北京大学量子材料科学中心

International Center for Quantum Materials, PKU

Weekly Seminar

2D confinement of heavy electrons in artificially engineered Kondo superlattices

Yuji Matsuda

Kyoto University

Time: 4:00pm, June 1, 2016 (Wednesday)

时间：2016年6月1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

Condensed matter systems that are both low-dimensional and strongly interacting often exhibit unusual electronic properties, with the high-Tc superconductivity in cuprates and iron pnictides as the most prominent example. A metallic state with the strongest electron correlation is realized in heavy fermion compounds, whose electronic structure is essentially 3D. Recently, by fabricating epitaxial superlattices built of alternating layers of Ce-based heavy-fermion and La- or Yb-based conventional nonmagnetic metals, we have succeeded in confining heavy fermions to two dimensions, resulting in slices of 2D Kondo lattice [1,2,3]. Superconductivity is observed in CeCoIn5/YbCoIn5 superlatttices even in the superlattice with only one-unit-cell-thick CeCoIn5 layers [3], where CeCoIn5 is a d-wave superconductor. Superconductivity is also observed in CeCoIn5/CeRhIn5 superlattices, where CeRhIn5 is a heavy fermion SDW compound. In this hybrid superlattice, d-wave superconductivity coexists with SDW and they influence each other. We show that these superconducting superlattices with atomic layer thickness exhibit highly unusual behaviors [3,4,5]. We discuss these phenomena in terms of the entanglement of Pauli paramagnetism and Rashba interaction associated with the local inversion symmetry breaking at the heavy fermion interface. The heavy fermion Kondo superlattices offer a new playground for exploring exotic superconducting phases [6].

This work has been done in collaboration with R. Toda, S.K. Goh, T. Watashige, T. Ishii, T. Yamanaka, K. Ishida, T. Terashima (Kyoto Univ.), M. Shimozawa, Y. Mizukami, T. Shibauchi (Univ. of Tokyo)

References

[1] H. Shishido et al. Science 327, 980 (2010).
[2] T. Ishii et al. Phys. Rev. Lett. 116, 206401 (2016).
[3] Y. Mizukami et al. Nature Physics 7, 849 (2011).
[4] S. K. Goh et al. Phys. Rev. Lett. 109, 157006 (2012).
[5] M. Shimozawa et al. Phys. Rev. Lett. 112, 156404 (2014).
[6] M. Shimozawa, S.K. Goh, T. Shibauchi, Y. Matsuda, Rep. Prog. Phys. in press.

About the speaker

Yuji Matsuda received his Ph.D. in Physics from the University of Tokyo (Japan) in 1987 and became a research associate at Department of Pure and Applied Science, the University of Tokyo. He became an associate professor in 1993 at Hokkaido University (Japan) after spending two years at Princeton University (USA) as a postdoctoral fellow. He moved to Institute for Solid State Physics, University of Tokyo, as an associate professor in 1997, and became a full professor at Kyoto University in 2004. He is a condensed matter experimentalist with interests in electronic and magnetic properties of solids.His current research interests include strongly correlated electron systems, in particular exotic superconductivity, heavy fermion systems, high-/T/_c superconductors, and quantum spin systems.