北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Spin group symmetry in magnetic materials and its application on new topological phases

Qihang Liu

Department of Physics, Southern University of Science and Technology

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Abstract

Symmetry formulated by group theory plays an essential role with respect to the laws of nature, from fundamental particles to condensed matter systems. In this talk, we elucidate that the crystallographic symmetries of a vast number of magnetic materials with light elements, in which the neglect of relativistic spin-orbit coupling (SOC) is an appropriate approximation, are considerably larger than the conventional magnetic groups. Thus, a symmetry description that involves partially-decoupled spin and spatial rotations, dubbed as spin group, is required. We then derive the classifications of spin “point groups” describing coplanar and collinear magnetic structures, and the irreducible co-representations of spin “space groups” illustrating more energy degeneracies that are disallowed by magnetic groups. These results directly give rise to our further discovery of SOC-free topological phases, including Z2 topological classification and topological semimetals, protected by new symmetries.

References

[1] Liu et al. arXiv:2103.15723 (PRX 2022).

[2] Liu et al. arXiv:2107.09984

About the speaker

Prof. Qihang Liu received his B.S. (2007) and Ph.D. degree (2012) from School of Physics, Peking University. He then worked at Northwestern University and University of Colorado, Boulder, and joined SUSTech as a faculty in 2018. Prof. Liu is mainly engaged in the field of computational condensed matter physics related to spin-orbitronics, and has published >70 peer-reviewed SCI papers, including Nat. Phys., Nat. Commun., PRX, PRL, etc. He is currently leading a National Key R&D Program of China (quantum manipulation and quantum information; junior program), and is selected as the “World’s Top 2% Scientists 2021” (identified by Stanford University).