北京大学量子材料科学中心
International Center for Quantum Materials, PKU

Weekly Seminar

Below the Mott gap: Cluster Mott insulator and quantum spin liquid

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Time: 4:00pm, March. 11, 2015 (Wednesday)
时间: 2015年3月11日 （周三） 下午4:00
Venue: Room 607, Science Building 5
地点: 理科五号楼607会议室

Abstract

Cluster Mott insulator (CMI) is a new class of physical systems where the electrons are localized in the cluster units instead of lattice sites. These cluster units build the lattice. Due to the sub-Mott-gap charge fluctuation in CMIs, the idea of cluster localization leads to an emergent gauge structure at low energies. I will present recent theoretical work on cluster Mott insulators (CMI) in which the physics of emergent lattices, charge fractionalization and quantum spin liquids can be realized.

I apply the theory to explain the puzzling experiments in real materials. For the two-dimensional anisotropic Kagome system like LiZn2Mo3O8, two distinct CMIs, type-I and type-II, arising from the repulsive interactions, are identified. In type-I CMI, the electrons are localized in one half of the triangle clusters of the Kagome system while the electrons in the type-II CMI are localized in every triangle cluster. Both CMIs are U(1) quantum spin liquids (QSL) with a spinon Fermi surface. In type-II CMI, however, the charge fluctuations give rise to local charge resonant valence bond (RVB) state that breaks the lattice symmetry. The spin degrees of freedom are immediately influenced, which gives the fractional spin susceptibility that is observed in LiZn2Mo3O8. For the three-dimensional cluster Mott insulator, the system can further support a charge fractionalization with an emergent gauge photon in the charge sector in addition to the spin fractionalization in the spin sector.

About the Speaker

Dr. Gang Chen graduated from University of Science and Technology of China in 2004 with University's highest honor. He did his graduate study in the Department of Physics and Astronomy in University of California at Santa Barbara, where he started to produce a number of highly influencing papers as the first author in several different branches in condensed matter physics. After he got a PhD under the supervise of Prof. Leon Balents in 2010, he did his postdoc fellows in University of Colorado at Boulder (2010-2013), and in Univesity of Toronto (2013-now). Gang is an expert of quantum materials. Basically if you give him lattice structure and chemical formula, he can write down a model for you. Gang also has a great interest in ultra cold atom systems. Gang has a large number of publications in high standard journals as the leading author. His first-author paper on the central spin problem in quantum dot was selected as `Journal Club for condense matter physics' by Prof. Leonid Glazman from Yale University, one of the world expert in this field. His two papers on ultracold polar molecules was featured in "Physics" as `spotlighting exceptional research`, and his first author PRB paper on ordered double perovskites was selected as PRB editor's suggestion. Because of his continuing research efforts to spin-orbit physics in iridate, he was invited to write a review paper in Annual Review of Condensed Matter Physics, which was just published last year, while being already cited more than 70 times by now.