatic geometric quantum gates. Double coherent stimulated Raman adiabatic passages (STIRAPs) have been developed to realize high-fidelity and robust state transfer [1]. Through shortcuts to adiabaticity, we experimentally speed up the STIRAPs [2], which inherits the merits of robustness and high fidelity. In order to speed up the adiabatic holonomic quantum computation and suppress the collective dephasing, we propose a simplified scheme to realize nonadiabatic holonomic quantum computation in decoherence-free subspaces [3]. Exploiting the concept of shortcuts to adiabaticity, we propose a scheme to implement high-fidelity, fast, robust and universal geometric quantum gates [4], which requires only a minimalistic qubit and one control field for its realization. Furthermore, we show that shortcuts to adiabaticity can be applied to improve the performance of atomic interferometer [5].

[1] Yan-Xiong Du, Zhen-Tao Liang,Wei Huang, Hui Yan, and Shi-Liang Zhu, “Experimental observation of double coherent stimulated Raman adiabatic passages in three-level L systems in a cold atomic ensemble”, Phys. Rev. A 90, 023821 (2014).

[2] Yan-Xiong Du, Zhen-Tao Liang, Yi-Chao Li, Xian-Xian Yue, Qing-Xian Lv, Wei Huang, Xi Chen, Hui Yan, and Shi-Liang Zhu, “Experimental realization of stimulated Raman shortcut-to-adiabatic passage with cold atoms”, Nat. Commun.7, 12479 (2016).

[3] Zhen-Tao Liang, Yan-Xiong Du, Wei Huang, Zheng-Yuan Xue, and Hui Yan, “Nonadiabatic holonomic quantum computation in decoherence-free subspaces with trapped ions”, Phys. Rev. A 89, 062312 (2014).

[4] Zhen-Tao Liang, Xian-xian Yue, Qing-xian Lv, Yan-Xiong Du, Wei Huang, Hui Yan, and Shi-Liang Zhu, “Proposal for implementing universal superadiabatic geometric quantum gates in nitrogen-vacancy centers”, Phys. Rev. A 93, 040305(R) (2016).

[5] Yan-Xiong Du, Xian-Xian Yue, Zhen-Tao Liang, Jia-Zhen Li, Hui Yan, and Shi-Liang Zhu, “Geometric atom interferometry with shortcuts to adiabaticity”, Phys. Rev. A 95, 043608 (2017).