Electronic structure and exotic exchange splitting in spin-density-wave $BaFe_2As_2$

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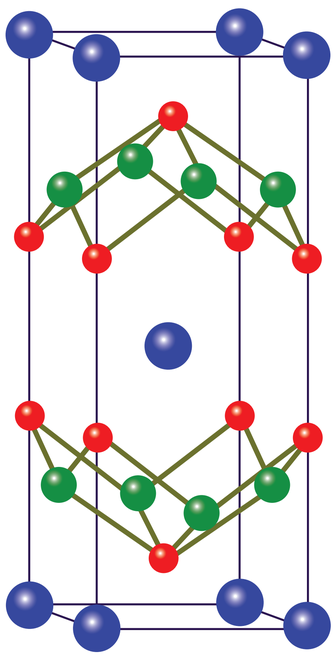
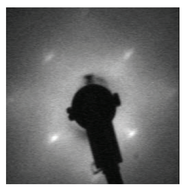
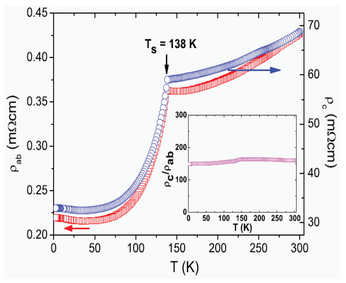
Abstract

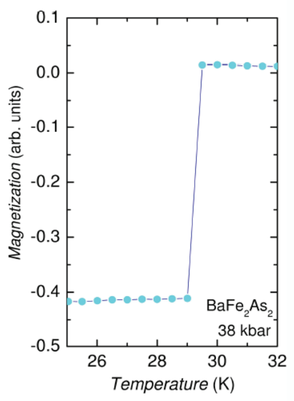
The magnetic properties in the parent compounds are often intimately related to the microscopic mechanism of superconductivity. Here we report the first direct measurements on the electronic structure of a parent compound of the newly discovered iron-based superconductor, BaFe2As2, which provides a foundation for further studies. We show that the energy of the spin density wave (SDW) in BaFe2As2 is mainly lowered through exotic exchange splitting of the band structure.

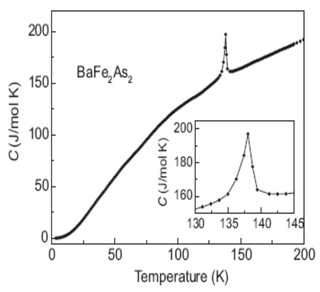
Crystal structure and basic properties







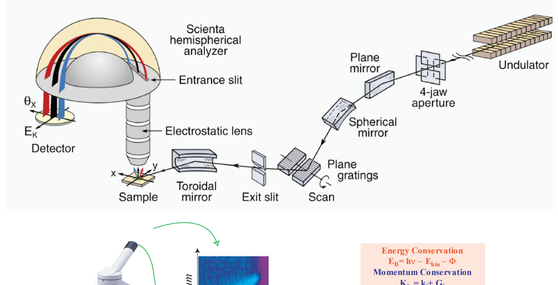


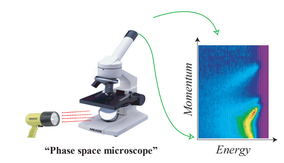


Ref.[1] X. H. Chen et al, Phys. Rev. Lett. 102, 117005 (2009).

Ref.[2] M. Rotter et al,Phy. Rev. B, 78, 020503 (2008).

Angle Resolved Photoemission Spectroscopy

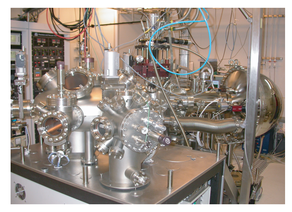




Energy Conservation
$E_B = h\nu - E_{kin} - \Phi$
Momentum Conservation
$K_{//} = k_{//} + G_{//}$

