Sharp SDW SC cross-over in 1111 Fe pnictides

P. Carretta, S. Sanna, G. Prando,

Università di PAVIA and CNISM, Italy

Roberto De Renzi,

Università di PARMA and CNISM, Italy

G.Lamura, M.Tropeano, M.Putti, C.Ferdeghini, M.R.Cimberle, A.Palenzona,

Università di Genova and CNR-SPIN, Italy

T. Shiroka,

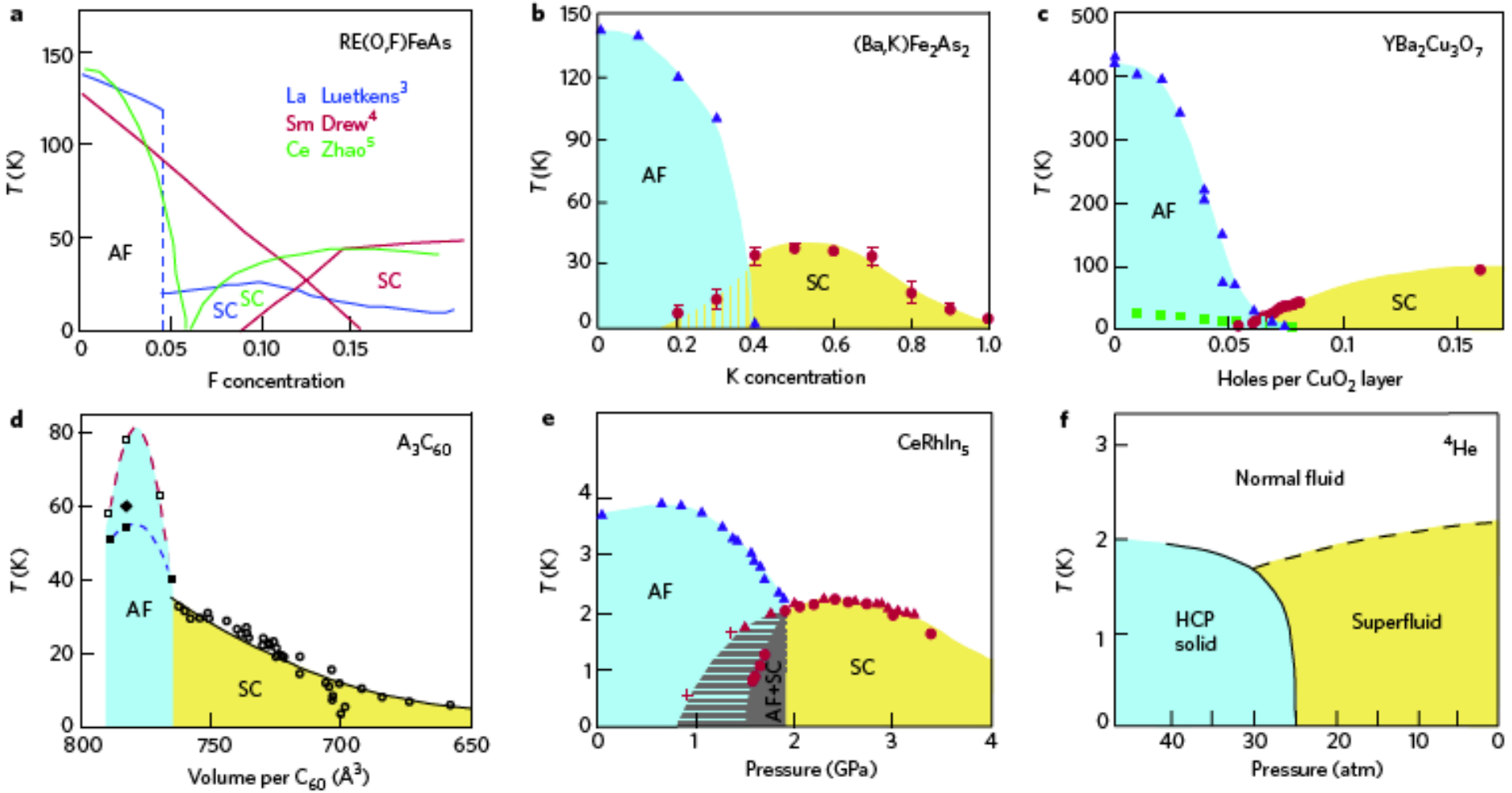
Laboratorium für Festkörperphysik, ETH-Hönggerberg, Zürich, Switzerland

K. Sedlak,

Paul Scherrer Institut, Villigen, Switzerland

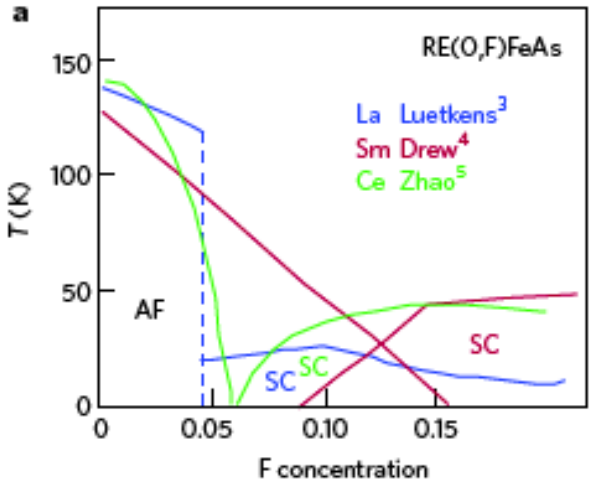
Abrupt disappearance or coexistance?

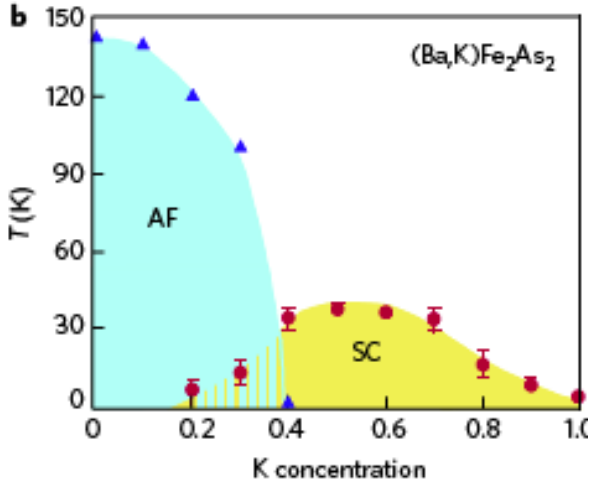
Y.J. Uemura News and Views Nature Materials 8 253

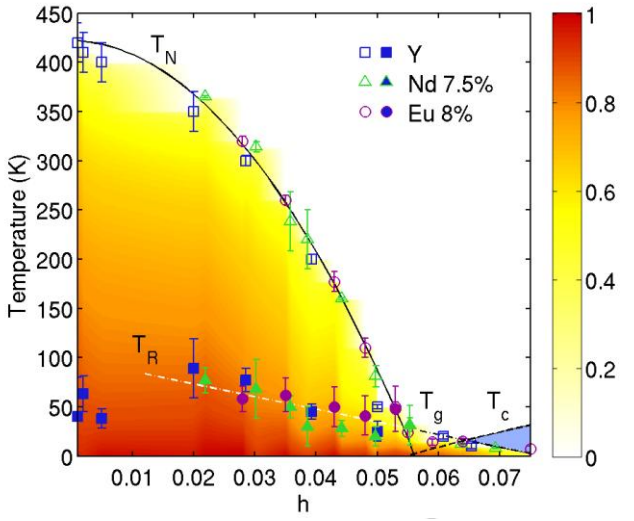


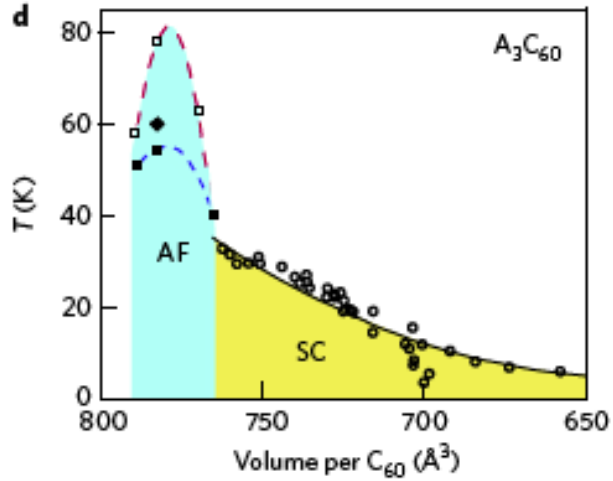
Abrupt disappearance or coexistance?

