Weekly Seminar

Exploring novel ferromagnetic and superconducting orders via proximity effect in material heterostructures

Peng Wei

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Time: 4:00pm, August 31, 2016 (Wednesday)

时间: 2016年8月31日 （周三）下午4:00

Venue: w563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Proximity effect in multilayer heterostructures allows the creation of electronic excitations or quasiparticles with mixed physical characters that is usually impossible to be obtained in a single material. For example, it allows quasiparticles with combined characters of superconductivity, ferromagnetism, and spin-orbit coupling etc. As a result, unconventional electronic excitations can be built. In particular, inducing superconductivity into well-defined metallic surface band with giant spin-obit coupling and Zeeman splitting have been shown as candidate for Majorana fermion [1]. In this talk, I will first present our most recent results in building novel ferromagnetic ground states of Dirac electrons in graphene [3], as well as inducing ferromagnetic order in topological insulators (TI) [2]. They further exemplify a precise and clean approach in modulating the spins of two-dimensional materials using the local exchange magnetic field. These experiments are done in heterostructures of graphene/EuS or TI/EuS with EuS a typical ferromagnetic insulator. Secondly, I will present our device based heterostructure platform for creating and detecting Majorana fermions using the nanowires of epitaxial gold heterostructure. By means of electron tunneling spectroscopy, I will demonstrate the unconventional superconductivity induced in the two-dimensional surface states of gold [4], in one dimensional gold nanowire, as well as possible tunneling signatures that may hint the Majorana fermion.

References:

[1.] Potter, A. C. and Lee, P. A., Topological superconductivity and Majorana fermions in metallic surface states, *Phys. Rev. B* **85**, 094516 (2012)

[2.] Wei, P., Katmis, F., Assaf, B. A., Steinberg, H., Jarillo-Herrero, P., Heiman, D. & Moodera, J. S., Exchange-Coupling-Induced Symmetry Breaking in Topological Insulators, *Phys Rev Lett* **110**, 186807, (2013).

[3.] Wei, P., Lee, S., Lemaitre, F., Pinel, L., Cutaia, D., Cha, W., Kamits, F., Zhu, Y., Heiman, D., Hone, J., Moodera, J. S. & Chen, C.-T., Strong interfacial exchange field in the graphene/EuS heterostructures, *Nature Materials* doi:10.1038/nmat4603 (2016)

[4.] Wei, P., Katmis, F., Chang, C.-Z., Moodera, J. S., Induced superconductivity and engineered Josephson tunneling devices in epitaxial (111)-oriented gold/vanadium heterostructures, *Nano Lett.*, *16* (4), pp 2714–2719 (2016)

About the Speaker

Peng Wei, assistant professor of physics in the Department of Physics and Astronomy, earned his Ph.D. in physics at University of California, Riverside. He is also a joint faculty to the Materials Science and Engineering program. Before joining UCR, he carried on postdoc research works at Massachusetts Institute of Technology. His research interests are in the areas of materials interface physics, low-dimensional material heterostructures, new quasiparticle ground states for future information processing technology including fault tolerant quantum computations, as well as various multi-functional materials. He works on synthesizing atomically controlled thin film layers via molecular beam epitaxy (MBE) and producing the associated low-dimensional devices via nanofabrication techniques. He studies emerging new phenomena in these materials utilizing spin dependent electrical transport, quantum coherent quasiparticle tunneling spectroscopy, and Josephson tunneling etc.