北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Spontaneous Loop Currents and Emergent Gauge Fields in Optical Lattices

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Time: 4:00pm, June.30, 2015 (Tuesday)

时间：2015年6月30日 （周二）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

Charged particles like electrons naturally couple to gauge fields, e.g., electromagnetic fields, and exhibit fascinating many-body phenomena such as Integer and Fractional Quantum Hall Effects. On the contrary, ultracold atoms are charge neutral and thus do not couple to the electromagnetic fields. At the same time, in recent optical lattice experiments, the methods of synthesizing artificial gauge fields with Raman schemes or lattice shaking have been developed. In this talk, however, I would like to discuss a fundamentally different mechanism---emergence of gauge fields via formation of spontaneous loop currents, which could be complementary to the developed synthetic approach and has its own strength in certain aspects. I will discuss experimental evidence of loop currents, spontaneous time-reversal symmetry breaking and chiral states of Bosons in optical lattices with valley degrees of freedom. Spin loop current and spontaneous spin Hall effect will be described as generic phenomena in a class of such optical lattices [1]. I will also discuss how time-reversal symmetry breaking could occur in a fermionic system where topological states such as Quantum Hall and Weyl semimetals spontaneously emerge [2].

References:

[1] Xiaopeng Li, S. Natu, A. Paramekanti, S. Das Sarma, Chiral Magnetism and Spontaneous Spin Hall Effect of Interacting Bose Superfluids, Nat Comms 5:5174 (2014)

[2] Xiaopeng Li, S. Das Sarma, Exotic Topological Density Waves in Cold Atomic Rydberg Fermions, Nat Comms 6:7137 (2015)

About the speaker

Dr. Xiaopeng Li received his Bachelor's degree from University of Science of Technology of China in 2008, and his Ph.D. degree from University of Pittsburgh in 2013. He is now working at University of Maryland, College Park, under the support of Theoretical Postdoctoral Fellowship from Joint Quantum Institute. Dr. Li's research interests focus on many-body physics in atomic systems and complex oxides. He did several original and creative works on orbital physics in optical lattices and spontaneous (Quantum) Hall effects, and published a number of papers on Nature Communications and Phys. Rev. Lett.