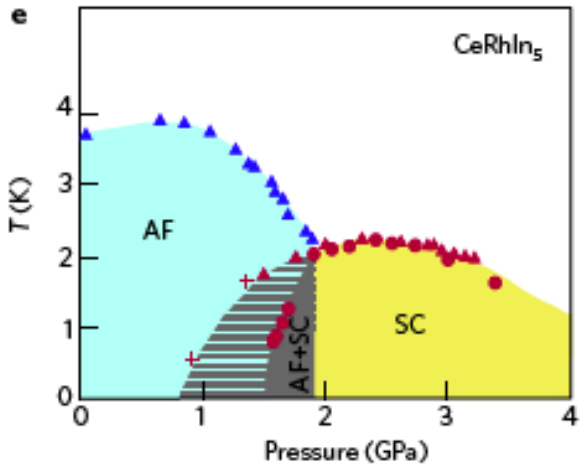
F. Coneri et al. Phys Rev B 81 104507 (2010)

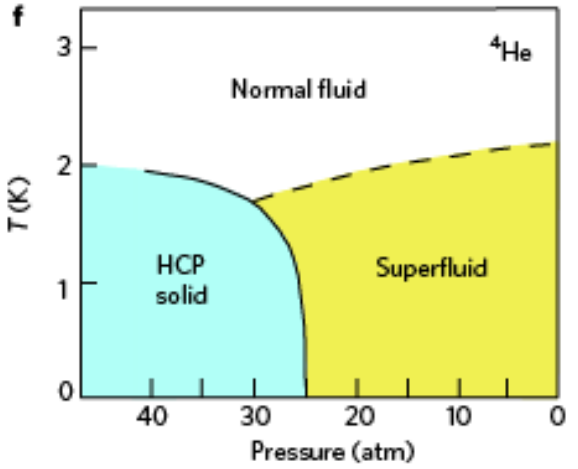












Abrupt disappearance or coexistance?

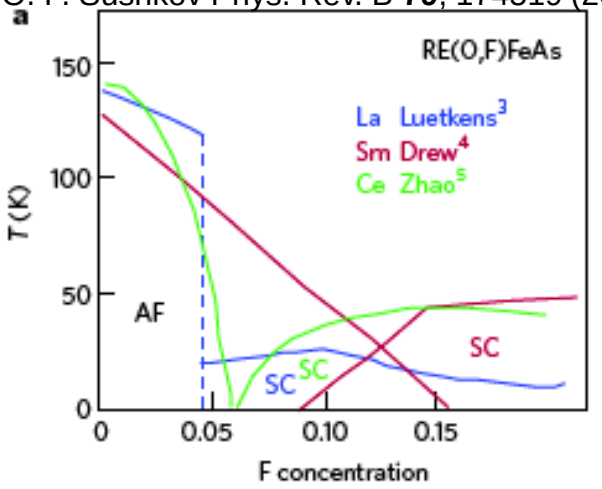
O. P. Sushkov, V. N. Kotov Phys. Rev. Lett. **94**, 097005 (2005)

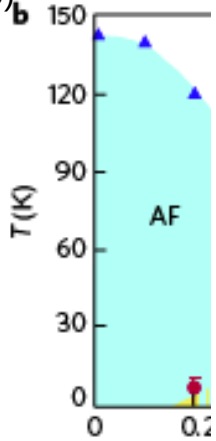
A. Lüscher, A. I. Milstein, O.P. Sushkov Phys. Rev. Lett. **98**, 037001 (2007)

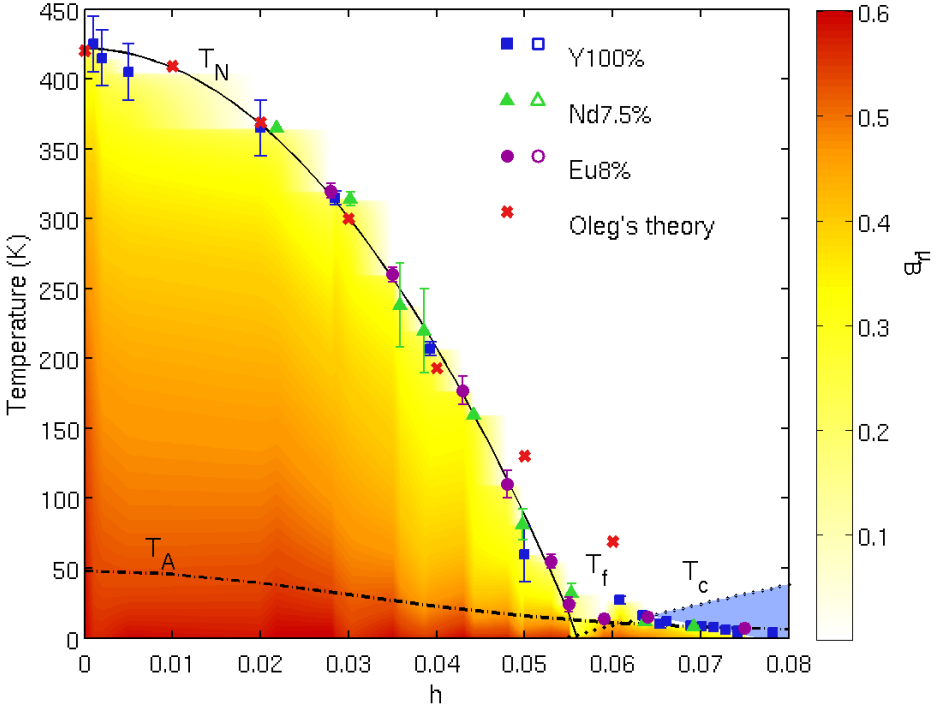
O. P. Sushkov Phys. Rev. B **79**, 174519 (2009)

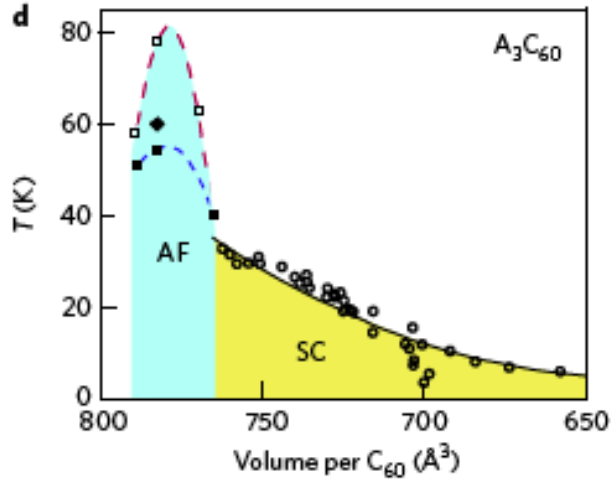
F. Coneri et al. Phys Rev B 81 104507 (20

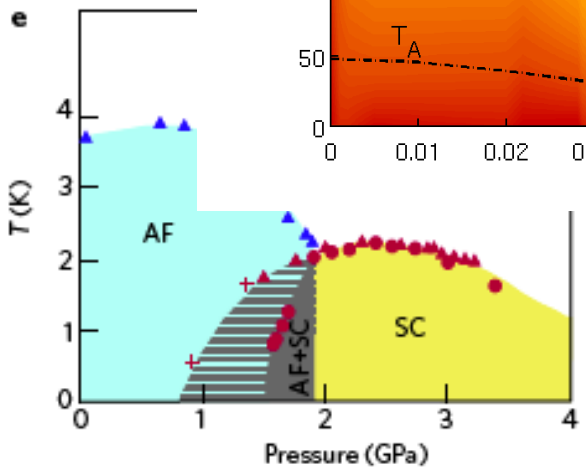
O. P. Sushkov arXiv:1105.2102 (2011)

