ARPES studies of the superconducting gap of iron-based superconductors

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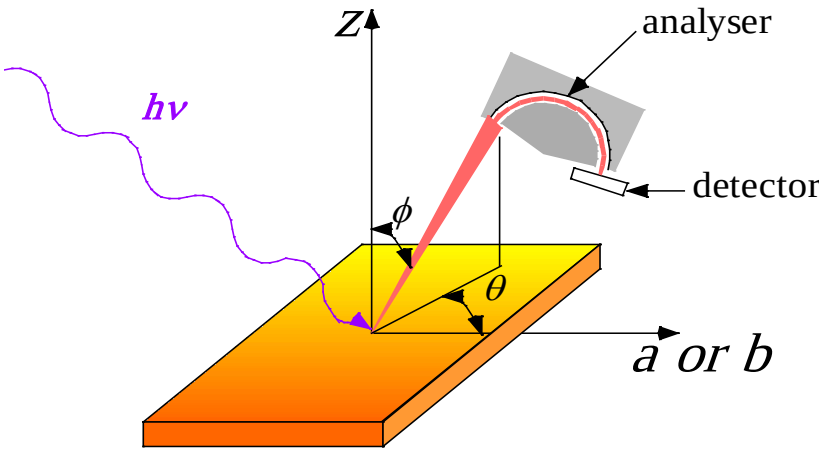
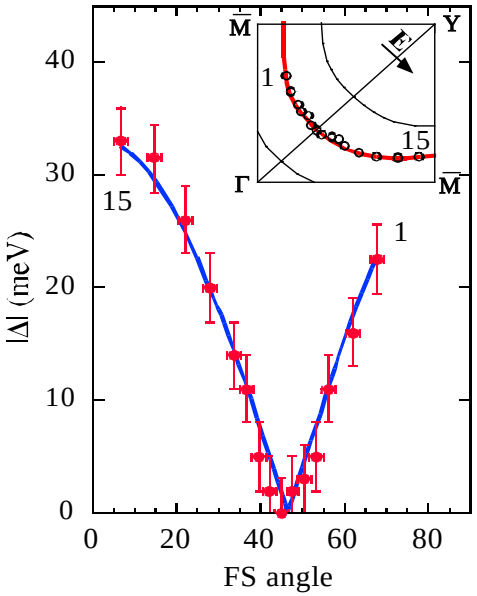
ARPES measures band structure, Fermi surface, orbital info, interactions,

superconducting gap





QuickTime™ and a
decompressor
are needed to see this picture.

k

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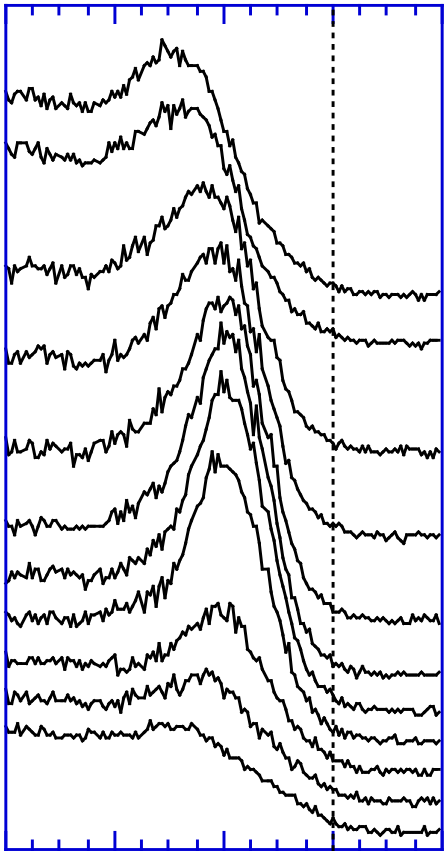

Outline

1. SC gap in “122”:
   optimally ($\Delta(k_x, k_y, k_z)$), over, under hole-doped
   optimally electron-doped

2. SC gap in “111”

3. SC gap in “11”

4. SC gap in $Tl(K)Fe_2Se_2$

published

unpublished

Collaborators

ARPES:

IOP: T. Qian, P. Richard, J. Dong, Y.-B. Huang, X.-P. Wang, N. Xu, Y.-B. Shi, H. Miao, P. Zhang, J. Bowen

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Tohoku Univ.: K. Nakayama, T. Kawahara, K. Sugawara, T. Arakane, Y. Sekiba, A. Takayama, S. Souma, T. Sato, T. Takahashi

PSI: M. Shi, X.-Y. Cui, E. Razzoli, M. Radovic

Renmin Univ.: Z.-H. Liu, W.-C. Jin, S.-C. Wang

UVSOR: K. Terashima *ALS*: A. Fedorov

Theory:

IOP: X. Dai, Z. Fang *BC*: Z. Wang *Purdue*: J.-P. Hu

Samples:

IOP: J.-L. Luo, N.-L. Wang, H.-Q. Luo, H.-H. Wen

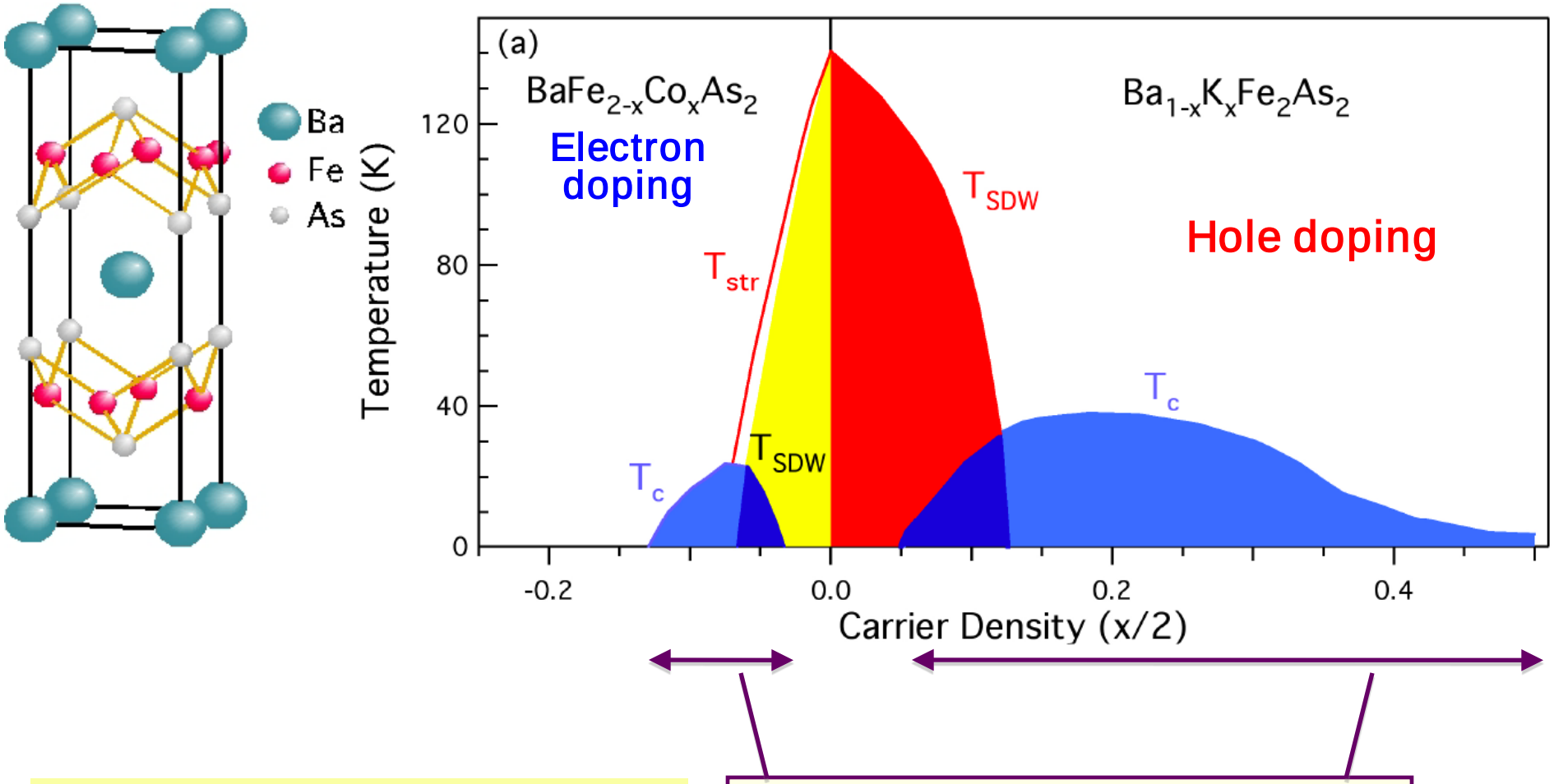
Renmin Univ.: G.-F. Chen

Zhejiang Univ.: L.-J. Li, G.-H. Cao, Z.-A. Xu

UT: C.-L. Zhang, P.-C. Dai

BNL: G.-D. Gu

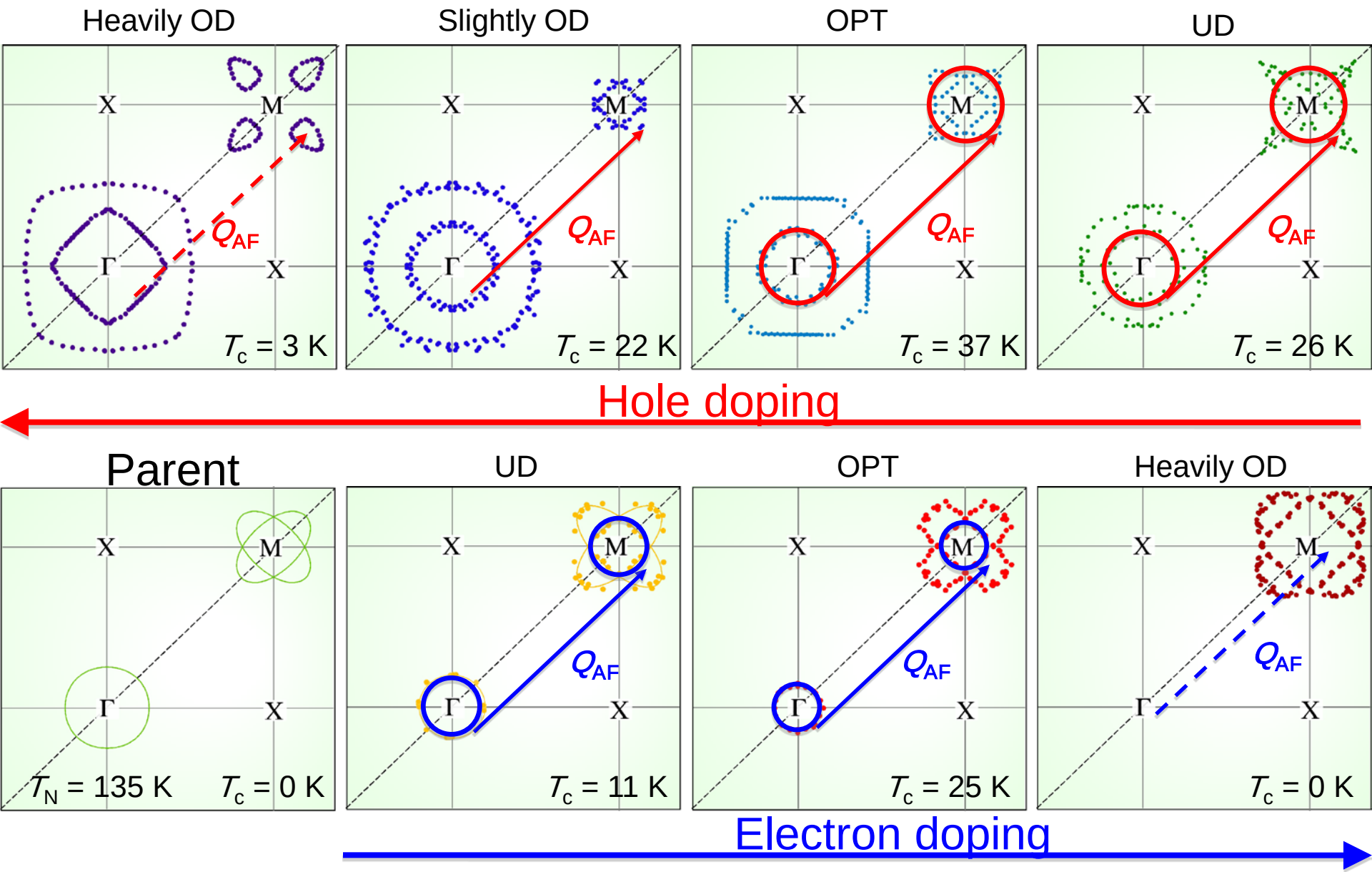
Phase diagram of Ba122 system



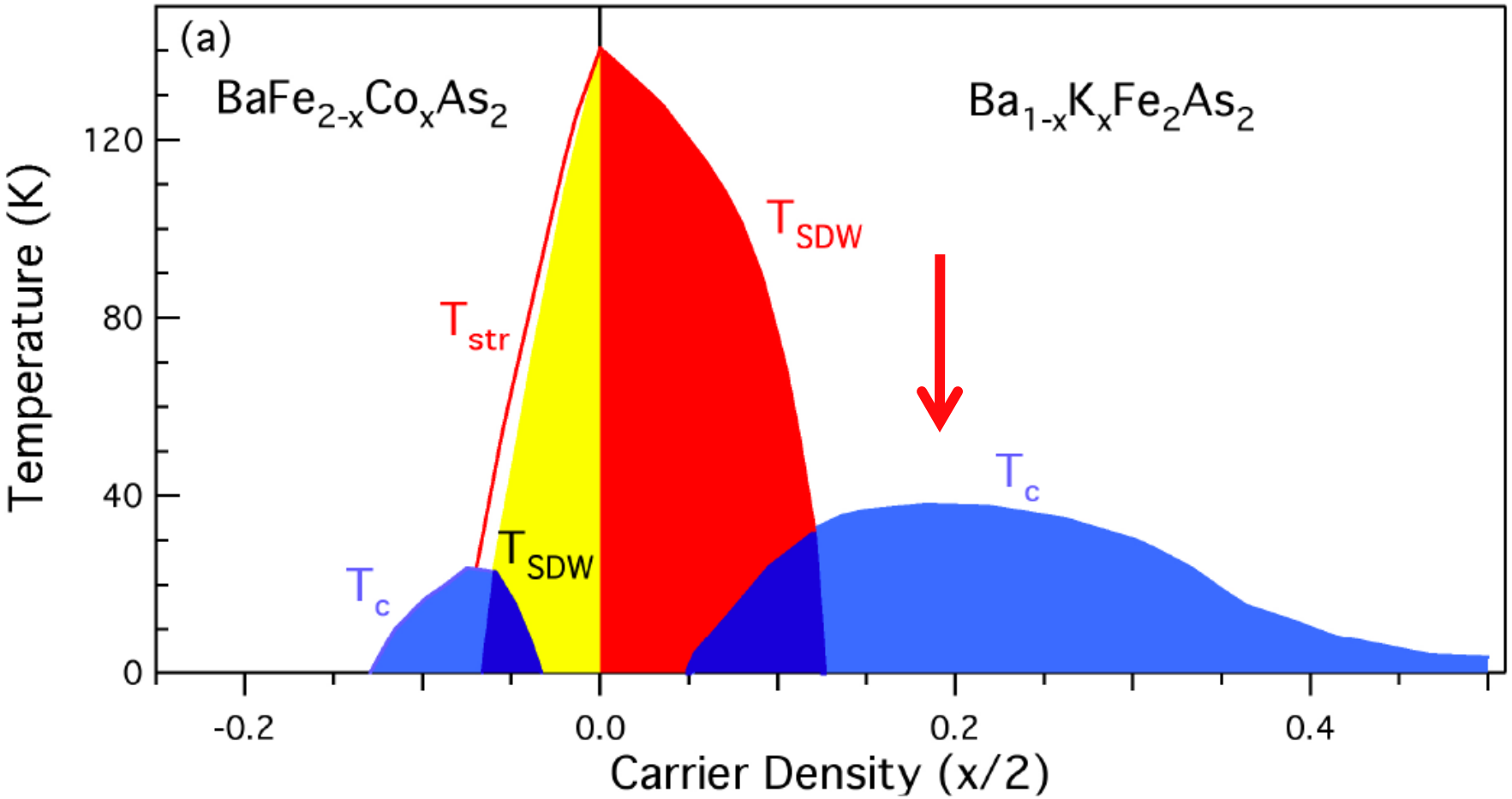
M. Neupane *et al.*, arXiv: 1005.2966
accepted by PRB

Electron-hole symmetry?

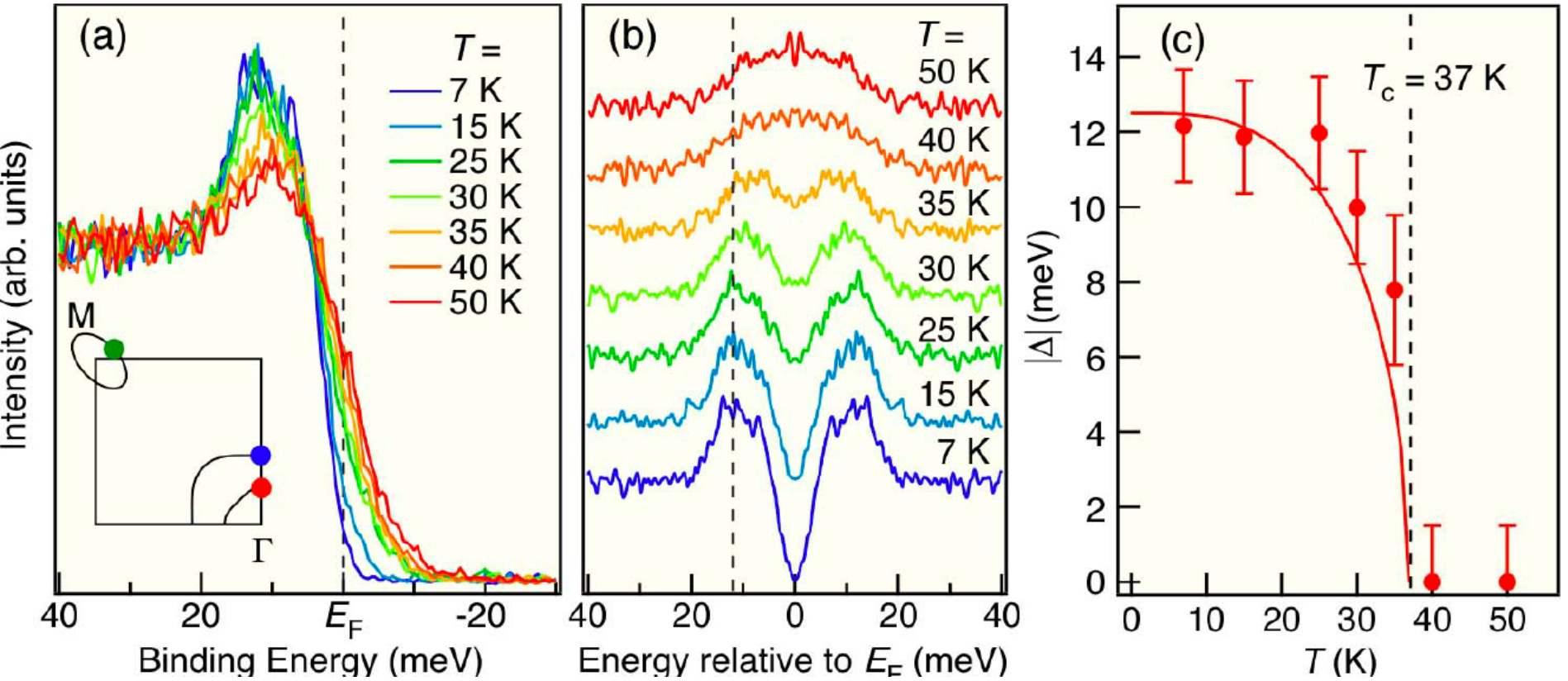
Fermi surface evolution in “122”



