北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Seminar

Magnetic Proximity Effects
in Two-Dimensional Materials roximitized Materials

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Venue: Room W563, Physics Building, Peking University

地点： 北京大学物理楼 西563

Abstract

Proximity effects can transform a given material through its adjacent regions to become superconducting, magnetic, or topologically nontrivial [1]. In bulk materials, the sample size often greatly exceeds the characteristic lengths of proximity effects allowing their neglect. However, in 2D materials such as graphene, transition-metal dichalcogenides (TMDs) and 2D electron gas (2DEG), the situation is drastically different. Even short-range magnetic proximity effects exceed their thickness and strongly modify spin transport and optical properties [2,3]. Experimental confirmation [4,5] of our prediction for bias-controlled spin polarization reversal in Co/h- BN/graphene [2] suggests that magnetic proximity effects may overcome the need for an applied magnetic field and a magnetization reversal to implement spin logic [6]. In TMDs, where robust excitons dominate their optical response, magnetic proximity effects cannot be described by the single-particle description. We predict a conversion between optically inactive and active excitons by rotating the magnetization of the substrate [3]. Combined magnetic and superconducting proximity effects could enable elusive Majorana bounds states (MBS) for fault-tolerant quantum computing. Exchanging (braiding) MBS yields a noncommutative phase, a sign of non-Abelian statistics and nonlocal degrees of freedom protected from local perturbations. MBS could be manipulated and braided in proximity-induced superconductivity in a 2DEG with magnetic textures from the fringing fields of magnetic tunnel junctions [7,8].

1. I. Žutić et al., preprint, to appear in Materials Today.
2. P. Lazić, K. D. Belashchenko, and I. Žutić, Phys. Rev. B **93**, 241401(R) (2016) .
3. B. Scharf et al., Phys. Rev. Lett. **119**, 127403 (2017) .
4. P. Asshoff et al., 2D Mater. **4**, 031004 (2017).
5. J. Xu et al., arXiv:1802.07790, to appear in Nat. Commun.
6. H. Wen et al., Phys. Rev. Appl. **5**, 044003 (2016) .
7. G. L. Fatin et al., Phys. Rev. Lett. **117**, 077002 (2016).
8. A. Matos-Abiague et al., Solid State Commun. **262**, 1 (2017).

About the Speaker

Igor Žutić received his Ph.D. in theoretical physics at the University of Minnesota in 1998, after undergraduate studies at the University of Zagreb, Croatia. He was a postdoc at the University of Maryland and the Naval Research Lab. In 2005 he joined the State University of New York at Buffalo as an Assistant Professor of Physics and got promoted to an Associate Professor in 2009 and to a Full Professor in 2013. Žutić's work spans topics from high-temperature superconductors, Majorana fermions, unconventional magnetism, and two-dimensional materials, to prediction of various spin-based devices that are not limited to the concept of magnetoresistance used in commercial application for magnetically stored information. Some of these devices, such as spin diodes, spin solar cells, spin transistors, and spin lasers have already been experimentally demonstrated. He has published over 100 refereed articles and given over 140 invited presentations on spintronics, magnetism, and superconductivity.

Igor Žutić is a recipient of 2006 National Science Foundation CAREER Award, 2005 National Research Council/American Society for Engineering Education Postdoctoral Research Award, and the National Research Council Fellowship (2003-2005). He is a Fellow of American Physical Society.