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Non-Fermi liquid behavior and non-universal superconducting gap structure in Fe-pnictides[1]

YUJI MATSUDA, Department of Physics, Kyoto University, Kyoto 606-8502, Japan

The discovery of Fe-pnictide superconductors with T_c exceeding 55 K raises fundamental questions about origin of high-T_c superconductivity. Here we report the systematic studies of the normal-state charge transport, Fermi surface structure and superconducting gap structure in high-quality single crystals of $BaFe_2(As_{1-x}P_x)_2$ ($0 \leq x \leq 0.71$), ranging from the SDW state to overdoped Fermi liquid state. Near the SDW boundary, the transport coefficients, including resistivity, Hall coefficient and magnetoresistance, exhibit striking deviations from the Fermi liquid properties [1]. The Fermi surface structure determined by the dHvA effect shows that in the superconducting dome the volume of the electron and hole sheets shrink linearly and the effective masses become strongly enhanced with decreasing x [2]. It is likely that these trends originate from the many-body interaction which gives rise to superconductivity. The penetration depth, thermal conductivity and NMR data for $BaFe_2(As_{0.67}P_{0.33})_2$ (T_c=30 K) provide unambiguous evidence for line nodes in the superconducting gap function [3], in sharp contrast to the other Fe-based compounds with fully gapped structure. This indicates that the gap structure of Fe-based high-T_c superconductors is not universal.

[1] S. Kasahara *et al.*, arXiv:0905.4427 [2] H. Shishido *et al.*, arXiv:0910.3634 [3] K. Hashimoto *et al.*, arXiv:0907.4399 [4] K. Hashimoto *et al.*, Phys. Rev. Lett. **102**, 017002 (2009), *ibid* **102**, 207001 (2009).

[1]In collaboration with T. Shibauchi, K. Hashimoto, M. Yamashita, H. Shishido, S. Kasahara, T. Terashima, (Kyoto Univ.) A.F. Bangura, A.I. Coldea, A. Serafin, and A. Carrington (Univ. of Bristol)