Optimally hole doped $Ba_{0.6}K_{0.4}Fe_2As_2$ (T_c ~ 37K)



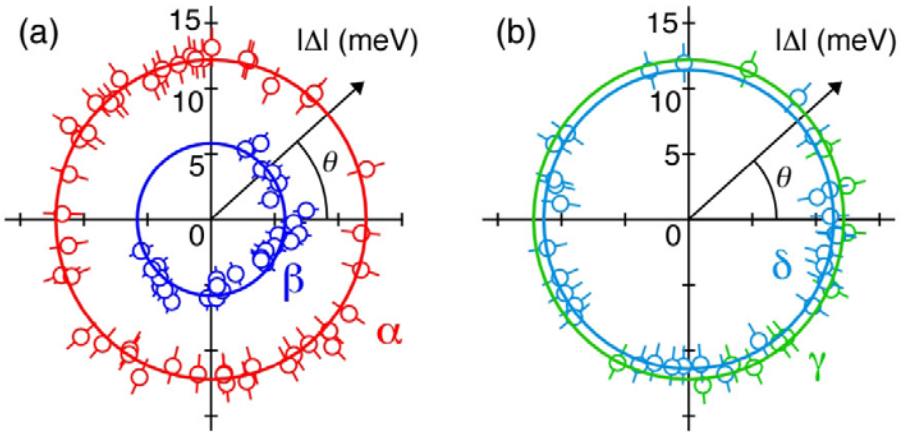
ARPES observation of superconducting gap

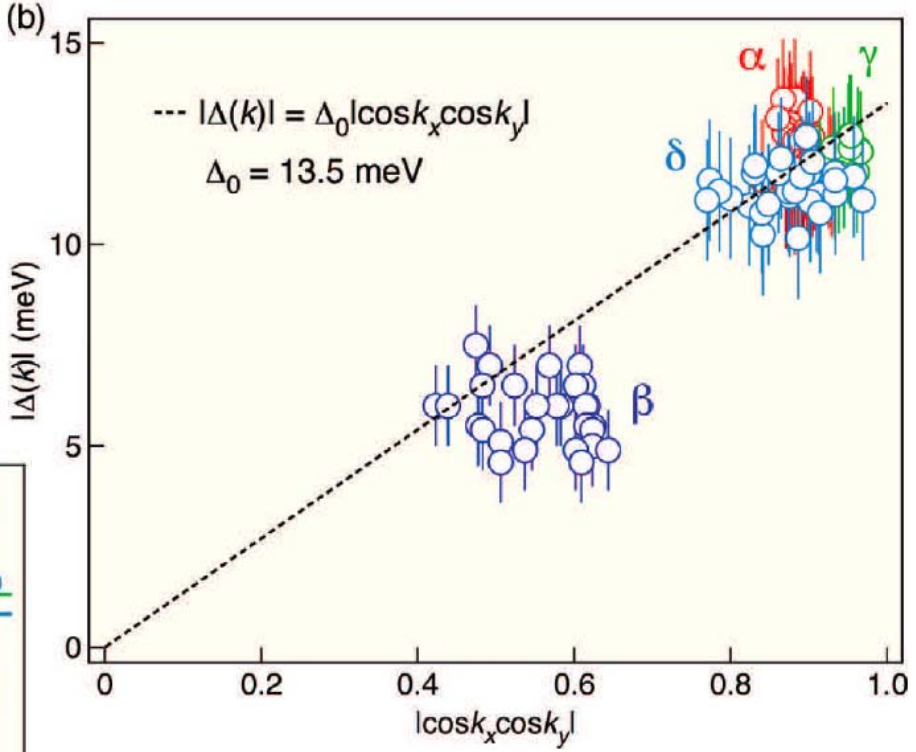


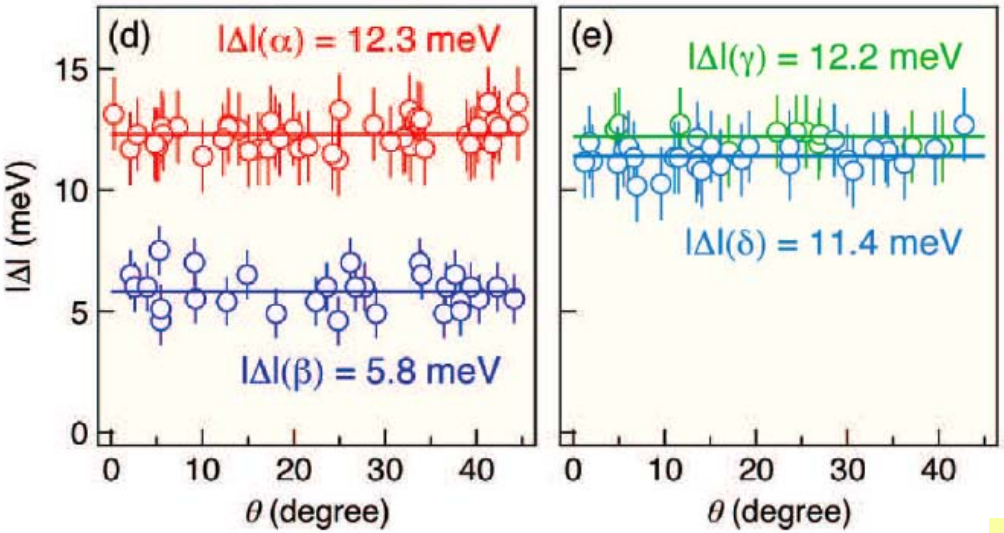
H. Ding *et al.*, EPL 83, 47001 (2008)

$2\Delta/T_c \sim 7$

Momentum dependence of SC gaps





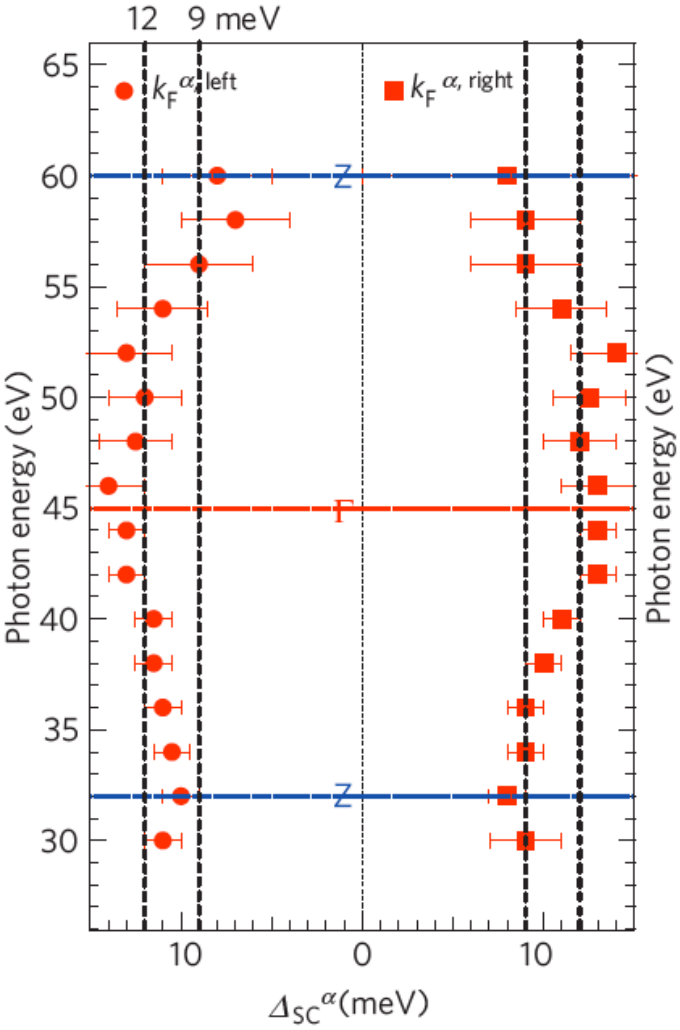


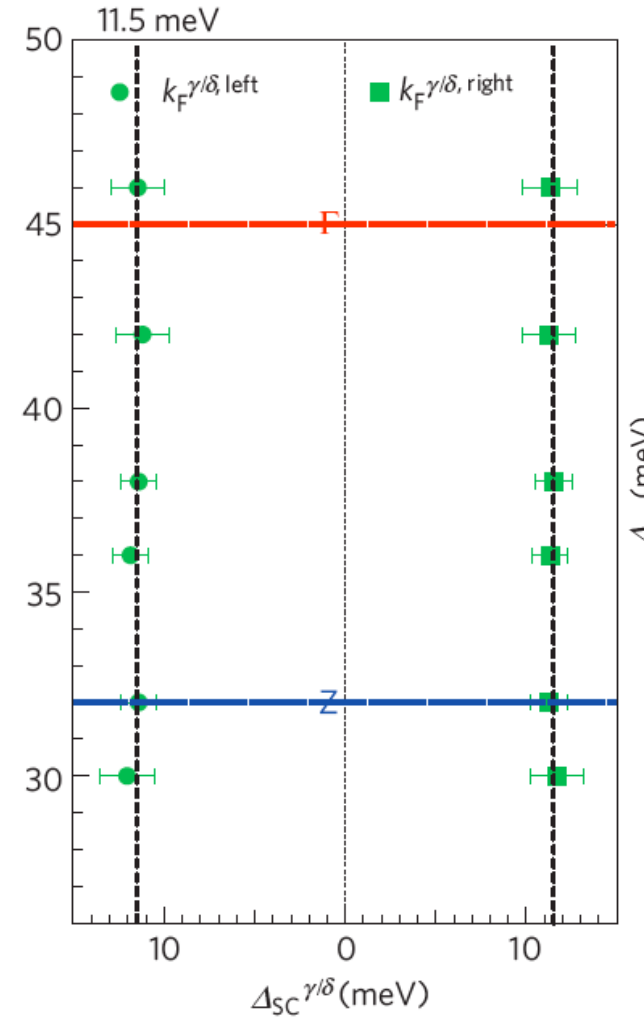
K. Nakayama *et al.*, EPL 85, 67002 (2009)

