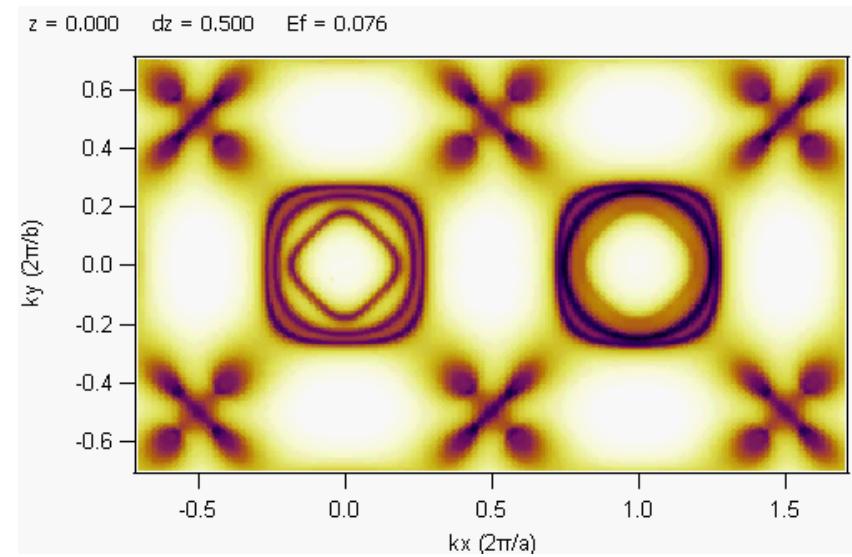
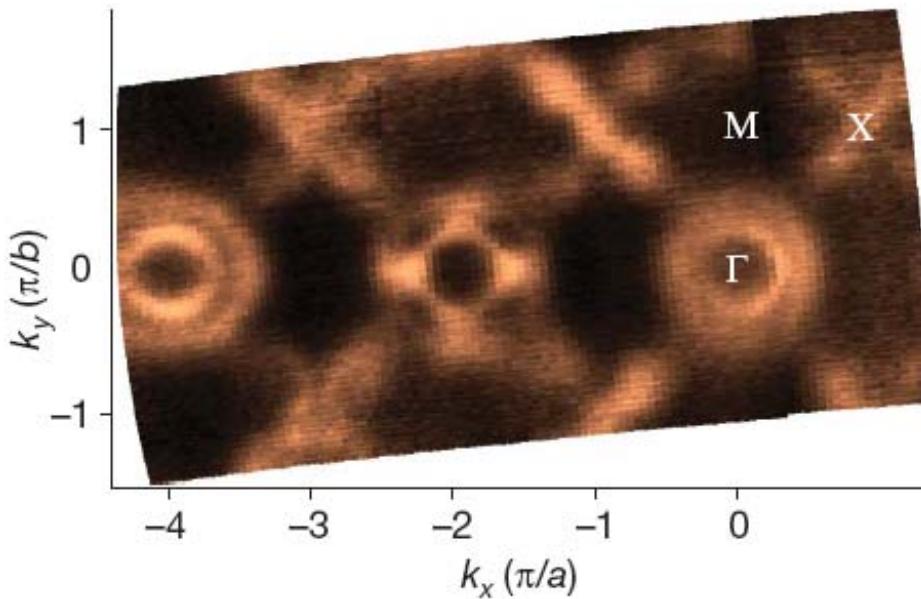
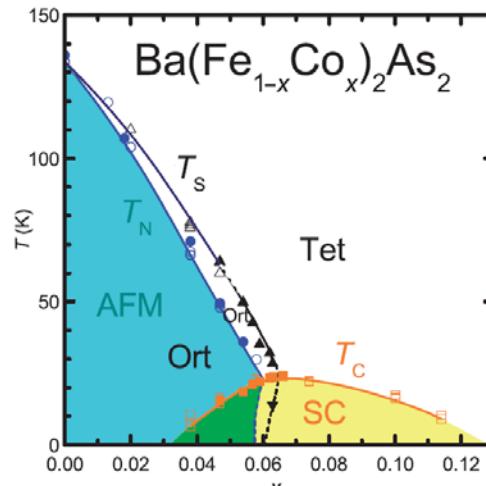
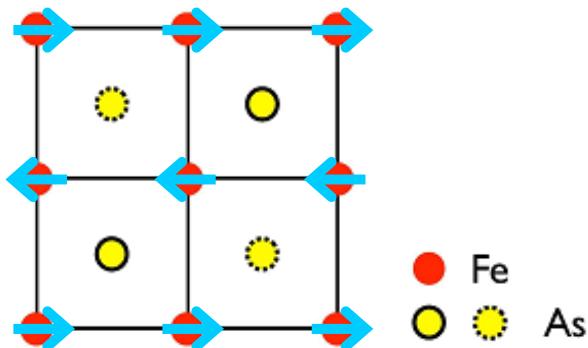
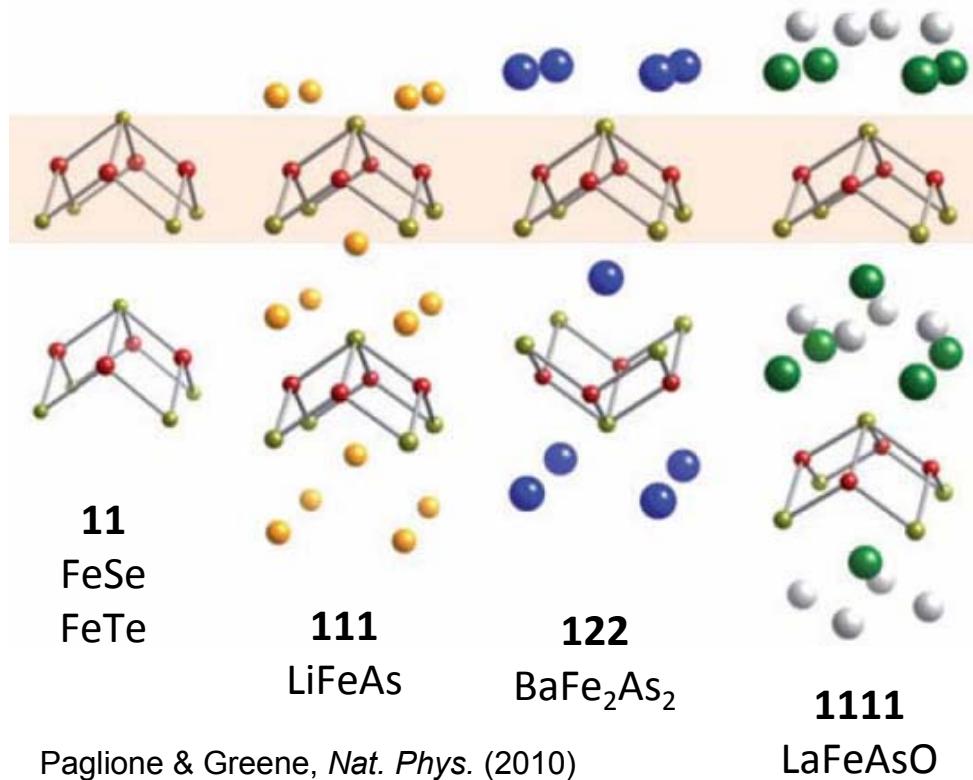


Complex electronic structure of iron-based superconductors as a key to high temperature superconductivity

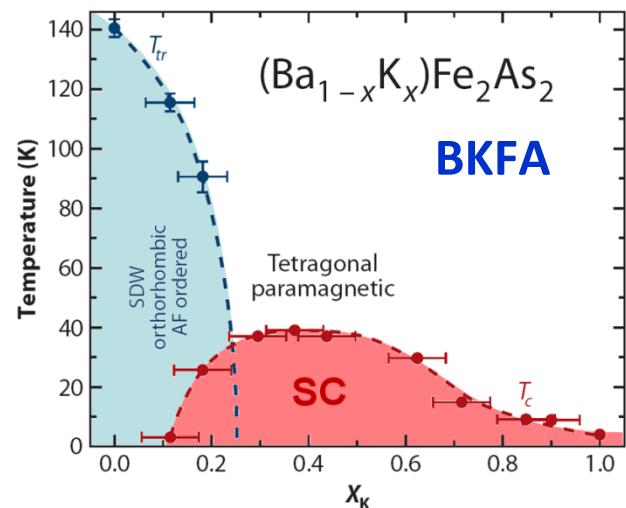


Alexander Kordyuk
Institute of Metal Physics

Iron-based superconductors (FeSC)

