MAR13-2012-020286

Abstract for an Invited Paper
for the MAR13 Meeting of
the American Physical Society

Nematic transition and hidden quantum critical point in iron-pnictide superconductors

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A central issue in the physics of iron-based superconductivity concerns the origin of the pairing interaction, in which the importance of the spin and orbital degrees of freedoms has been discussed. Clarifying the anomalies inherent to this system and unveiling their connections to the high-temperature superconductivity are of primary importance. Here, we report our investigations on clean single crystals of $BaFe_2(As_{1-x}P_x)_2$ [1]. 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.

[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).