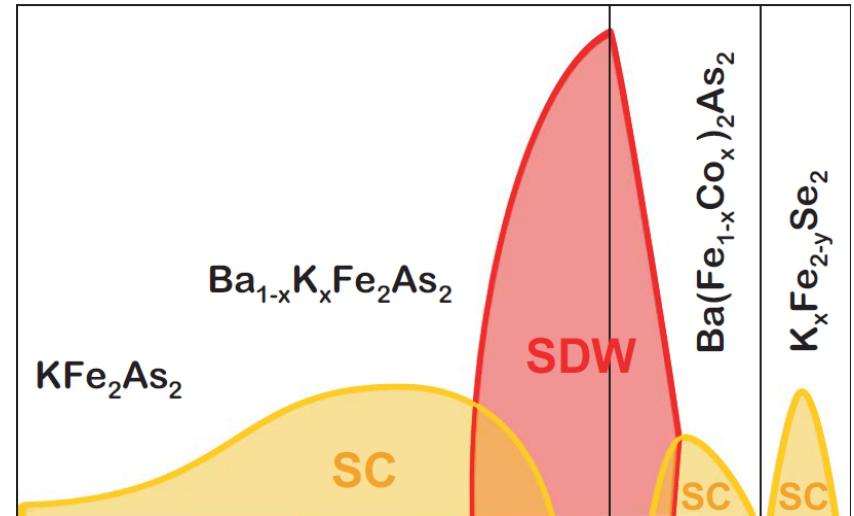
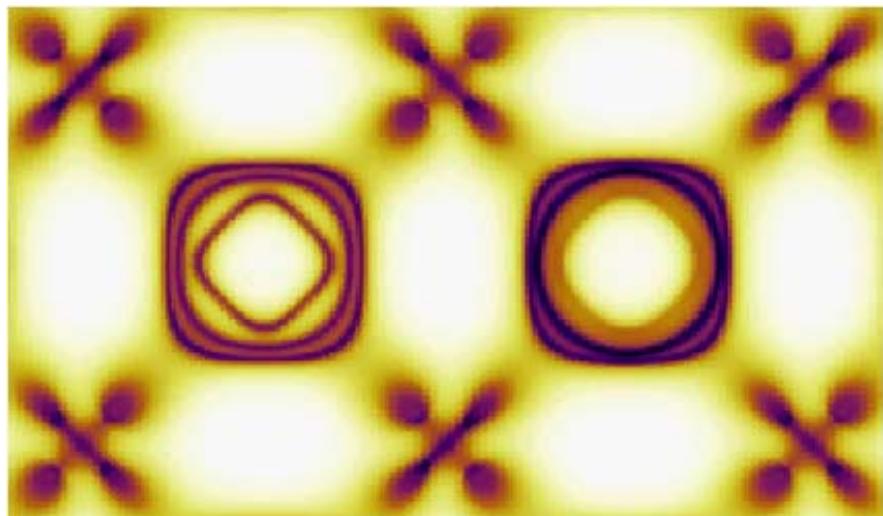
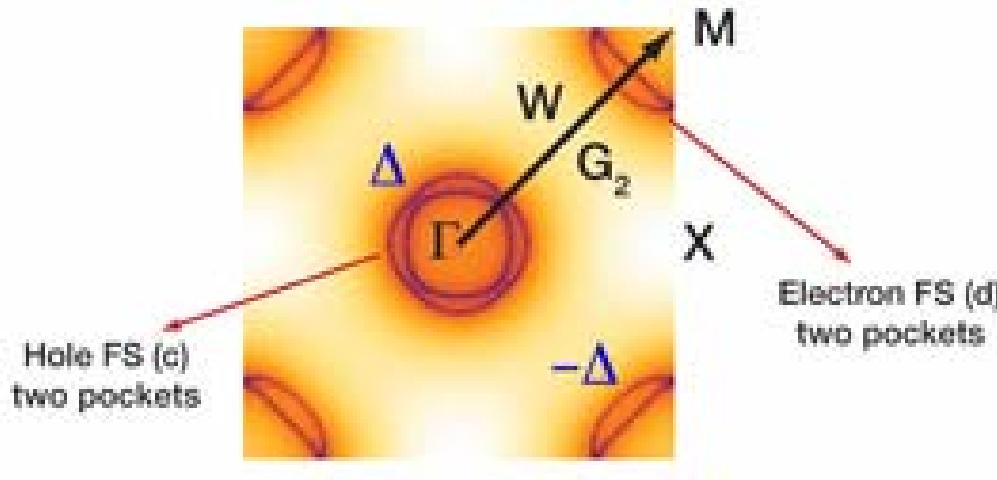


ARPES vs Strong Correlations – part 2

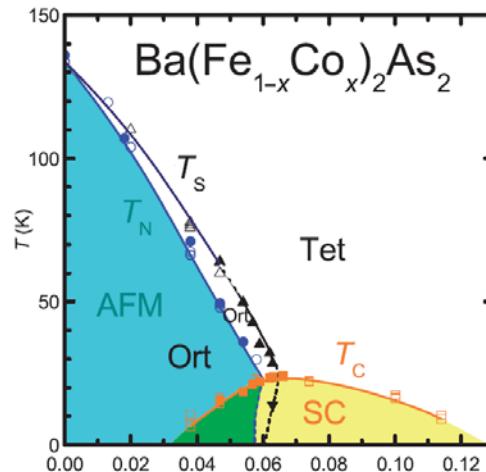
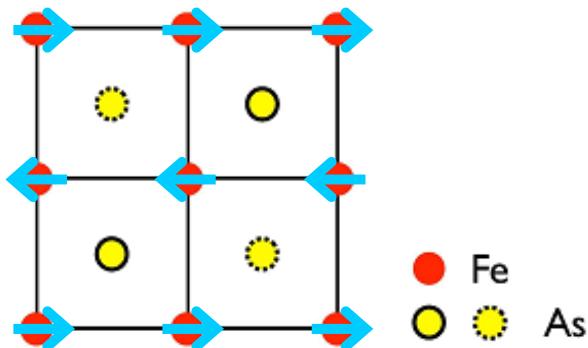
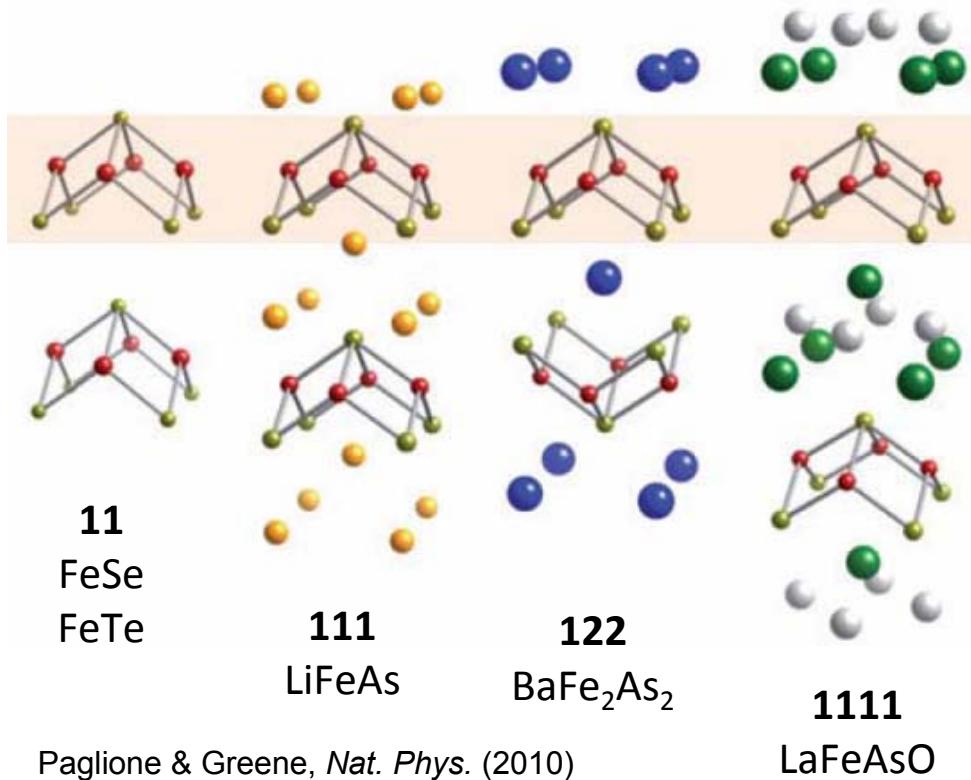


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Institute of Metal Physics
Kyiv, Ukraine

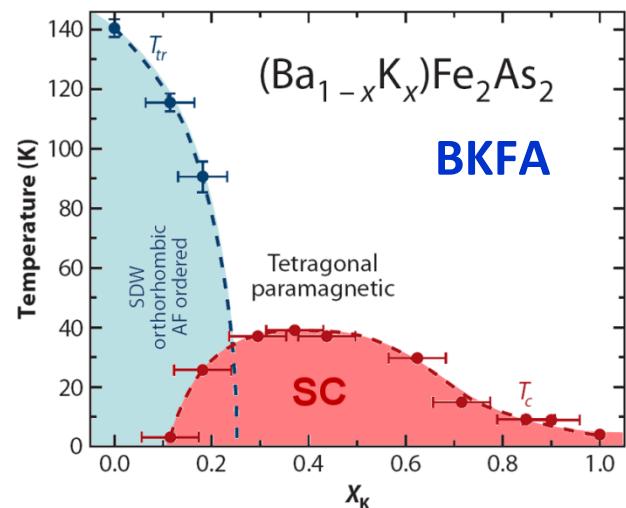


Iron-based superconductors: Fermi surface topology

Iron-based superconductors (FeSC)

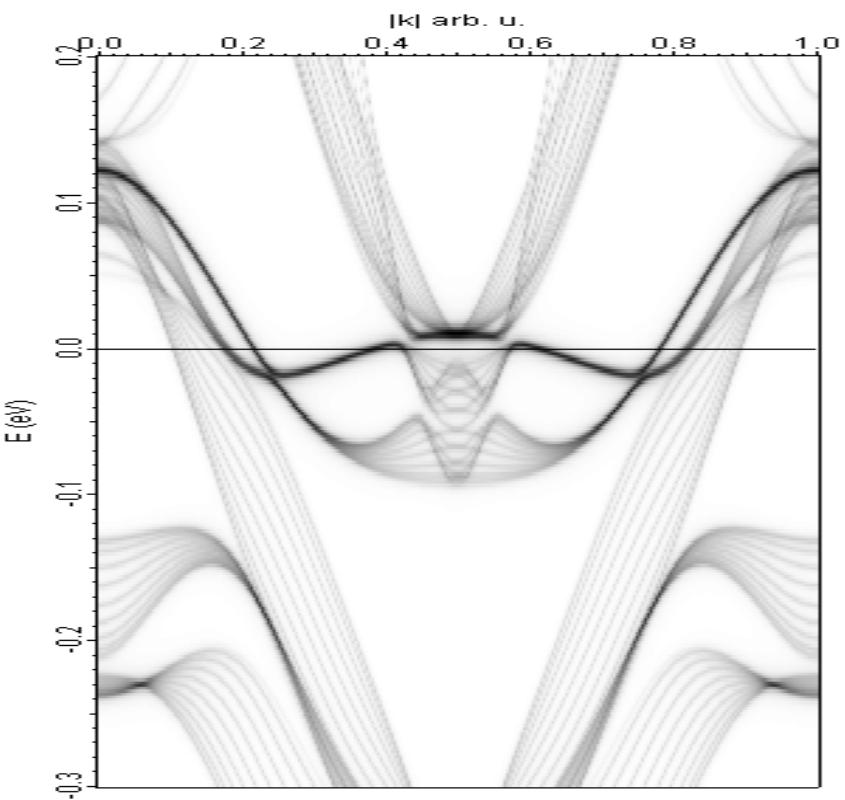
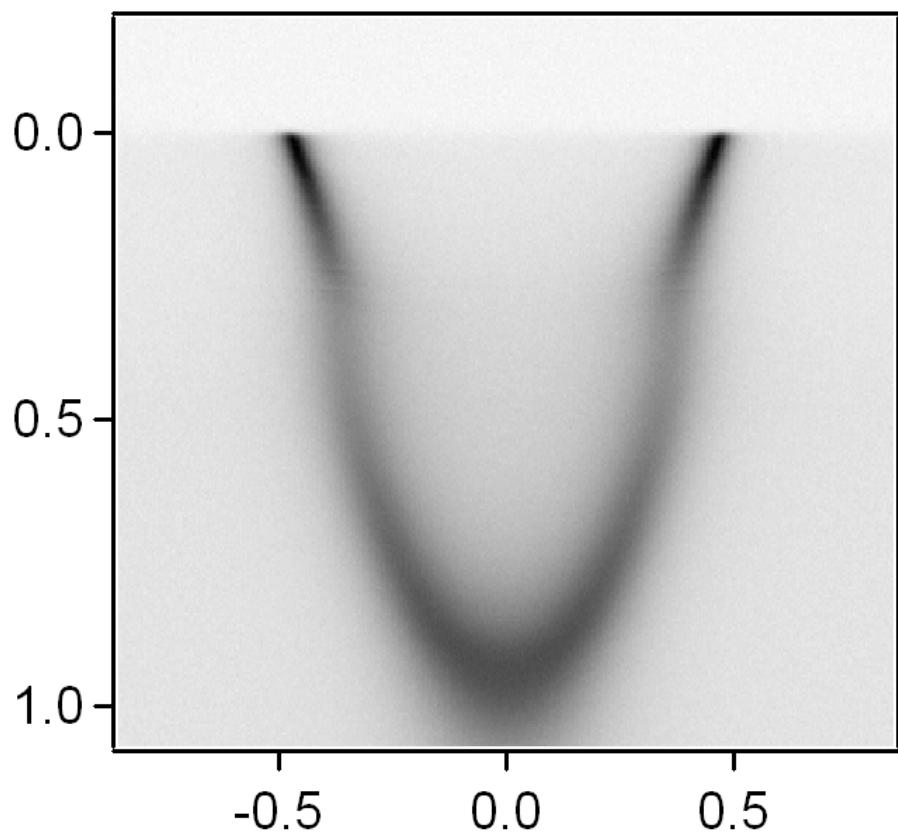


S.Nandi et al. [PRL 2010](#)



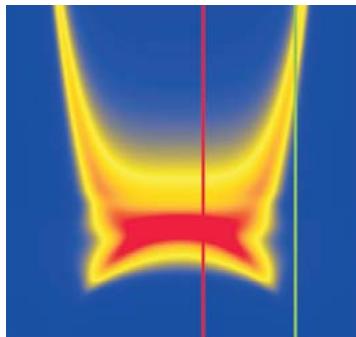
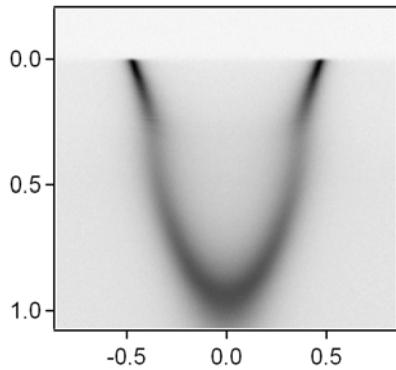
H.-H.Wen & S.Li [Annu. Rev. Cond. Mat. Phys. 2011](#)

