



seminar

Classification of three-dimensional Dirac semimetals

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Time: 10:00am, July 18, 2016 (Monday)

时间: 2016年7月18日 (周一) 上午10:00

Venue: w563, Physics building, Peking University

地点: 北京大学物理楼, 西563会议室

Abstract

A three-dimensional (3D) Dirac semimetal (SM) is the 3D analogue of graphene having linear energy dispersion around Fermi points. Owing to the nontrivial topology of electronic wave functions, the 3D Dirac SM shows nontrivial physical properties and hosts various exotic quantum states such as Weyl SMs and topological insulators under proper external conditions. There are several kinds of Dirac SMs proposed theoretically and partly confirmed experimentally, but its unified picture is still missing. In this talk, we propose a general framework to classify stable 3D Dirac SMs in systems having the time-reversal, inversion and uniaxial rotational symmetries. We show that there are three distinct classes of 3D Dirac SMs depending on the underlying symmetry protecting the Dirac points. In class I, the Dirac SMs are protected by symmorphic symmetries, and have a pair of Dirac points created by band inversion. On the other hand, class II Dirac semimetals, protected by type-I nonsymmorphic symmetries, have a single Dirac point at a time-reversal invariant momentum on the rotation axis. Finally, class III Dirac semimetals are protected by type-II nonsymmorphic symmetries, and possess either line nodes or point nodes on the Brillouin zone boundaries.

Reference:

1. [B.-J. Yang](#) and N. Nagaosa, "Classification of stable three-dimensional Dirac semimetals with nontrivial topology" Nat. Comm. 5, 4898 (2014).
2. [B.-J. Yang](#), T. Morimoto, and A. Furusaki, "Topological charges of three-dimensional Dirac semimetals with rotation symmetry", Phys. Rev. B 92, 165120 (2015).
3. [B.-J. Yang](#), T. A. Bojesen, T. Morimoto, and A. Furusaki, "Topological semimetals protected by type-II nonsymmorphic symmetries", arXiv:1604.00843

About the Speaker

Prof. Bohm-Jung Yang is an Assistant Professor of Department of Physics and Astronomy in Seoul National University. After granted a PhD from Seoul National University in 2008, Bohm-Jung did a couple of postdoc researches in Department of Physics in Toronto University with Yong-Baek Kim (2008-2010) and in CERG (correlated electron research group) in RIKEN, Japan with Naoto Nagaosa (2010-2014). Since around 2015, he has been a faculty member in Seoul National University. He has authored a number of important papers in fields of Dirac semimetals, iridates and quantum magnetism.