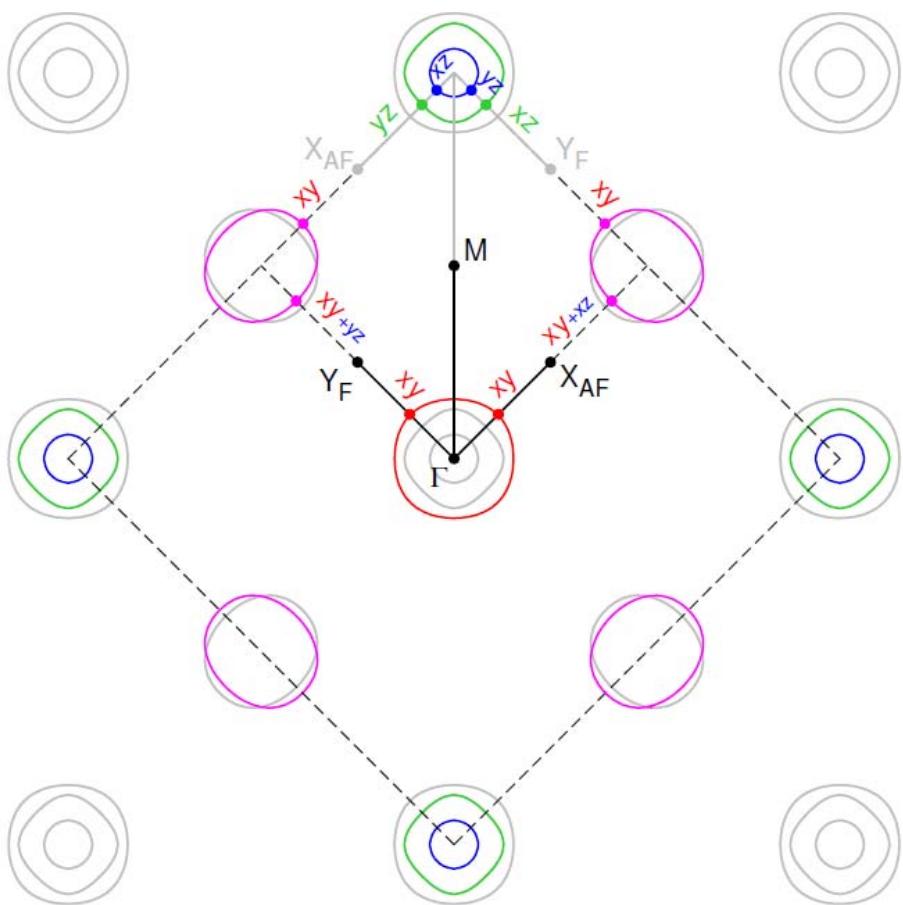
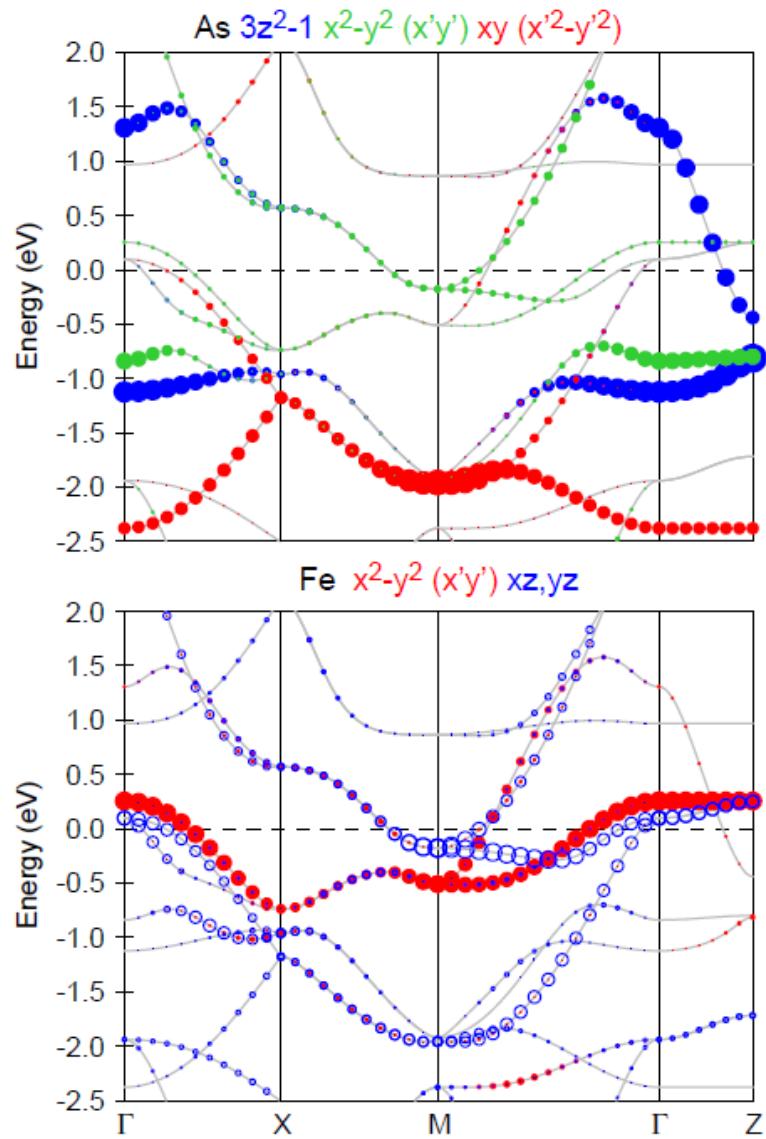


S.Nandi et al. [PRL 2010](#)

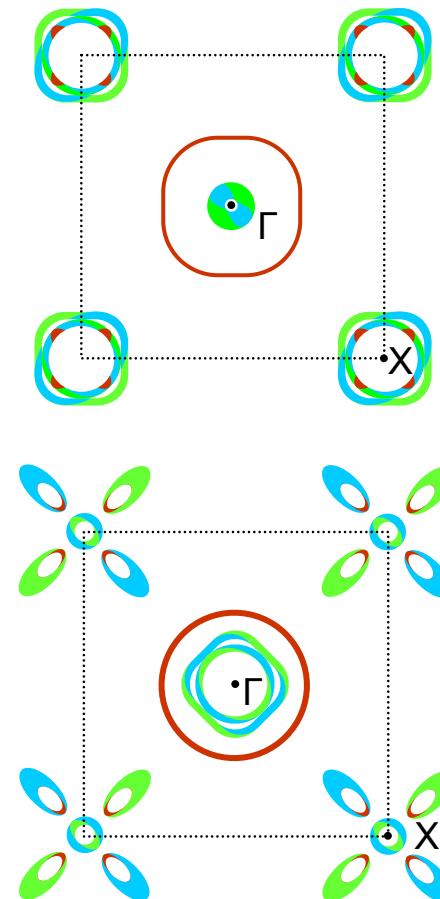
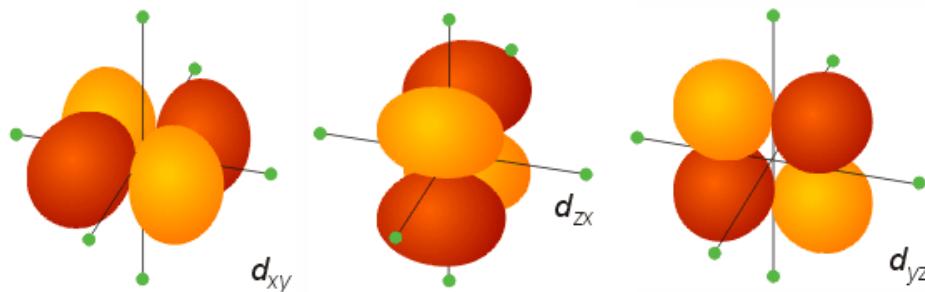
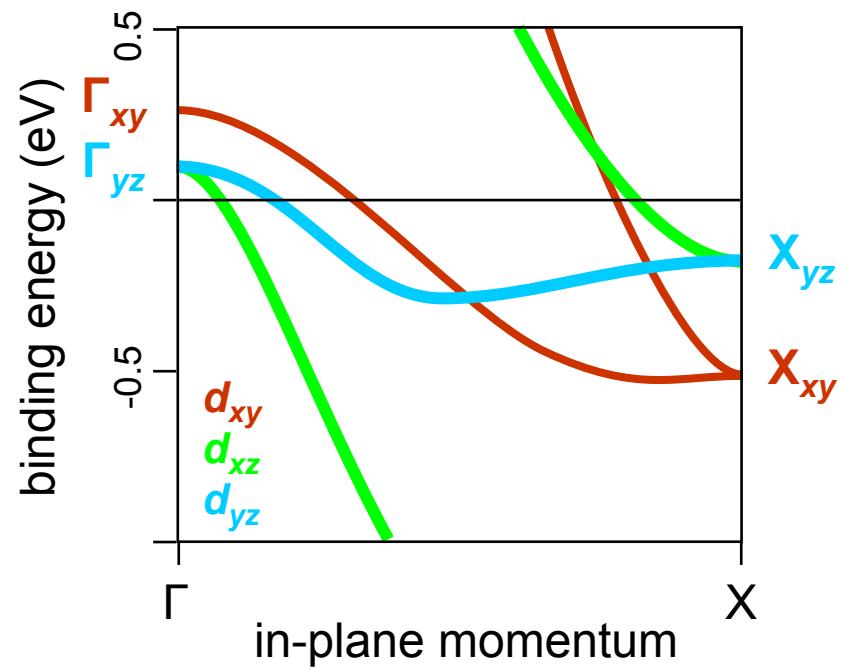