Cu-SC vs Fe-SC



Cu-SC vs Fe-SC

Cuprates

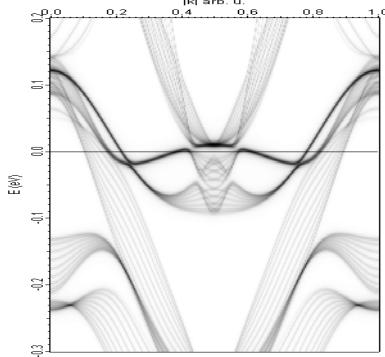


Band structure is simple but...

complexity of the **cuprates** is
encapsulated in complex
 $k\omega$ -dependence of the self-energy
that is defined by the spectrum of
spin-fluctuations

Cu-SC vs Fe-SC

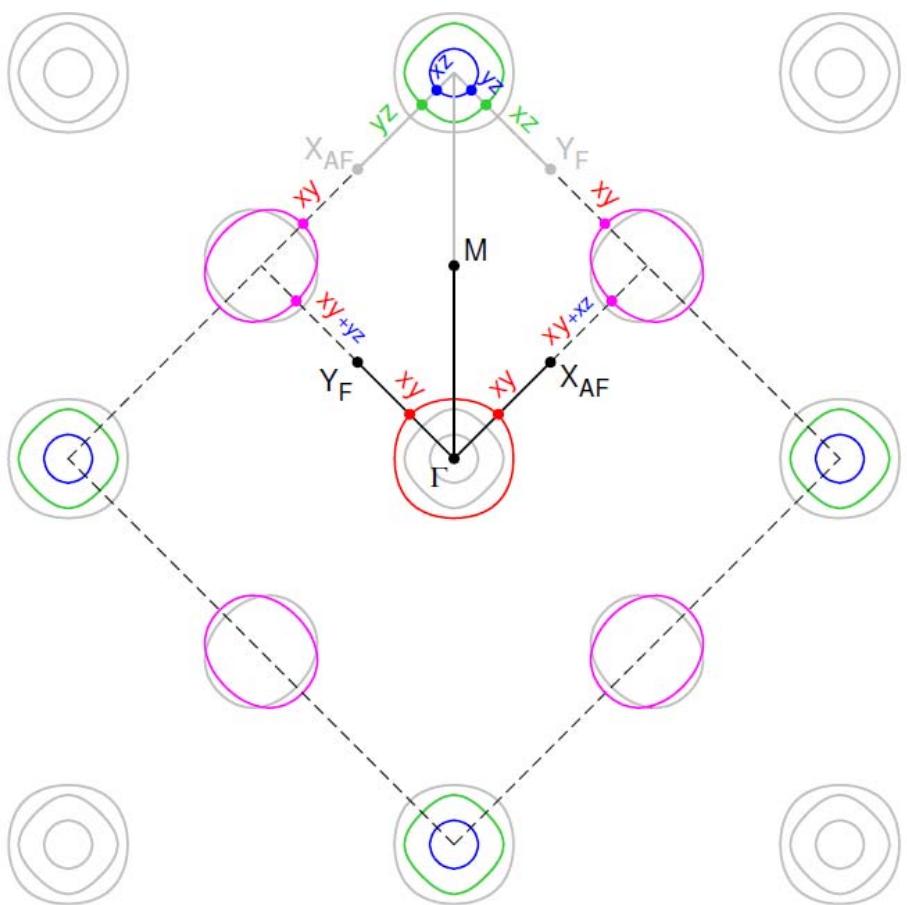
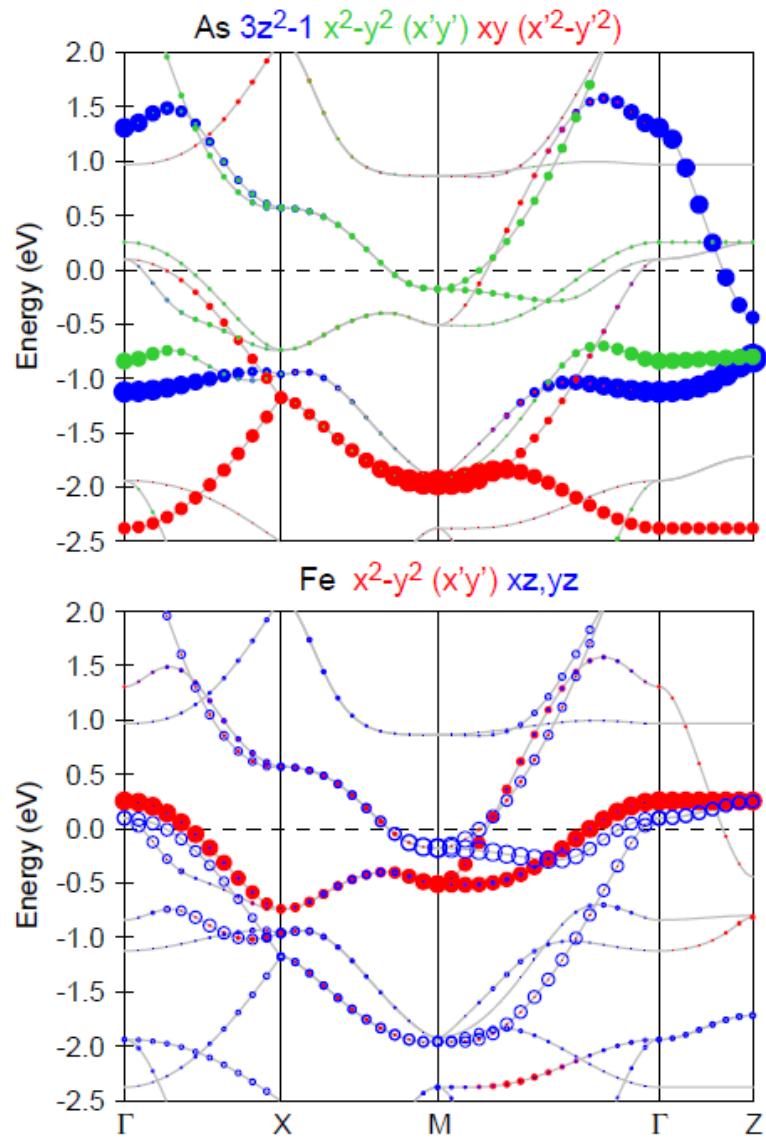
Fe-SC



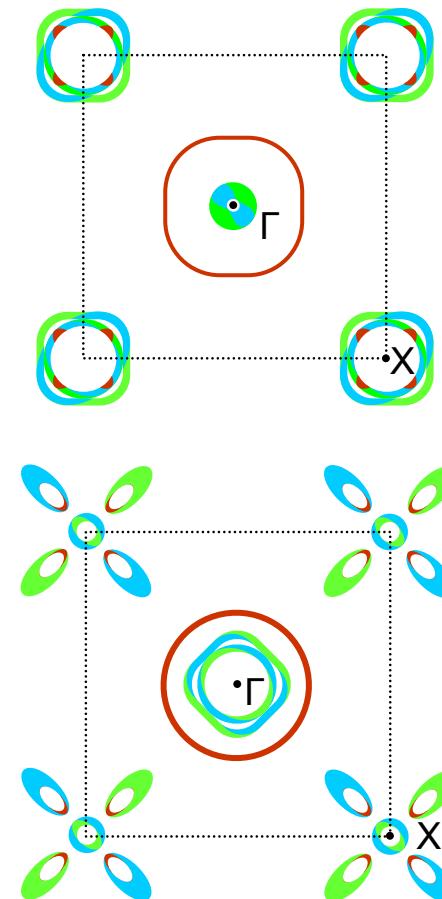
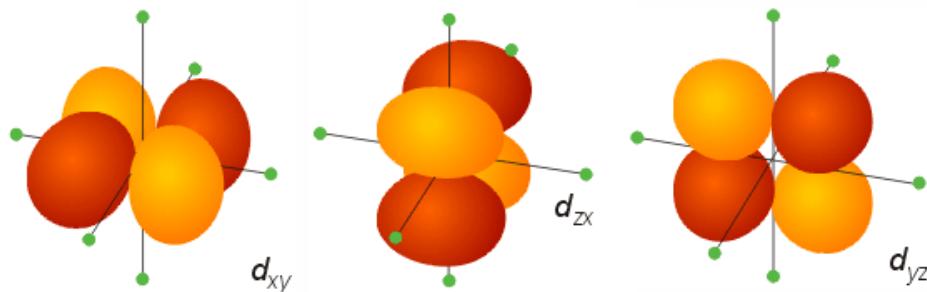
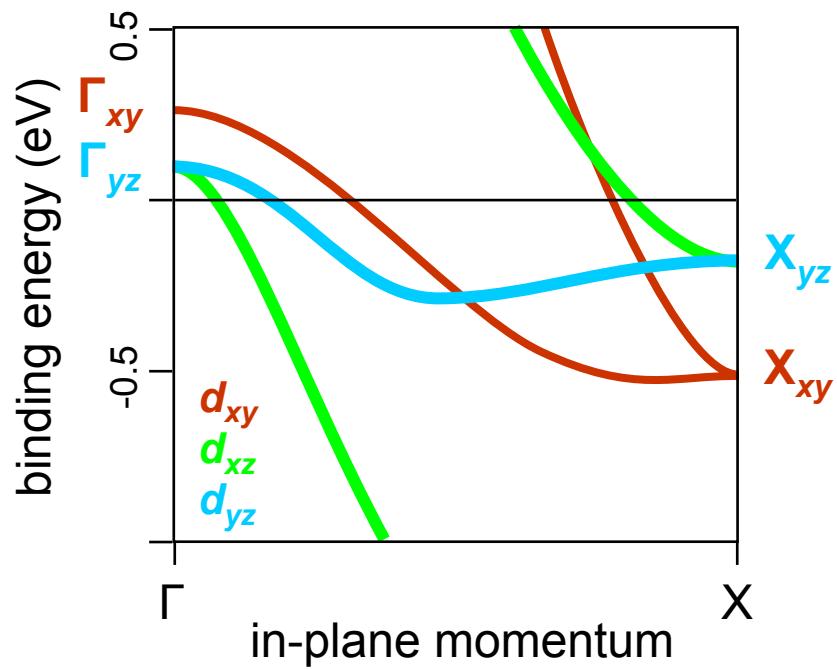
Complexity of Fe-SC is in **complex band structure**. Both **phonons** and **SFs** are important but multi-band effects should be taken into account

ARPES + LDA + self-energy analysis

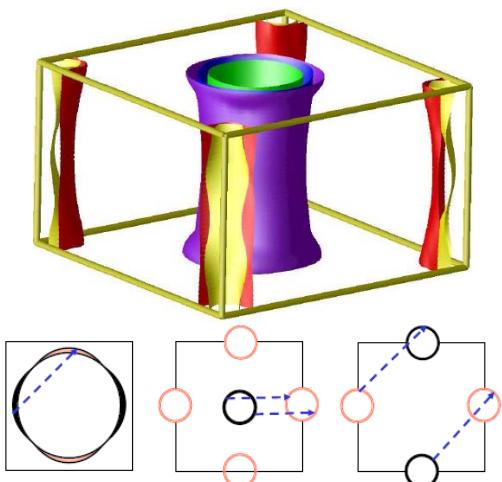
FeSC electronic band structure



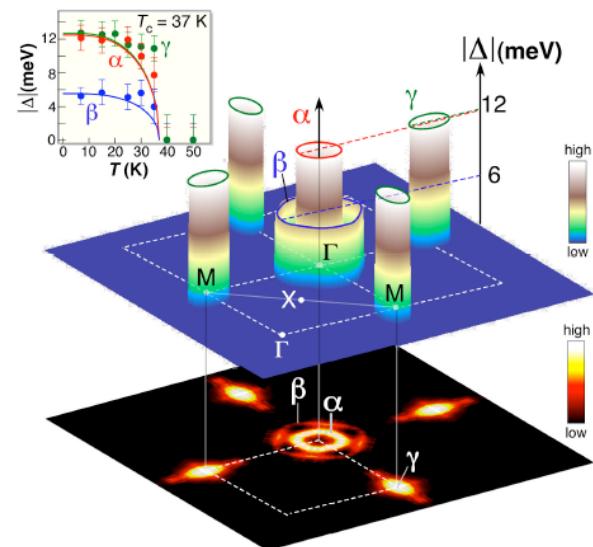
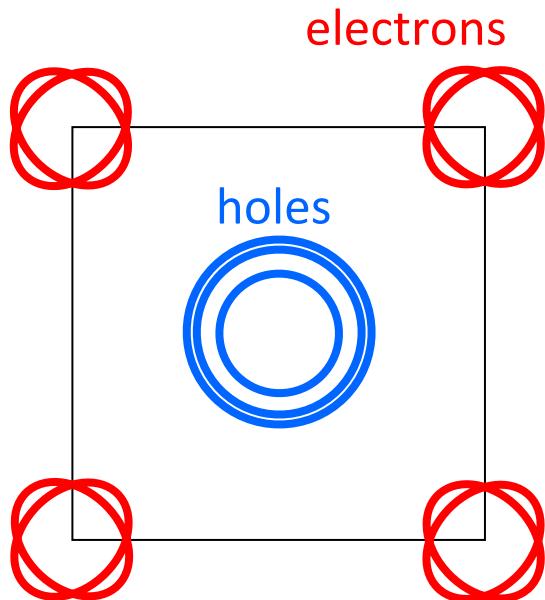
Iron-based superconductors: electronic structure



