

MSU

activities in iron – based superconductors

Alexander Vasiliev

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All studies are provided in collaboration with



Leibniz Institute
for Solid State and
Materials Research
Dresden



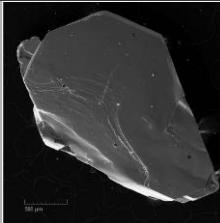
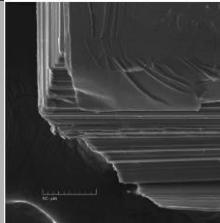
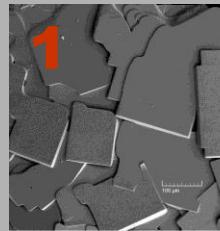
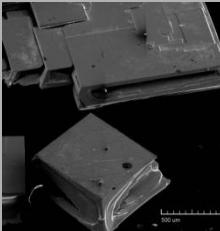
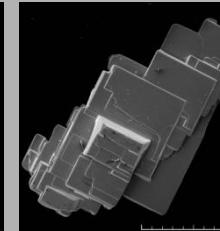
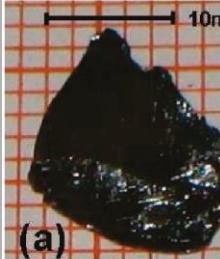
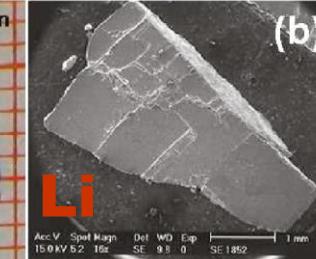
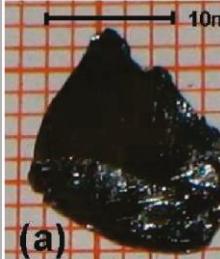
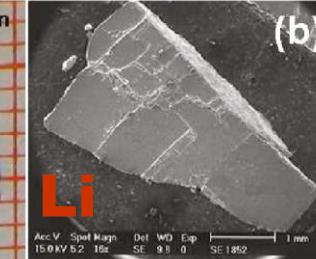
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↔ MSU ↔



ILTPE - B.Verkin Institute for Low Temperature Physics and Engineering
of the National Academy of Sciences of Ukraine