H.-H.Wen & S.Li [Annu. Rev. Cond. Mat. Phys. 2011](#)

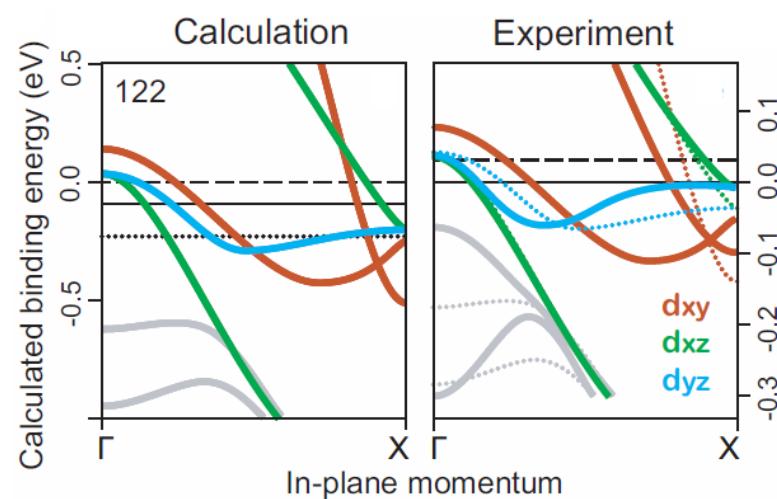
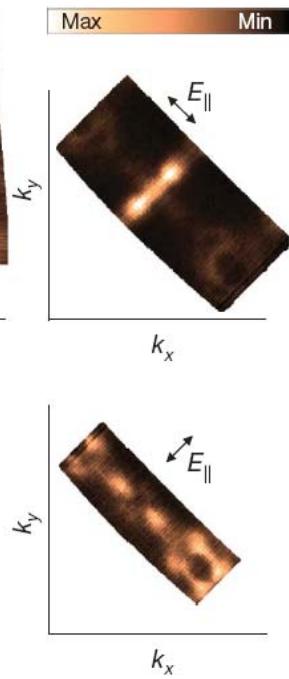
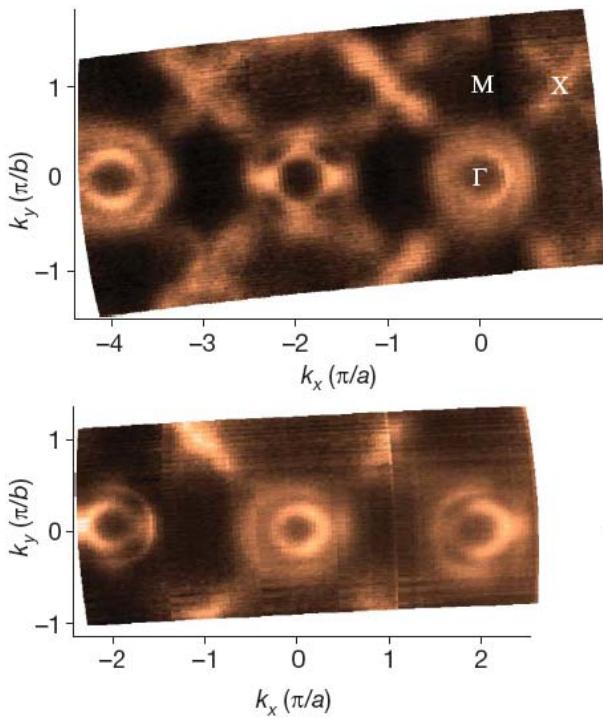
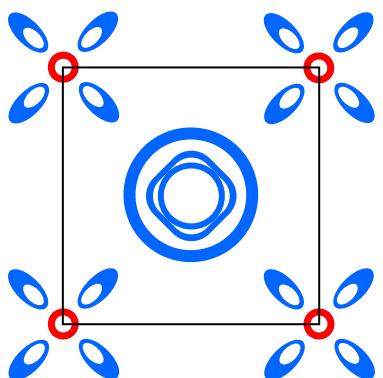
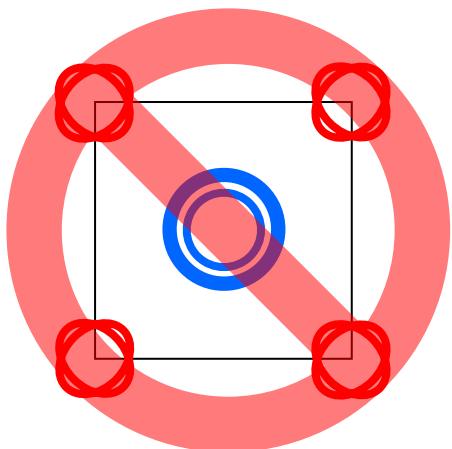
FeSC electronic band structure



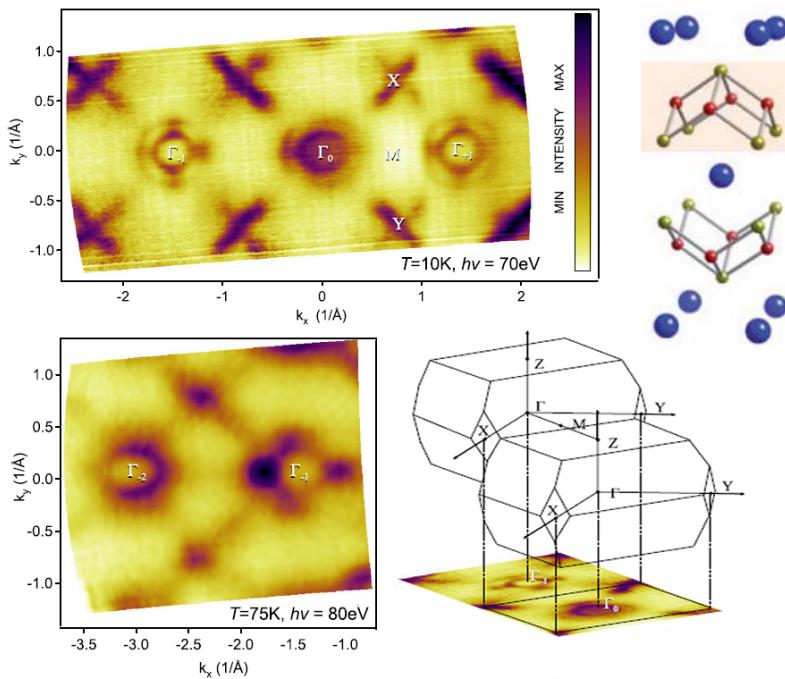
Iron-based superconductors: electronic structure



Fermi surface of BKFA

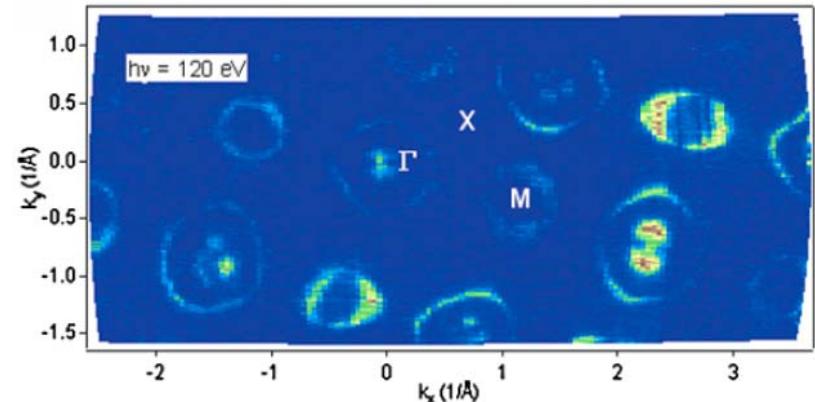
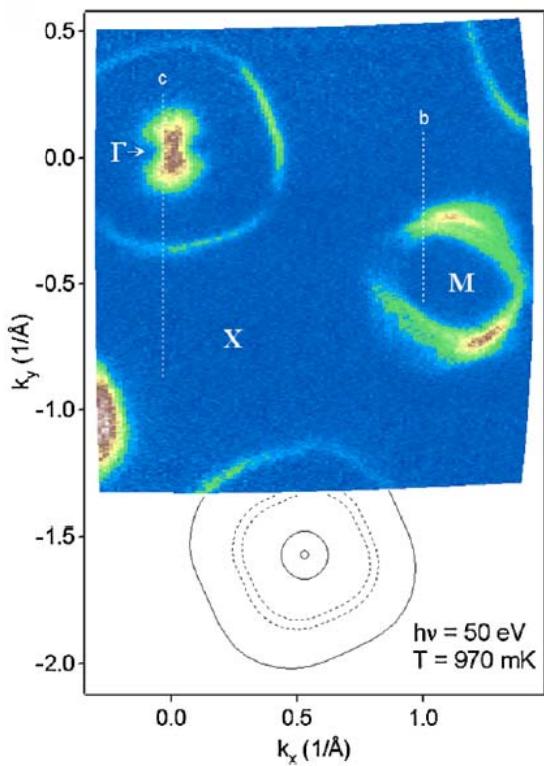