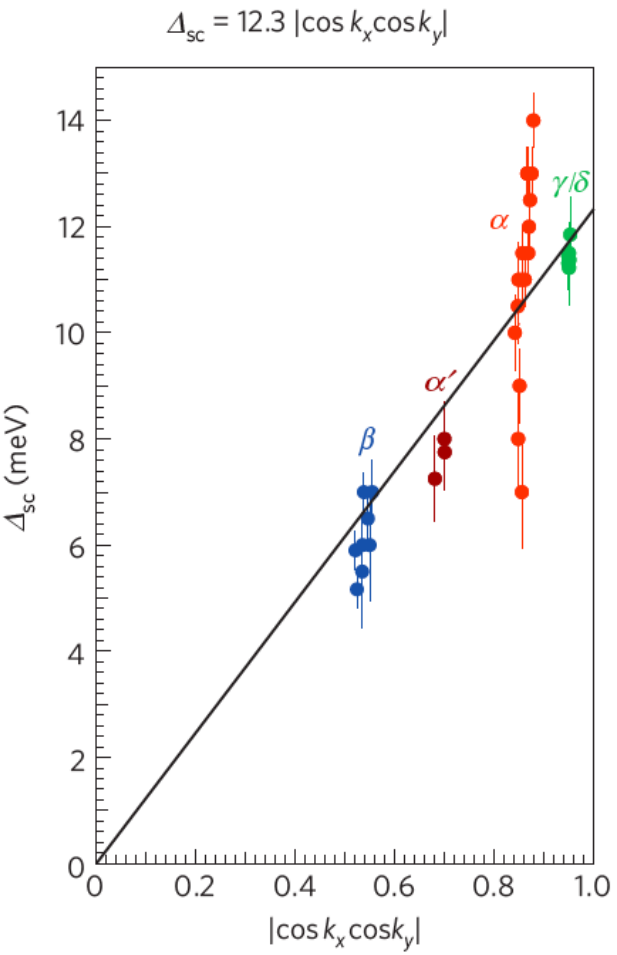
kz dependence of SC gaps

Δ on smaller hole FS

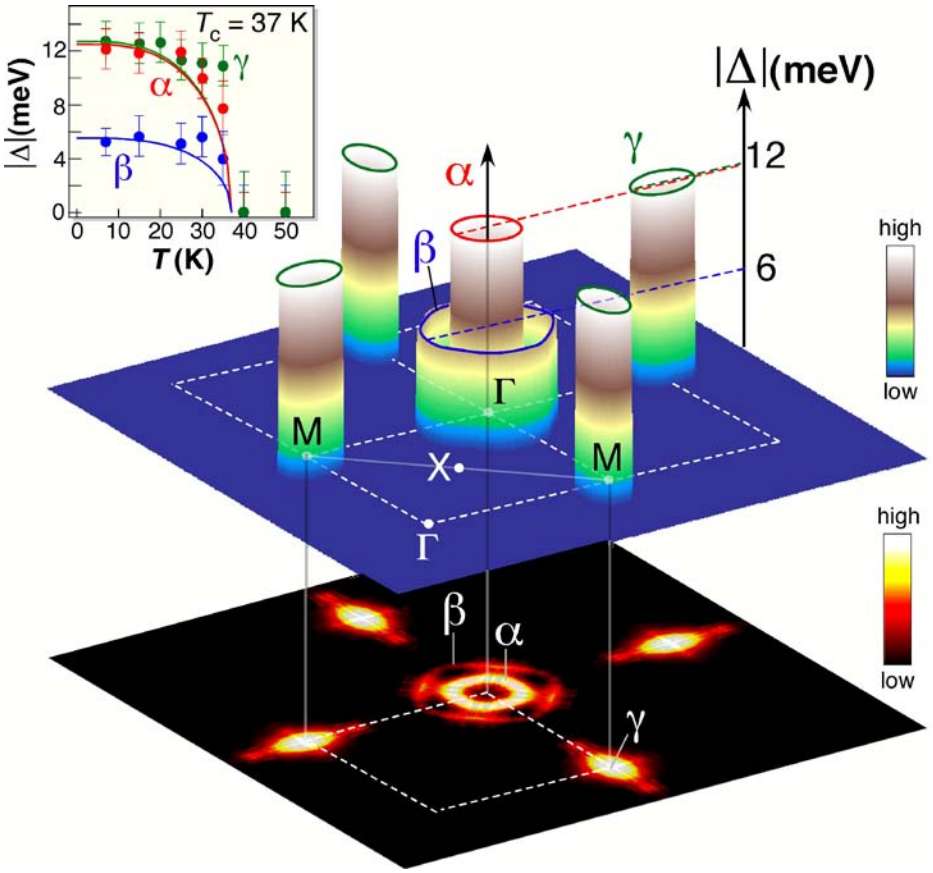
Δ on electron FS



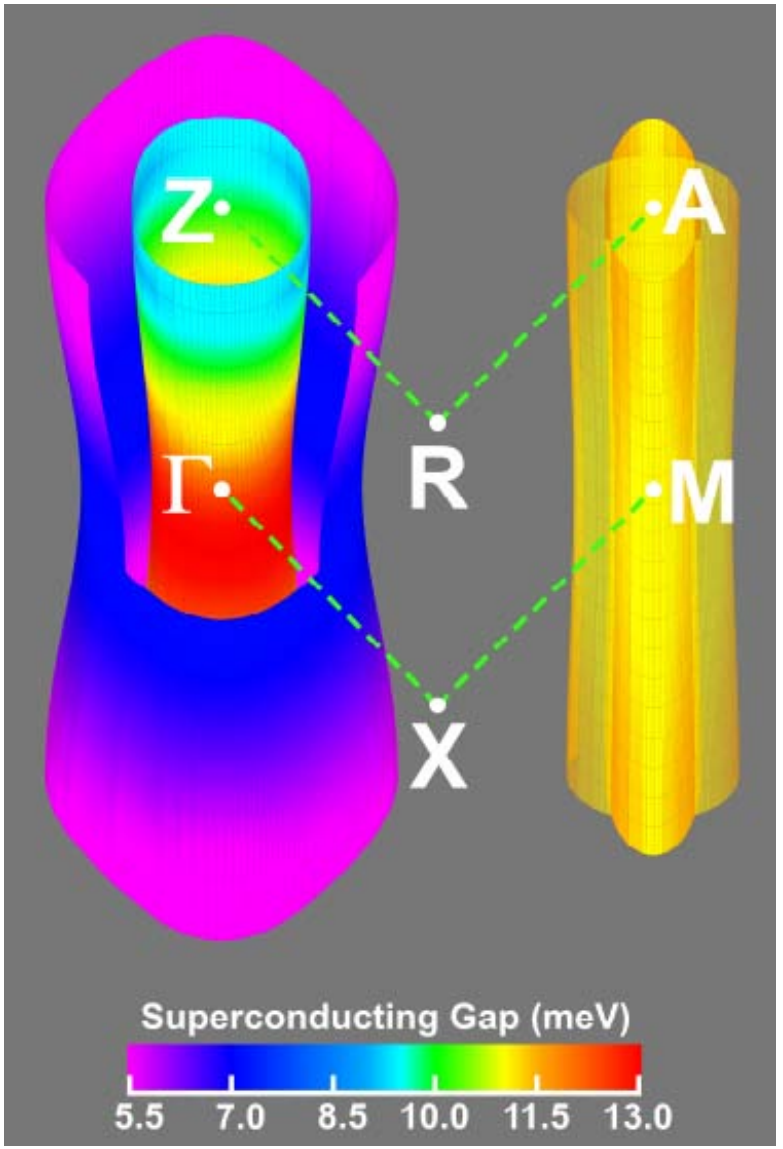




Fermi surface dependent nodeless superconducting gap

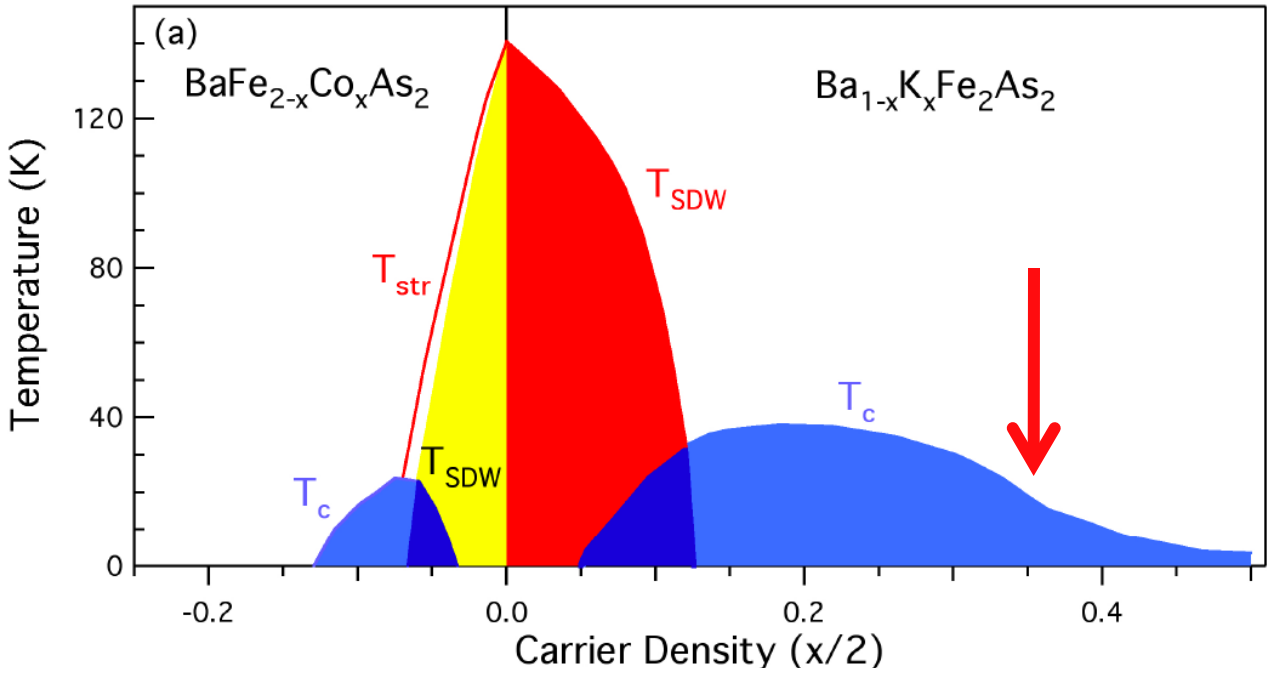


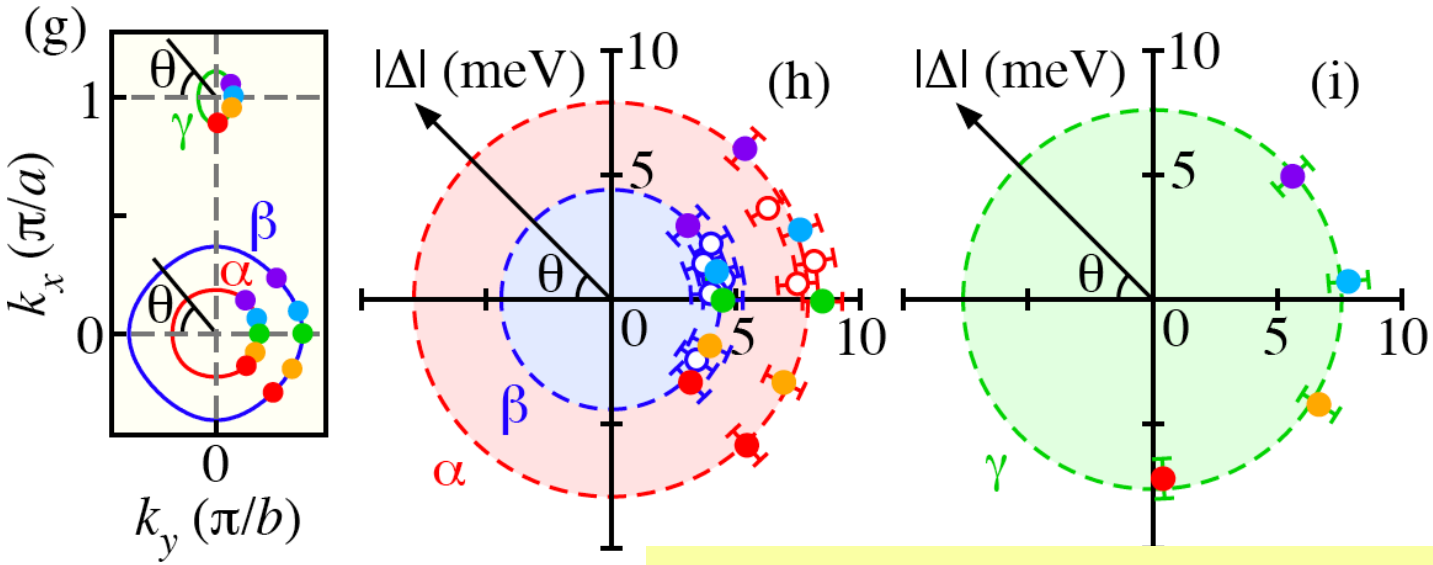