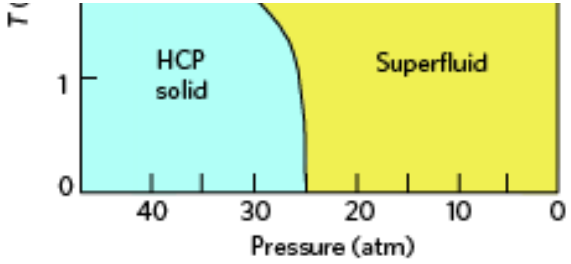






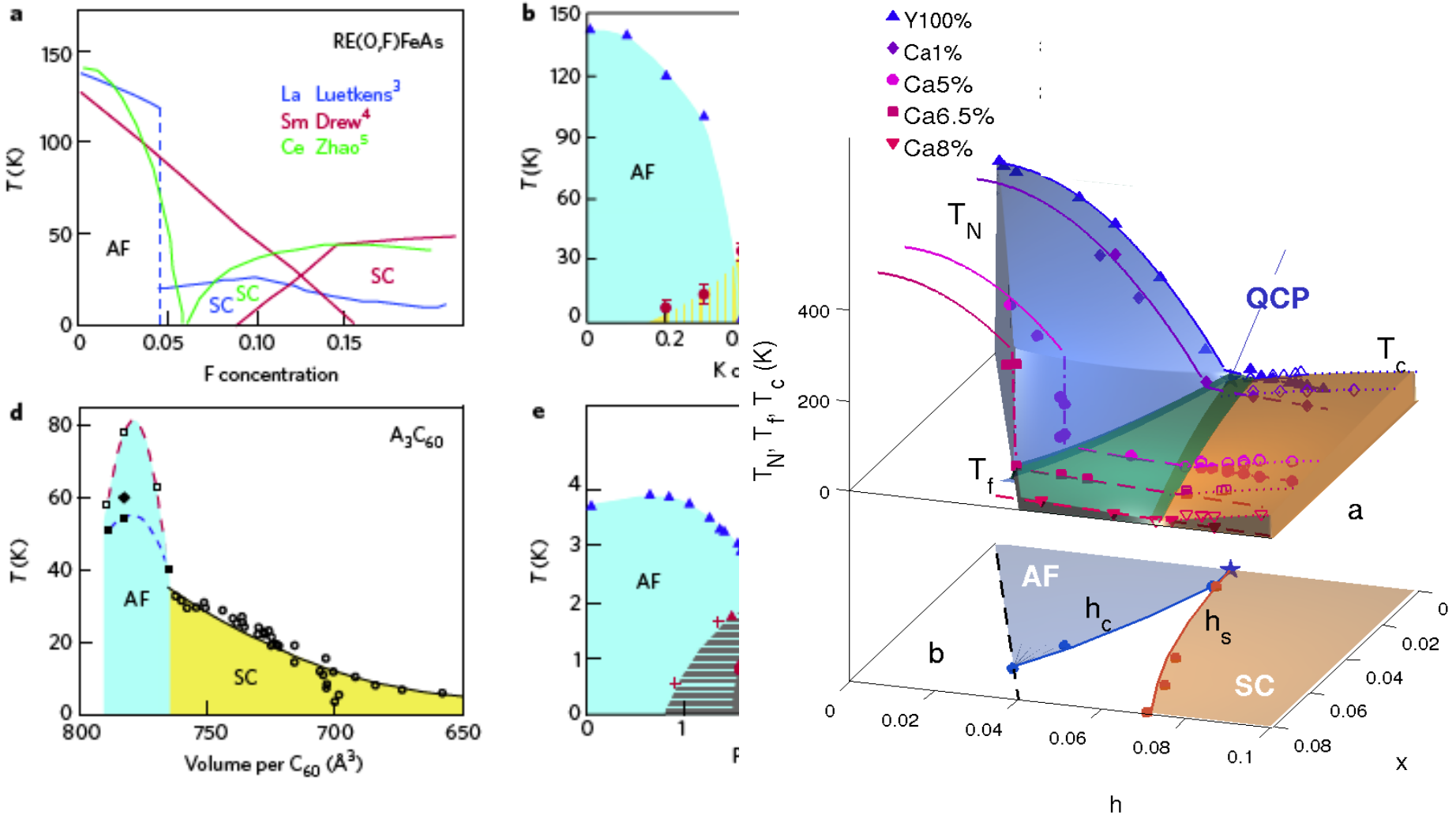






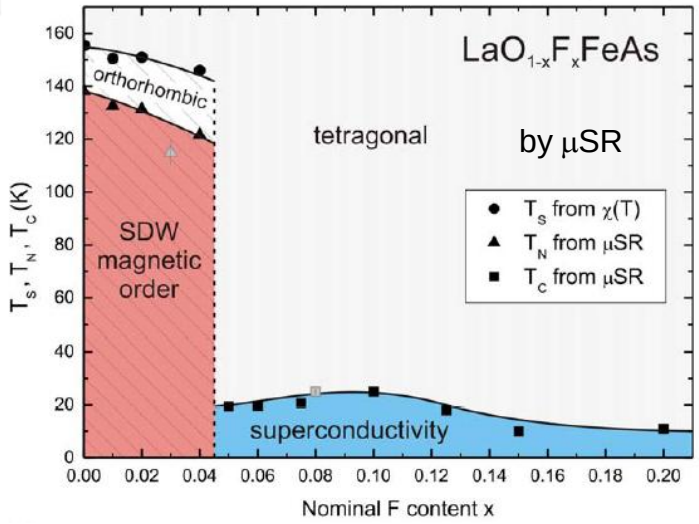
Abrupt disappearance or coexistance?

S. Sanna et al. Phys Rev B 82 100503R (2010)

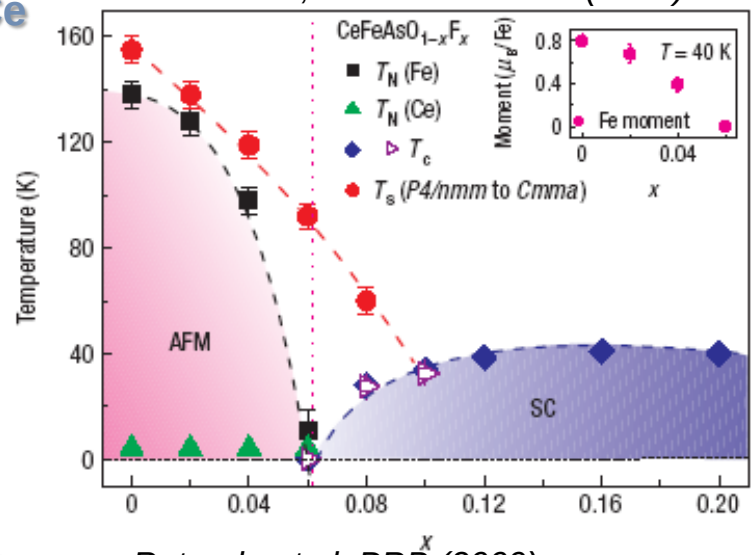


Magnetic-SC boundary in RE-1111 pnictides

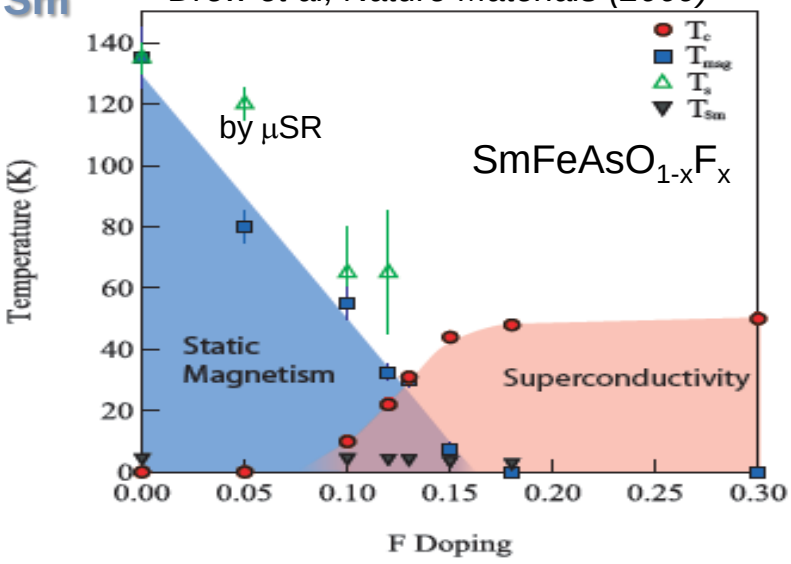
La *Luetkens et al, Nature Materials (2009)*



