



# 中心系列讲座 ICQM Weekly Seminar Series

## “Anderson localization and topological states in 1D optical superlattices”



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**Time: 4:00am, Dec. 21, 2011 (Wednesday)**

**时间: 2011年12月21日 (周三) 下午4:00**

**Venue: Room 607, Conference Room A, Science Building 5**

**地点: 理科五号楼607会议室**

### Abstract

For bosonic atoms trapped in the 1D incommensurate optical lattices, a superfluid-to-Bose-glass transition is expected with increasing the strength of incommensurate potentials. We study universal properties of ground-state properties and finite-temperature quantum critical behavior of one-dimensional hard-core bosons in trapped incommensurate optical lattices. Through the analysis of universal scaling relations in the quantum critical regime, we demonstrate that the superfluid-to-Bose-glass transition and the general phase diagram of disordered hard-core bosons can be uniquely determined from finite-temperature density distributions of the trapped disordered system.

For the same optical lattice systems, we show that one-dimensional quasi-periodic optical lattice systems can exhibit edge states and topological phases which are generally believed to appear in two-dimensional systems. When the Fermi energy lies in gaps, the Fermi system on the optical superlattice is a topological insulator characterized by a nonzero topological invariant. The topological nature can be revealed by observing the density profile of a trapped fermion system, which displays plateaus with their positions uniquely determined by the ration of wavelengths of the bichromatic optical lattice. The butterfly-like spectrum of the superlattice system can be also determined from the finite-temperature density profiles of the trapped fermion system. This finding opens an alternative avenue to study the topological phases and Hofstadter-like spectrum in one-dimensional optical lattices.

[1] Li-Jun Lang, Xiaoming Cai, Shu Chen, **arXiv:1110.6120**, “Edge states and topological phases in one-dimensional optical superlattices” [2] X. Cai, S. Chen, and Y. Wang “Quantum criticality in disordered bosonic optical lattices” **Phys. Rev. A**, 83, 043613 (2011)

[3] X. Cai, S. Chen, and Y. Wang “Ground-state and dynamic properties for hard core bosons in 1D incommensurate optical lattices with harmonic trap” **Phys. Rev. A**, 81, 053629 (2010)

[4] X. Cai, S. Chen, and Y. Wang “Superfluid to Bose-glass transition for hard-core bosons in incommensurate optical lattices” **Phys. Rev. A**, 81, 023626 (2010)

### About the speaker

陈澍，中国科学院物理研究所研究员。1999年获中科院物理所博士学位。1999年10月-2004年11月先后为德国拜罗伊特大学，杜塞尔多夫大学和美国佐治亚理工学院博士后，2004年12月底入选中科院百人计划，任物理所“百人计划”研究员。2008年7月起任研究员。主要研究方向为低维强关联系统，及冷原子理论研究，已发表论文60余篇包括Phys. Rev. Lett.四篇，Phys Rev A & B 40篇。