A. A. Kordyuk, *J. Supercond. Nov. Magn.* 2012

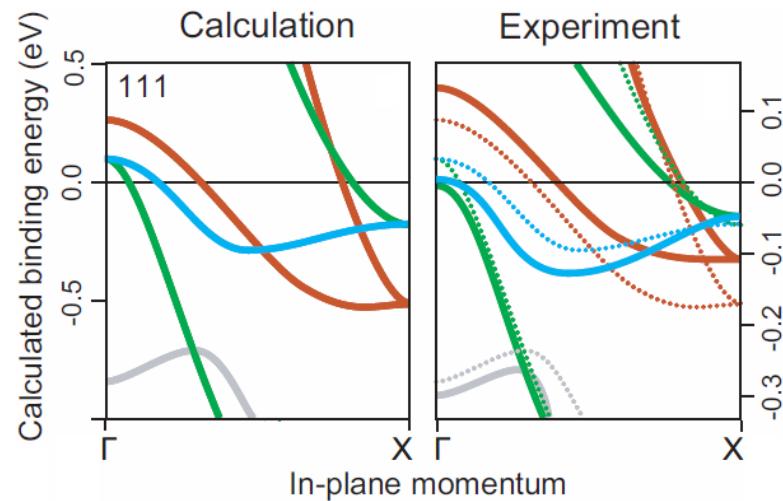
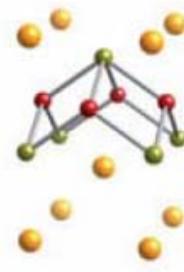
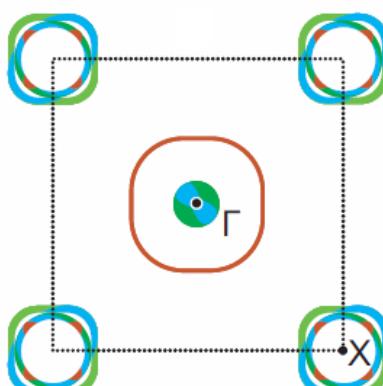


V. Zabolotnyy *Nature* 2009

Fermi surface of LiFeAs

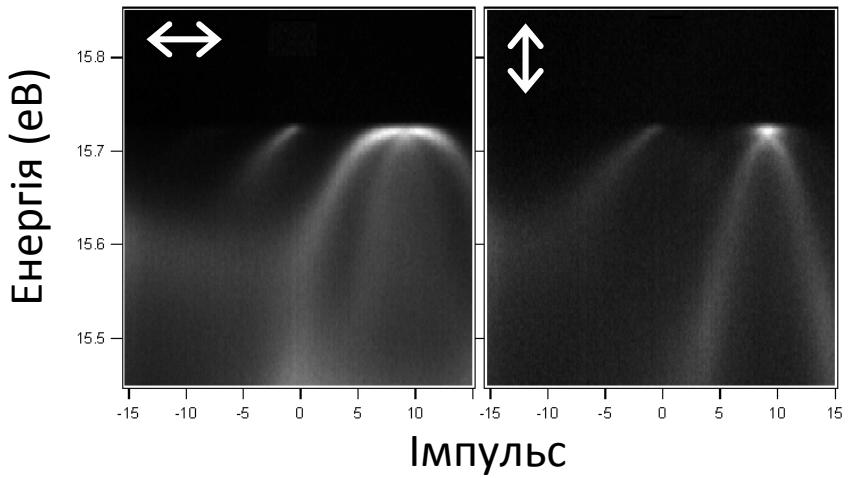


Borisenko PRL 2010



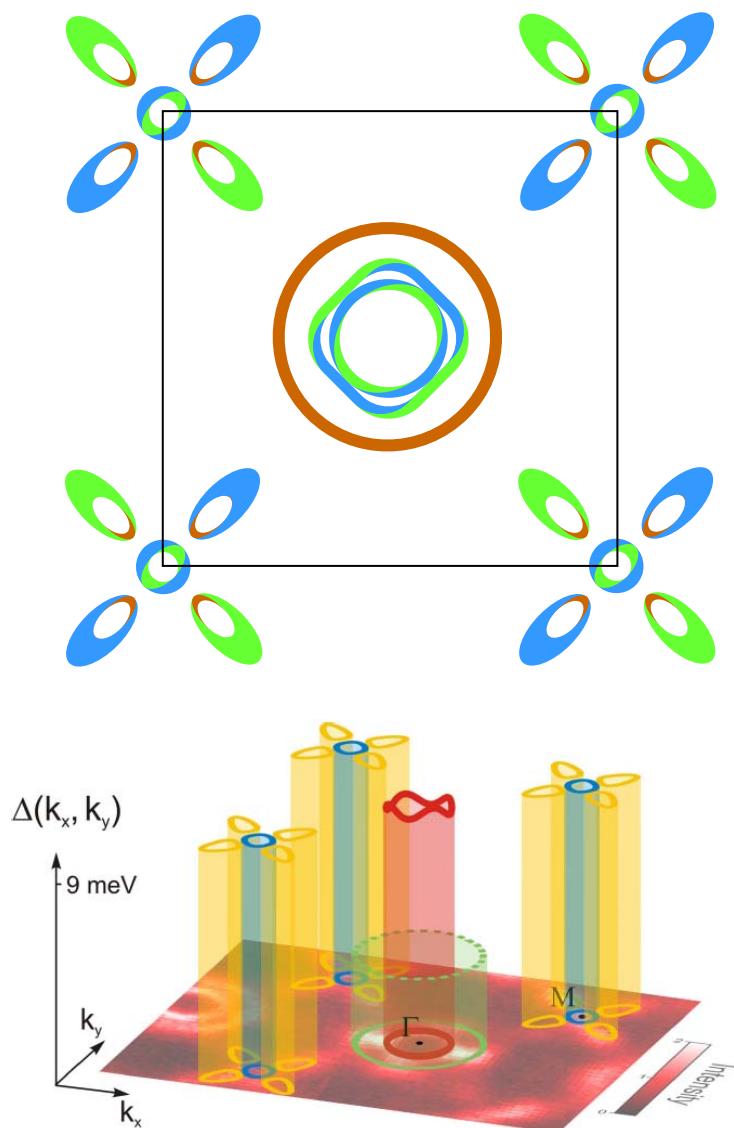
J. Supercond. Nov. Magn. 2012
Low Temp. Phys. 2012

