北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Probing Spin and Valley Dynamics in Semiconductors

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低维量子国家重点实验室

Time: 3:00pm, June 16, 2021 (Wednesday)

时间: 2021年6月16日 （周三）下午3:00

Venue: Room W563, Physics building, Peking University

地点: 北京大学物理楼，西563会议室

Abstract

Optical orientation enables spin (and in some cases, valley) generation, manipulation and detection in semiconductors. In this talk, we present ultrafast spin and valley dynamics in two new classes of semiconductors: hybrid organic-inorganic perovskites and atomically-thin transition metal dichalcogenides.

Hybrid organic-inorganic perovskites have demonstrated potential applications in optoelectronic devices, such as solar cells, light emitting diodes and high energy radiation detectors. In addition, the strong spin-orbit coupling in these materials can be exploited for spintronic applications. However, direct probes of spin dynamics in these materials are still at an early stage. Here, we demonstrate optical orientation and detection of spin polarization and spin coherence in two representative perovskites. Time-resolved Faraday rotation measurements reveal long spin lifetimes of electrons and holes and dephasing of spin polarization in the presence of an applied magnetic field due to inhomogeneous broadening of the *g*-factors.

Interest in atomically-thin transition metal dichalcogenide (TMD) semiconductors such as MoS_2 and WSe_2 has exploded in the last few years, driven by the new physics of coupled spin/valley degrees of freedom and their potential for new spintronic and 'valleytronic' devices. We directly measure the coupled spin-valley dynamics of *resident electrons* and *resident holes* in *n*-type and *p*-type monolayer TMD semiconductors using time-resolved Kerr rotation. Very long relaxation timescales in the nanosecond to microsecond range are observed at low temperatures – orders of magnitude longer than typical exciton lifetimes. In contrast with III-V or II-VI semiconductors, electron spin relaxation in monolayer TMDs is found to accelerate rapidly in small transverse magnetic fields. This indicates a novel mechanism of electron spin dephasing in monolayer TMDs.

About the speaker

杨鲁懿，清华大学物理系副教授，博士生导师。2007年获清华大学学士学位。2013年在美国加州大学伯克利分校获得物理博士学位。2013-2016年在美国国家强磁场实验室（洛斯阿拉莫斯国家实验室）任博士后（LANL Director's Postdoctoral Fellow）。2016-2019年在加拿大多伦多大学物理系任助理教授，2016年被评为加拿大高级研究所的全球学者（CIFAR Azrieli Global Scholar），2017年被授予Canada Research Chair头衔。2018年获得国家级人才计划，2019年9月至今在清华大学物理系任教。