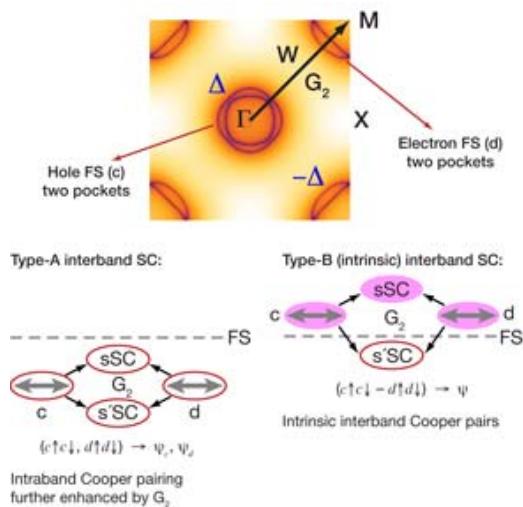
Fermi surface of BKFA



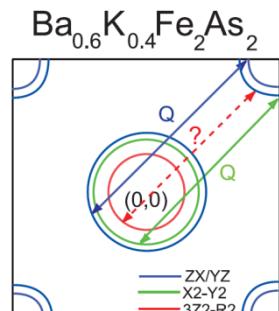
Mazin & Schmalian 2009



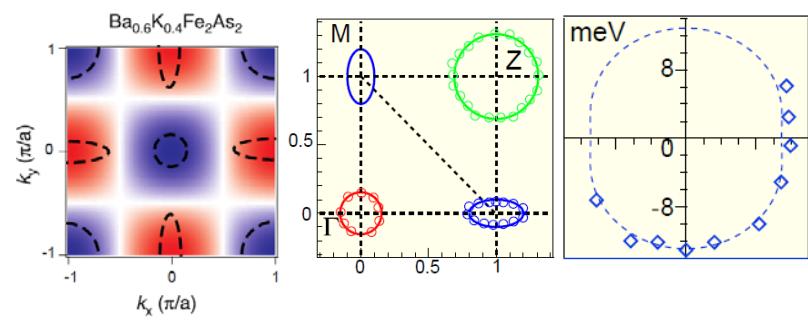
Ding *EPL* 2008



Tesanovic *Physics* 2009

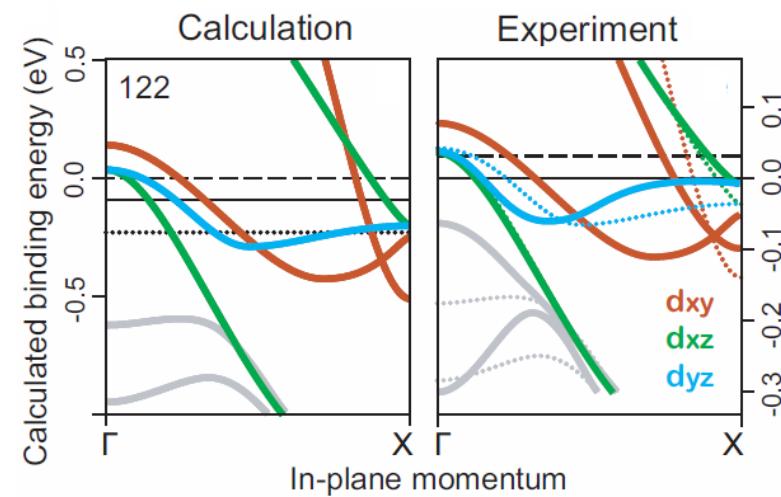
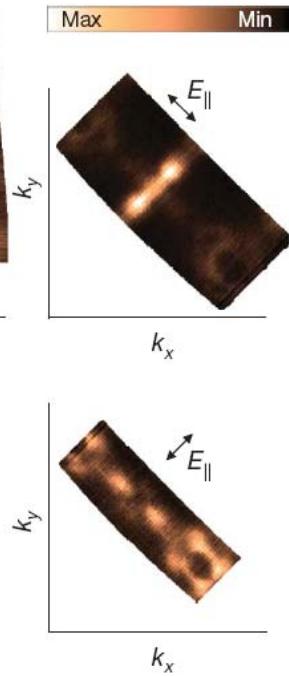
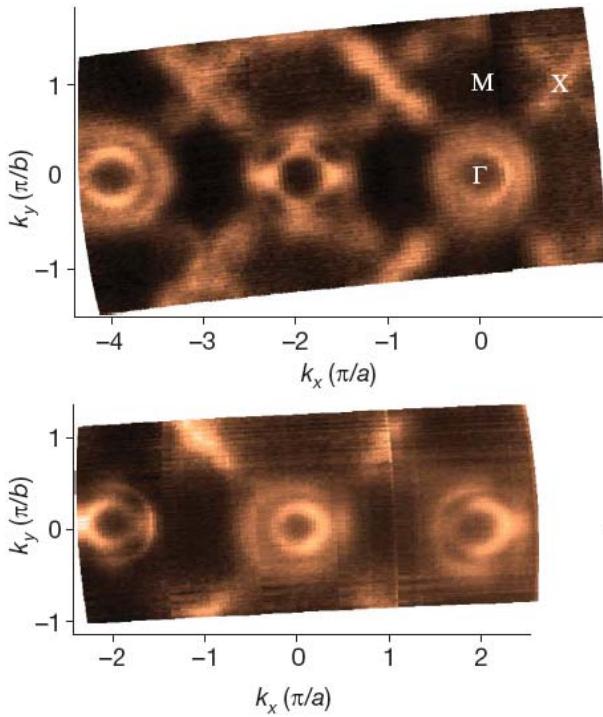
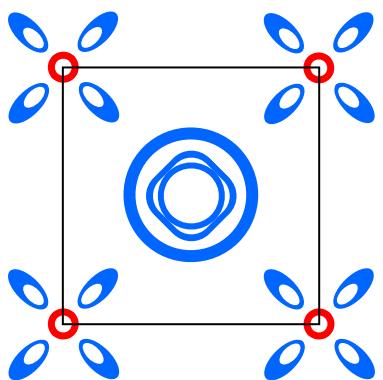
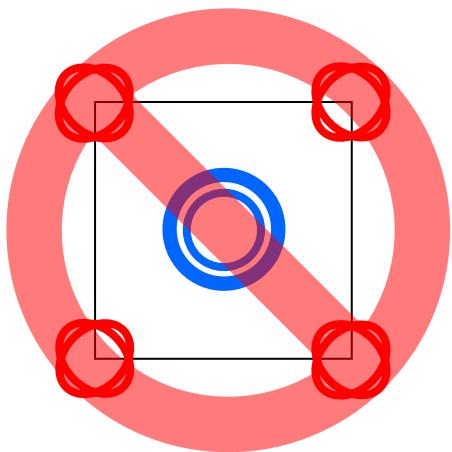


Shimojima *Science* 2011

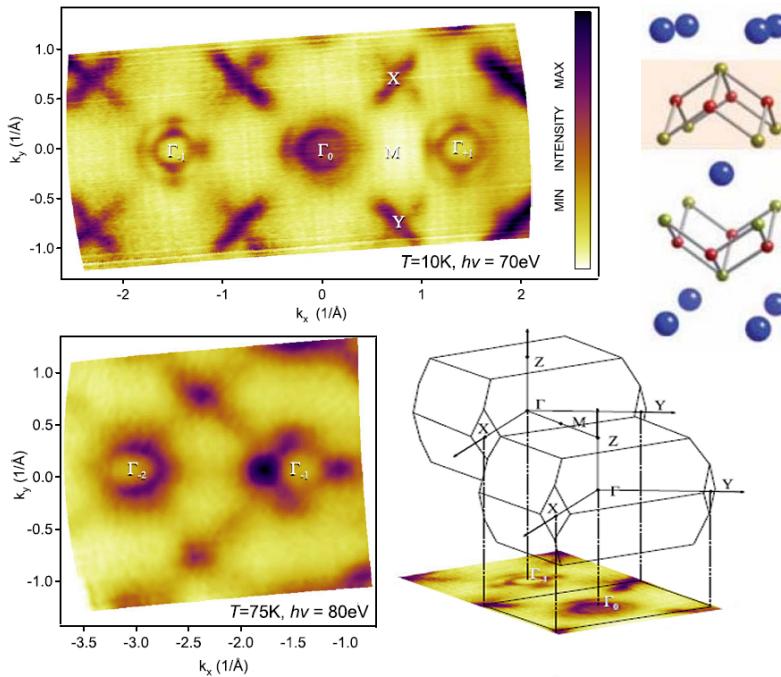


Hu & Ding arXiv:1107.1334

Fermi surface of BKFA

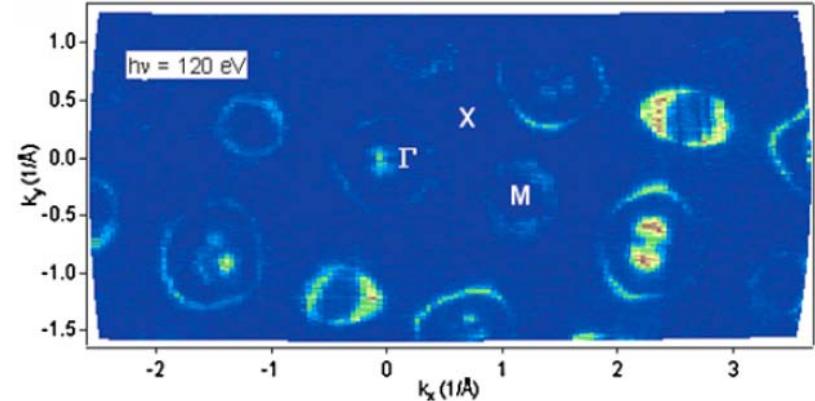
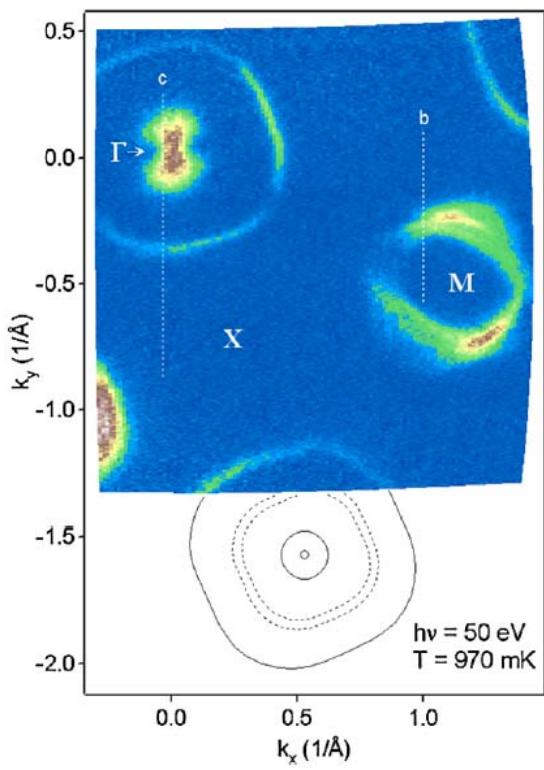


A. A. Kordyuk, *J. Supercond. Nov. Magn.* 2013

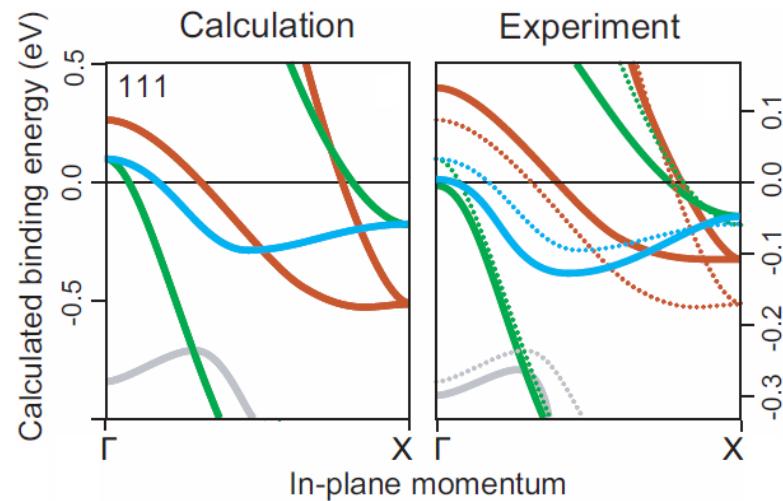
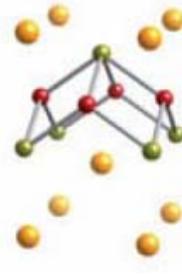
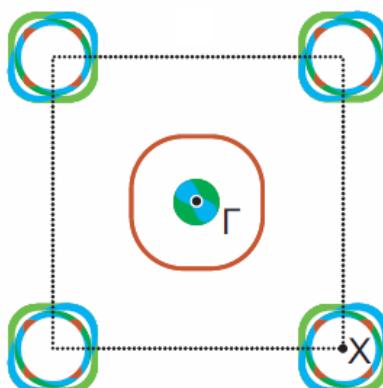


V. Zabolotnyy *Nature* 2009

Fermi surface of LiFeAs

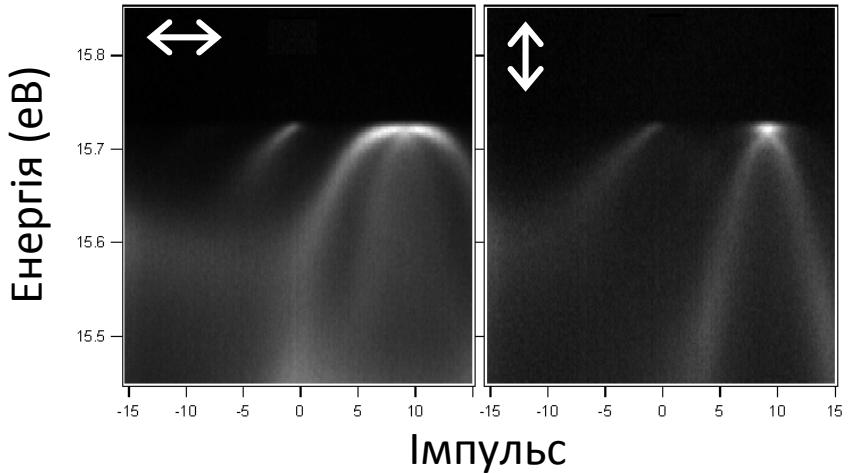


Borisenko *PRL* 2010



Kordyuk, *J. Supercond. Nov. Magn.* 2013

polarization



Kordyuk *PRB* 2010

Small Fermi surfaces

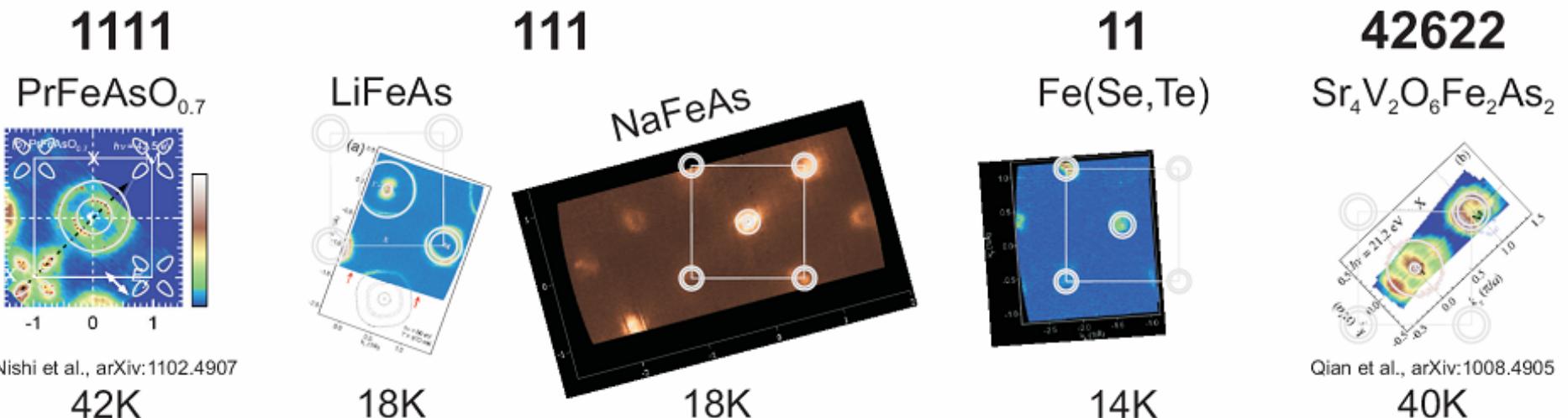
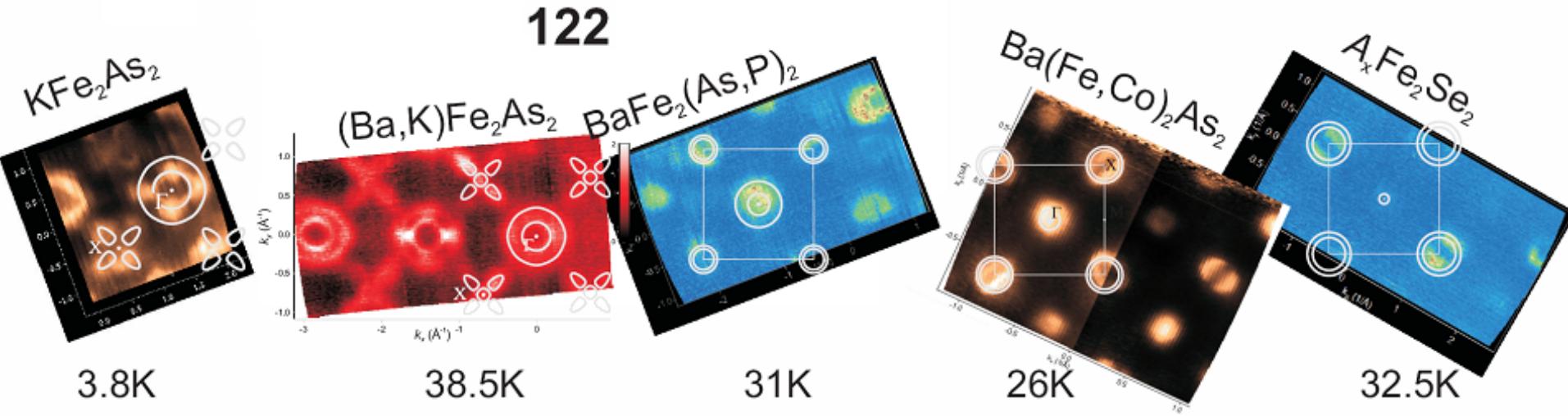
=