поляризація

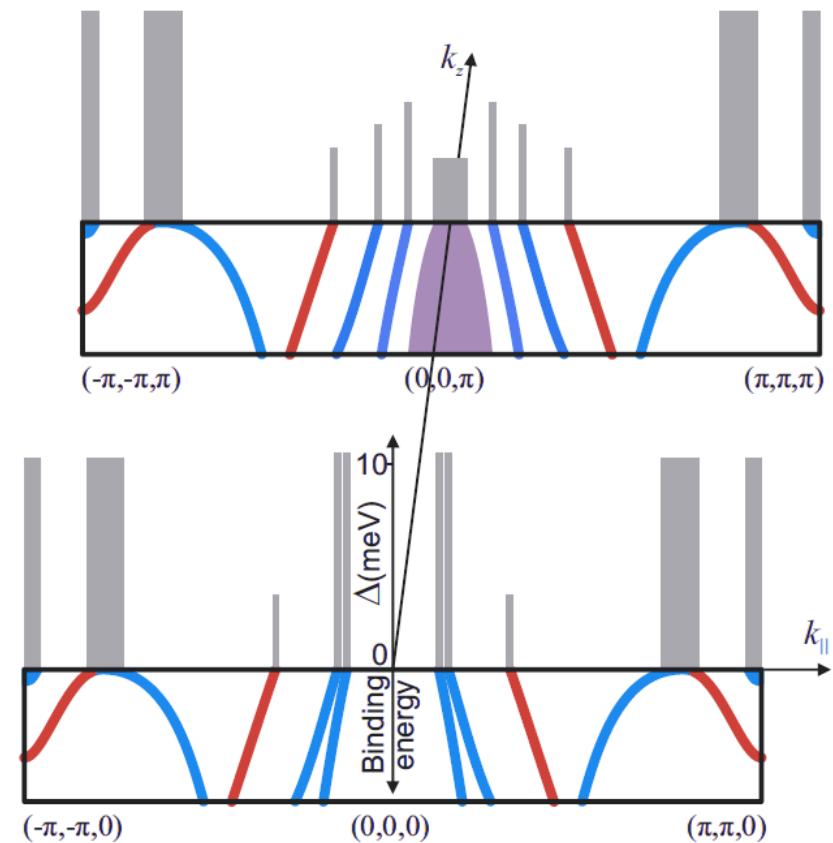


Kordyuk PRB 2011

BKFA: Fermi surface and gaps



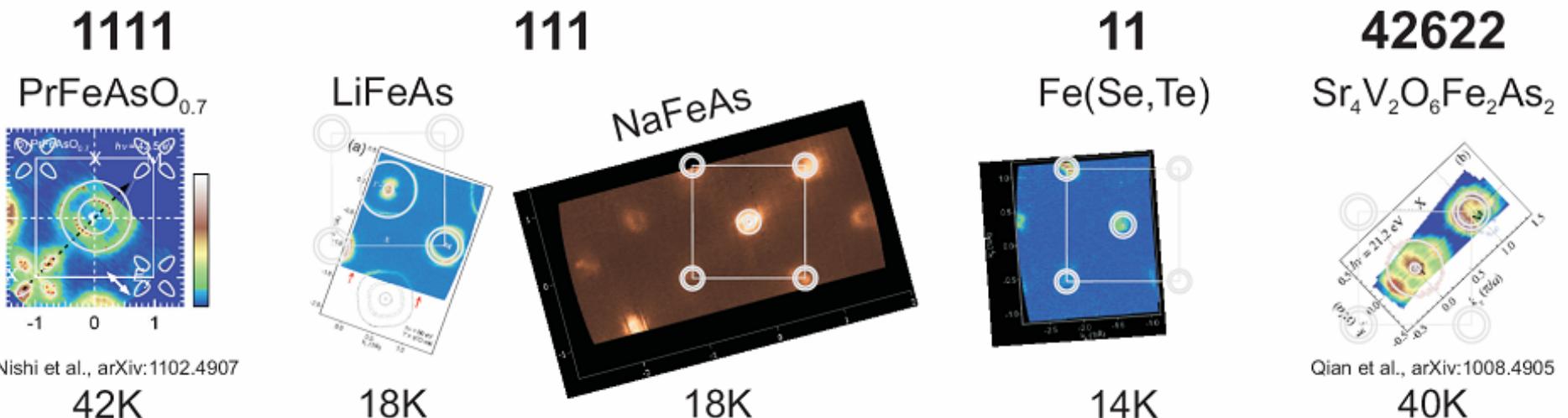
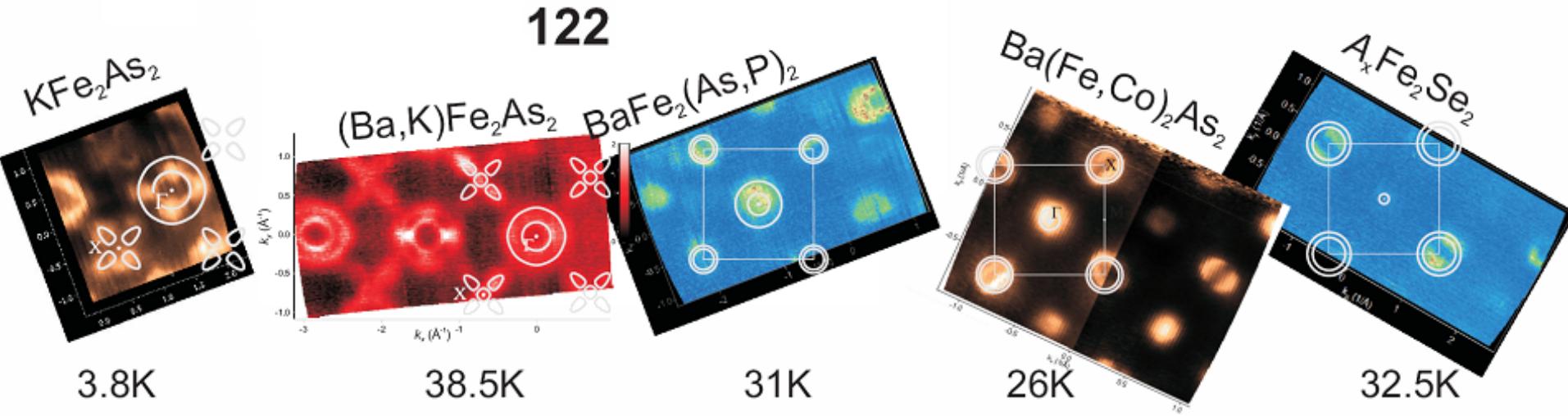
D. Evtushinsky [PRB 2009](#), [NJP 2009](#)