Synthesis

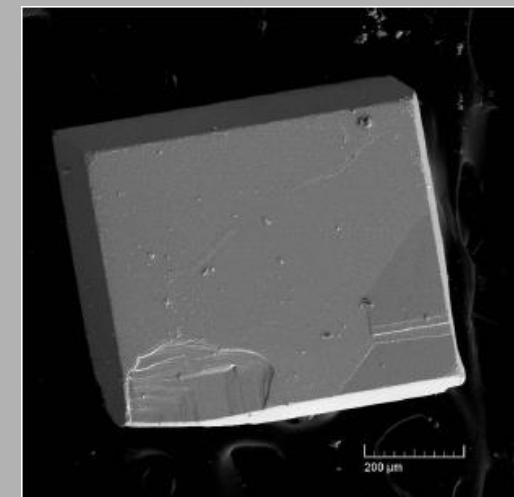
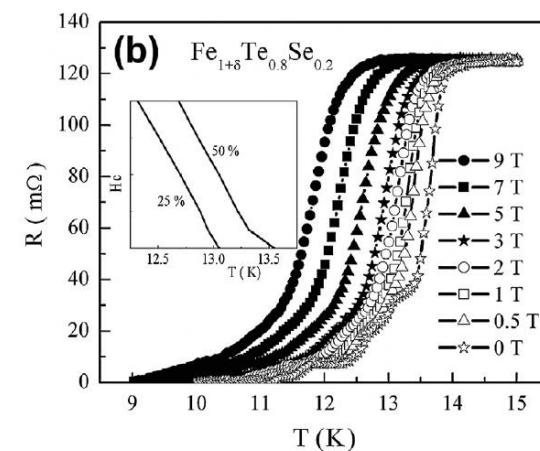
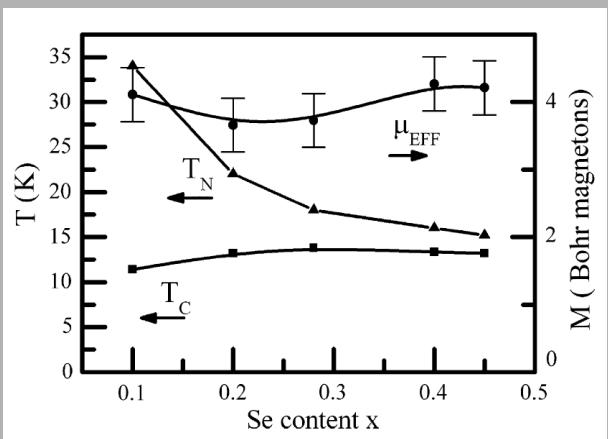
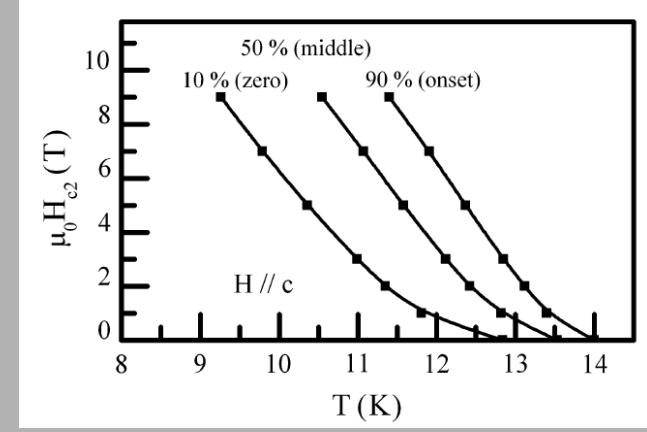
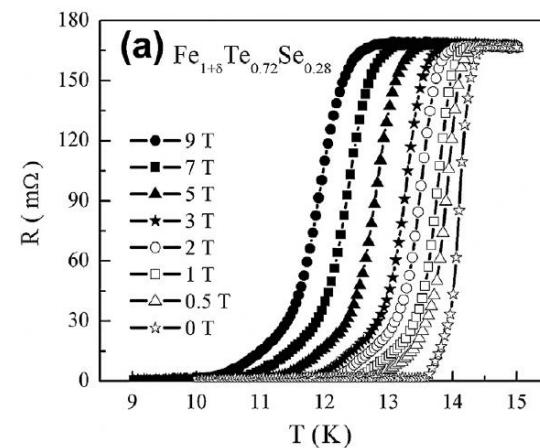
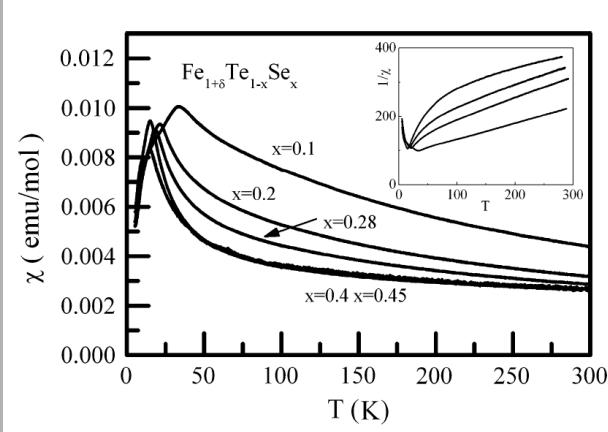
Family	Compositions	Images
11	FeSe	 
	Fe(Se,Te) (1) Fe(Te,S) (2)	 
	Fe(Se,Te,S)	 
111	LiFeAs	 
	NaFeAs	  Acc. V. 15.0 kV Spat. Magn. 5.2 15μm Def. WD. 9.8 mm Exp. 0 SE 1852