vicinity to Lifshitz transition

=

vicinity to 2D-3D crossover

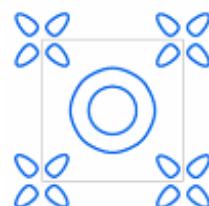
FS's of iron-based superconductors



FS's of iron-based superconductors

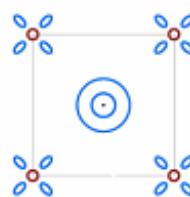
122

KFe_2As_2



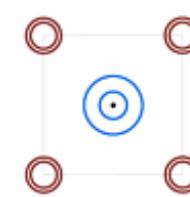
3.8K

$(Ba,K)Fe_2As_2$



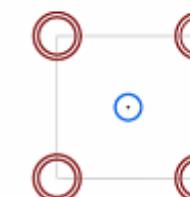
38K

$BaFe_2(As,P)_2$



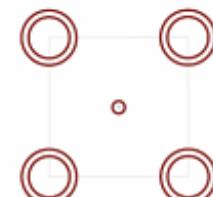
31K

$Ba(Fe,Co)_2As_2$



26K

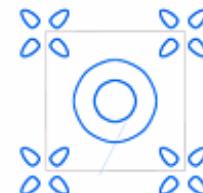
$A_xFe_2Se_2$



31K

1111

$PrFeAsO_{0.7}$



42K

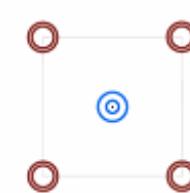
111

$LiFeAs$



18K

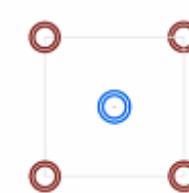
$NaFeAs$



18K

11

$Fe(Se,Te)$



14K

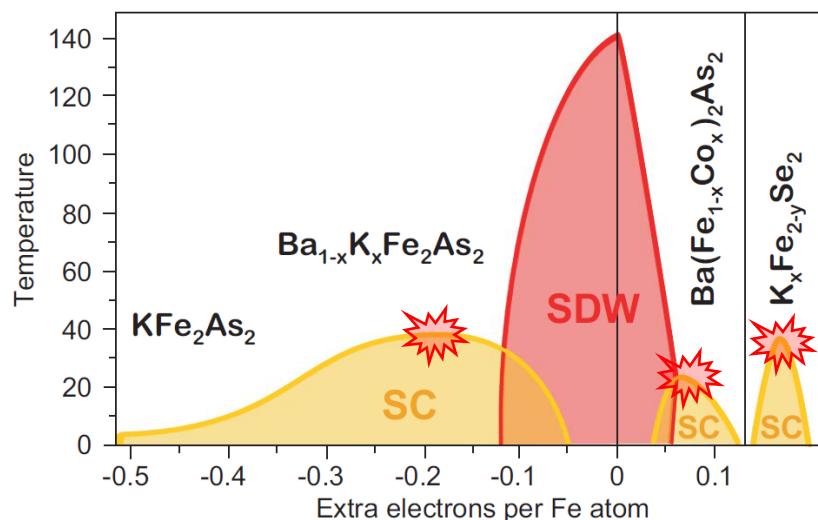
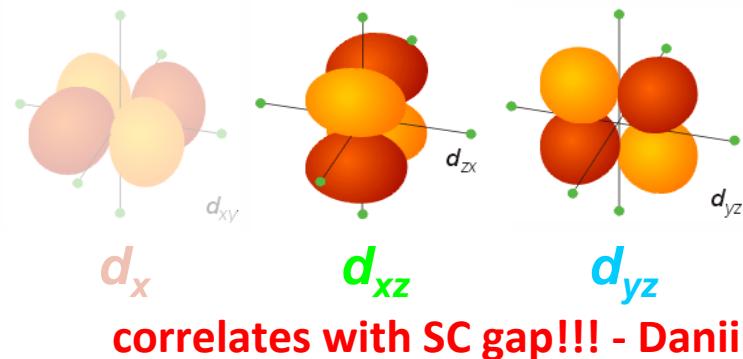
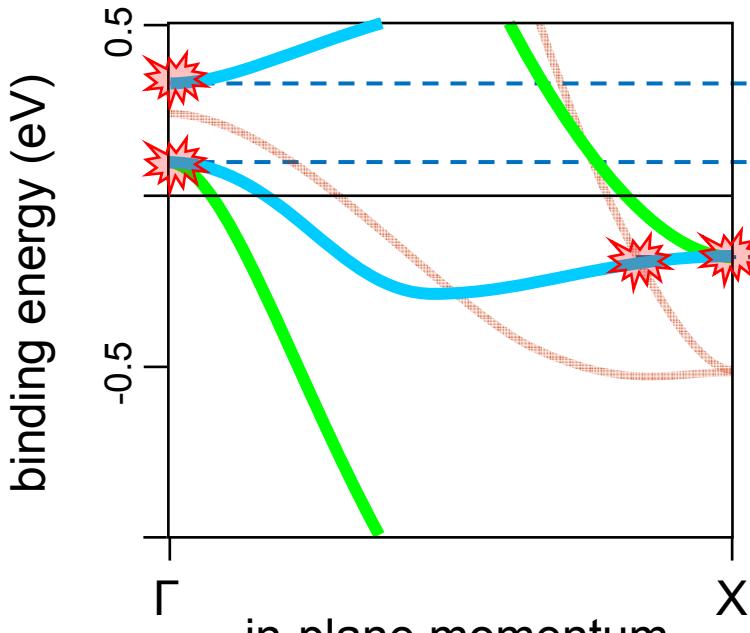
42622

$Sr_4V_2O_6Fe_2As_2$



40K

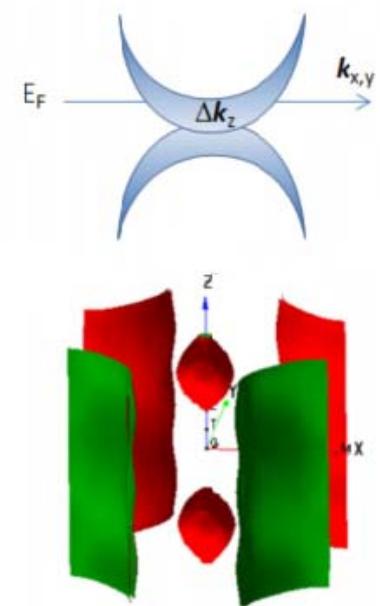
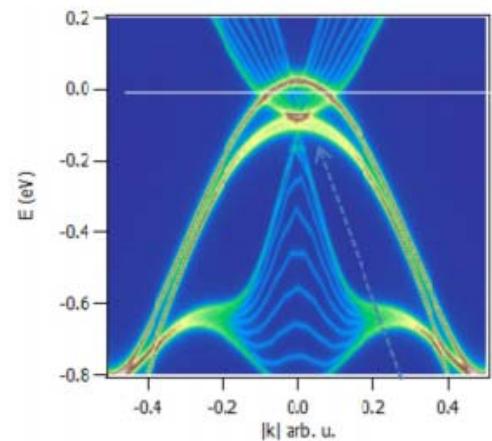
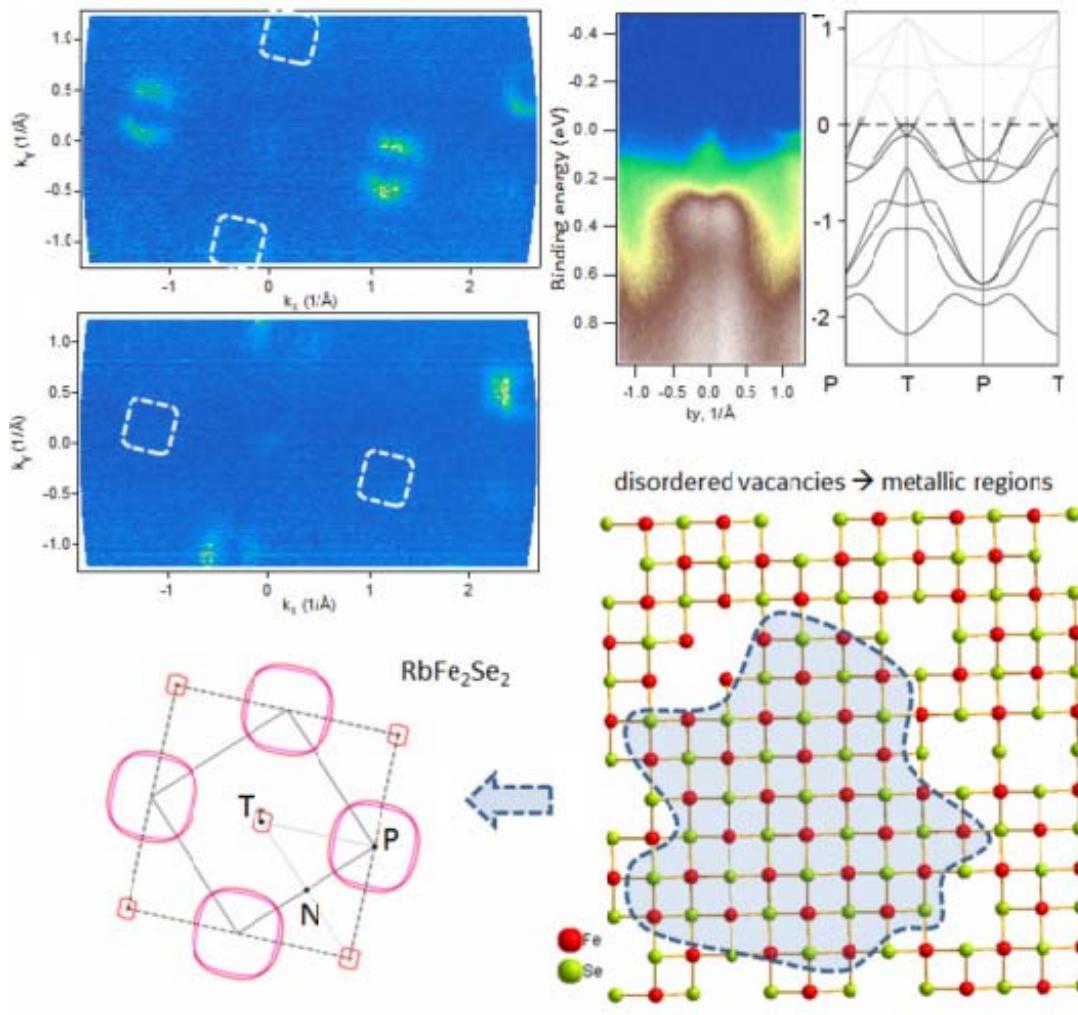
FeSC: electronic structure and superconductivity



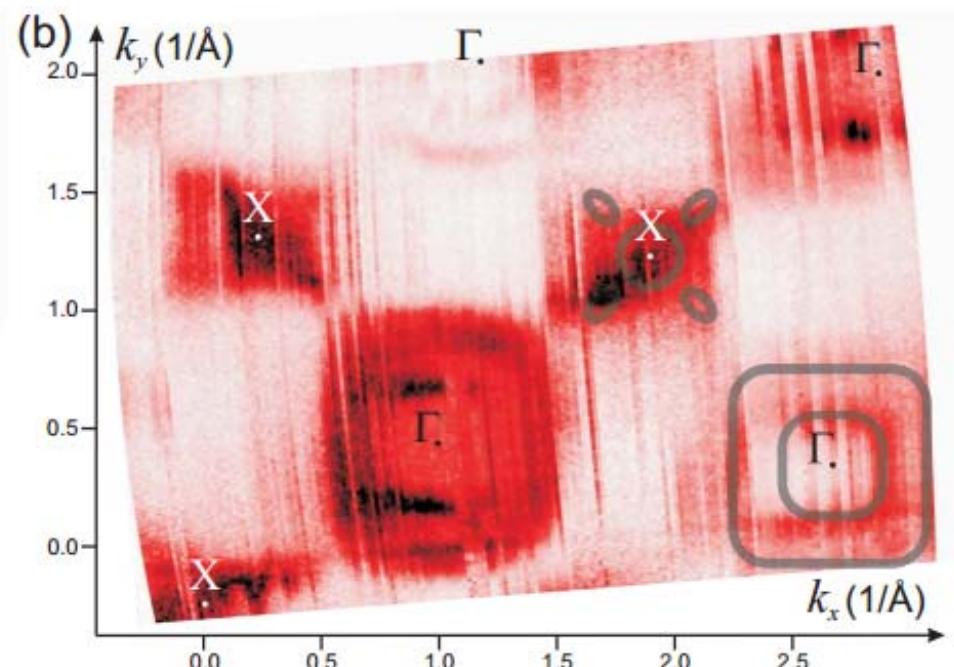
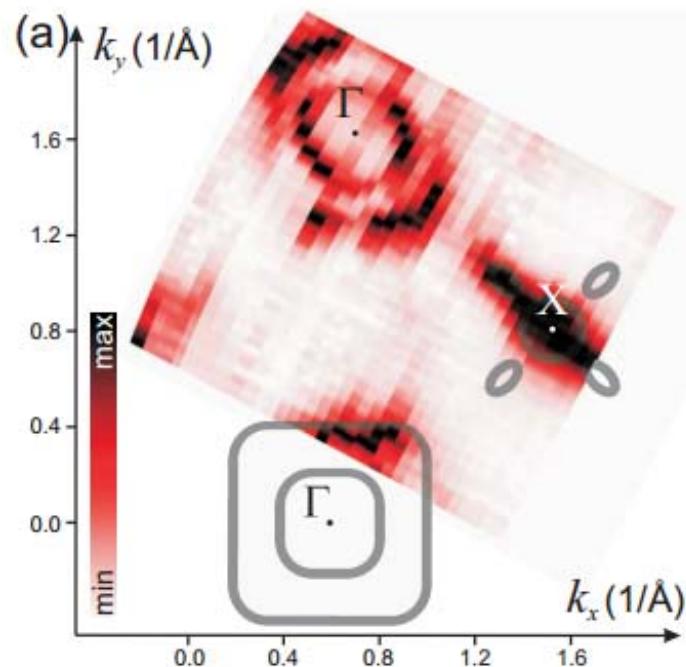
A. A. Kordyuk, *J. Supercond. Nov. Magn.* (2013)