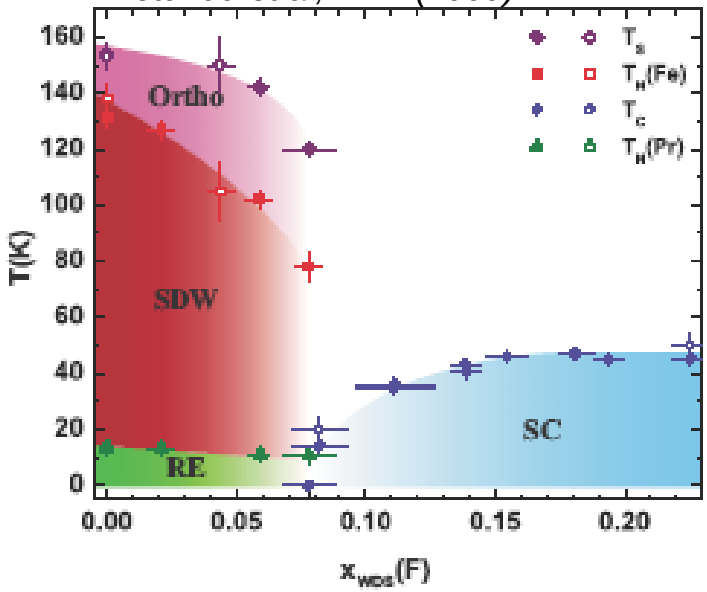
Ce *Zhao et al, Nature Materials (2008)*



Sm *Drew et al, Nature Materials (2009)*

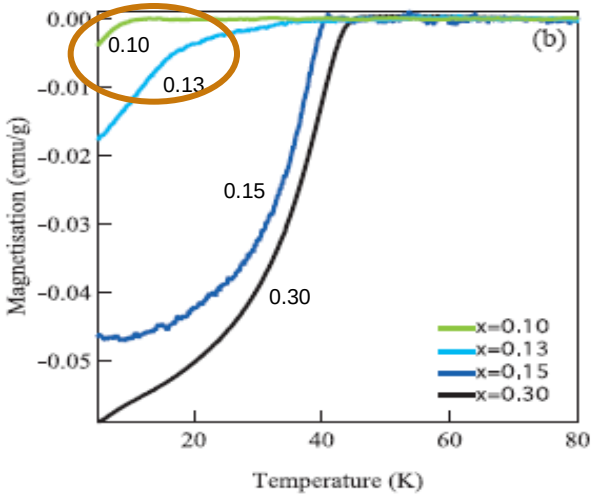


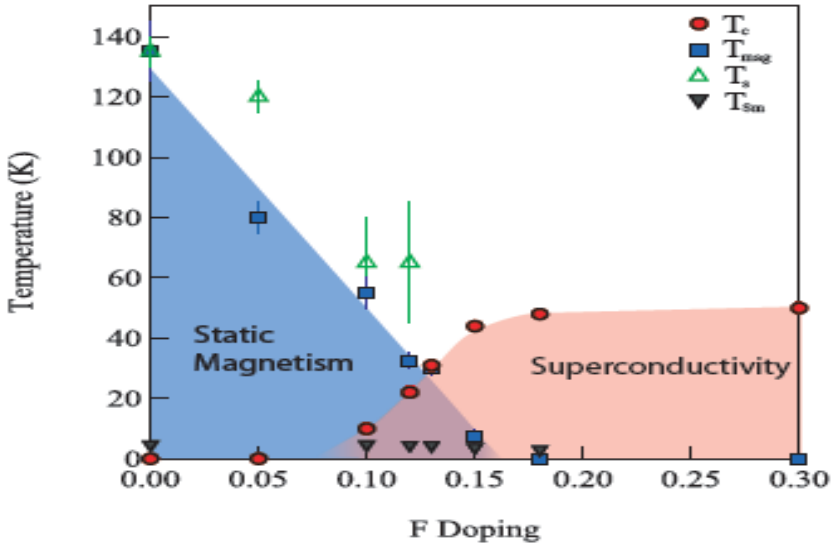
Pr *Rotundu et al, PRB (2009)*



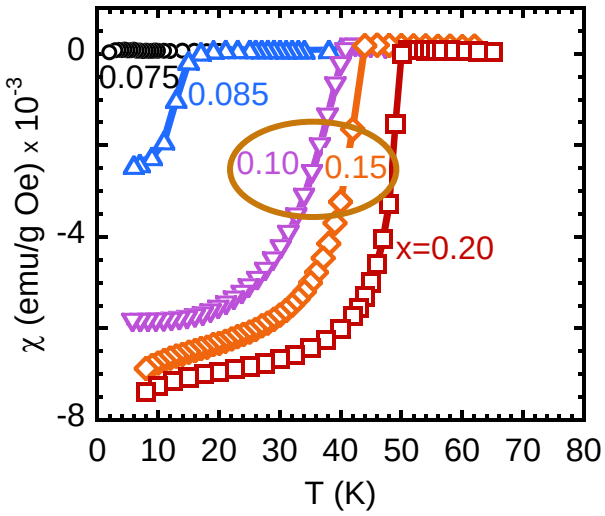
Magnetic-SC boundary in $SmFeAsO_{1-x}F_x$

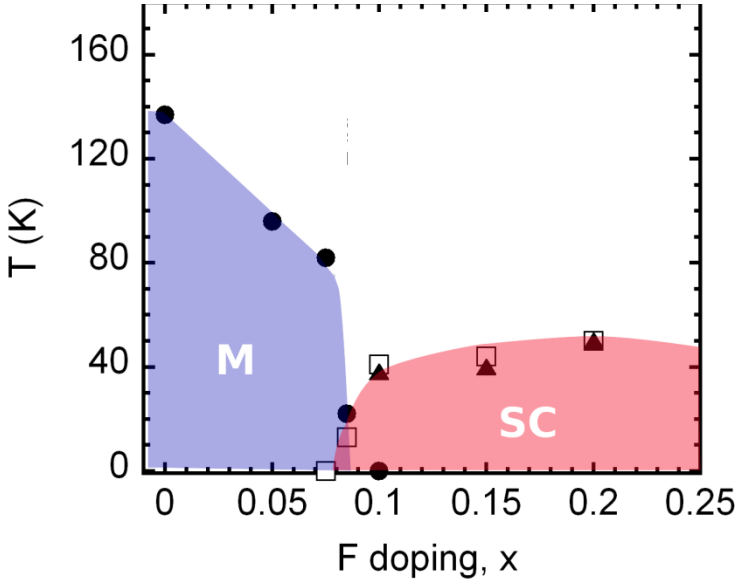
Drew et al, Nature Materials (2009)





Sanna et al, PRB 80, 052503 (2009)