D. Chareev, et al., CrystEngComm, 15, 1989 (2013).

I. Morozov, et al., Cryst. Growth and Design, 10, 4428 (2010)

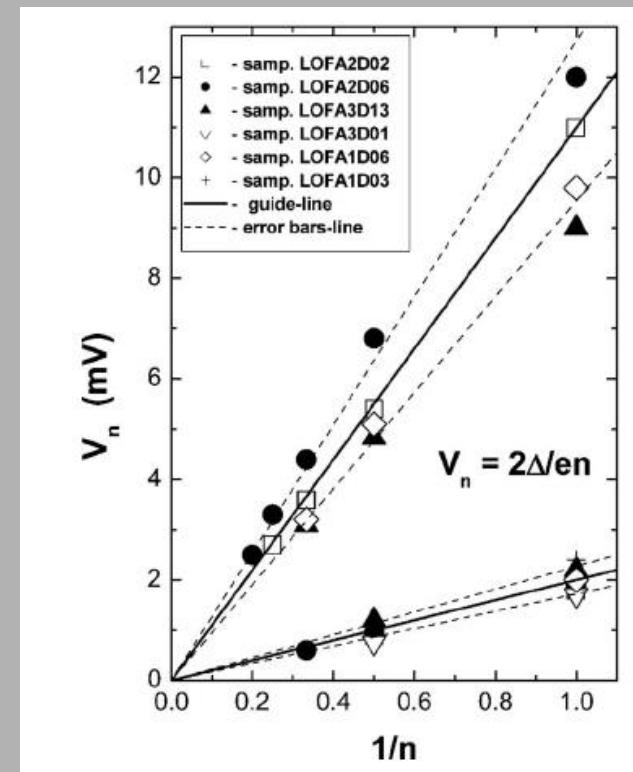
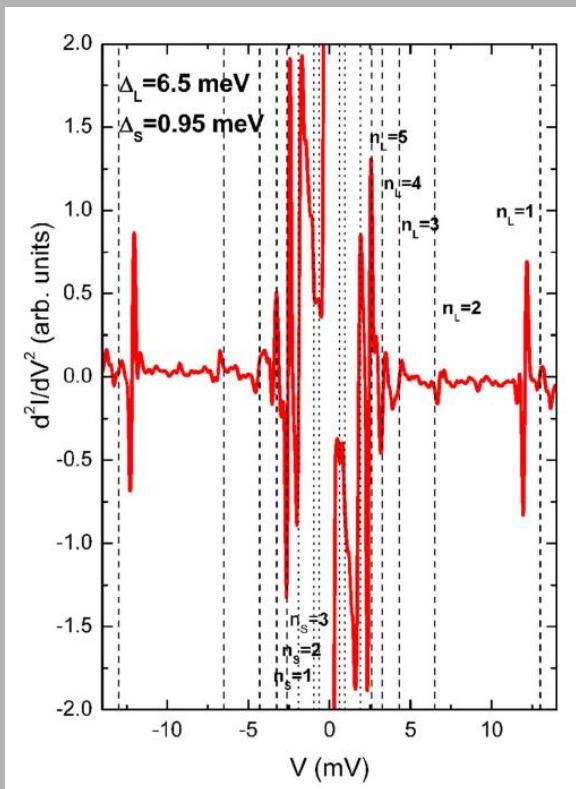
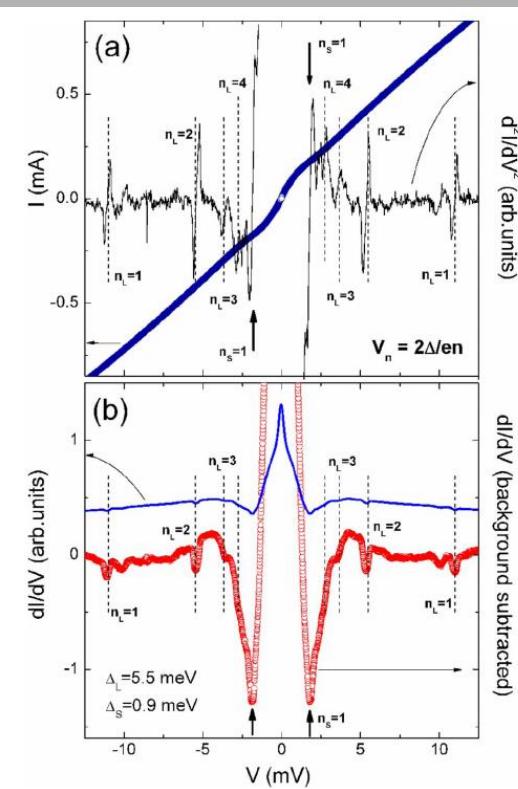
Primary characterization

