



清华大学高等研究院

Institute for Advanced Study, Tsinghua University

学术报告

Title:

Manipulating spin states of Cooper pairs: Towards flux-free control of Majorana zero modes via spin-orbit interactions

Speaker:

Xin Liu

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Time:

3:00pm, Thursday, August 20, 2015

Venue:

Conference Hall 322, Science Building, Tsinghua University

Abstract

Manipulating spin states of particles has triggered many innovational fields such as spintronics and topological insulators which focus on the single electron spin. Besides electron, Cooper pairs also have their spin states which are known as spin-singlet and spin-triplet states. In this talk, I first give a unified theory of the spin-singlet and spin-triplet Cooper pairs in the presence of either magnetization or spin-orbit coupling [1]. Then I will prove that Majorana zero modes (MZMs) on the boundary of topological superconductors only have spin-triplet superconducting correlations [2]. This is universal for all TSCs. At last, I will show that a spin-orbit coupling induced spin $U(1)$ phase can play the same role with charge $U(1)$ phase for the spin-triplet Josephson coupling, leading to a flux-free control of MZMs.

References:

- [1] Xin Liu, J. K. Jain and Chao-Xing Liu, "Long-Range Spin-Triplet Helix in Proximity Induced Superconductivity in Spin-Orbit-Coupled Systems", Phys. Rev. Lett. 113, 227002 (2014).
- [2] Xin Liu, Jay D. Sau and S. Das Sarma, "Universal spin-triplet superconducting correlations of Majorana fermions", Phys. Rev. B 92, 014513 (2015).

Biography:

Dr. Xin Liu obtained his bachelor's degree in Nankai University and master's degree in Chern Institute of Mathematics under the supervision of Prof. Molin Ge. He received his Ph. D. from Texas A&M University in 2012. After graduation, he worked in The Pennsylvania State University from 2012 to 2014 and in Condensed Matter Theory Center at University of Maryland from 2014-2015 as a postdoc researcher. Starting from Jul 2015, Dr. Xin Liu joined Huazhong University of Science and Technology as a professor. His research interests focus on topological superconductors, spin-triplet superconductivity, topological insulators and spintronics.