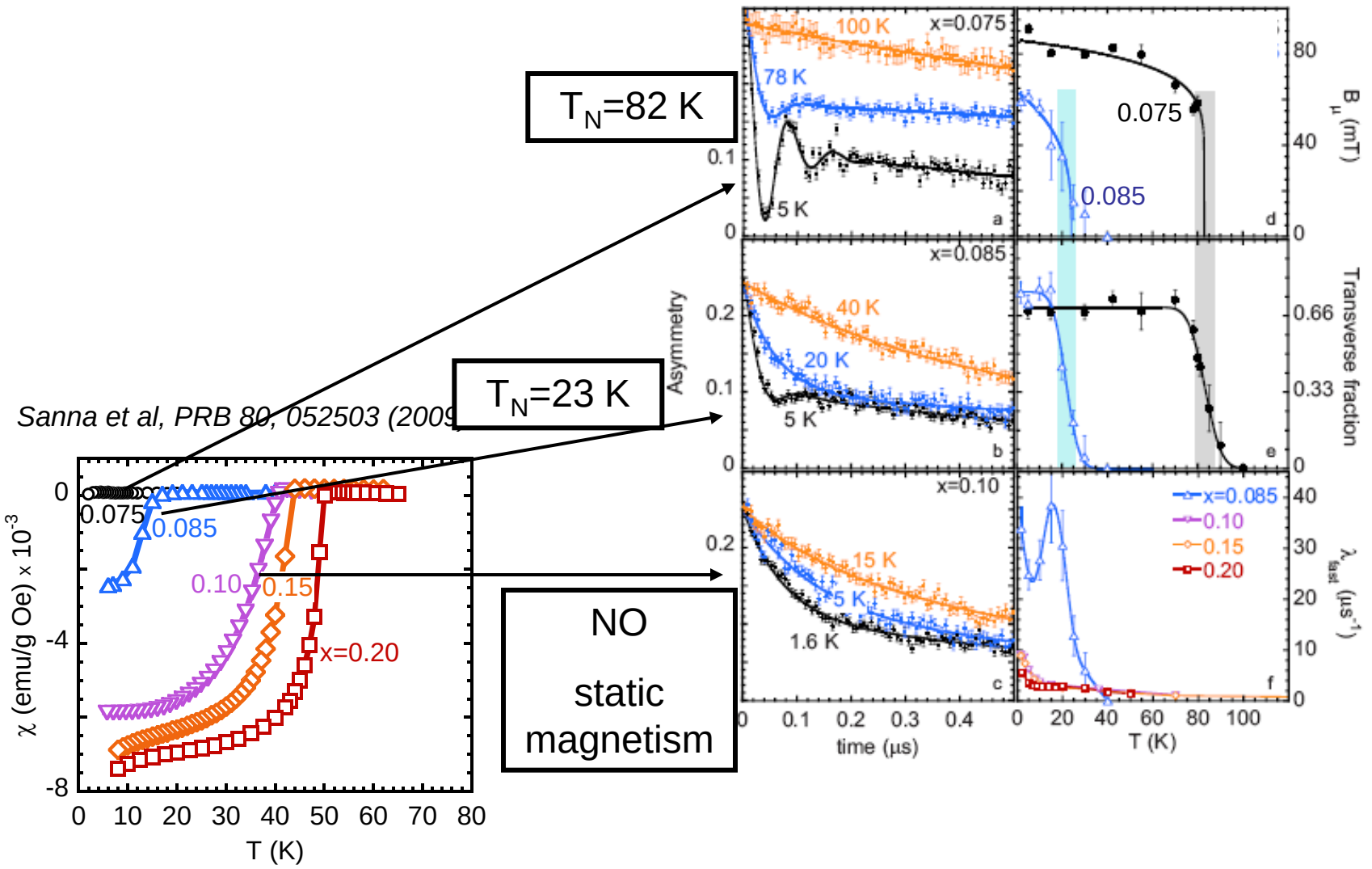




Nanoscopic coexistence in a *narrow range*

(one sample)

Magnetic-SC boundary in $SmFeAsO_{1-x}F_x$



Magnetic-SC boundary in $SmFeAsO_{1-x}F_x$

100% muons experience

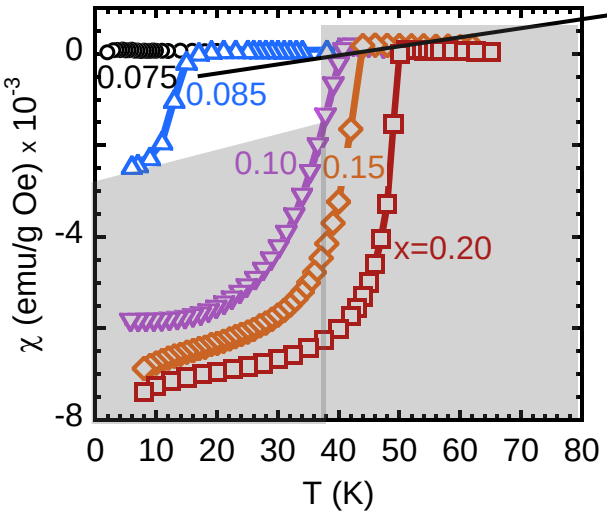
static internal fields

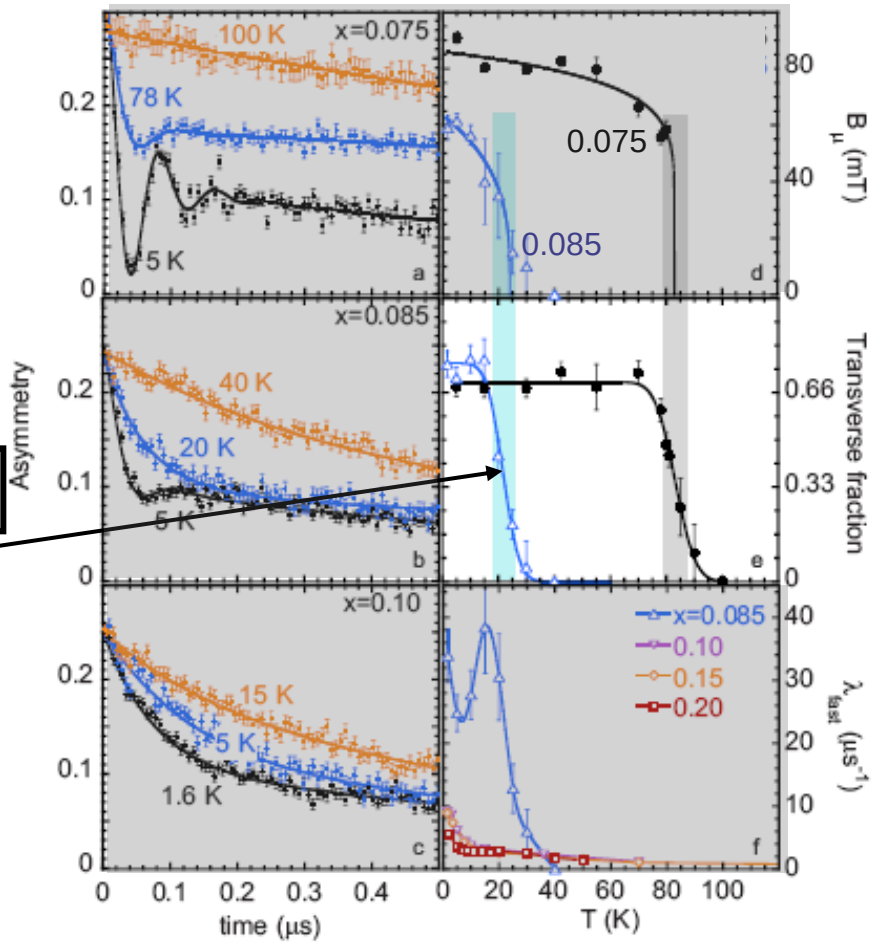
at low temperature

&

Sizeable SC response

T_N=23 K

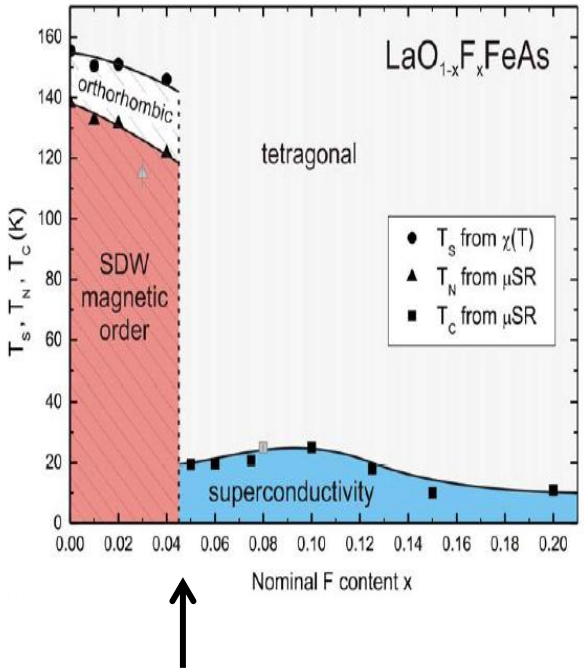




Unified behavior in RE-1111: RE=La, Sm

La

Luetkens et al, Nature Materials (2009)