A. A. Kordyuk et al., *Phys. Rev. B* **83**, 134513 (2011)

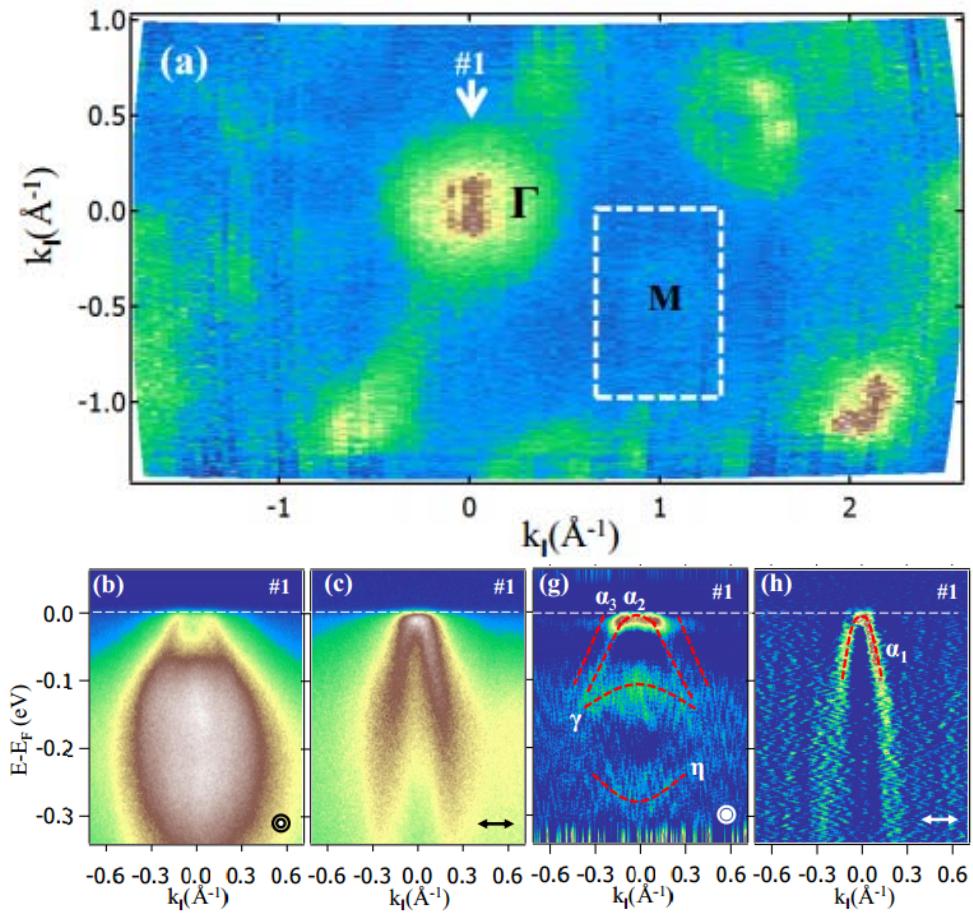
A-FeSe Rb_{0.77}Fe_{1.61}Se₂ T_c = 32.6 K



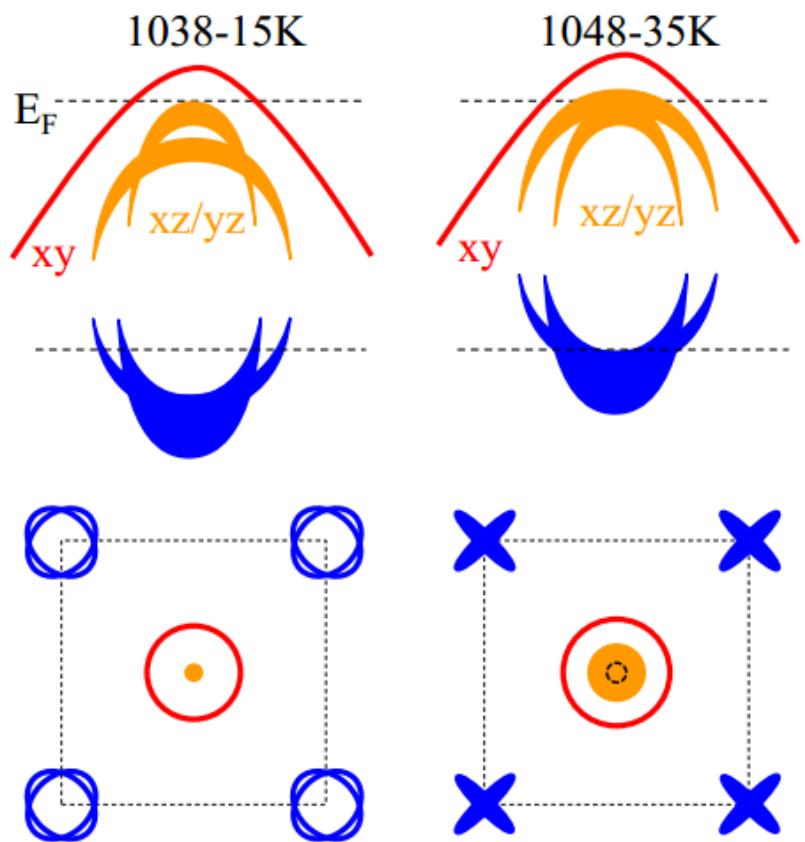
$\text{Ca}_{1-x}\text{Na}_x\text{Fe}_2\text{As}_2$ **33K**



$(\text{CaFe}_{0.95}\text{Pt}_{0.05}\text{As})_{10}\text{Pt}_3\text{As}_8$
 $(\text{CaFeAs})_{10}\text{Pt}_{3.58}\text{As}_8$

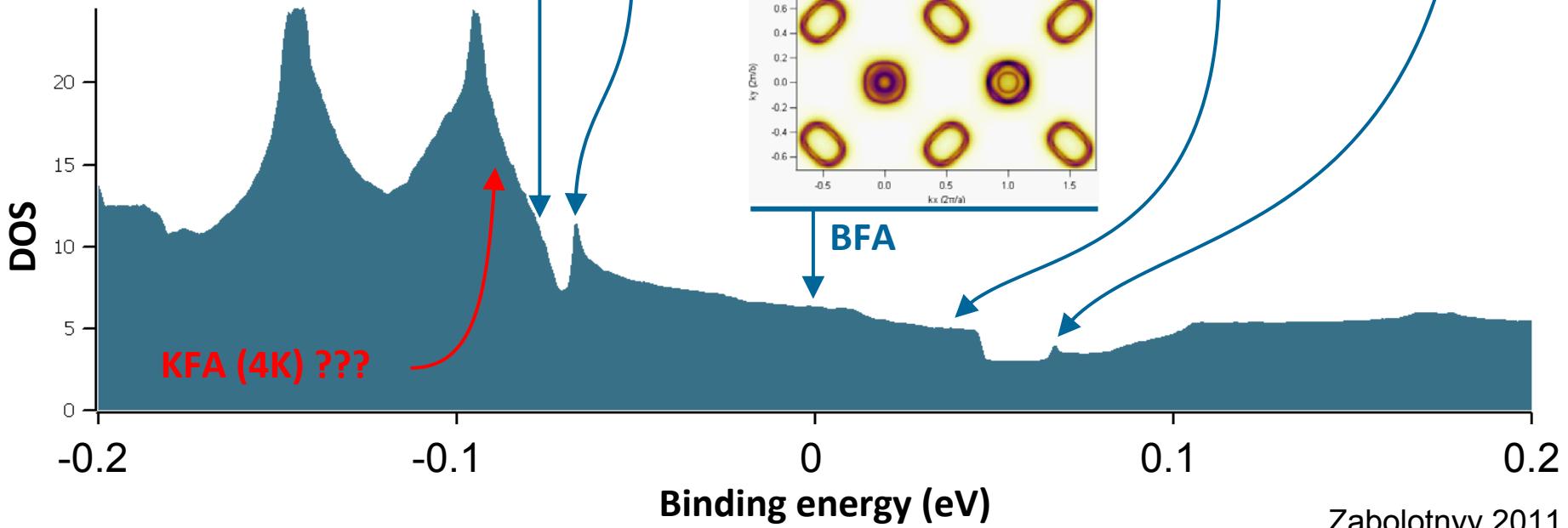
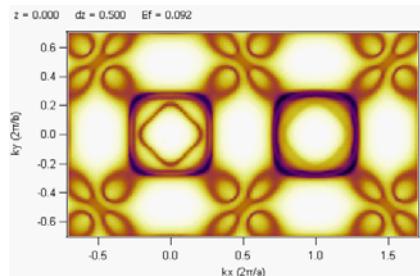


“10 3 8” – 15K
 “10 4 8” – 35K



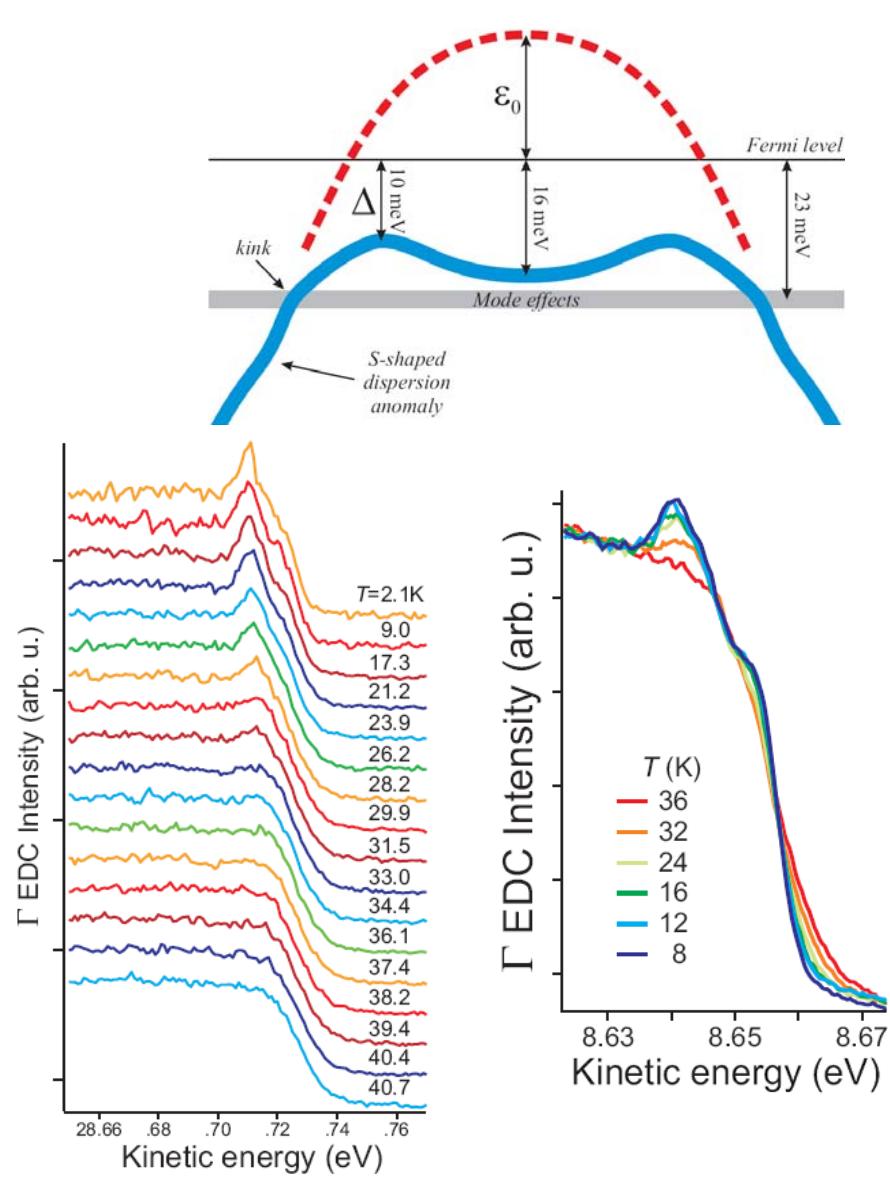
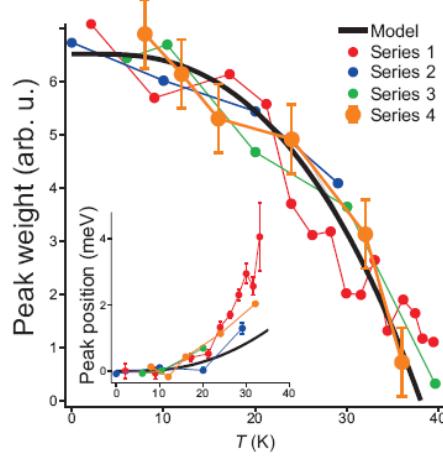
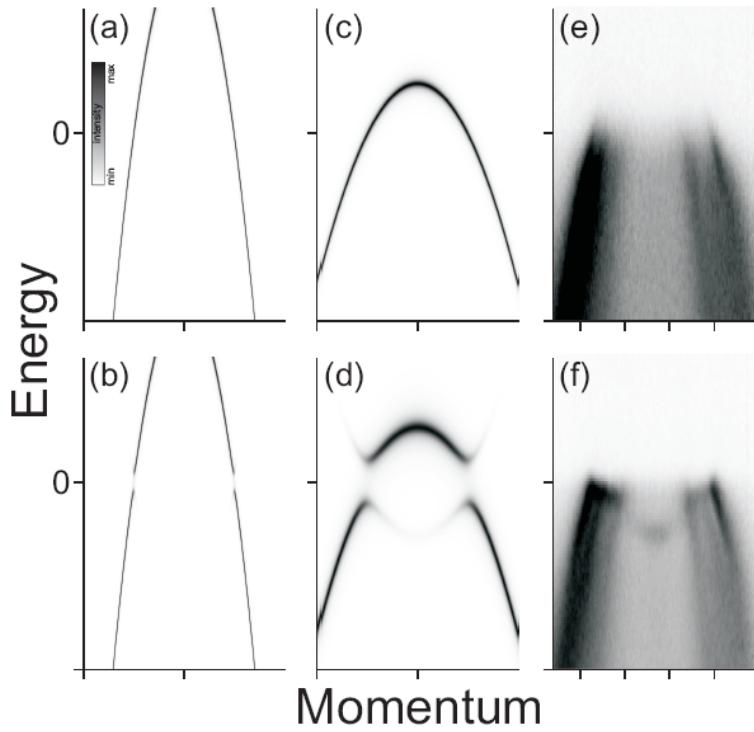
BFA: density of states

