北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

Research on two-dimensional superconductivity using multifunctionality of electric double transistors

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Time: 4:00Pm, Nov. 14, 2018 (Wednesday)

时间：2018年11月14日 （周三）下午4:00

Venue: Room W563, Physics building, Peking University

地点：北京大学物理楼，西563会议室

Abstract

Recently, two-dimensional (2D) superconductivity with highly crystallinity has been an active research area accompanied with the technological advances in thin film fabrication, such as MBE, exfoliation, and ionic gating [1]. Among them, the ionic gating by electric double layer transistor (EDLT) is a convenient technique to access the clean 2D superconducting state. In this seminar, I will discuss two topics of our recent progress in the research on 2D superconductors.

The first topic is the quantum phase transition (QPT) occurring at low temperature near zero, which is one of the remarkable phenomena of 2D superconductors. Such a QPT was predominantly investigated as a superconductor-insulator transition (SIT) tuned by magnetic field in dirty superconductors. Based on the detailed analyses of magneto-transport properties in ZrNCl- and Mo_2-EDLT, we provide a totally different view of magnetic field–temperature (*B*-*T*) phase diagram, containing QPT, in highly crystalline 2D superconductors [2]. These clean 2D superconducting systems commonly show the wide range of a quantum metallic state in out-of-plane magnetic field, which transfer to the weakly localized metal through the quantum critical point QCP characterized by quantum Griffiths singularity [3]. I discuss such a phase diagram appears as a generic feature of highly crystalline 2D superconductors.

In the second topic, I introduce our recent progress in the study on ultrathin FeSe films, which have been uniquely evolved into a high transition temperature T_c superconductor above 40 K [4]. We have developed an electrochemical etching technique, which is another functionality of EDLT, as a new access to the thin limit [5]. Based on the thickness and gating material dependence of the critical parameters, such as T_c, B_{c2} and J_c, we will discuss the robustness of high-T_c phase of FeSe in the thin limit [6] and the increase in transport T_c around 50 K [7].

[1] Y. Saito, T. Nojima & Y. Iwasa, Nature Rev. Mater. **2**, 16094 (2017).
[2] Y. Saito, T. Nojima & Y. Iwasa, Nature Commun. **9**, 778 (2018).
[3] Y. Xing *et al*., Science **350**, 542 (2015).
[4] Q. Y. Wang *et al*., Chin. Phys. Lett. **29**, 037402 (2012).
[5] J. Shiogai, Y. Ito, T. Mitsuhashi, T. Nojima, and A. Tsukazaki, Nature Phys. **12**, 42-47 (2016).
[6] J. Shiogai, S. Kimura, S. Awaji, T. Nojima, and A.Tsukazaki, Phys. Rev. B **97**, 174520 (2018).
[7] T. Miyakawa *et al*., Phys. Rev. Mater. **2**, 031801(R) (2018).

About the speaker

Educational Background

1986 B.Sci., Faculty of Science, Hiroshima University
1988 M. Sci., Graduate School of Science, Hiroshima University
1991 Ph. D, Graduate School of Science, Hiroshima University

Professional Career

1991 JSPS Research Fellow (DC) (Hiroshima University, JAPAN)
1991 - 1999 Assistant Professor (Dept. Phys., Chiba University, JAPAN)
1997 - 1998 JSPS Visiting Researcher (Leiden University, The Netherland)
1999 – 2006 Associate Professor (Center for Low Temep. Sci., Tohoku University, JAPAN)
2006 - present Associate Professor (Institute for Materials Research, Tohoku University, JAPAN)

Research Subjects

2D superconductivity at the interfaces and in thin films / Vortex matter physics in superconductors/ Superconducting multilayers.