Coexistence of magnetism and superconductivity in $\text{Fe}_{1+\delta}\text{Te}_{1-x}\text{Se}_x$



Andreev spectroscopy

Two sets of subharmonic gap structures in $\text{LaFeAsO}_{0.9}\text{F}_{0.1}$ were detected indicating the existence of two distinct superconducting gaps: $\Delta_L=5.51 \text{ meV}$ and $\Delta_S=10.2 \text{ meV}$.



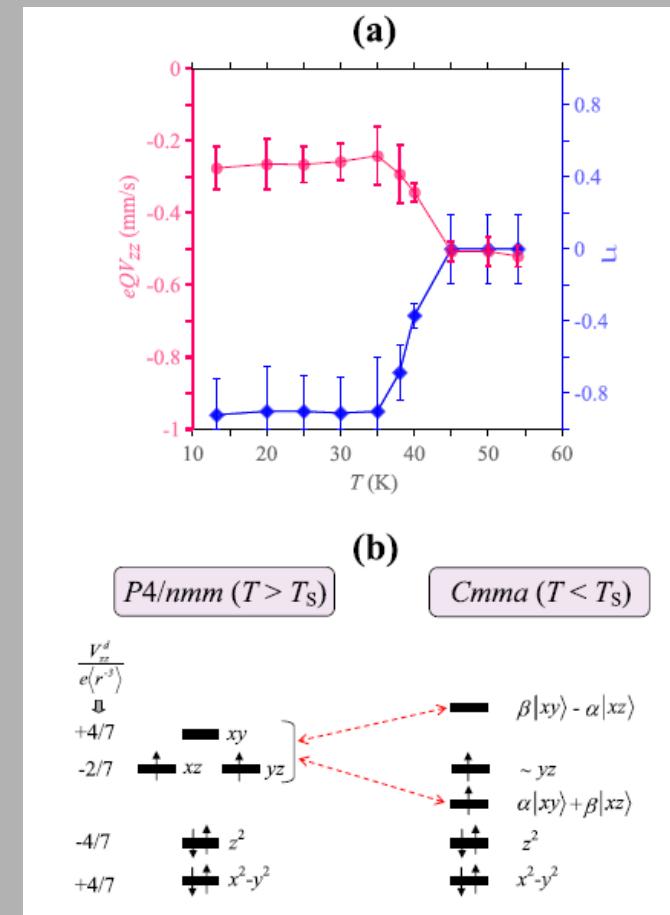
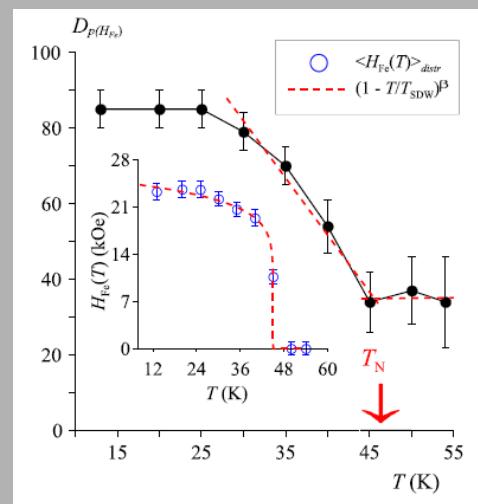
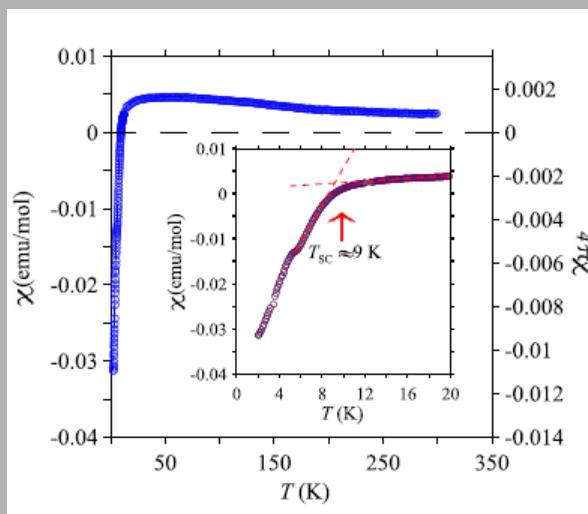
Ya. G. Ponomarev, et al., Phys. Rev. B 79, 224517 (2009).