H. Ding *et al.*, EPL 83, 47001 (2008)



Y.-M. Xu *et al.*, Nature Physics (2011)

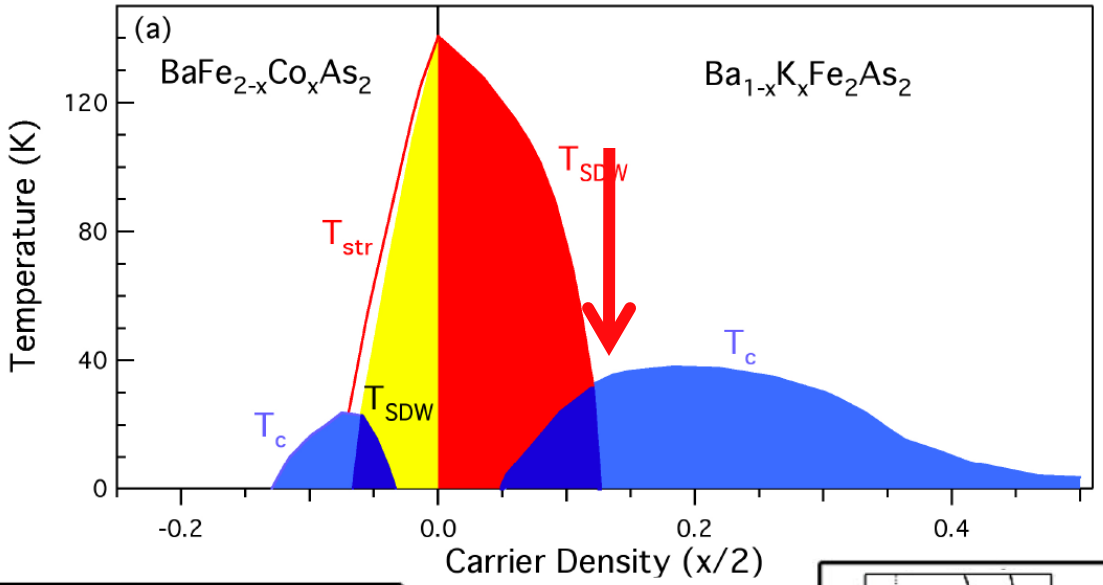
overdoped $Ba_{0.3}K_{0.7}Fe_2As_2$ (T_c ~ 20K)

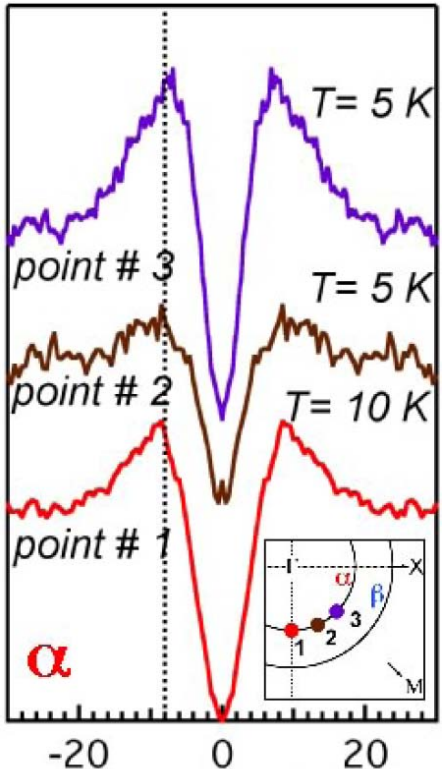


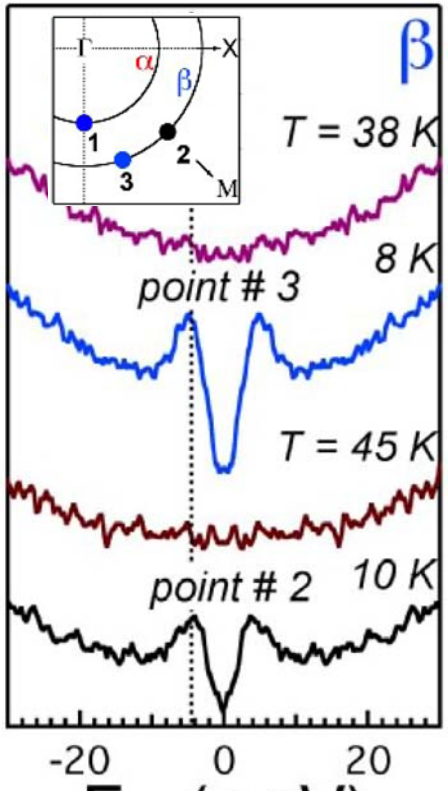


K. Nakayama *et al.*, PRB 83, 020501(R) (2011)

underdoped $Ba_{0.75}K_{0.25}Fe_2As_2$ (T_c = 26K)