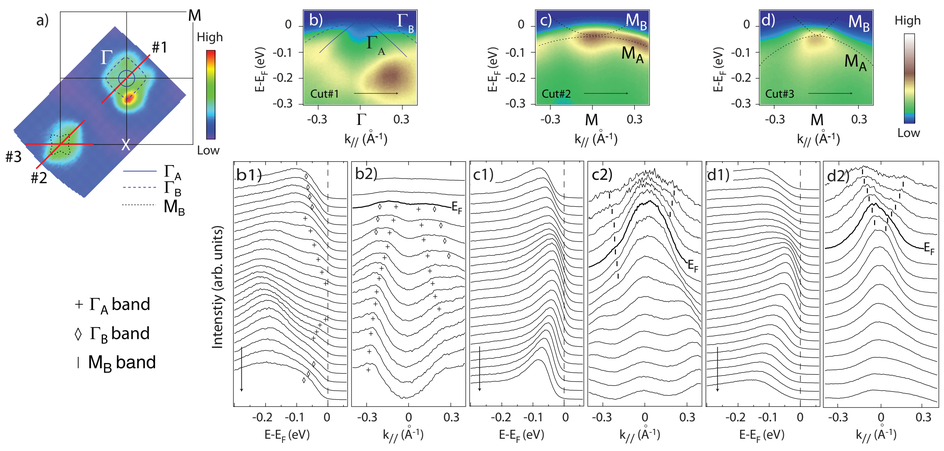
	ΔE	$\Delta\theta$
past	*40 meV*	*2°*
now	*4 meV*	*0.2 °*

ARPES in Fudan



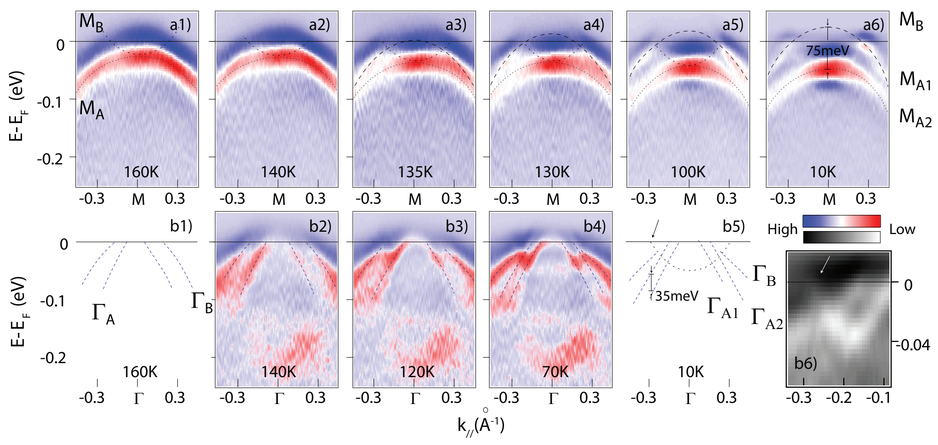
- High flux Helium lamp
- High angular resolution analyzer: R4000
- Low temperature (10K)
- 5meV total energy resolution

Normal state Fermi Surface and band structure

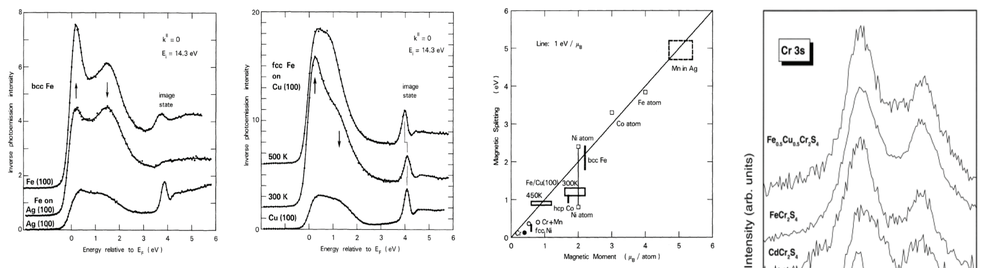


Data were taken at 160K with 21.2 eV photons at HiSOR.

Band splitting dependent with temperature



Exchange splitting



Exchange splitting is crucial for the Ferromagnet.

The exchange splitting is observed not only in FM.

The stoner ratio for the exchange splitting is about 1eV/μ_B for these FM and AFM.

The stoner ratio is about 0.1eV/μ_B for BaFe2As2, which is anomously small.

Ref.[3] F. J. Himpsel, Phys. Rev. Lett. 67, 2363, (1991).

Ref.[4] V. Tsurkan, Solid state communication, 114, 149 (2000).

FS and exchange splitting of M_B band

Different bands were observed using different photon polarizations.

Not all the bands split.

The scale of the exchange splitting for different band is different.

The exchange splitting is closely related to SDW transition.

Summary

We have measured the electronic structure of an iron pnictide in detail. Large exchange splittings and possible gaps that stabilize the SDW state have been observed. Our results would shed light on the understanding of the relationship between the SDW and superconductivity, and set the foundation for further studies in this field.

Ref.[5] L. X. Yang et al, Phys. Rev. Lett. 102, 107002 (2009).