



清华大学高等研究院

Institute for Advanced Study, Tsinghua University

物理学术报告 Physics Seminars (biweekly)

- Title:** Spontaneous Loop Currents and Emergent Gauge Fields in Optical Lattices
- Speaker:** Xiaopeng Li
University of Maryland
- Time:** 4:00pm, Wednesday, July 1, 2015
(3:30~4:00pm, Tea, Coffee, and Cookie)
- Venue:** Conference Hall 322, Science Building, Tsinghua University

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)