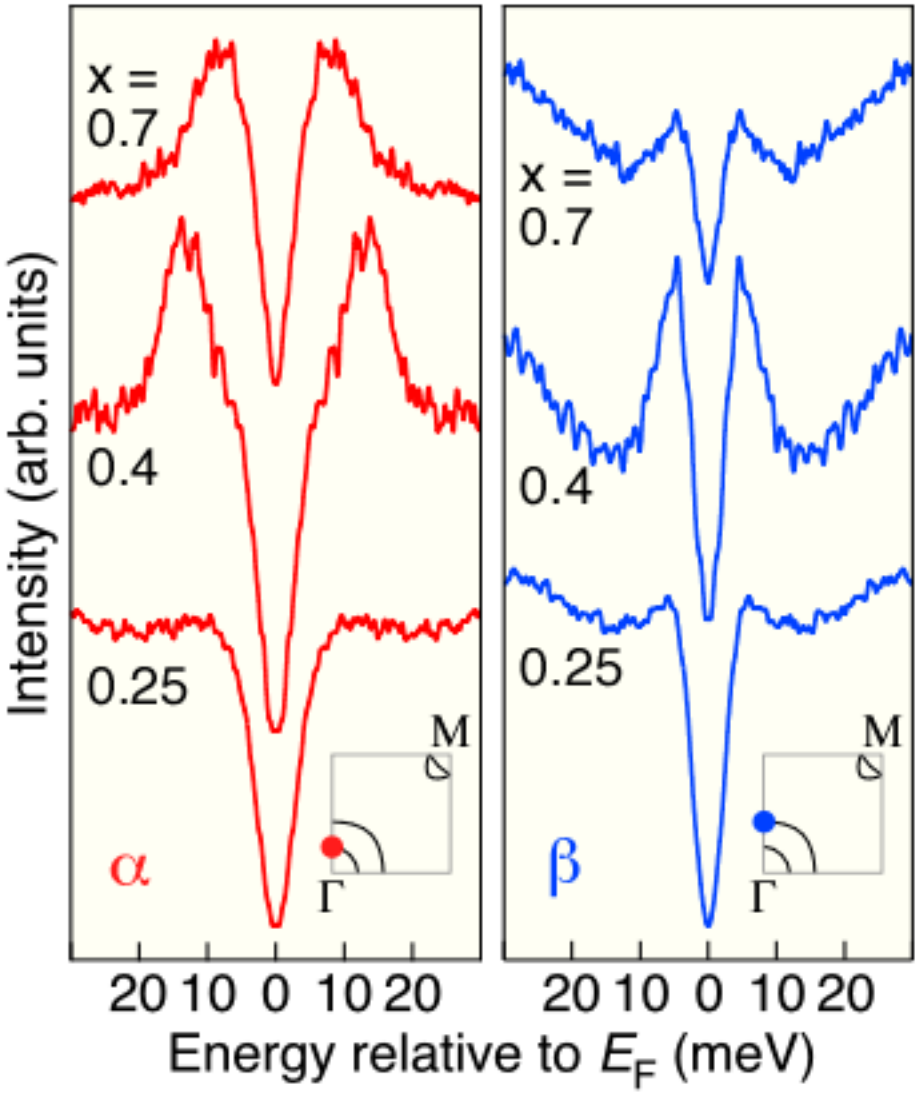


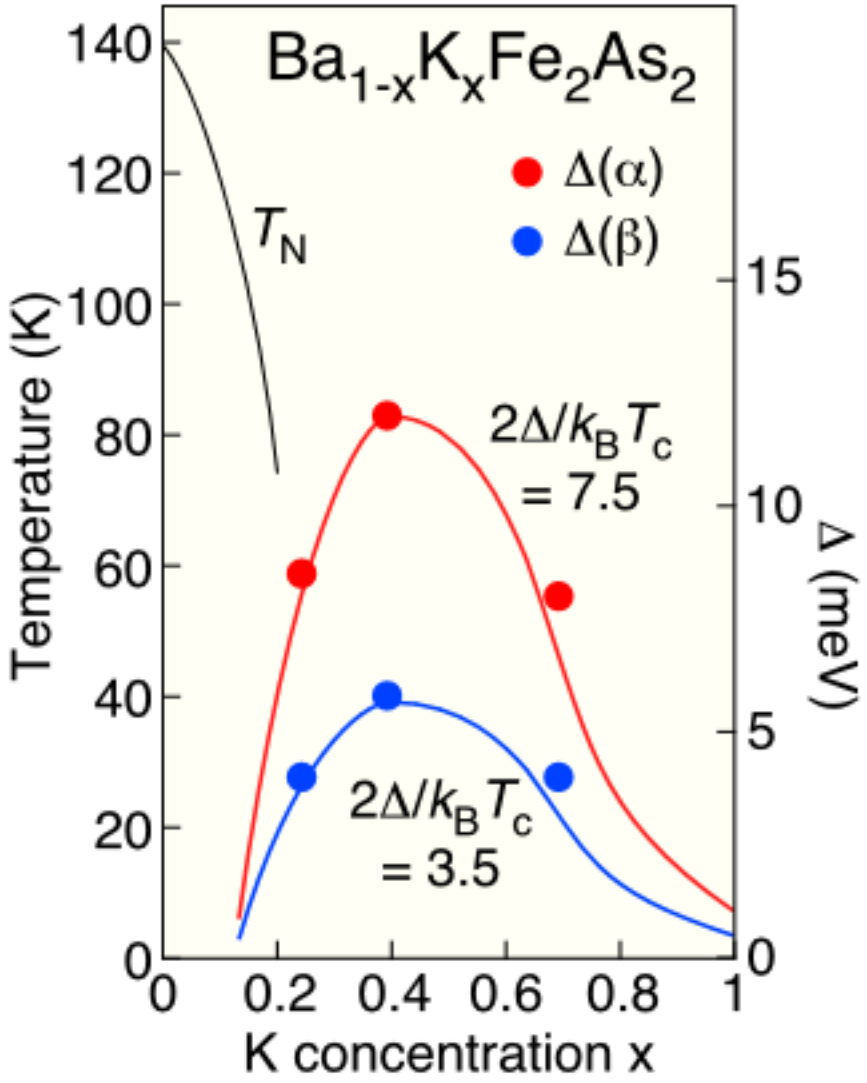




Y.-M. Xu *et al.*,
arXiv:0905.4467

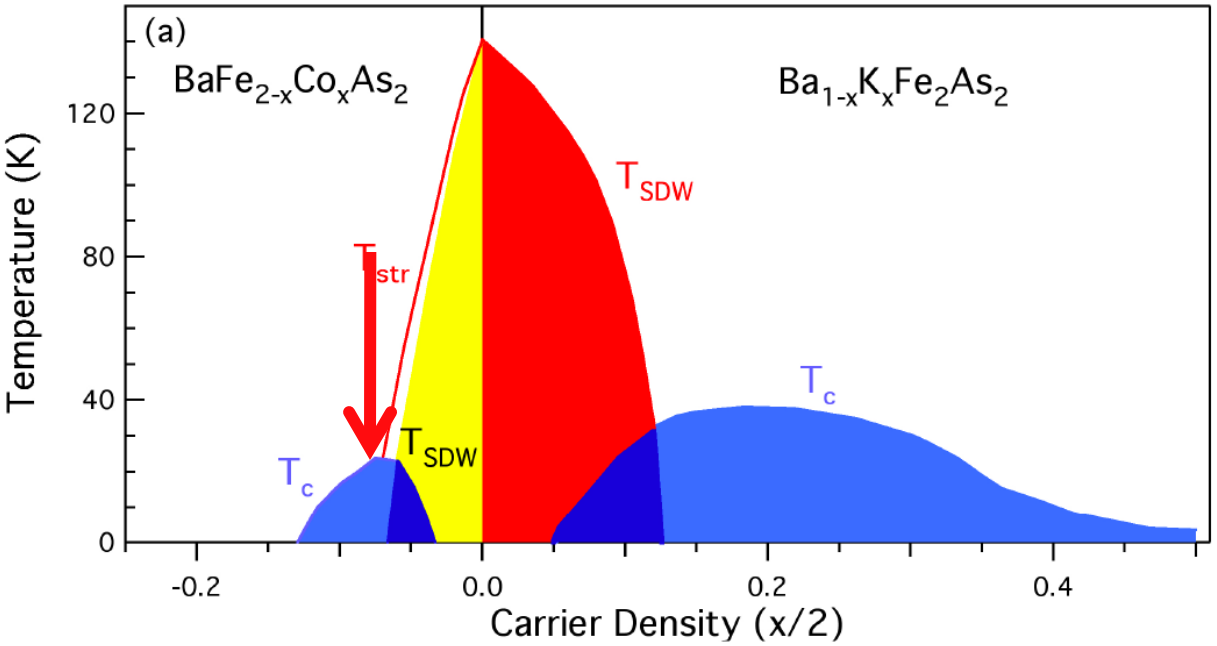
Doping dependence of the SC gaps in $Ba_{1-x}K_xFe_2As_2$

