北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Quantum Spin Hall and Excitonic Condensation in Semiconductor Double Layers

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时间：2018年11月8日 （周四）上午10:00

Venue: Room W563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

摘要

Two-dimensional (2D) topological effects that interplay with electron-electron interactions have attracted lots of attention in the field of condensed matter physics. Quantum spin Hall (QSH) effect is such a typical topological effect. In this talk I will mainly present recent experimental studies of QSH effect in inverted InAs/GaSb quantum wells(QWs). In inverted InAs/GaSb QWs, using charge-neutral point (CNP) density as a tuning parameter, we observed two distinct QSH regimes: I), in dense limit in CNP, a single-particle hybridization gap opens, which hosts time-reversal-symmetry (TRS) QSH effect [1,2]; II), as dilute limit is approached, a spontaneous excitonic gap opens in the bulk, with the emergence of TRS-broken QSH effect where helical edges persist under high magnetic fields [1,3]. To clarify the interesting observation in regime II), we performed transport and THz measurements, and observed conclusive evidence for long-sought-after excitonic insulator(EI) [1]. The TRS-broken property of EI would be discussed. In the rest of my talk, I will discuss recent progresses of artificial graphene in nanopatterned GaAs QWs [4,5], which would offer exclusive tunability to 2D topological effects.

[1]. Lingjie Du et al, Nature Communications, 8, 1971 (2017)
[2]. Lingjie Du et al, Phys. Rev. Lett. 119, 056803 (2017)
[3]. Lingjie Du et al, Phys. Rev. Lett. 114, 096802 (2015)
[4]. Sheng Wang et al, Nature Nanotechnology, 13, 29 (2017)
[5]. Lingjie Du et al, Nature Communications, 9, 3299 (2018)

个人简介

Dr. Lingjie Du （杜灵杰）is currently a Postdoctoral Scientist in the group of Prof. Arron Pinczuk, Columbia University. His research focuses on nanofabrication and light scattering of artificial graphene and resonant light scattering of quantum phases around 5/2, both based on ultrahigh mobility GaAs/AlGaAs heterostructures. He obtained his BA in Physics (2008) with honor, and MS (2011) in CM Physics, both from Najing University. He obtained his Ph. D (2016) from Rice University under the supervision of Prof. Rui- Rui Du. During Ph.D research he has accomplished the now well-known work of observation of the quantized quantum spin Hall helical edge conductance in InAs/ GaAs and the subsequent discovery of topological exciton insulator (analogous to the BCS superconductor) in the same material in dilute limit. He has published over 20 papers including 5 Phys. Rev. Lett., 2 Nature Commun., and 1 Nature Nano.