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

D. Evtushinsky 2011

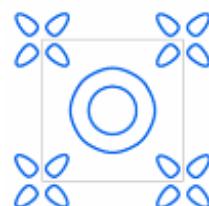
FS's of iron-based superconductors



FS's of iron-based superconductors

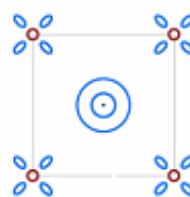
122

KFe_2As_2



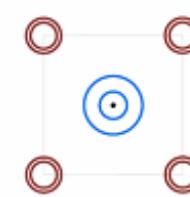
3.8K

$(Ba,K)Fe_2As_2$



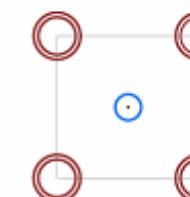
38K

$BaFe_2(As,P)_2$



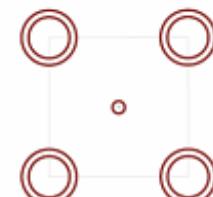
31K

$Ba(Fe,Co)_2As_2$



26K

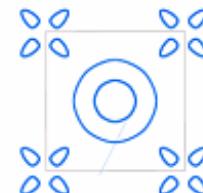
$A_xFe_2Se_2$



31K

1111

$PrFeAsO_{0.7}$



42K

111

$LiFeAs$



18K

$NaFeAs$



18K

11

$Fe(Se,Te)$



14K

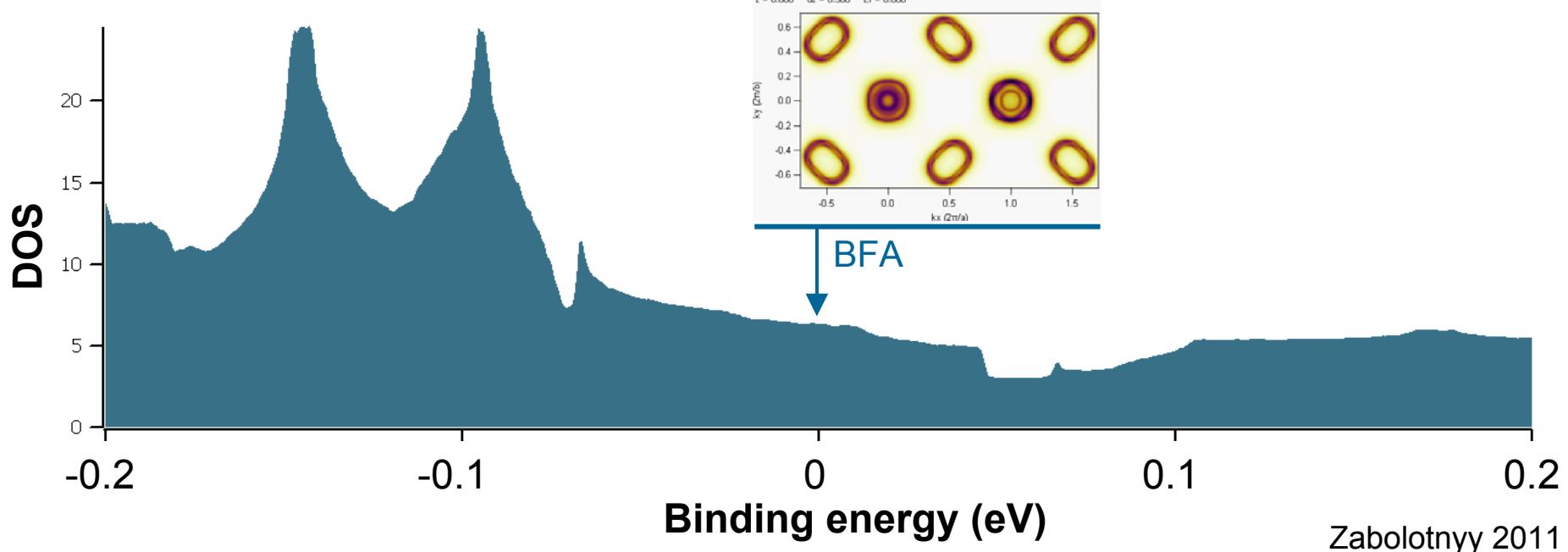
42622

$Sr_4V_2O_6Fe_2As_2$

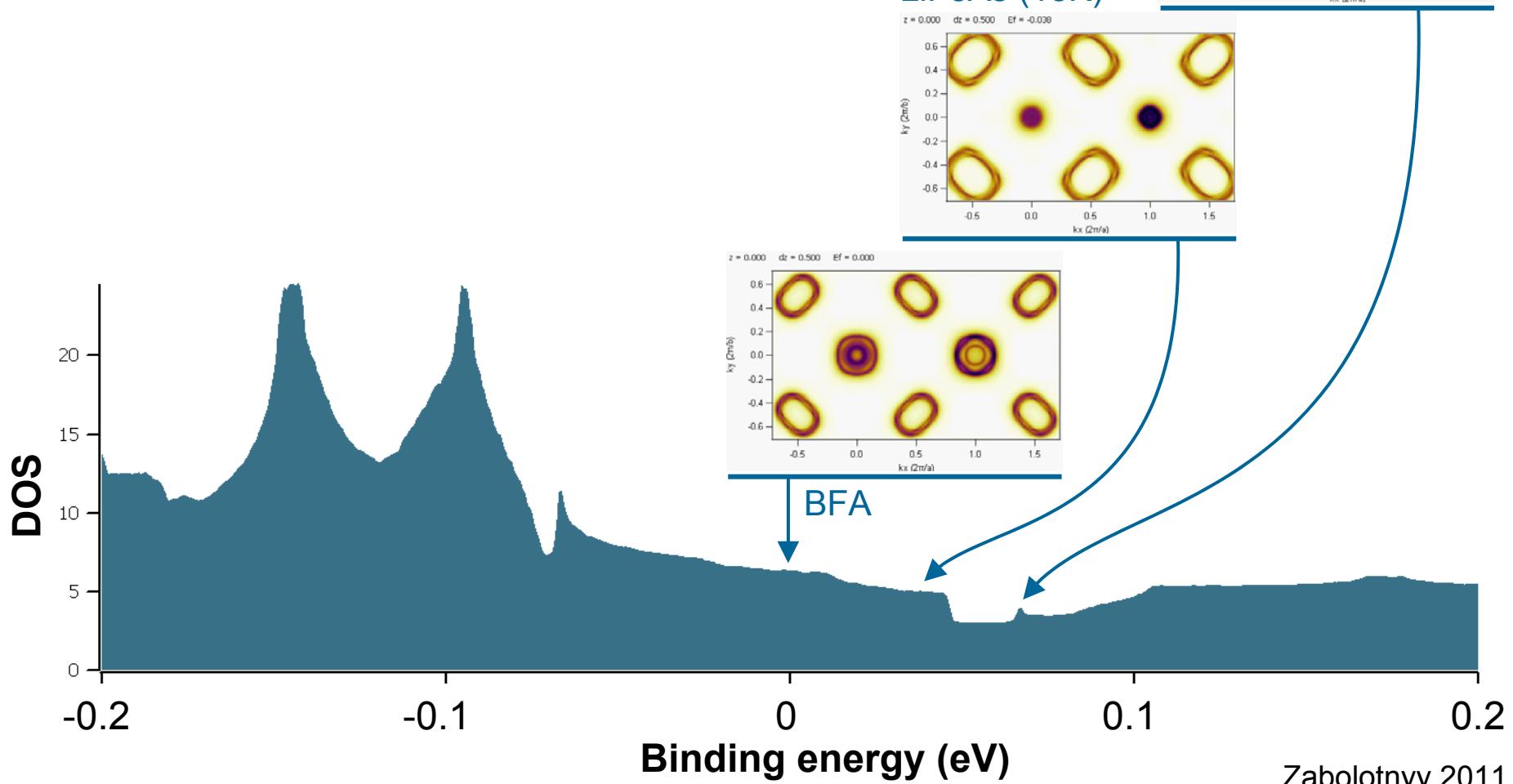


40K