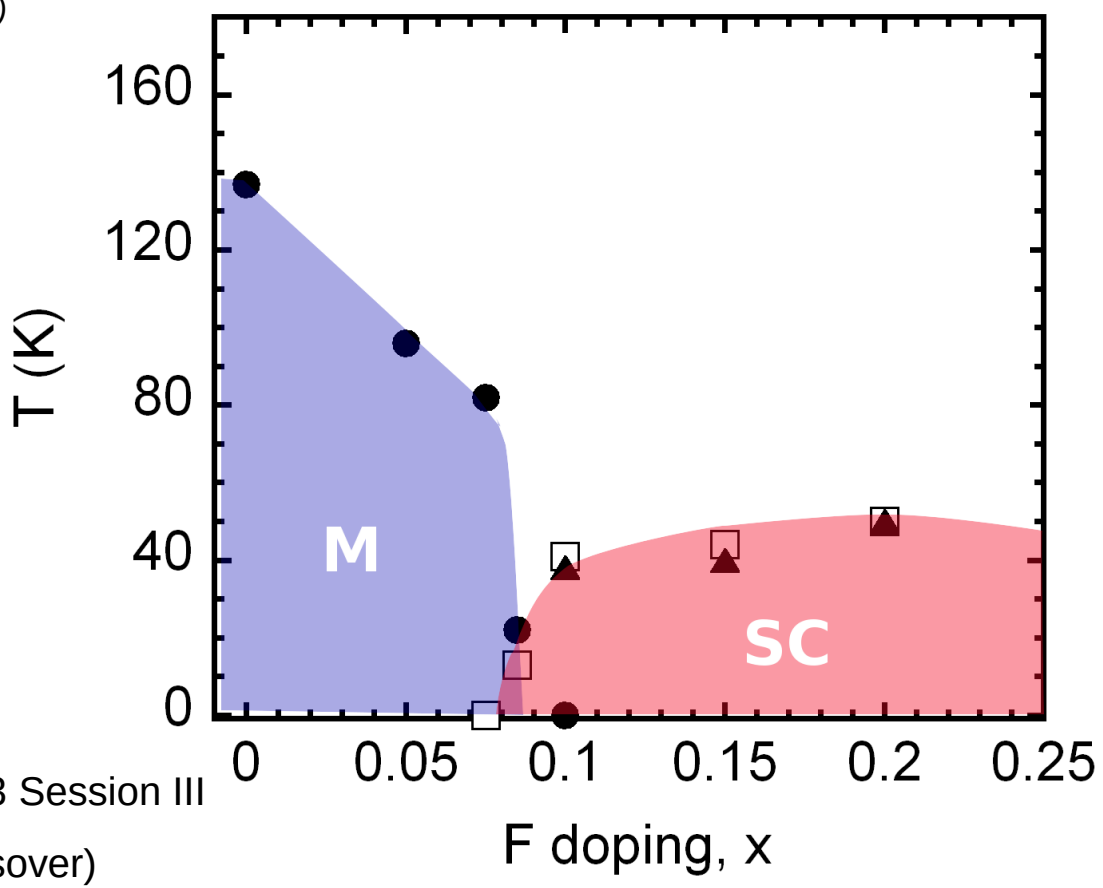
See R. Khasanov *et al.* Poster P63 Session III

(pressure on a sample at the crossover)

$$\xi = 2.6 \text{ nm}$$

Sm

Sanna et al, Phys. Rev. B 80 052503 (2009)

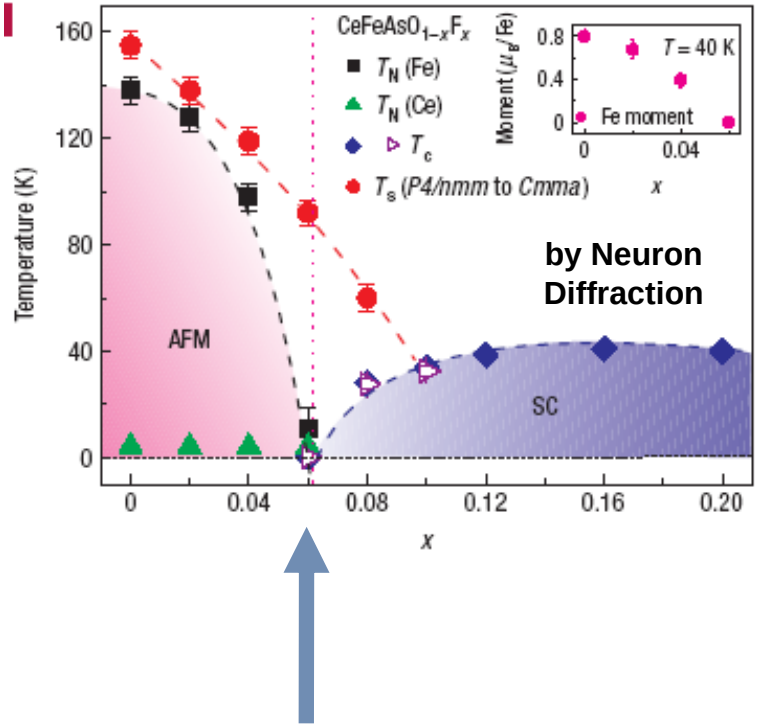


$$\xi = 1.5 \text{ nm}$$

Unified behavior in RE-1111: RE=Ce

$CeFeAsO_{1-x}F_x$

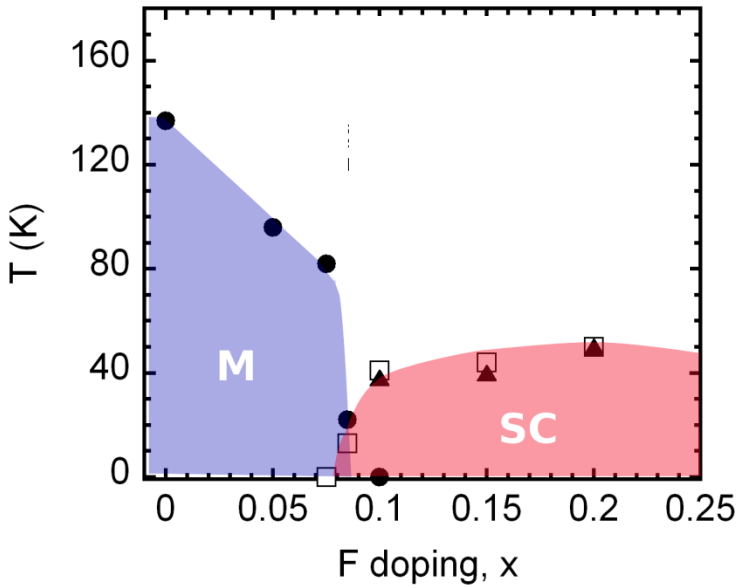
Zhao et al, Nature Materials (2009)



We looked here to start with

$SmFeAsO_{1-x}F_x$

Sanna et al, PRB 80, 052503 (2009)



Unified behavior in RE-1111: RE=Ce

RAPID COMMUNICATIONS

PHYSICAL REVIEW B **82**, 060508(R) (2010)

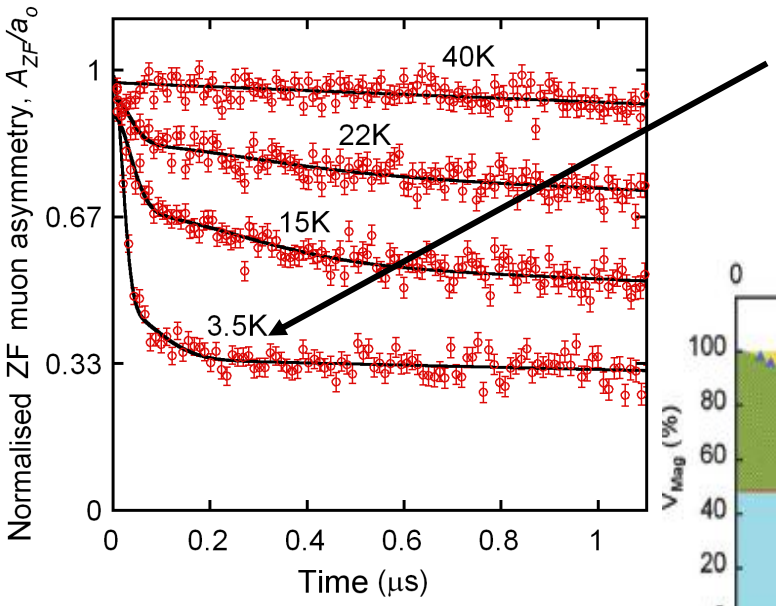
Nanoscopic coexistence of magnetic and superconducting states within the FeAs layers of $CeFeAsO_{1-x}F_x$

