



### Weekly Seminar

## Recent progress on the superconducting pairing mechanism in iron based superconductors

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Time: 4:00pm, March 9, 2016 (Wednesday)

时间: 2016年3月9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

The pairing mechanism in iron based superconductors (IBS) remain unresolved. In this talk I will give an overview of the research on the pairing mechanism and gap symmetry in IBS. The Fermi surfaces have different structures among different systems. Some have both electron and hole pockets, such as  $Ba_{1-x}K_xFe_2As_2$ ,  $Na(Fe_{1-x}T_x)As$ ,  $FeTe_{1-x}Se_x$  etc., for which the early proposed  $S^\pm$  pairing manner holds very well. On the other hand, some systems have only or dominantly the electron pockets, such as the monolayer  $FeSe$  thin film,  $K_{1-x}Fe_{2-y}Se_2$  and recently discovered  $Li_{1-x}Fe_xOHFeSe$ . We have conducted extensive STM/STS study on the  $Na(Fe_{1-x}T_x)As$  ( $T=Co, Cu, Mn$ )[1],  $Ba_{1-x}K_xFe_2As_2$ [2],  $KFe_2As_2$ [3], and  $Li_{1-x}Fe_xOHFeSe$ [4] single crystals. We found the clear evidence of the in-gap quasi-particle states induced by the non-magnetic Cu impurities in  $Na(Fe_{0.97-x}Co_{0.03}Cu_x)As$ , 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 and a simple linear relation  $\Omega \propto k_B T_c$ , being explained as a consequence of the  $S^\pm$  pairing. The STS spectrum in  $Li_{1-x}Fe_xOHFeSe$  clearly indicates the presence of double superconducting gaps with  $\Delta_1 \approx 14.3$  meV and  $\Delta_2 \approx 8.6$  meV. Further analysis allows us to assign the larger (smaller) gap to the outer (inner) hybridized electron pockets[4]. We will give explicit evidence about the gap structures in systems with only the dominant electron pockets. The huge value  $2\Delta_1/k_B T_c = 8.7$  discovered here undoubtedly proves the strong coupling mechanism. Finally we show a universal relation between the condensation energy and  $T_c$  in iron based superconductors, which may point to the quantum critical behavior and unconventional mechanism[5].

References:

- [1] H. Yang et al., Nature Communications 4, 2947 (2013).
- [2] Z. Y. Wang, et al., Nature Physics 9, 42(2013).
- [3] D. L. Fang, X. Shi et al., Phys. Rev. B 92, 144513 (2015).
- [4] Z. Y. Du et al., Nature Communications 7, 10565 (2016).
- [5] J. Xing, et al., Phys. Rev. B 89, 140905 (R) (2014).

### About the speaker

闻海虎, 南京大学教授, 博士生导师, 国家杰出青年基金获得者, 长江特聘教授, 美国物理学会会士。1991年中科院博士毕业, 1991-1993荷兰自由大学博士后, 1996.10-1998.5德国洪堡基金学者。长期从事超导材料和物理研究, 在高温超导体磁通动力学、高温超导机理问题和非常规超导材料合成和物理性质研究方面获得一批重要成果。目前任南京大学超导物理和材料研究中心主任, *Physica C*, *Philosophical Magazine* 杂志, 《物理》杂志, 中国科学G 的编委。2000年获得中国青年科技奖, 2004年获得国家自然科学基金二等奖(第一完成人), 2009年获得香港求是杰出成就集体奖, 2010年获得华人物理学会亚洲成就奖, 科技部目标导向性超导973项目“高温超导材料和物理研究”首席科学家, 2013年获得国家自然科学基金一等奖(第四完成人)。在包括 *Nature Physics*, *Nature Communications*, *Physical Review Letters* 在内的SCI 杂志上发表论文 300 余篇, 他人引用超过6500次, h-index 45, 在国内外会议上作邀请报告近百场。