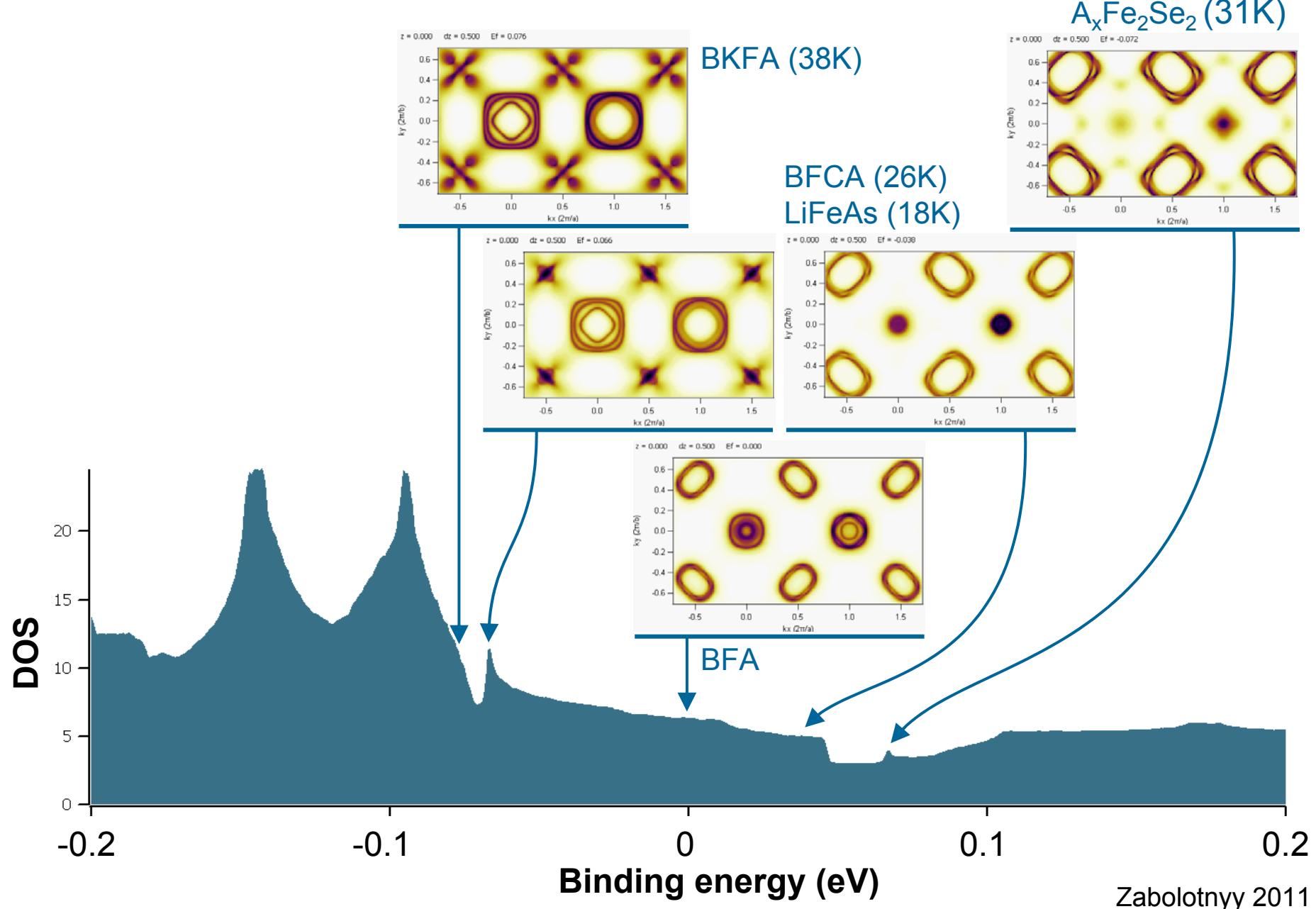
BFA: density of states



BFA: density of states

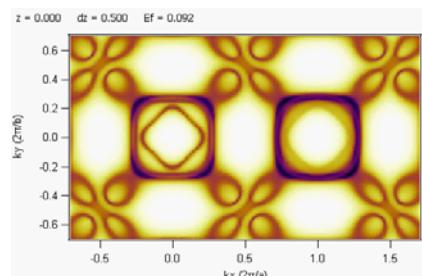


BFA: density of states

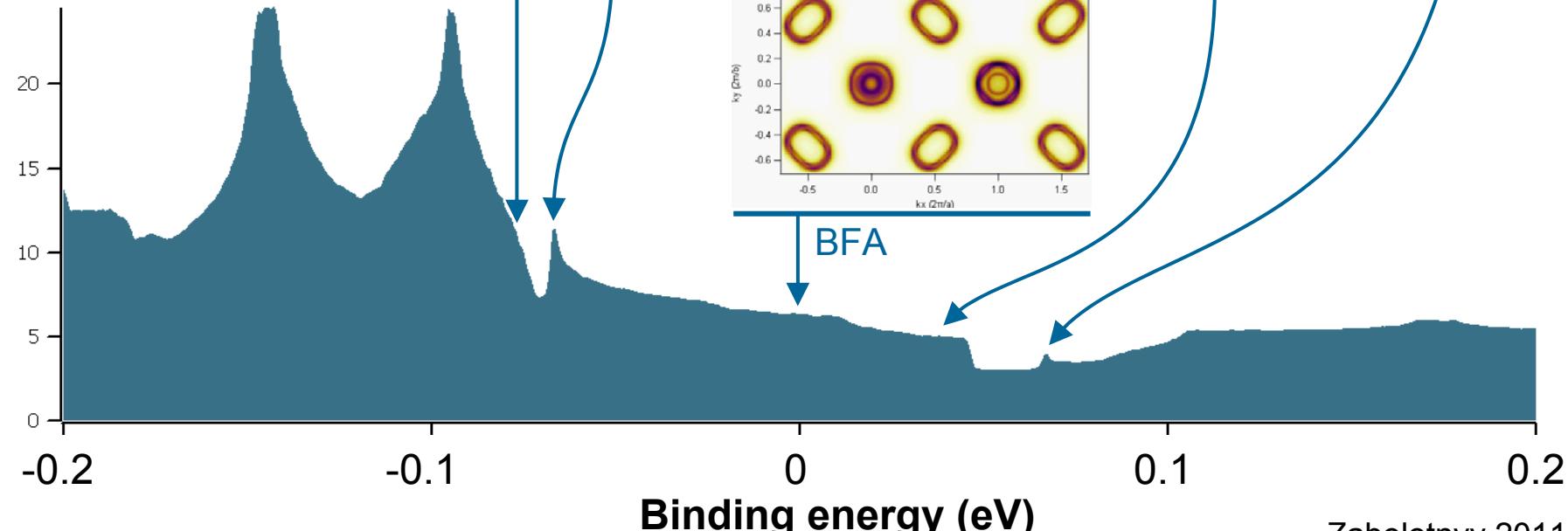


BFA: density of states

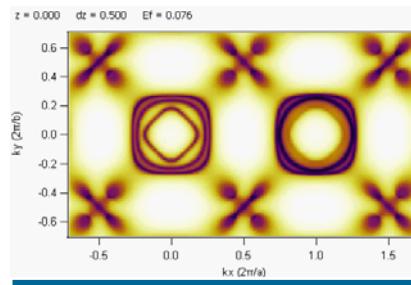
Hole doped KFA



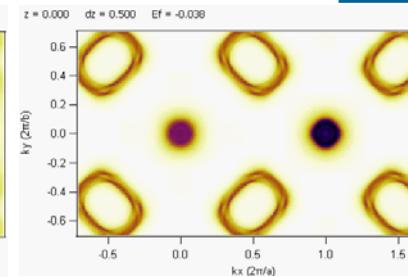
DOS



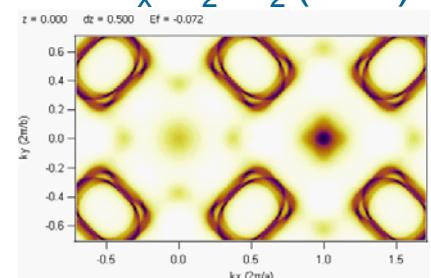
BKFA (38K)



BFCA (26K)
LiFeAs (18K)

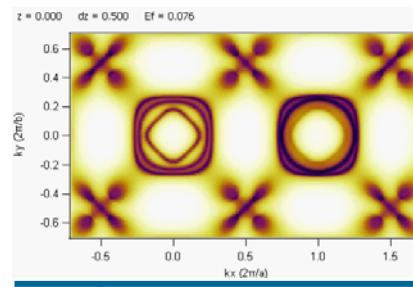
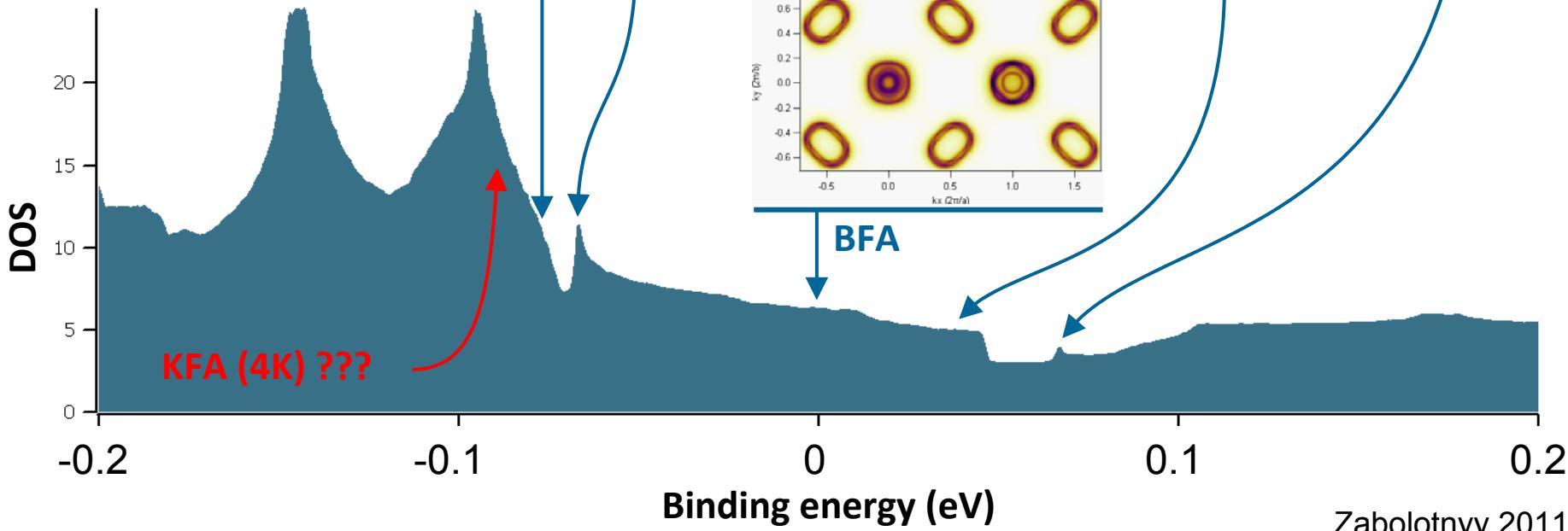
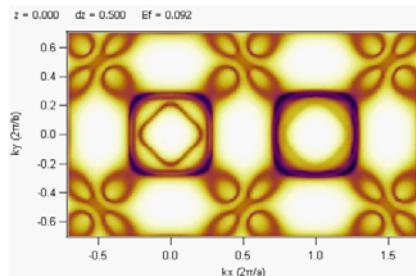


$A_xFe_2Se_2$ (31K)

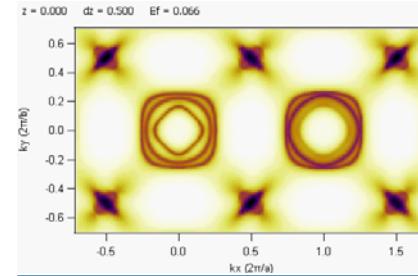


BFA: density of states

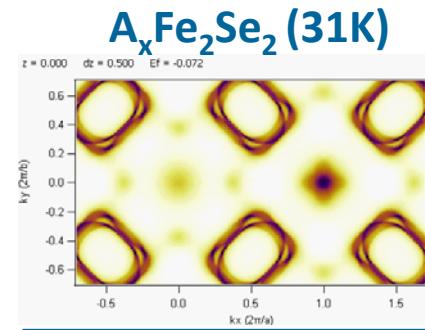
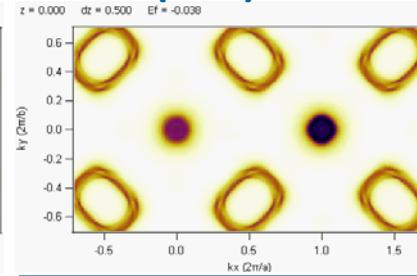
Hole doped KFA