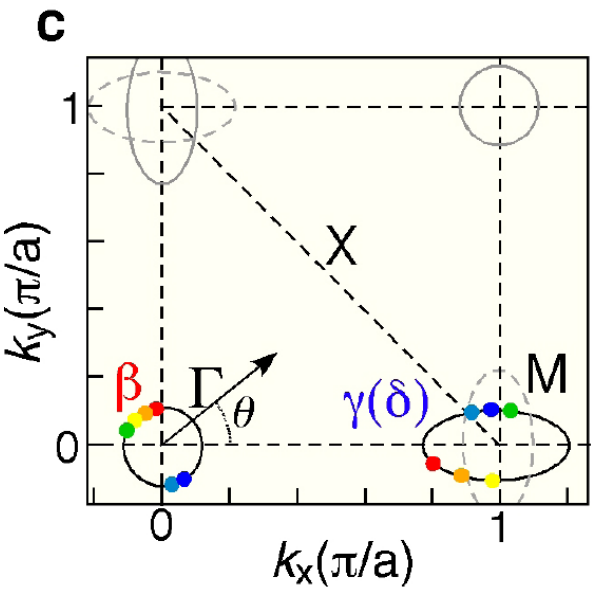


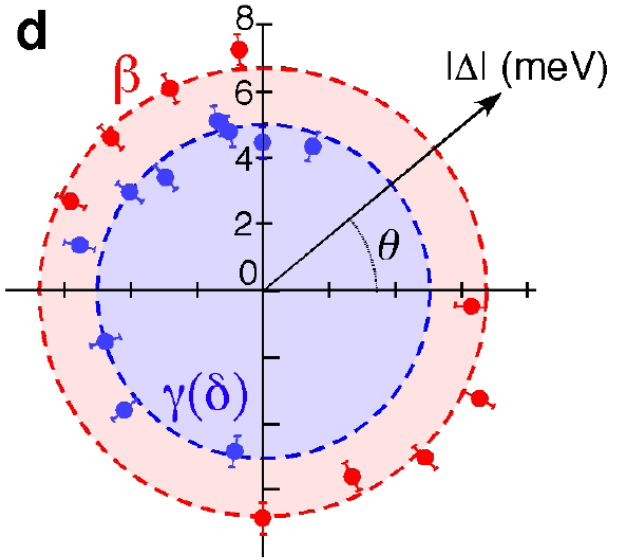


K. Nakayama *et al.*, PRB 83, 020501(R) (2011)

Electron doped $BaFe_{1.85}Co_{0.15}As_2$ (T_c = 25.5K)

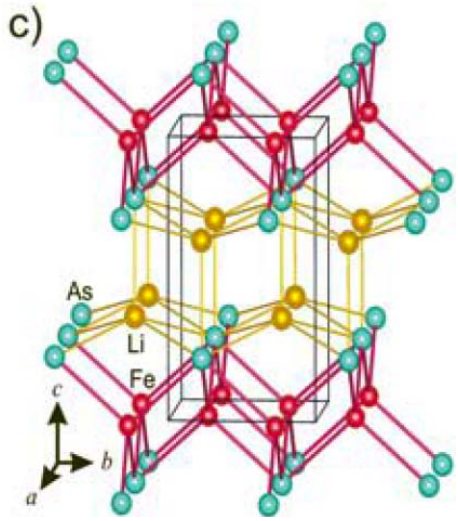


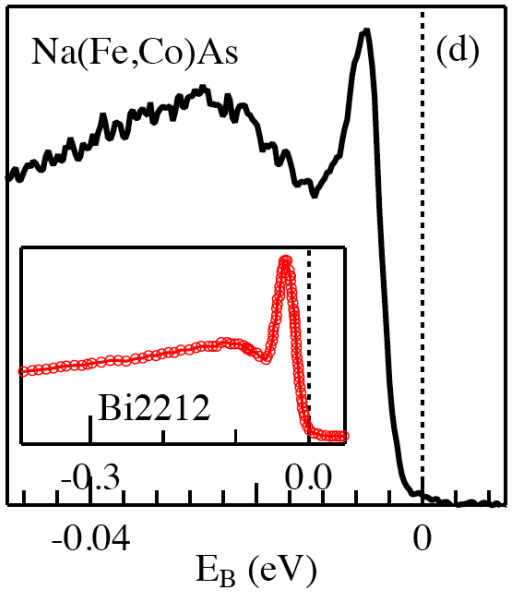


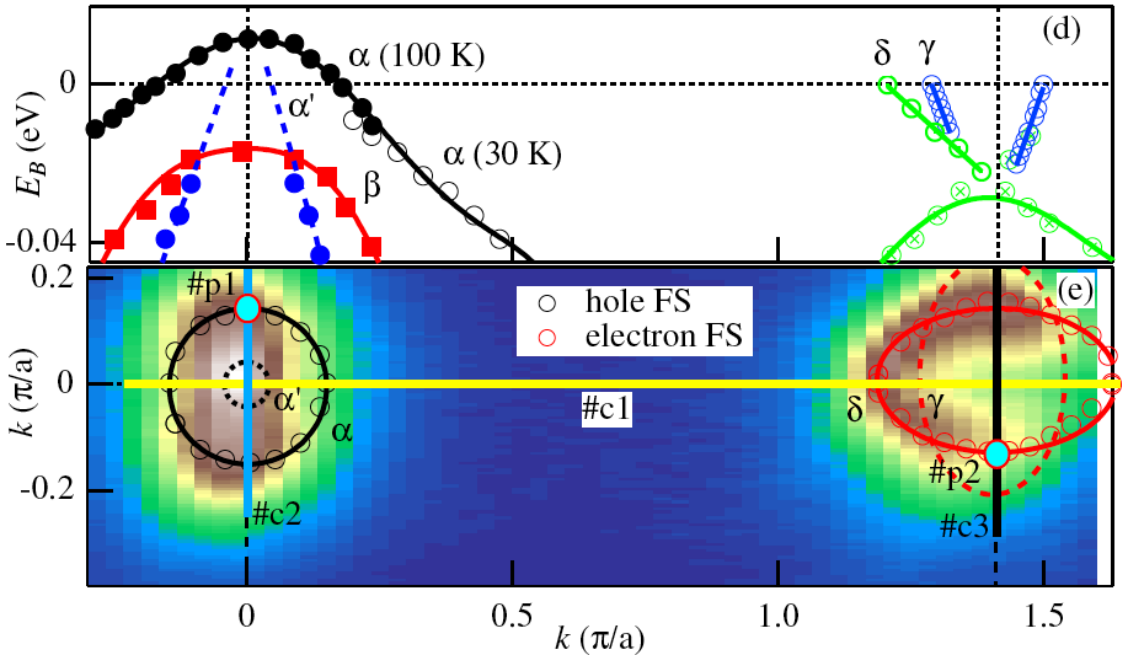


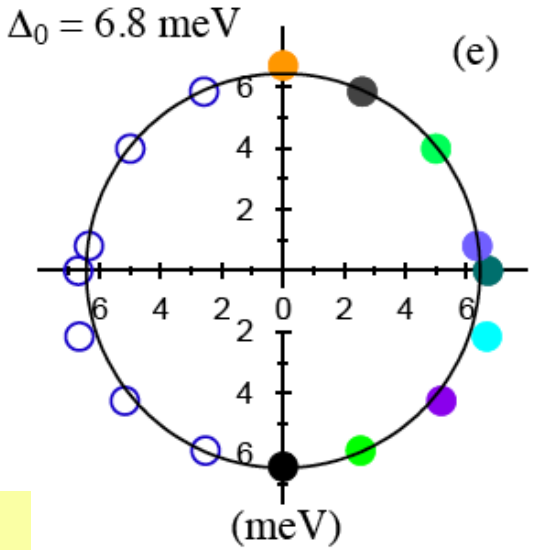
K. Terashima et al, PNAS 106, 7330 (2009)

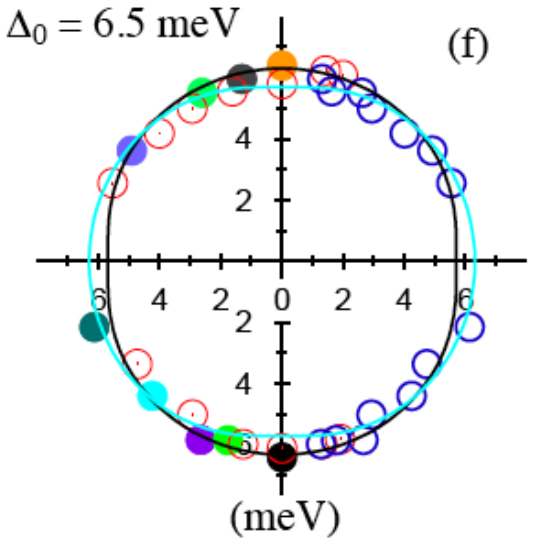
"111" - Electron doped $NaFe_{0.95}Co_{0.05}As$ (T_c = 18K)