Hole doped KFA

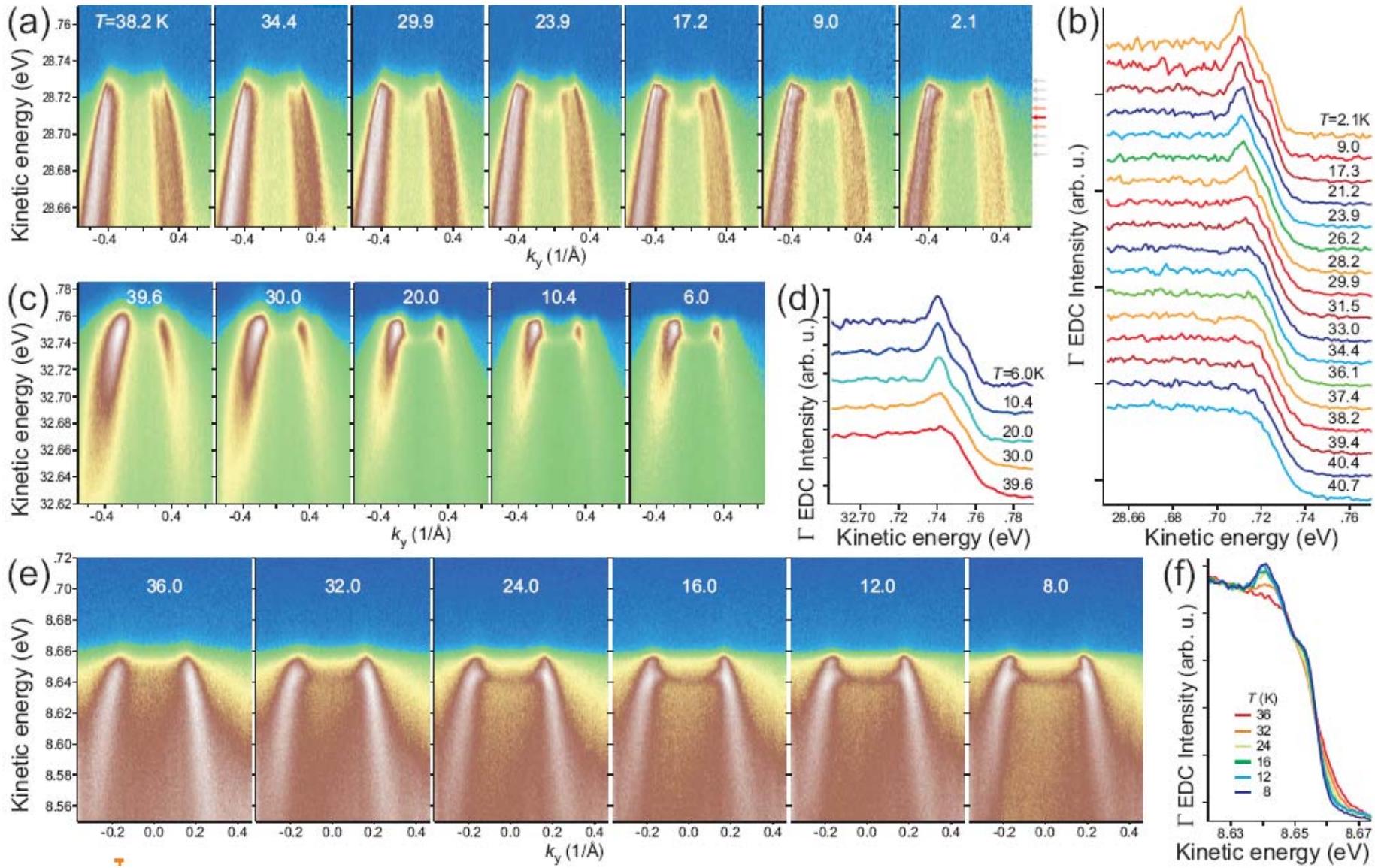


- The band structure of Fe-SC is well captured by LDA but do not take it too literally. **The calculated Fermi surface is usually bad starting point for theory.**
- Main contributors to SC are **dxz, yz** electrons and T_c for different compounds seems to correlate with the position of the Van Hove singularities (Lifshitz transitions) for the xz - and yz -bands.

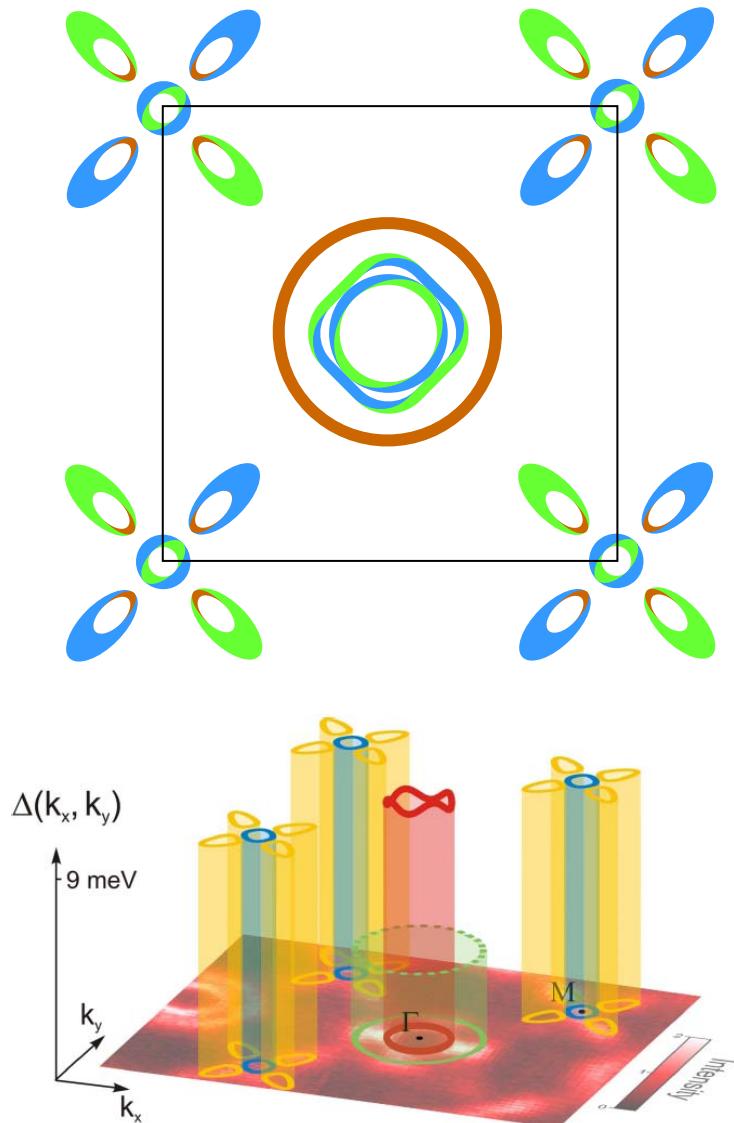
Fusion of bogoliubons in BKFA



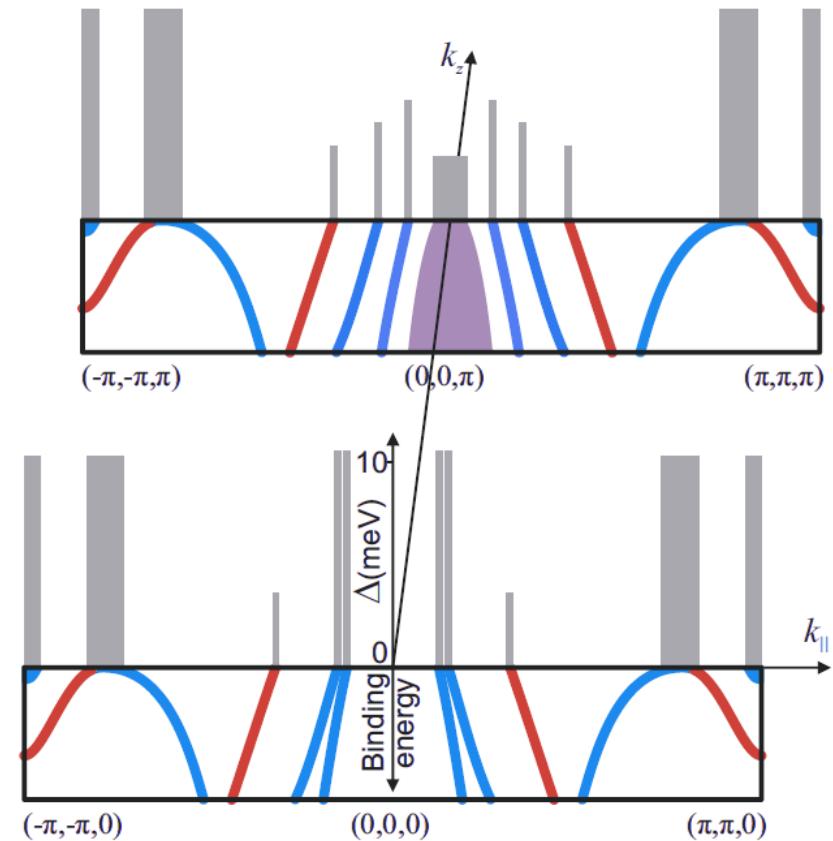
BKFA: band structure



BKFA: Fermi surface and gaps



D. Evtushinsky [PRB 2009](#), [NJP 2009](#)



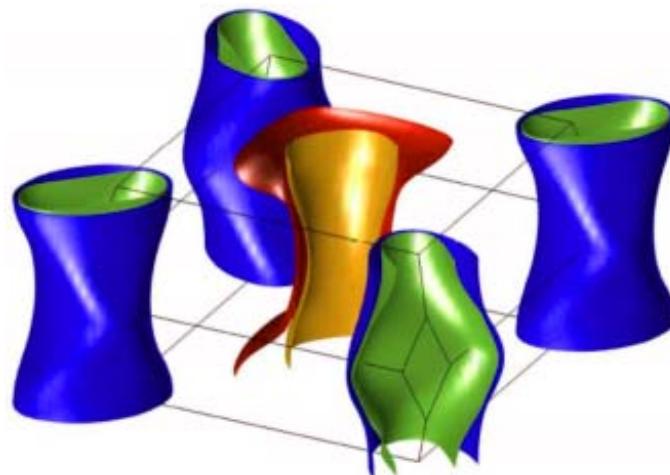
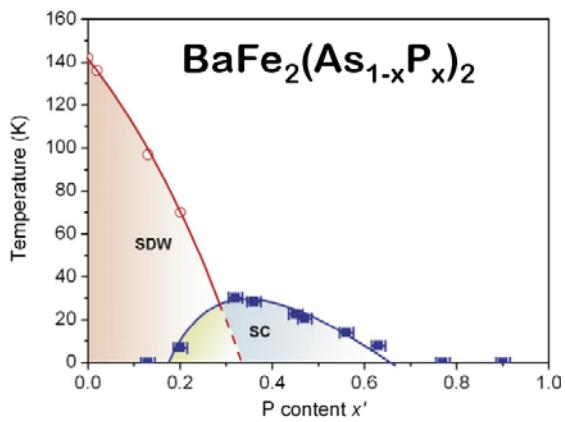
Δ correlates with the orbital composition:
 $\Delta = 3\text{--}4$ meV for $3dxz$ and $3dz^2$
 $\Delta = 10.5$ meV for $3dxz/yz$.

D. Evtushinsky 2011

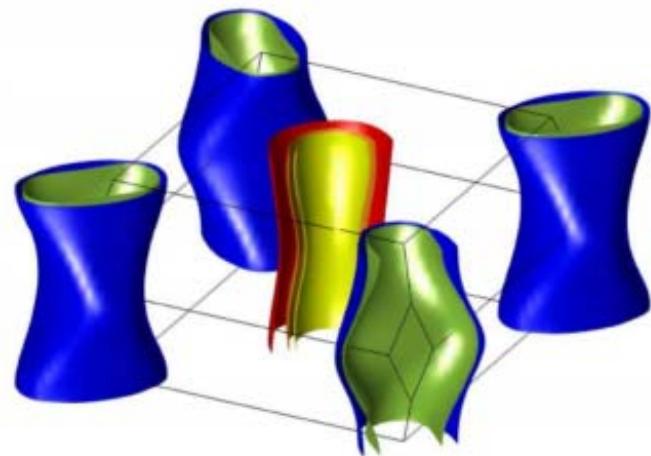
122

isovalent doping

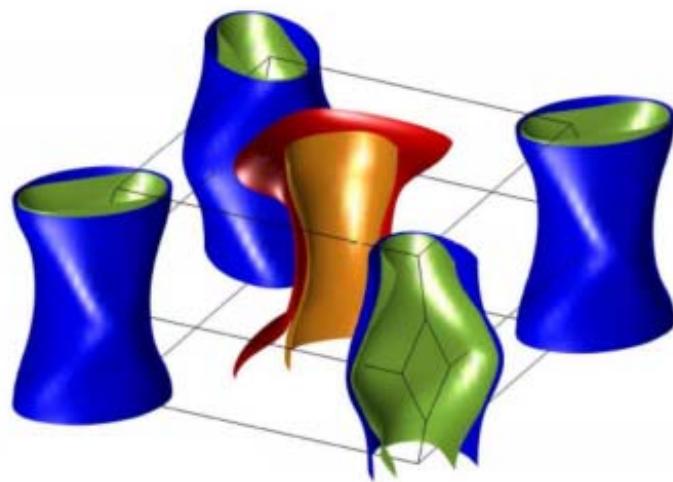
$\text{BaFe}_2(\text{As}_{1-x}\text{P}_x)_2$ (BFAP)

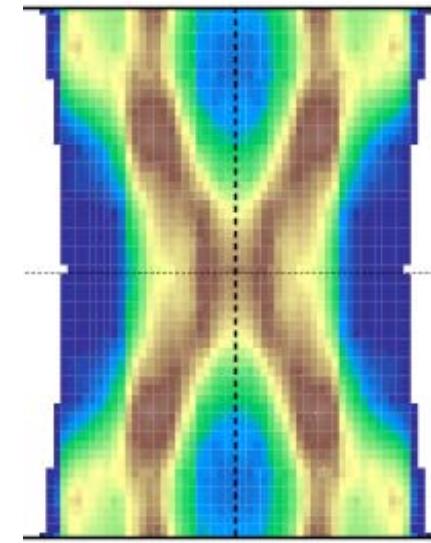
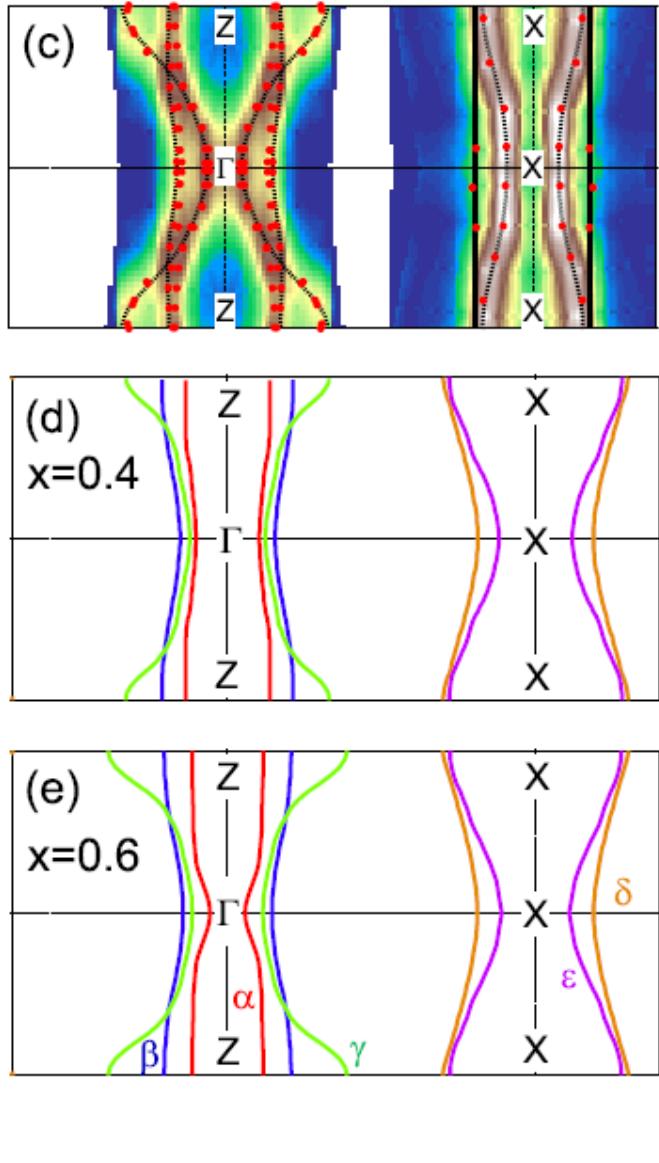
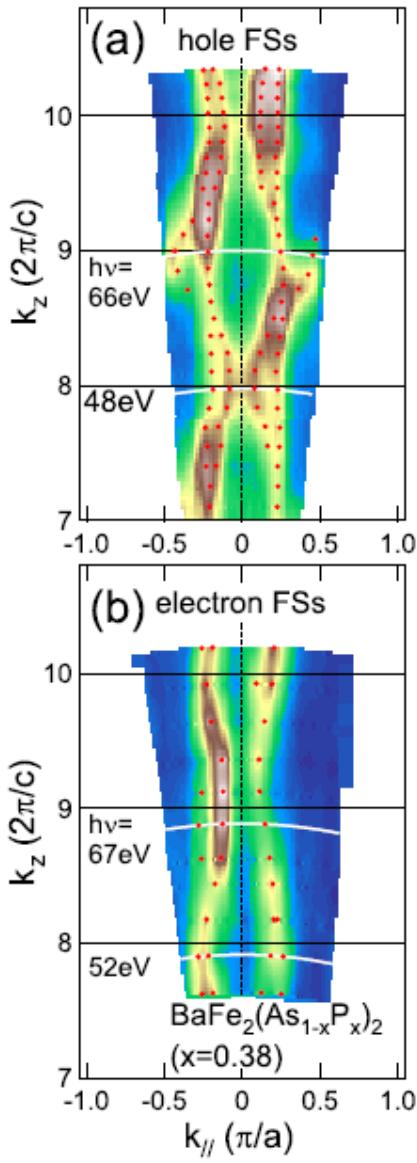


