北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Topological Excitations in 1D and 2D Charge Density Wave Systems

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时间：2019年4月3日 （周三）下午16:00

Venue: Room W563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Topological excitations or domain walls in magnetic, ferroelectric, multiferroic, and charge density wave (CDW) materials have played multiply important roles for various fundamental and technological issues. In this talk, we will review our recent research activity for atomic scale observation and manipulation of topological excitations in prototypical 1D and 2D CDW systems. In a 1D CDW system of indium atomic wires on silicon surfaces, we identified a new type (Z_4) of soliton topological excitations [1], which can deliver and manipulate topologically protected quaternary-digit information [2]. As a model system of complex 2D CDW systems, domain walls of the unique Mott-CDW insulating states of 1*T*-TaS_2 are investigated extensively [3-5]. In this system, domain walls have been related with emerging superconductivity and novel device applications. We discovered not only a method to manipulate domain walls in nanoscale [3] but also well defined in-gap states within domain walls [4]. These states are largely governed by strong electron correlation intrinsic to this material and structural reconstruction of domain walls, indicating multiple internal degrees of freedom within domain walls [4]. A network of such domain walls, as formed in the nearly commensurate CDW phase, can host novel electronic states, which can explain the emergence of superconductivity generically [5]. As a more conventional 2D CDW system, we focussed on 2*H*-$NbSe_2$. Its CDW ground state has been known mysteriously as being incommensurate without a domain wall identified. We discovered a very unusual form of discommensuration in this material [6]. All these results tell us the rich physics 'within' topological excitations, which in turn indicates the possibility of manipulating exotic quantum states through topological excitations in various 1D/2D systems.

[1] S. M. Cheon, S.-H. Lee, T.-H. Kim and H. W. Yeom, Science 350 (2015), 6257.
[2] T.-H. Kim, S. M. Cheon, and H. W. Yeom, Nature Phys. 13 (2017), 444.
[3] D. Cho *et al.*, Nat. Commun. 7 (2016), 10453.
[4] D. Cho *et al.*, Nat. Commun. 8 (2017), 392.
[5] J. H. Park, G. Y. Cho, D. Cho, and H. W. Yeom, Nat. Commun. under review.
[6] G. Gye, E. Oh, and H. W. Yeom, Phys. Rev. Lett. 122, 016403 (2019).

About the speaker

Prof. Han Woong Yeom was born in Seoul, and studied physics as an undergraduate at Seoul National University before going on to Tohoku University in Japan as a doctoral student. Thereafter he was a research associate at the Department of Chemistry, University of Tokyo (1996–2000). He then returned to his native South Korea, where he was an assistant/associate professor at the Department of Physics, Yonsei University (2000–2009), and then a full professor (2009–2010). Afterwards he moved to the Department of Physics, POSTECH (2010–present), where he served as Director of Center for Atomic Wires and Layers (2003–2013) and Director of Center for Artificial Low Dimensional Electronic Systems, Institute for Basic Science (2013–present). Prof. Han Woong Yeom's major research interests lie in nano and atomic-scale structures on solid surfaces and low dimensional electronic properties of artificial materials. He has published over 180 SCI papers, including 30 in Phys. Rev. Lett. with more than 4500 citations. He is now leading Presidential Advisory Council of Science and Technology of Korea.