北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Mobility Edges in 1D bichromatic incommensurate potentials

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Time: 4:00pm, July 7, 2017 (Friday)

时间：2017年7月7日 （周五）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

We theoretically study a one-dimensional (1D) mutually incommensurate bichromatic lattice system which has been implemented in ultracold atoms to study quantum localization. It has been universally believed that the tight-binding version of this bichromatic incommensurate system is represented by the well-known Aubry-Andre model. Here we establish that this belief is incorrect and that the Aubry-Andre model description, which applies only in the extreme tight-binding limit of very deep primary lattice potential, generically breaks down near the localization transition due to the unavoidable appearance of single-particle mobility edges (SPME). In fact, we show that the 1D bichromatic incommensurate potential system manifests generic mobility edges which disappear in the tight-binding limit, leading to the well-studied Aubry-Andre physics. We carry out an extensive study of the localization properties of the 1D incommensurate optical lattice without making any tight-binding approximation. We find that, for the full lattice system, an intermediate phase between completely localized and completely delocalized regions appears due to the existence of the SPME, making the system qualitatively distinct from the Aubry-Andre prediction. Using the Wegner flow approach, we show that the SPME in the real lattice system can be attributed to significant corrections of higher-order harmonics in the lattice potential which are absent in the strict tight-binding limit. We calculate the dynamical consequences of the intermediate phase in detail to guide future experimental investigations for the observation of 1D SPME and the associated intermediate phase. We consider effects of interaction numerically, and conjecture the stability of SPME to weak interaction effects, thus leading to the exciting possibility of an experimentally viable nonergodic extended phase in interacting 1D optical lattices.

[Reference] arXiv 1704.04498

About the speaker

Dr. Xiao Li received his Bachelor's degree from Peking University in 2008, and his PhD in 2014 under the guidance of Dr. Qian Niu from University of Texas at Austin. He is currently a Postdoctoral Fellow working with Dr. S. Das Sarma at the Condensed Matter Theory Center, University of Maryland, College Park. Dr. Li is primarily interested in novel topological phases in low-dimensional systems, as well as spin quantum computation.