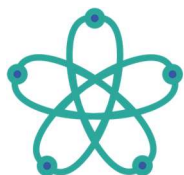


THE UNIVERSITY OF HONG KONG



HK Institute of
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香港量子研究院



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Representation Theory for Massless Quasiparticles in BdG Systems

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Abstract:

Linearly dispersive gapless quasiparticles can appear at general momentum points of superconductors due to topological reasons like K theory or symmetry indicators theory. However, the zero modes associated with these quasiparticles are generally ‘accidental’ from symmetry point of view. In this talk, we apply projective representation (rep) theory to analyze the bulk gapless quasiparticles in BdG systems. Different from the description of semimetals, we need to specially treat the particle-hole ‘symmetry’ since it is anti-commuting with the BdG Hamiltonian. Hence the notion of ‘simple irreducible reps (irreps)’ and ‘composite irreps’ are introduced to label the energy modes. We show that without charge conjugation symmetry (unitary symmetry that commutes with the Hamiltonian), no robust bulk zero modes exist at any fixed momentum point in the bulk. However, robust zero modes at certain high symmetry momentum points can be protected by (effective) charge conjugation symmetries, resulting in gapless quasiparticles with linear, quadratic, or higher-order dispersions determined by the effective $\mathbf{k} \cdot \mathbf{p}$ theory. The low energy physical properties of the system are determined by the rep carried by the zero modes. This theory provides a framework to classify nodal Superconductors/Superfluids/Quantum Spin Liquids with specified (projective) symmetry group and sheds light on the realization of Majorana-type massless quasiparticles in condensed matter physics.

Biography:

Zheng-Xin Liu obtained his Ph.D in the Hong Kong University of Science and Technology in 2010. After that he worked in the Institute for Advanced Study in Tsinghua University as a post doctor and then as an associate member. He joined Renmin University of China in 2015. Dr. Liu's research area includes quantum magnetism, topological phases and symmetries in condensed matter physics. Recently, his interest is focused on quantum spin liquids in Kitaev materials and band structure of itinerant electrons in magnetically ordered systems.

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Room 522, 5/F, Chong Yuet Ming Physics Building,
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Phone: 3917 1108. Anyone interested is welcome to attend.