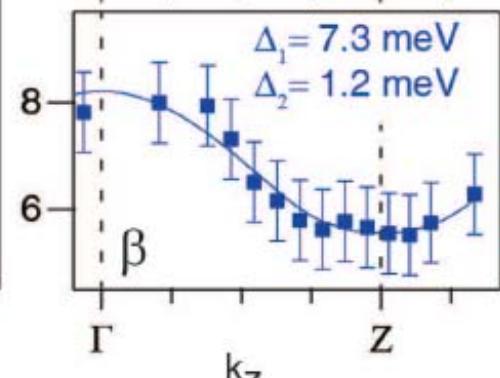
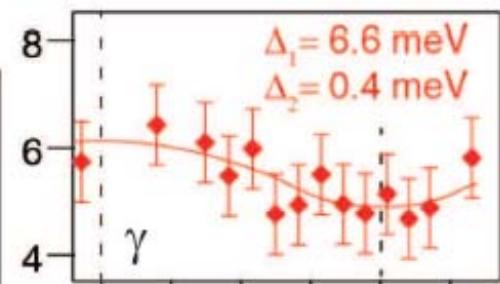
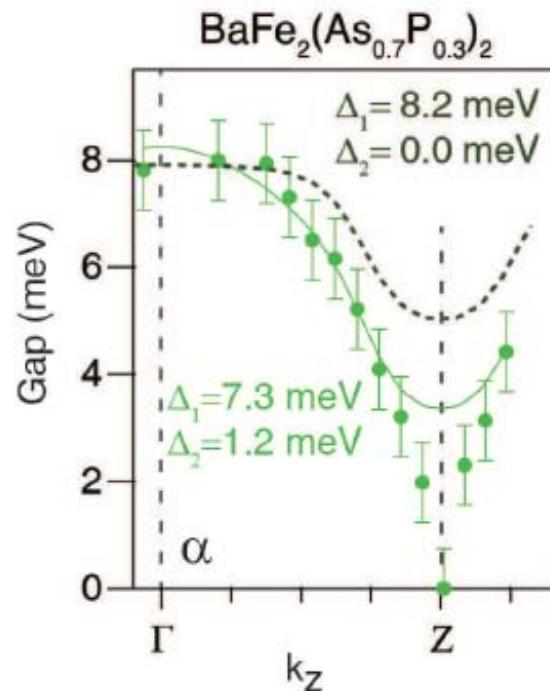
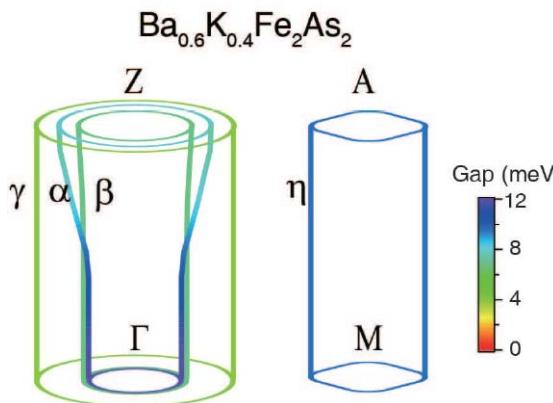
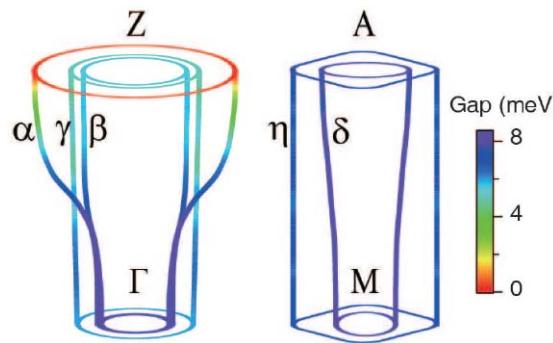
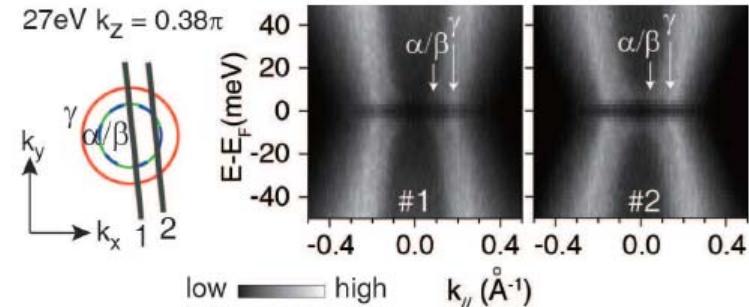
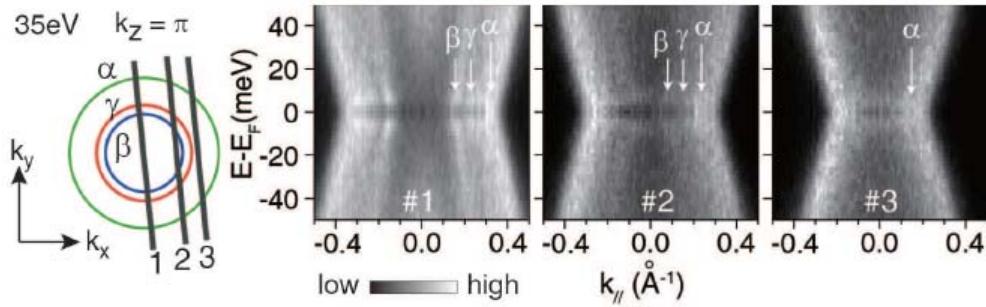
BaFe_2As_2



BaFe_2P_2



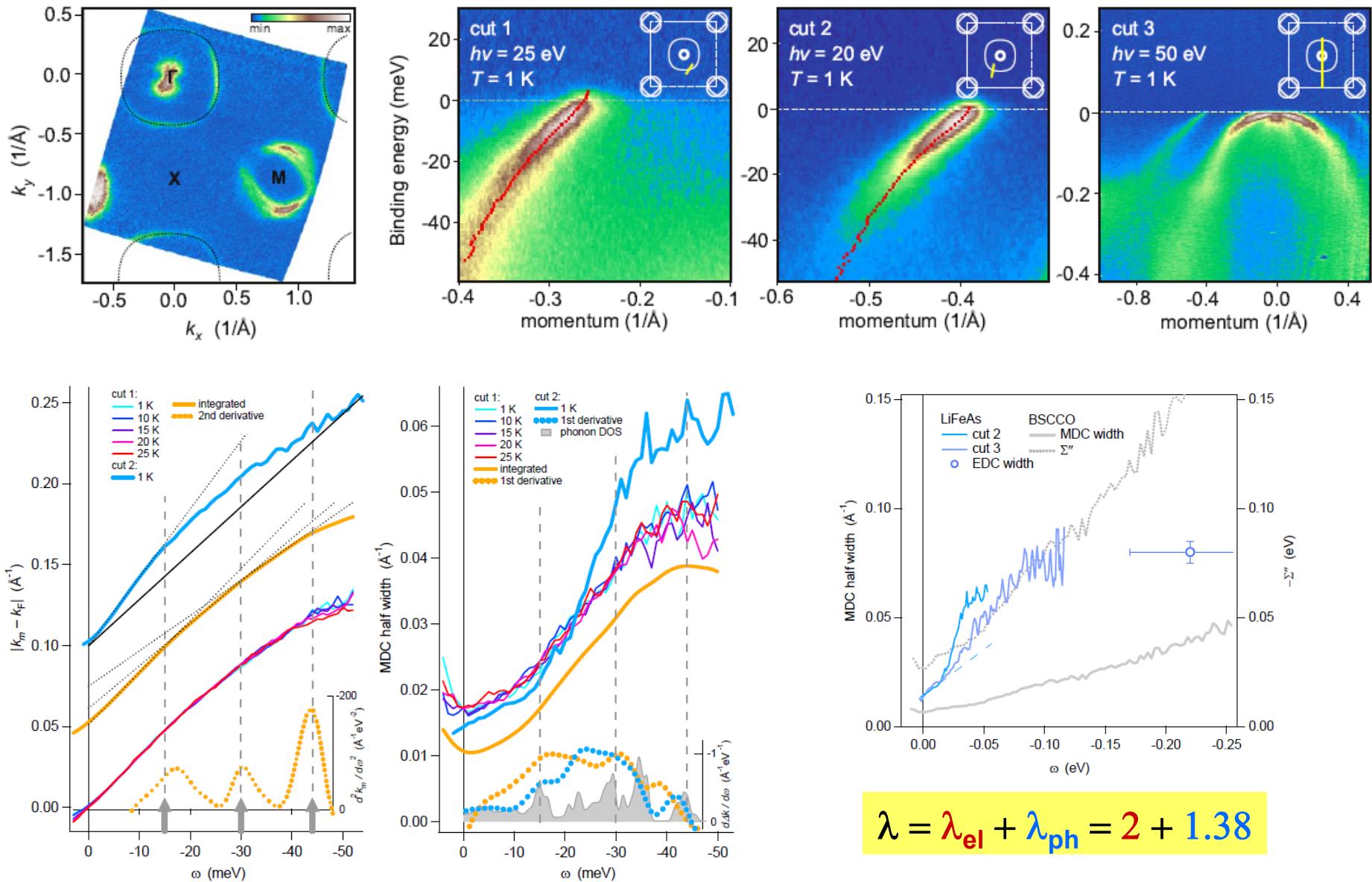




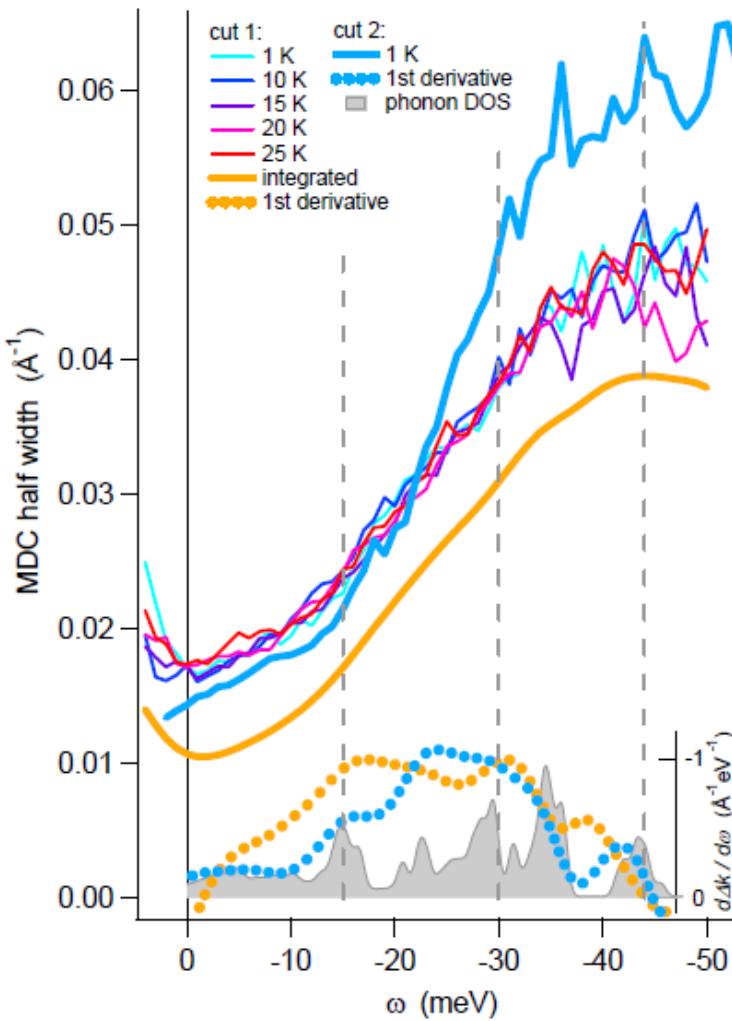
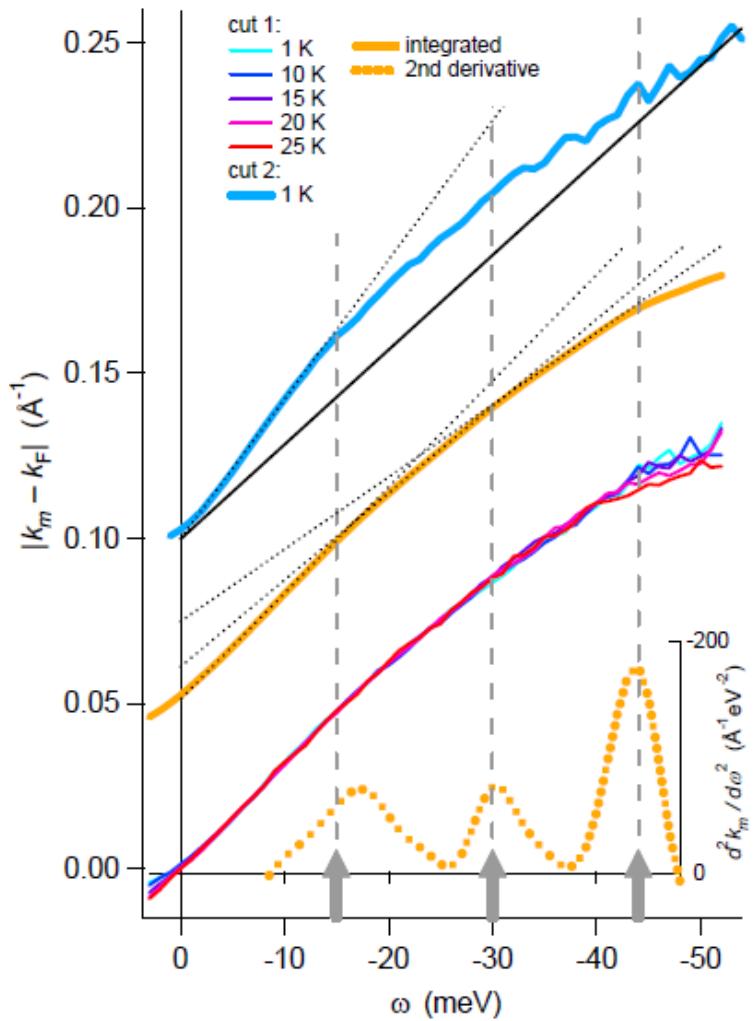
Self-energy in Fe-SC

