清华大学高等研究院

Institute for Advanced Study, Tsinghua University

学术报告

Title: **Dirac cones merging transition and geometric phase in Stückelberg interferometer with cold atoms**

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Time: **10:30am, Wednesday, Jan 21, 2014**

Venue: **Conference Hall 322, Science Building, Tsinghua University**

Abstract

Dirac cones lie at the heart of many interests in studying two-dimensional crystals such as graphene systems. Besides its unusual density-of-states, a Dirac cone possesses geometric information hidden in the wavefunction, e.g., Berry's phase and mass. The latter determines the type of topological states of matter. Thanks to recent progresses in engineering topological band structure with cold atoms, the physical parameter regime in artificial crystals extends beyond that of its solid-state counterpart. For example, the merging of Dirac cones, a topological Lifshitz transition, was first experimentally realized in cold atoms and probed via Landau-Zener transitions [1]. We provide a quantitative model to account fully for the signatures observed [2]. When considering successive Landau-Zener transitions with two Dirac cones, a Stückelberg interferometer is realized. We show that the interference pattern contains an extra phase shift in the form of a gauge-invariant open-path Berry phase of the wavefunction [3]. The latter is a Bloch wave analogue of the Pancharatnam's phase in optical interference, in that it reveals band coupling effect of quantum crystals. The latter can serve as a useful bulk probe for topological band structures.

References:

[1] L. Tarruell, D. Greif, T. Uehlinger, G. Jotzu, and T. Esslinger, Nature 483, 302 (2012).
[2] L.-K. Lim, J.-N. Fuchs, and G. Montambaux, Phys. Rev. Lett. 108, 175303 (2012).
[3] L.-K. Lim, J.-N. Fuchs, and G. Montambaux, Phys. Rev. Lett. 112, 155302 (2014).