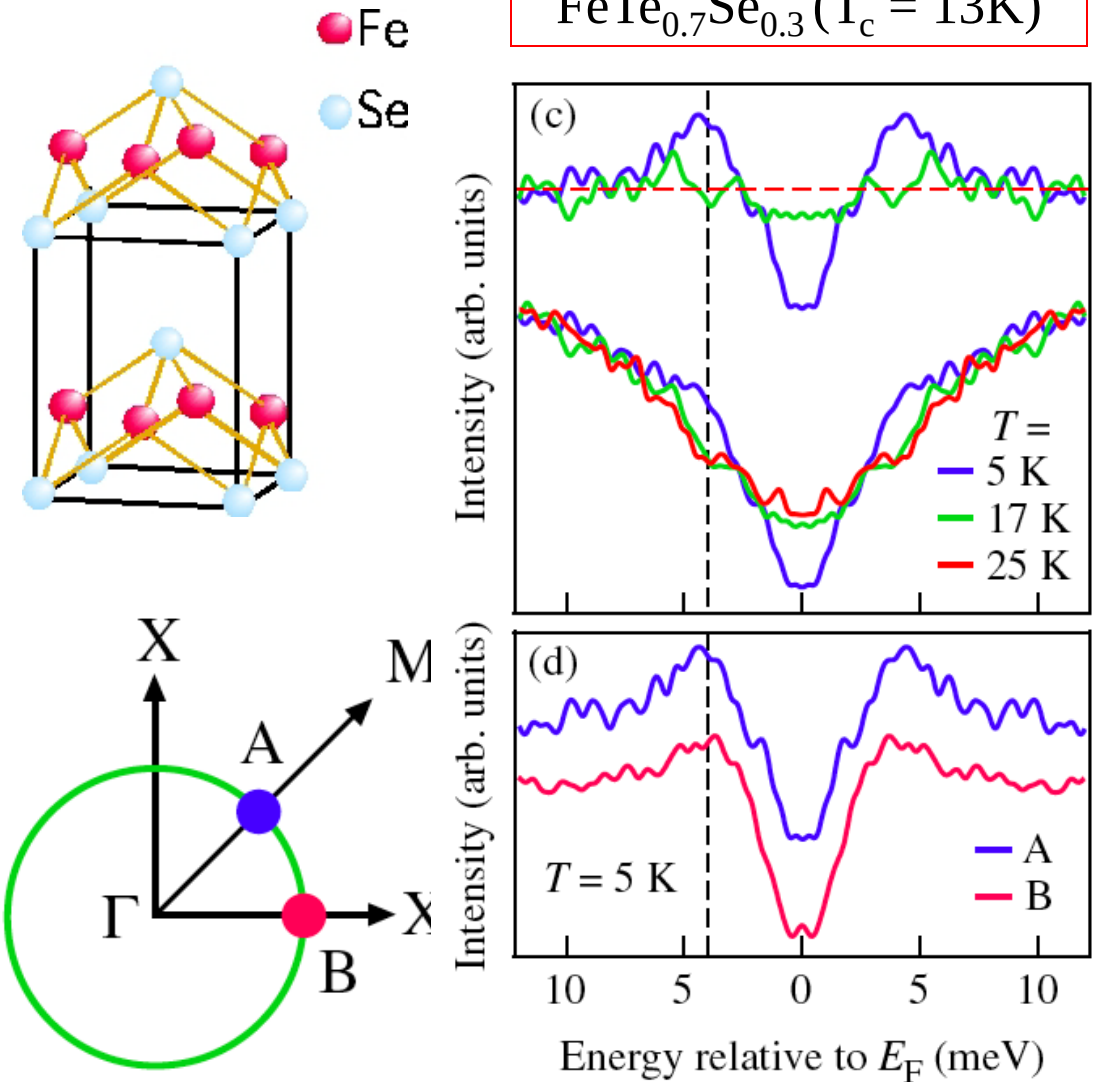


Z.-H. Liu *et al.*, arXiv:1008.3265

“11” – $FeTe_{1-x}Se_x$ (T_c = 13 - 14K)

$FeTe_{0.7}Se_{0.3}$ (T_c = 13K)

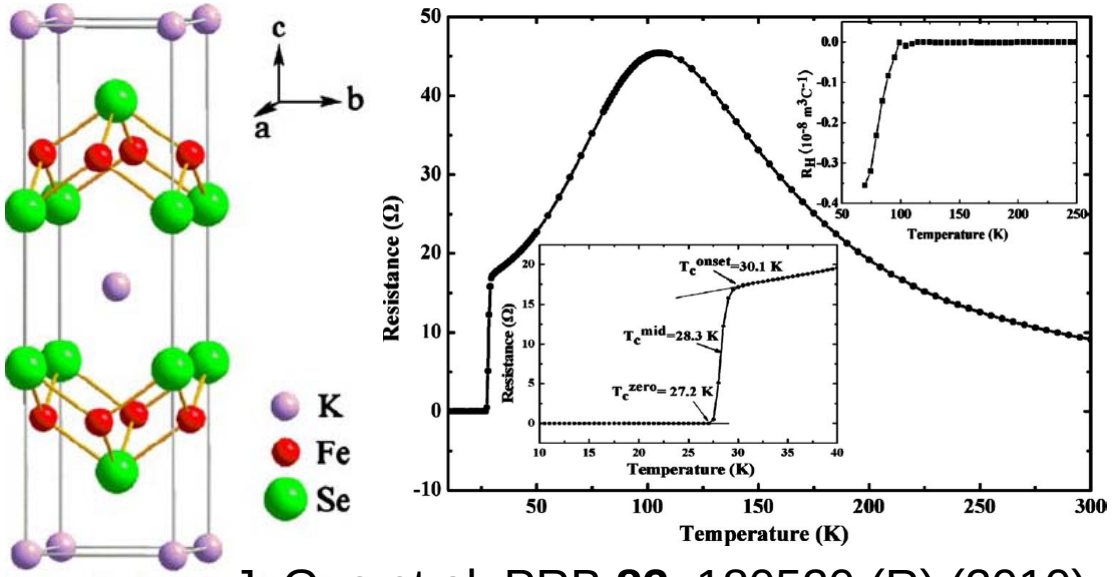
$FeTe_{0.5}Se_{0.5}$ (T_c = 14K)



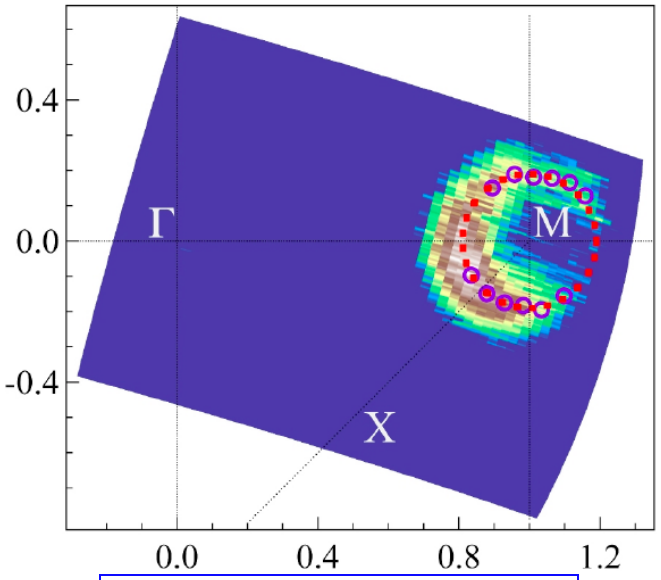
K. Nakayama *et al.*, PRL 105, 197001 (2010)

New results

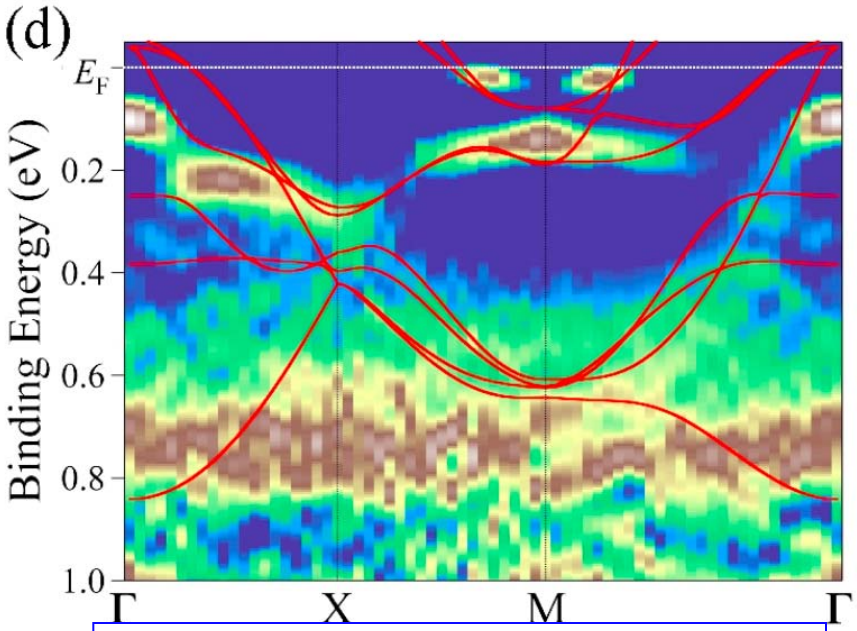
New "122" – $KFe_{2-x}Se_2$ (T_c ~ 31K)



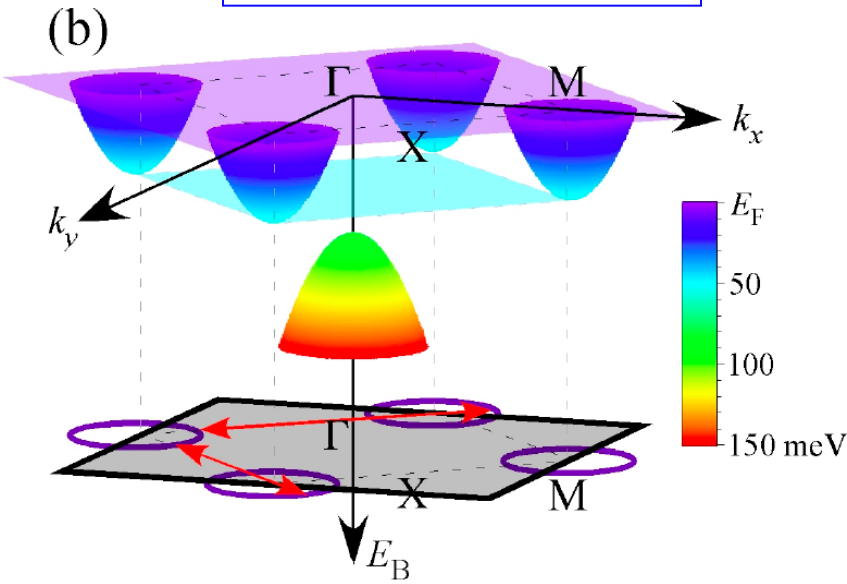
J. Guo et al, PRB **82**, 180520 (R) (2010)



Absence of hole FS



Bandwidth renormalization = 2.5



T. Qian et al, arXiv:1012.6017

Summary

1.SC gaps of many iron-based superconductors are FS-dependent but nodeless

2.May be also sensitive to orbital characters

3.Weak-coupling vs local pairing?