Observation of Tensor Monopoles with a Superconducting Quantum Circuit

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Time: 5.00pm
Venue: Remote via Zoom (ID and Passcode will be sent upon registration)
Host: Associate Professor David Wilkowski

Abstract

Monopoles play a center role in gauge theories and topological matter. There are two fundamental types of monopoles in physics: vector monopoles and tensor monopoles. Examples of vector monopoles include the Dirac monopole in three dimensions and Yang monopole in five dimensions, which have been extensively studied and observed in condensed matter or artificial systems. However, tensor monopoles are less studied, and their observation has not been reported. On the other hand, superconducting quantum circuits provide an excellent platform for quantum computation and quantum simulation due to their scalability, controllability, and flexibility. Here we experimentally construct a tunable spin-1 Hamiltonian to generate a tensor monopole and then measure its unique features with superconducting quantum circuits. The energy structure of a 4D Weyl-like Hamiltonian with threefold degenerate points acting as tensor monopoles is imaged. Through quantum-metric measurements, we report the first experiment that measures the Dixmier-Douady invariant, the topological charge of the tensor monopole. Moreover, we observe topological phase transitions characterized by the topological Dixmier-Douady invariant, rather than the Chern numbers as used for conventional monopoles in odd-dimensional spaces.

Short Biography

Yang Yu is a professor in physics at Nanjing University. He received his Ph.D from the University of Kansas in 2002, then he joined MIT as a postdoc associate in the Research Lab for Electronics, before going back to Nanjing university as a professor in 2005. Yang Yu is one of the pioneers in the field of superconducting quantum computing based on Josephson junctions and SQUIDs. With collaborators, he realized the first Rabi oscillations of the superconducting phase qubit. He has published more than 100 peer review papers, including 3 in Sciences and 11 in PRL.

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Registration

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