北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Special Seminar

Valleytronics in 2D semiconductors

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Time: 10:00am, June 8, 2016 (Wednesday)

时间: 2016年6月8日 （周三）上午10:00

Venue: w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

The Bloch bands in many crystals have a degenerate set of energy extrema in momentum space known as valleys. For band-edge carriers, the valley index becomes a discrete degree of freedom in addition to spin, which can be utilized as information carrier. In atomically thin transition metal dichalcogenides, a newly emerged class of semiconductors in the 2D limit, I will show that electrons and holes have a time-reversal pair of valleys that are associated with varieties of novel phenomena. These include the valley optical transition selection rules, valley Hall effects, and valley magnetic moment, which are analog of the spin phenomena in conventional semiconductors. Moreover, the generic nature of valley as a momentum space index further enables valley phenomena that spin can not have. On the latter, I will give several examples: (1) the nonlinear valley and spin currents arising from Fermi pocket anisotropy; (2) valley and spin pump by intervalley scattering at non-magnetic disorders; (3) anomalous light coupling properties of interlayer excitons in the Moire pattern of heterobilayers. These unique control possibilities of valley pseudospin, together with its spin-like properties, suggest that the utilization of valley pseudospin may lead to versatile electronics and optoelectronics.

About the Speaker

Dr. Yao received his BSc degree from Peking University in 2001, and his PhD from the University of California, San Diego in 2006. After two years undertaking postdoctoral work at University of Texas at Austin, he joined the University of Hong Kong as Assistant Professor in 2008, and was promoted to Associate Professor in 2014. The central theme of his research is to explore novel quantum phenomena associated with internal degrees of freedom of electrons such as spin and valley pseudospin for new concept quantum devices, and the current focus is exploring such phenomena in atomically thin two-dimensional materials and their van der Waals heterostructures. He received the Croucher Innovation Award in 2013, and OCPA Achievement in Asia Award (Robert T. Poe Prize) in 2014. He has published 70+ peer-reviewed papers, with a latest annual citation rate of 2500+ on Google Scholar, and 19 of the papers are cited >100 times.