Seminar

Studying 2D magnetism and superconductivity with a Sagnac MOKE microscope

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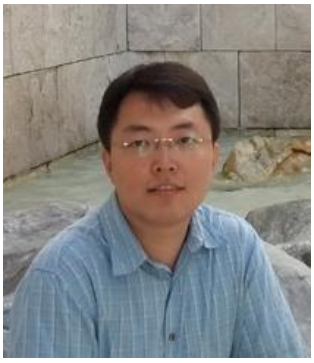

Time: 4:00pm, May. 7, 2018 (Monday)

时间: 2018年5月7日 （周一）下午 4:00

Venue: Room W563, Physics Building, Peking University

地点: 北京大学物理楼 西563

Abstract

In this talk, I will discuss our recent results on 2D magnetism and superconductivity using a scanning Sagnac MOKE microscope, which is based on a Sagnac interferometer technique first developed at Stanford [1], and has achieved unprecedented nanoradian level Kerr and Fraday sensitivity even at DC. In exfoliated $Cr_2Ge_2Te_6$(CGT) atomic layers, we report [1] the discovery of intrinsic ferromagnetism in 2D van der Walls crystals, defying the well-known Mermin-Wagner theorem. Unlike 3D magnetism, the ferromagnetic order in this 2D system is stabilized by magnetic anisotropy from the CGT structure, which is not present in graphene. As a result, changing the magnetic anisotropy with a small external magnetic field was found to strongly enhance the Curie temperature, which is a feature unique to 2D magnetism. An emerging alternative route for developing new multifunctional perovskite is by modification of the oxygen octahedral structure. We demonstrate [2] the control of structural oxygen octahedral rotation in ultrathin perovskite $SrRuO_3$ films by the deposition of a $SrTiO_3$ capping layer, which can be patterned to achieve local control. We show an increase in the Curie temperature of $SrRuO_3$ due to the suppression octahedral rotations revealed by the synchrotron x-ray diffraction. In epitaxial Bi/Ni bilayer samples, we report [3] the observation of 2D superconductivity that spontaneously breaks time-reversal symmetry (TRS). Because of strong spin-orbit interaction and lack of inversion symmetry in a Bi/Ni bilayer, superconducting pairing cannot be classified as singlet or triplet. We propose a theoretical model where magnetic fluctuations in Ni induce the superconducting pairing of the dxy ± idx2+y2 orbital symmetry between the electrons in Bi. In this model, the order parameter has a nonzero phase winding number around the Fermi surface, thus making it a rare example of a 2D topological superconductor. We will also discuss a more recent result of realizing a spin-polirized 2D electron gas between two non-magnetic insulators.

1. “Discovery of intrinsic ferromagnetism in 2D van der Waals crystals”, Nature, 546, 265-269 (2017).
2. “Localized Control of Curie Temperature in Perovskite Oxide Film by Capping-layer-induced Octahedral Distortion”, Phys. Rev. Lett. , 119, 177203 (2017).
3. “Time-Reversal-Symmetry-Breaking Superconductivity in Epitaxial Bismuth/Nickel Bilayers”, Science Advances, 3, 3, e1602579 (2017).

About the Speaker

Jing Xia is an associate professor of physics at the University of California, Irvine. Established in 2011, his group fabricates and studies novel condensed matter phases whose novel properties may be exploited for quantum devices and computing. Between 2008 and 2011, Dr. Xia was a Tolman postdoc fellow at Caltech working on non-Abelian quantum Hall states and its potential application in quantum computing. Dr. Xia obtained his Ph.D. degree in 2008 from Stanford where he invented the loopless Sagnac interferometer, an ultra-sensitive magnetic probe that he used to study unconventional superconductors; and his B.S. degree in 2003 from University of Science and Technology of China. The awards that Dr. Xia has received include Sloan Fellow, NSF Career award and Lee-Osheroff-Richardson Prize for low-temperature physics.