- crystal quality**
- 3D**
- lack of manpower**

LiFeAs: renormalization

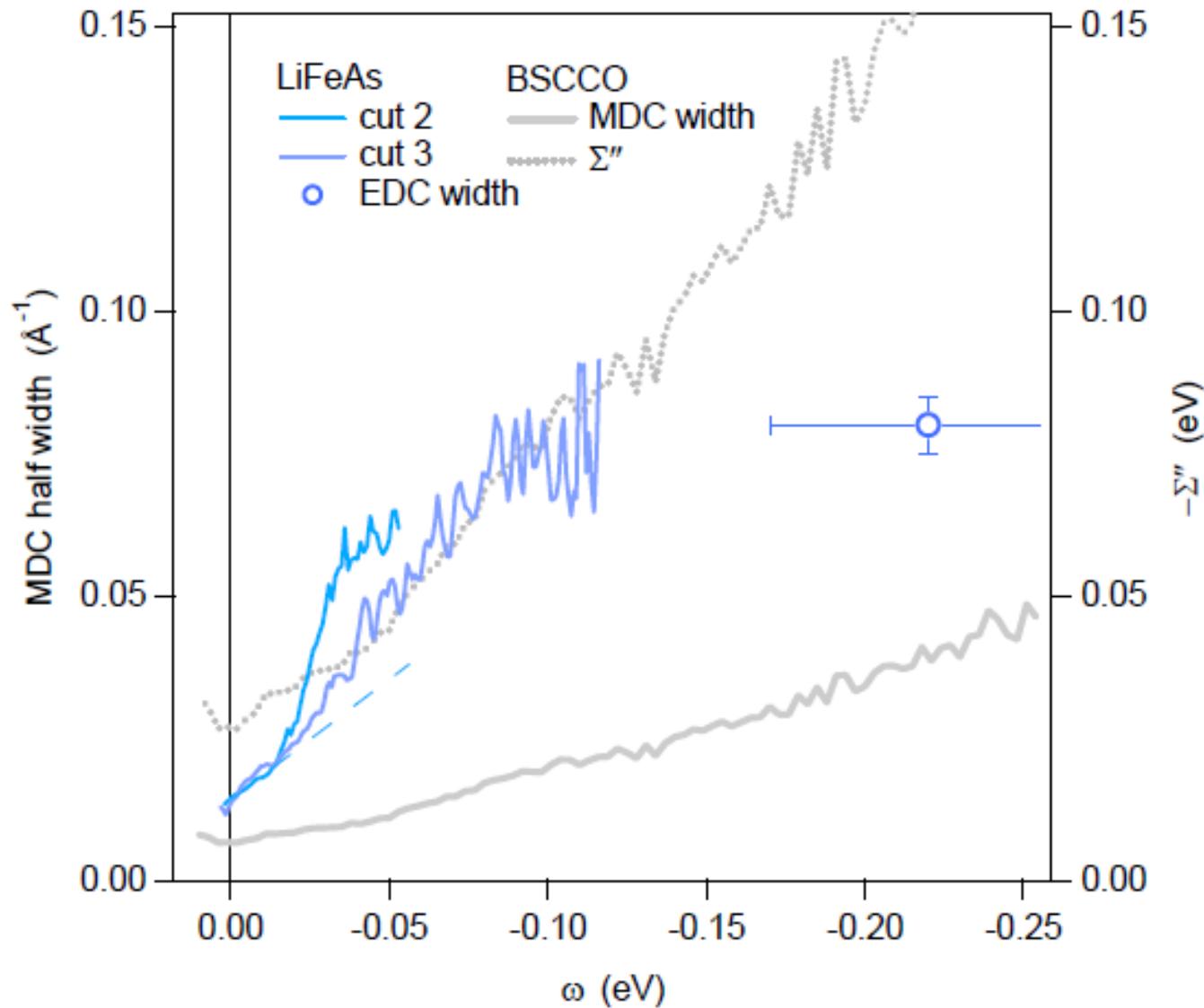


LiFeAs: renormalization

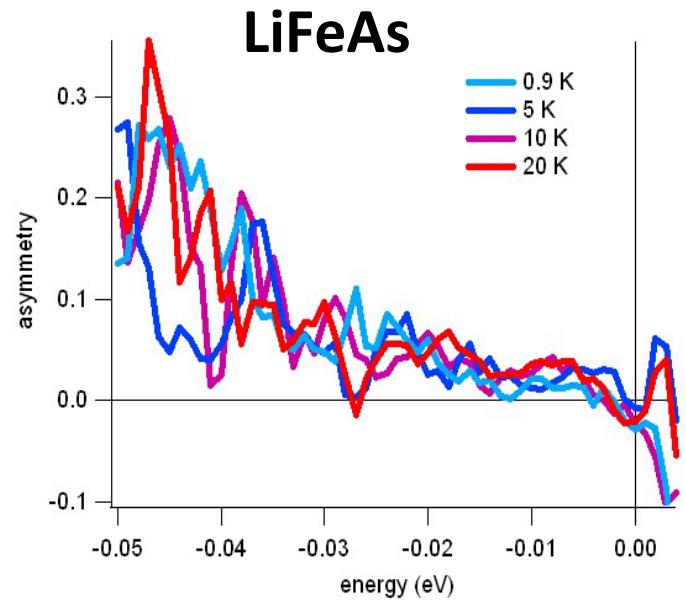
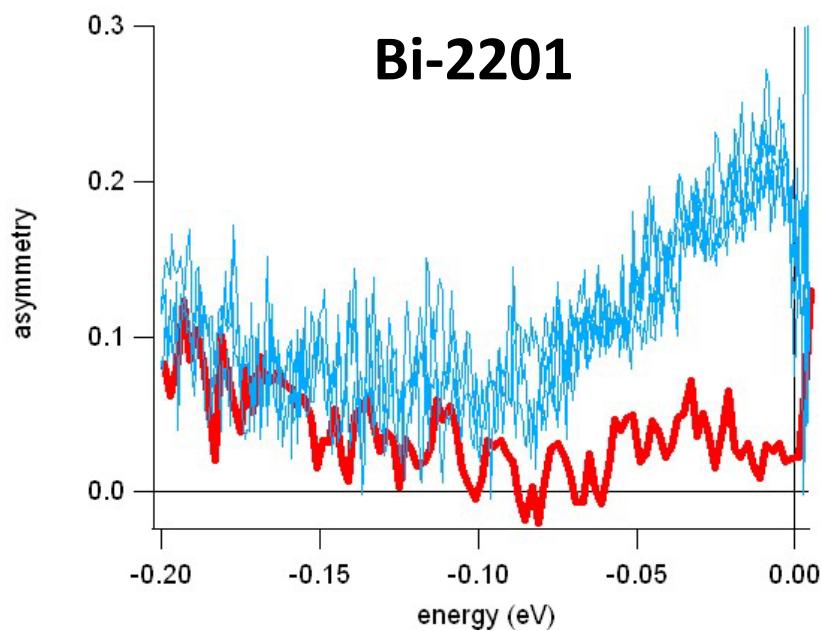
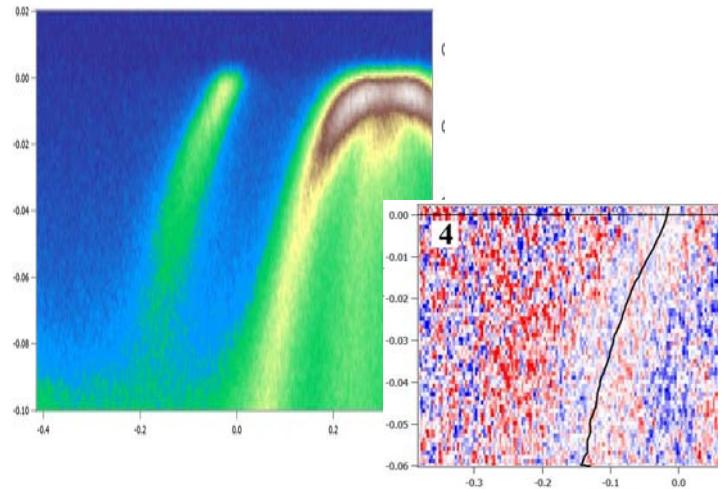
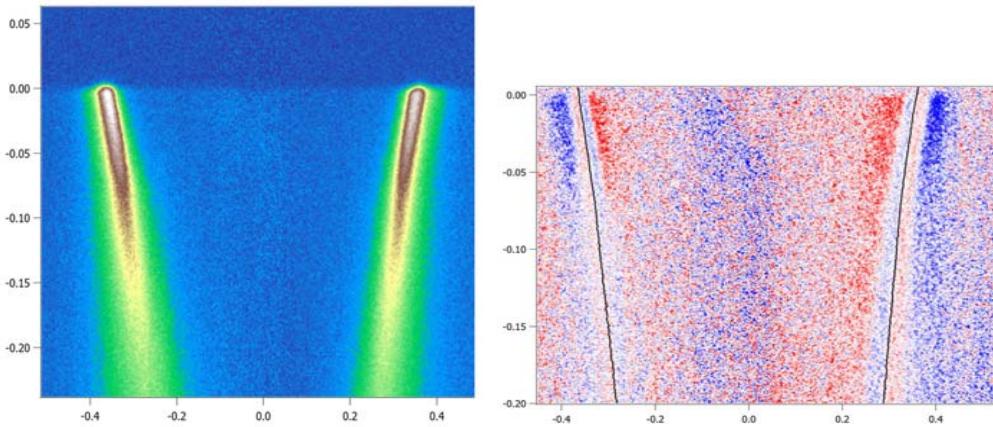


$$\lambda = \lambda_{\text{el}} + \lambda_{\text{ph}} = 2 + 1.38$$

LiFeAs: renormalization



MDC asymmetry = k-dependent self-energy



Cuprates vs ferropnictides

	Cu-SC	Fe-SC
band structure	simple (1 band, split)	complex (5 bands)
renormalization	k-dependent	band dependent
$1+\lambda$ (ω cutoff)	k-dependent 2 (0.5 eV)	>4 (50 meV) 3 (1.5 eV)
SC gap	k-dependent	band dependent
pseudogap	k-dependent	no
main interaction	SF	(phonons + SF) *multi-bands

Collaboration

IMP

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Mark Golden (UvA)
Toni Valla (BNL)
...



Neutron Scattering

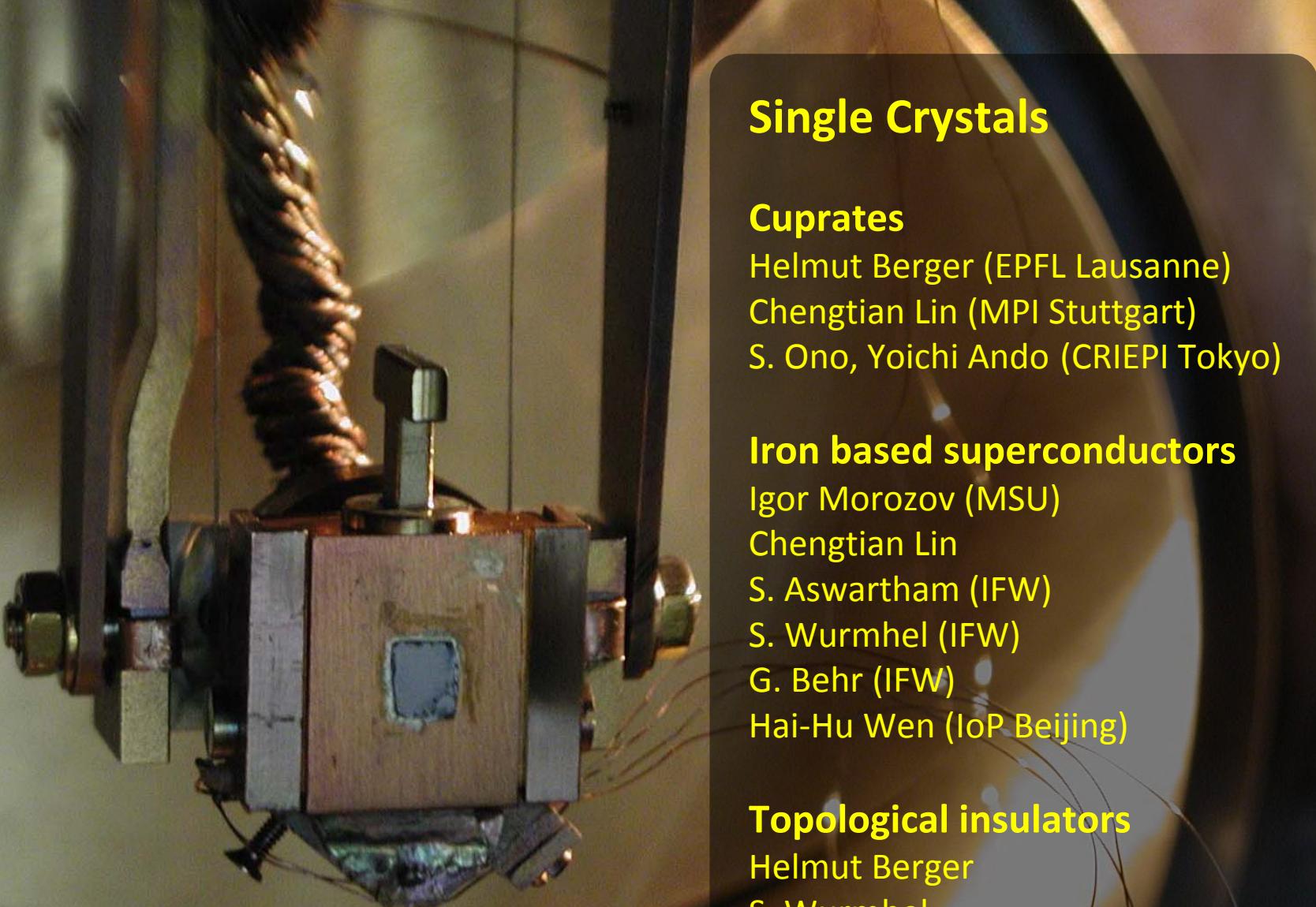
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Single Crystals

Cuprates

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Chengtian Lin (MPI Stuttgart)

S. Ono, Yoichi Ando (CRIEPI Tokyo)

Iron based superconductors

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Chengtian Lin

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Vladimir Strocov
Luc Patthey
Joel Mesot

ELETTRA (Trieste)

Alexei Barinov
Pavel Dudin
Stefano Turchini



The background image shows a large, modern building with a dark, angular facade. It is illuminated from within by several horizontal rows of bright yellow lights, which create a glowing effect against the dark sky. The building is set against a backdrop of dark hills or mountains under a dark, cloudy sky.

Thank you!