凝縮系物理学ゼミナール

Condensed Matter Seminar

Location: Room 413, School of Science Bldg. 5 (理学 5 号館 413 号室)

Date: 13:30-15:00, Wednesday, 25 July 2012

“Quantum criticality and emergent electronic nematic phase in an iron-based superconductor $BaFe_2(As_{1-x}P_x)_2$ with line nodes”

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Abstract: A central issue in the physics of iron-based superconductivity concerns the origin of the pairing interaction, in which importance of the spin and orbital degrees of freedoms has been discussed. Clarifying the anomalies inherent to this system is thus of primary importance as well as unveiling their connections to the high-temperature superconductivity. Here, we report our investigations on clean single crystals of $BaFe_2(As_{1-x}P_x)_2$ [1] as a test material of iron-pnictides. The observed quantum critical point (QCP) behaviors as represented by non-Fermi liquid transport [1], effective mass enhancement [2], and a sharp peak in the zero-temperature magnetic penetration depth [3] at a critical doping are discussed. In addition, we discuss the development of electronic nematicity, a unidirectional self-organized state which breaks the underlying crystal lattice symmetry. Our highly sensitive magnetic anisotropy measurements, together with high resolution synchrotron X-ray diffraction experiments, indicate that electronic nematicity develops in the normal state, far above the magneto-structural and superconducting transitions, resulting in a new phase diagram of iron-based superconductors. The development of electronic nematicity appears to help the emergence of superconductivity whilst the QCP provides the highest superconducting transition temperature.

References:

[1] S. Kasahara *et al*., Phys. Rev. B **81**, 184519 (2010).
[2] H. Shishido *et al*., Phys. Rev. Lett. **104**, 057008 (2010).
[3] K. Hashimoto *et al*., Science **336**, 1554-1557 (2012).
[4] S. Kasahara *et al*., Nature **486**, 382-385 (2012).