S. Sanna,[1,*] R. De Renzi,[2] T. Shiroka,[3,4] G. Lamura,[5] G. Prando,[1,6] P. Carretta,[1] M. Putti,[5] A. Martinelli,[7] M. R. Cimberle,[8] M. Tropeano,[5] and A. Palenzona[5]

[1]*Dipartimento di Fisica "A. Volta," Unità CNISM di Pavia, I-27100 Pavia, Italy*

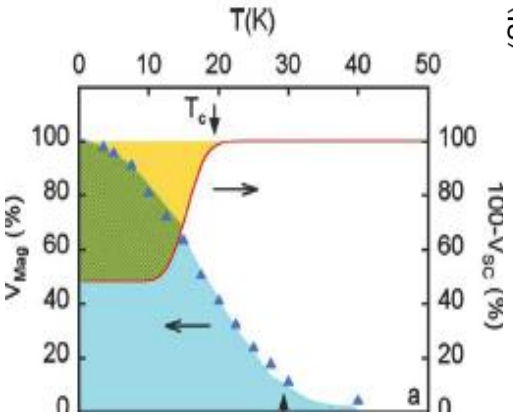
$CeFeAsO_{0.94}F_{0.06}$

ZF-μSR

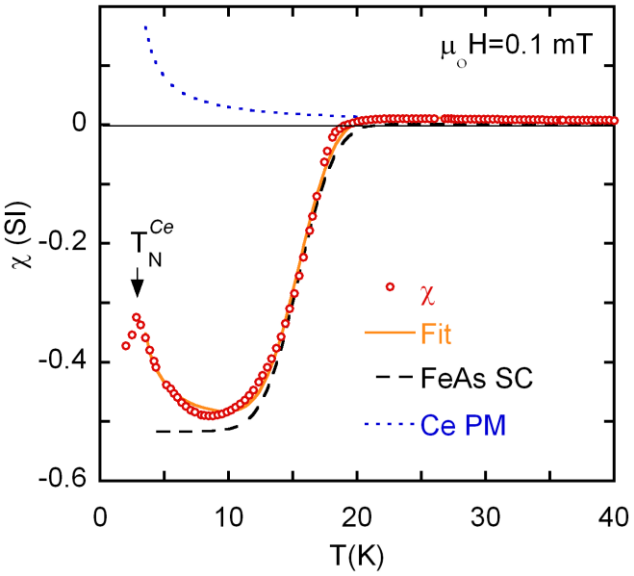


No oscillations!

Fast relaxation
(ΔB~50 mT)