Ya.G. Ponomarev, et al. JETP, 113, 461 (2011).

Ya.G. Ponomarev, et al. JSNM, 26, 2867 (2013).

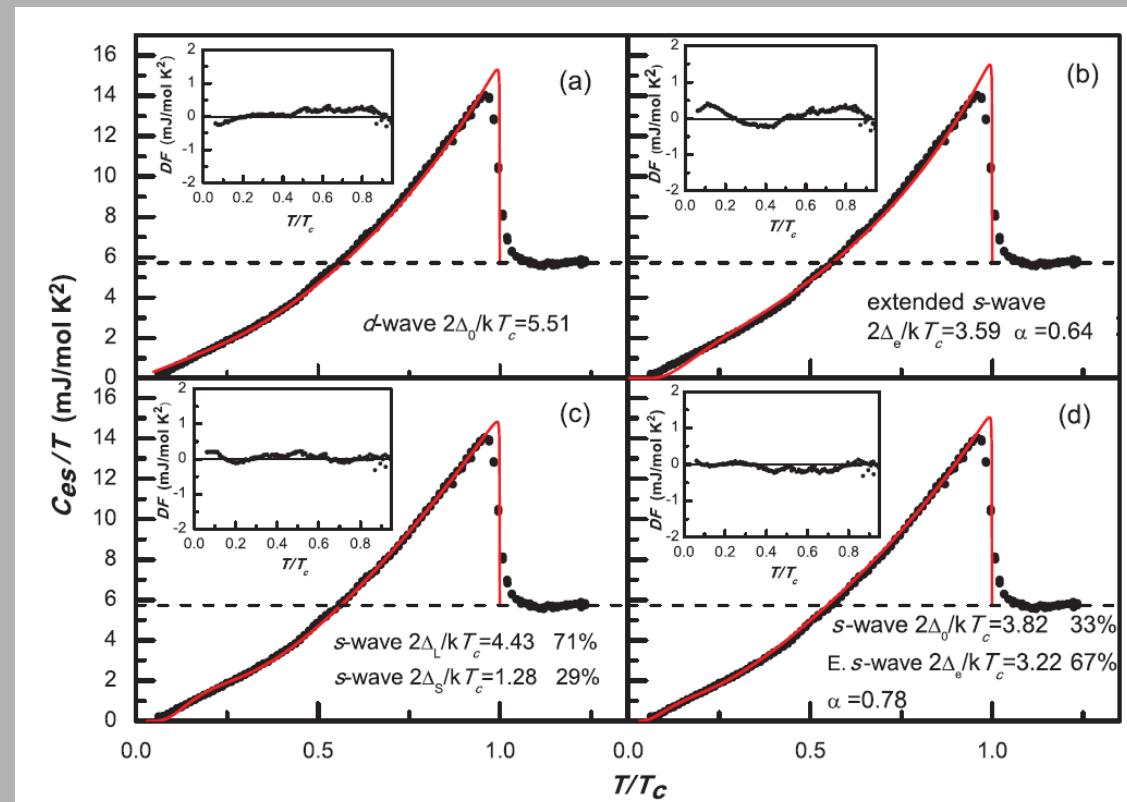
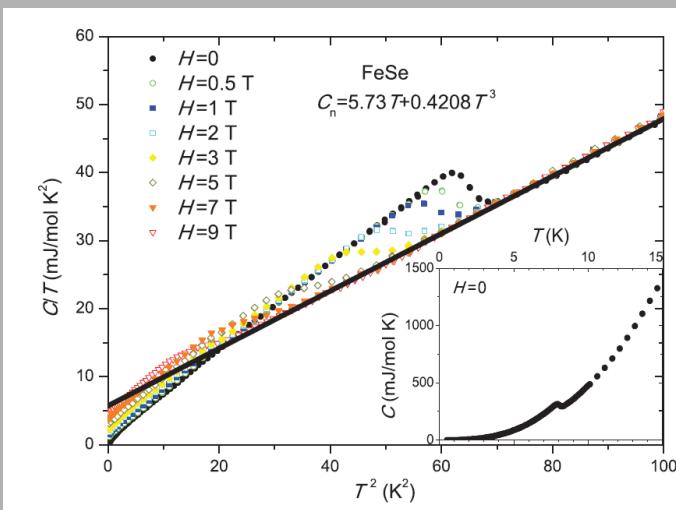
Mössbauer studies

