MAR14-2013-020429

Abstract for an Invited Paper
for the MAR14 Meeting of
the American Physical Society

Controlled impurity study and observation of a bosonic mode in iron based superconductors by STM measurements: implications for the pairing symmetry and mechanism

HAI-HU WEN, Nanjing University

The pairing mechanism in the iron pnictides remains unresolved yet. The pairing model based on the magnetic origin predicts a sign reversal gap on the electron and hole Fermi pockets, leading to the $S^{\pm}$ pairing, however, a more conventional S^{++} pairing gap was suggested based on the orbital fluctuation mediated pairing. Here we show the clear evidence of the in-gap quasi-particle states induced by the non- or very weak magnetic Cu impurities in $Na(Fe_{0.97-x}Co_{0.03}Cu_x)As$ by measuring the scanning tunneling spectroscopy, giving strong evidence of the $S^{\pm}$ pairing. Furthermore, we show the presence of the bosonic mode with the energy identical to that of the neutron resonance with a simple linear relation $\Omega/k_BT_c \approx 4.3$ in several systems. This mode can also be explained very well as the consequence of the $S^{\pm}$ pairing. These observations strongly suggest that the antiferromagnetic spin fluctuation is the key factor for superconductivity. In collaboration with: Huan Yang, Zhenyu Wang, Delong Fang, Lei Shan, Qiangua Wang, Chenglin Zhang, and Pengcheng Dai, et al.

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[3] Huan Yang et al., Nature Communications **4**, 2947 (2013).