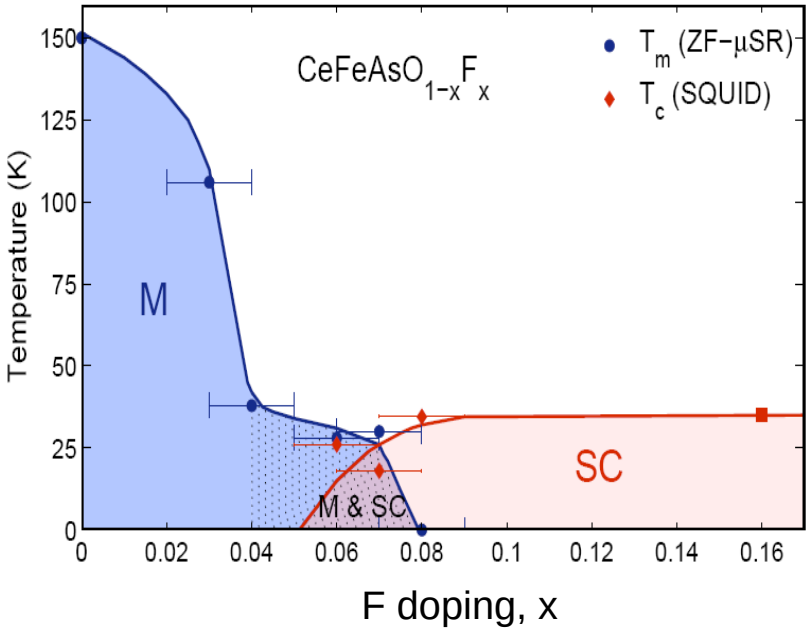
SQUID



Unified behavior in RE-1111: RE=Ce

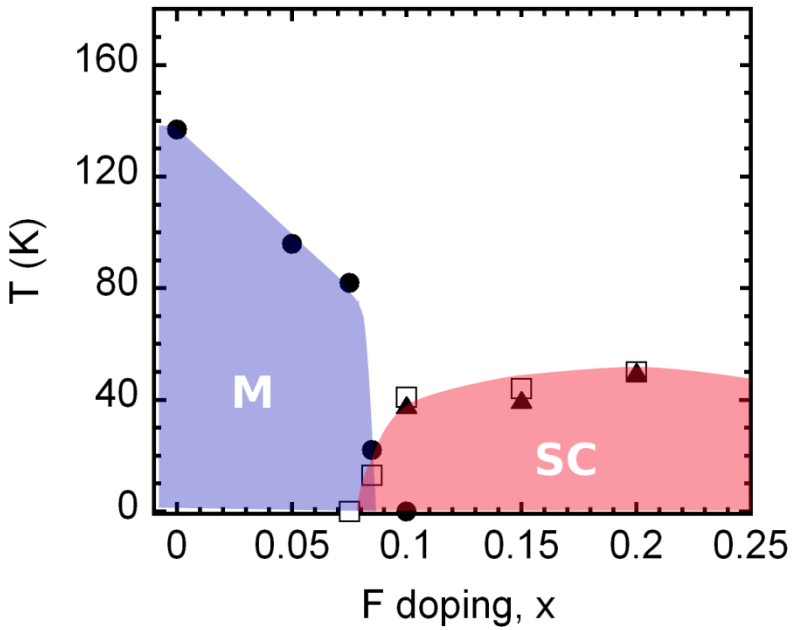
$CeFeAsO_{1-x}F_x$

Unpublished data



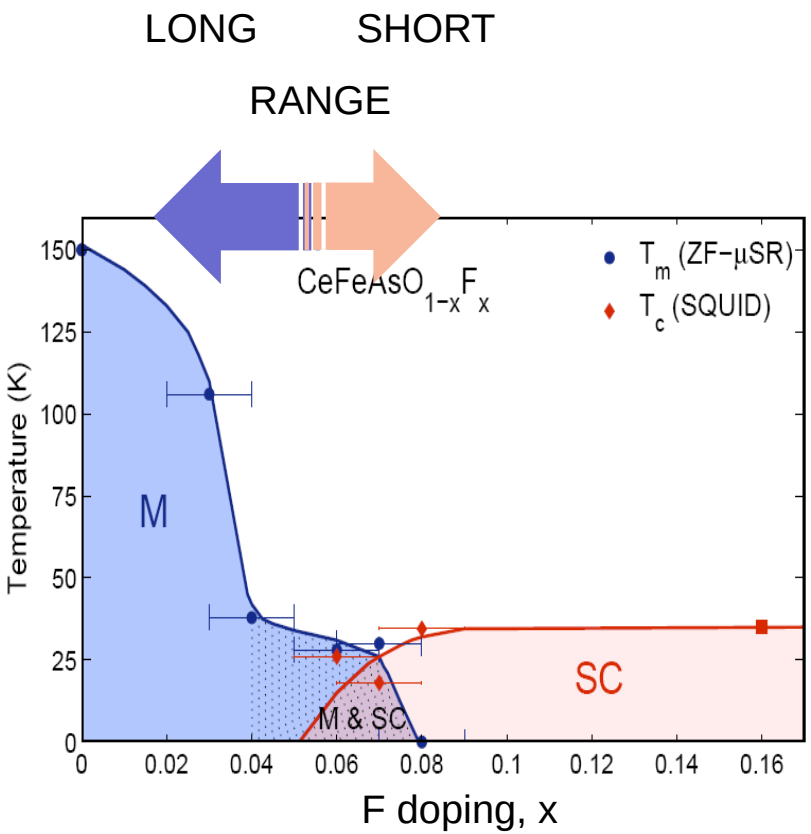
$\xi = 1.9$ nm

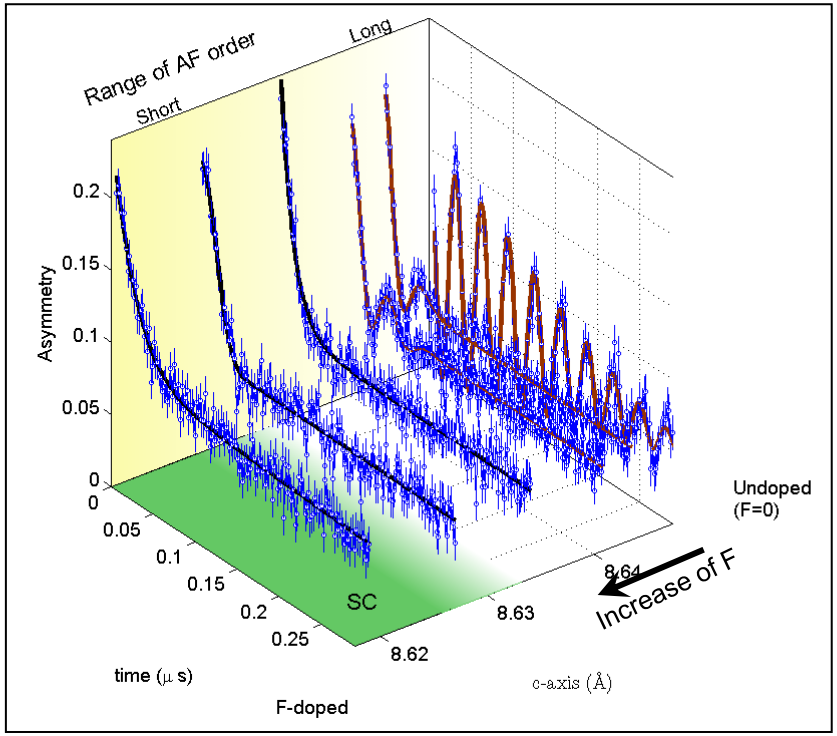
$SmFeAsO_{1-x}F_x$



$\xi = 1.5$ nm

From long to short range magnetic order



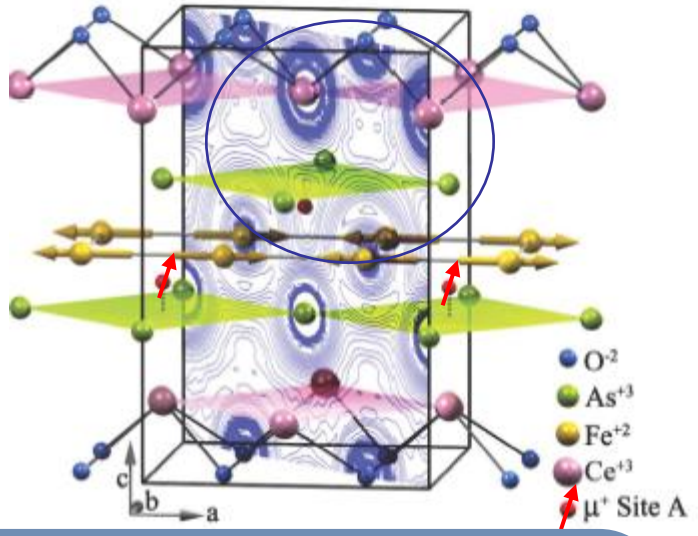


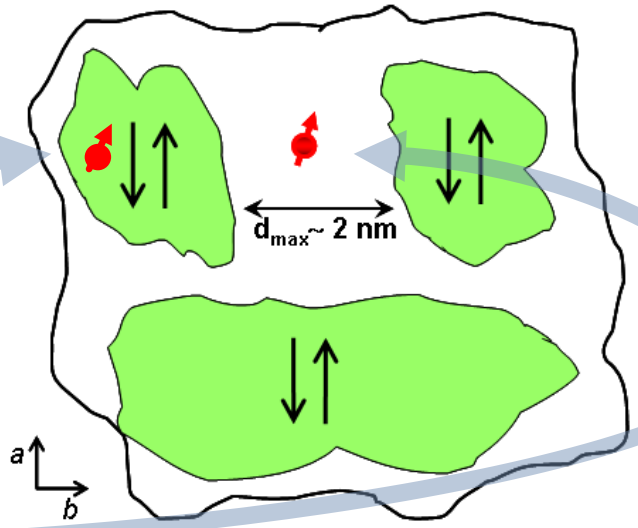
What is nanoscopic coexistance?

$REFeAsO_{1-x}F_x$

$$\xi_{Sm} = 1.5 < \xi_{Ce} = 1.9 < \xi_{La} = 2.6\text{nm}$$

$d < \xi$ $\qquad$ $d > \xi$



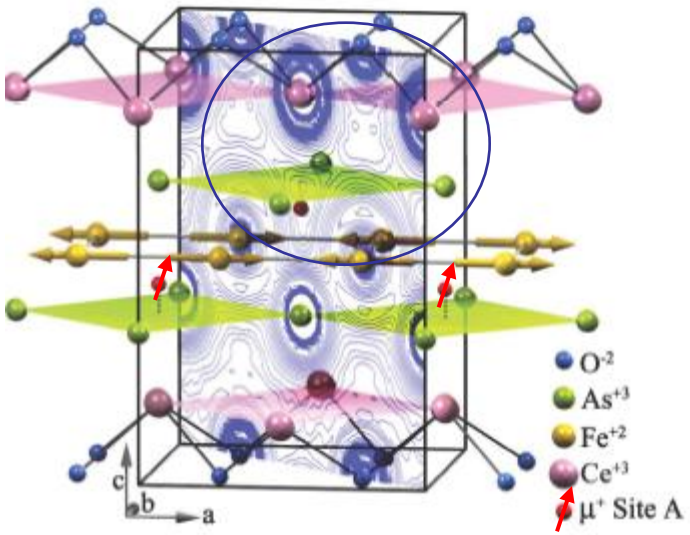


B_μ ~50 mT in SDW domain

$B_\mu \propto \frac{1}{r^3}$ >0 within d/2=1 nm

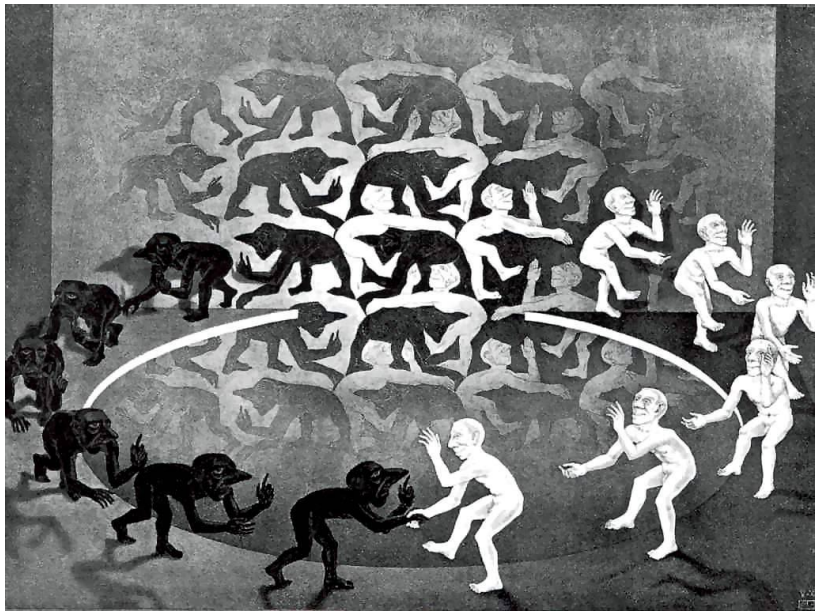
What is nanoscopic coexistance?

$REFeAsO_{1-x}F_x$



$$\xi_{Sm} = 1.5 < \xi_{Ce} = 1.9 < \xi_{La} = 2.6\text{nm}$$

$d < \xi$ $\qquad$ $d > \xi$



Percolation threshold

SDW, SC fractions ≈ 50%

MAIN CONCLUSIONS

- Nanoscopic coexistence at the AF-SC boundary common for RE=Ce, Sm.
- Abrupt drop of T_{SDW} in La, Ce, Sm: similar phase diagrams
- Nanoscopic coexistance: is domain size at crossover limited by ξ?