北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Dirac spin liquids and competing orders in 2D quantum magnets

Xue-Yang Song 宋雪洋

Harvard University

Time: 4: 00 Pm, Dec. 30, 2019 (Monday)

时间：2019年12月30日 （周一）下午4:00

Venue: Room W563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

We explore a low-energy theory for 2D quantum magnets, the Dirac spin liquid (DSL), a version of Quantum Electrodynamics (QED_3) with four flavors of Dirac fermions coupled to photons. We study the spatial/time-reversal symmetry properties of the magnetic monopoles, an important class of excitations that drive confinement. We show that the underlying band topology of spinon insulators, e.g. wannier insulator protected by rotation provides crucial information on the tricky Berry phase of monopole (under rotations). The understanding of monopole quantum numbers in Dirac spin liquids provides a unified framework to understand 2D quantum magnetism. In particular, it allows us to naturally account for various orders on both bipartite lattices such as the square and honeycomb lattice as well as the non-bipartite triangular and Kagome lattices. A dichotomy in behavior between the bipartite and non bipartite lattices is traced to the difference in monopole symmetry properties on these two lattices. We characterize universal signatures of the Dirac spin liquid state, including those that result from monopole excitations, which serve as a guide to numerics and to experiments on existing materials. Even when unstable, the Dirac spin liquid unifies multiple seemingly unrelated ordered states, which could help organize the plethora of phases observed in strongly correlated two dimensional materials.

Refs:

[1] Xue-Yang Song, Chong Wang, Ashvin Vishwanath & Yin-Chen He, arXiv: 1811.11182 (2018).

[2] Xue-Yang Song, Chong Wang, Ashvin Vishwanath & Yin-Chen He, Nature Communications 10, 4254 (2019).

[3] John McGreevy, "Quantum electrodynamics in a piece of rock", Nature Review Physics (2019).

About the speaker

Xue-Yang Song grew up in north China and was a member of national physics Olympiad team in 2013. She earned B.S. from the school of Physics, Peking University in 2017 and then joined the PhD program in physics at Harvard University. Her research applies quantum mechanic to study exotic eletronic systems, e.g. topological order, non-fermi liquid, usually arising from strong interactions. She is also curious about information entanglement properties in quantum systems.