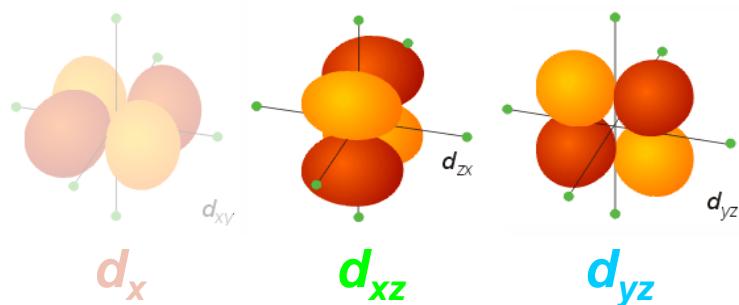
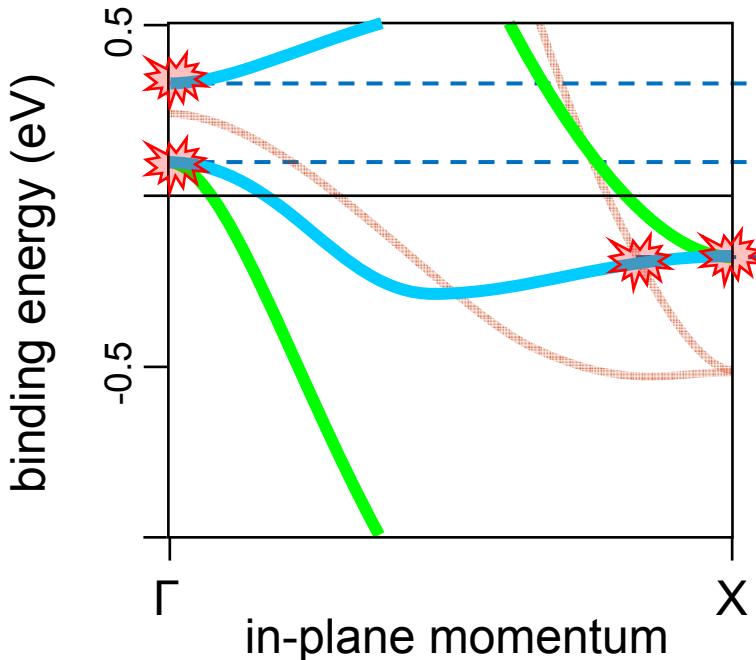
BKFA (38K)



BFCA (26K)
LiFeAs (18K)



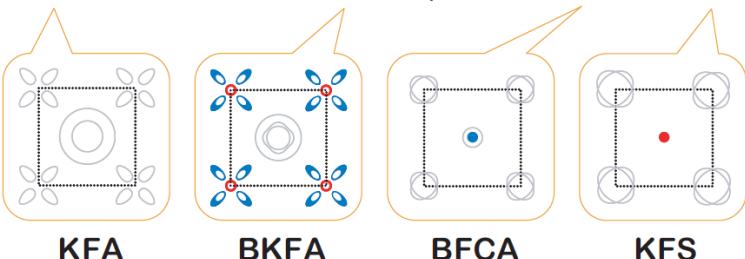
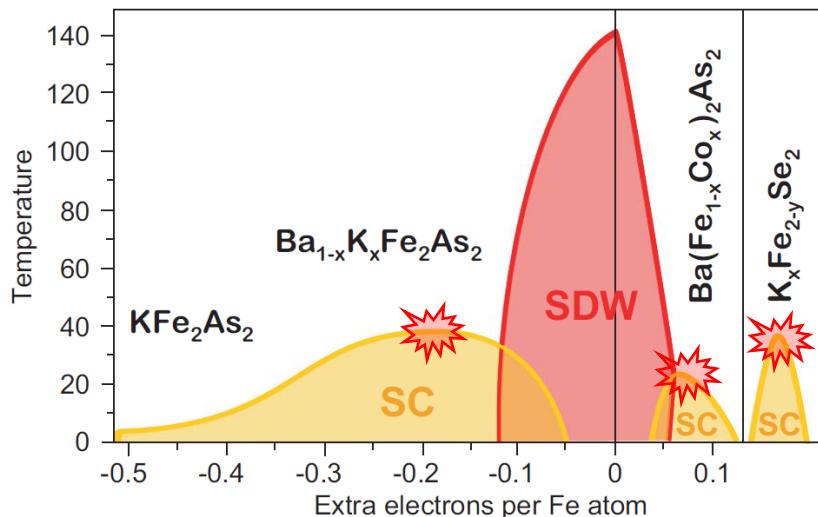
FeSC: electronic structure and superconductivity



$A_xFe_2Se_2$ (31K)

BFCA (26K)
LiFeAs (18K)

BKFA (38K)



Conclusions

- 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.**
- the Fermi surface of every optimally doped compound (the compounds with highest T_c) has the Van Hove singularities of the **Fe $3d_{xz/yz}$** bands in the vicinity to the Fermi level. This suggests that the **proximity to** an electronic topological transition, known as **Lifshitz transition**, for one of the multiple Fermi surfaces makes the superconductivity dome at the phase diagram.
- Based on this empirical observation, one can predict, in particular, that the hole overdoping of KFe_2As_2 and $LiFeAs$ compounds is a possible way to increase the T_c .

Collaboration

IMP

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Roman Viznichenko

ARPES, IFW Dresden

Sergey Borisenko
Volodymyr Zabolotny
Daniil Evtushinsky
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Jörg Fink ...

ARPES Worldwide

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



Neutron Scattering

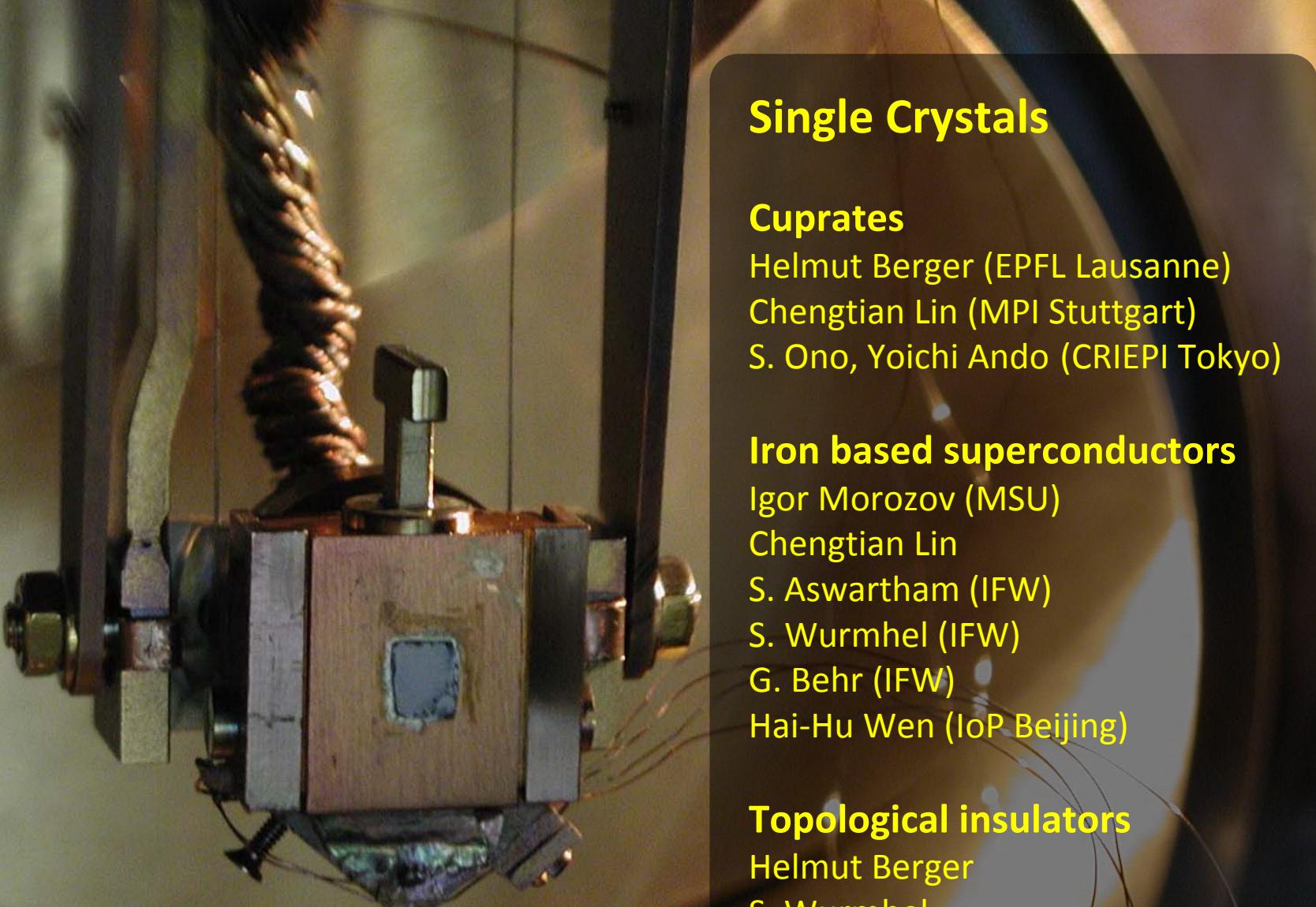
Vladimir Hinkov
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Eugene Krasovskii
Thomas Dahm
Doug Scalapino
Andrey Chubukov
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Single Crystals

Cuprates

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Chengtian Lin (MPI Stuttgart)
S. Ono, Yoichi Ando (CRIEPI Tokyo)

Iron based superconductors

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Chengtian Lin
S. Aswartham (IFW)
S. Wurmhel (IFW)
G. Behr (IFW)
Hai-Hu Wen (IoP Beijing)

Topological insulators

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Synchrotron Light

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Serguei Molodtsov

SLS (PSI Villigen)

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Vladimir Strocov
Luc Patthey
Joel Mesot

ELETTRA (Trieste)

Alexei Barinov
Pavel Dudin
Stefano Turchini



Thanks!