Magnetic phase transition in LiFeAs is first order in nature
A sharp evolution of the $V_{zz}(T)$ and $\eta(T)$ parameters near $T \approx T_N, T_S$ is interpreted as a manifestation of the anisotropic electron redistribution between the dxz, dyz and dxy orbitals of the iron ions.



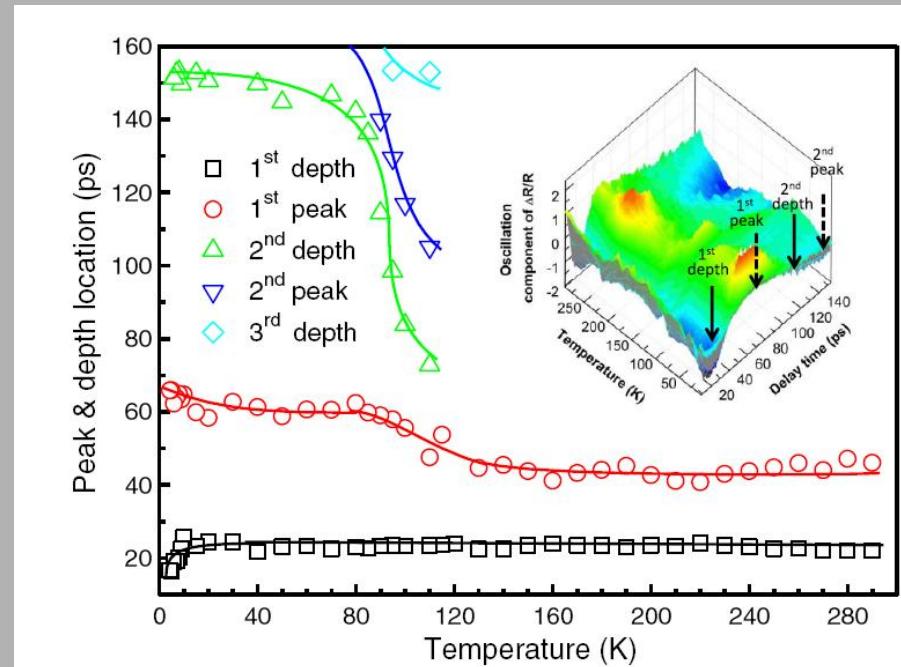
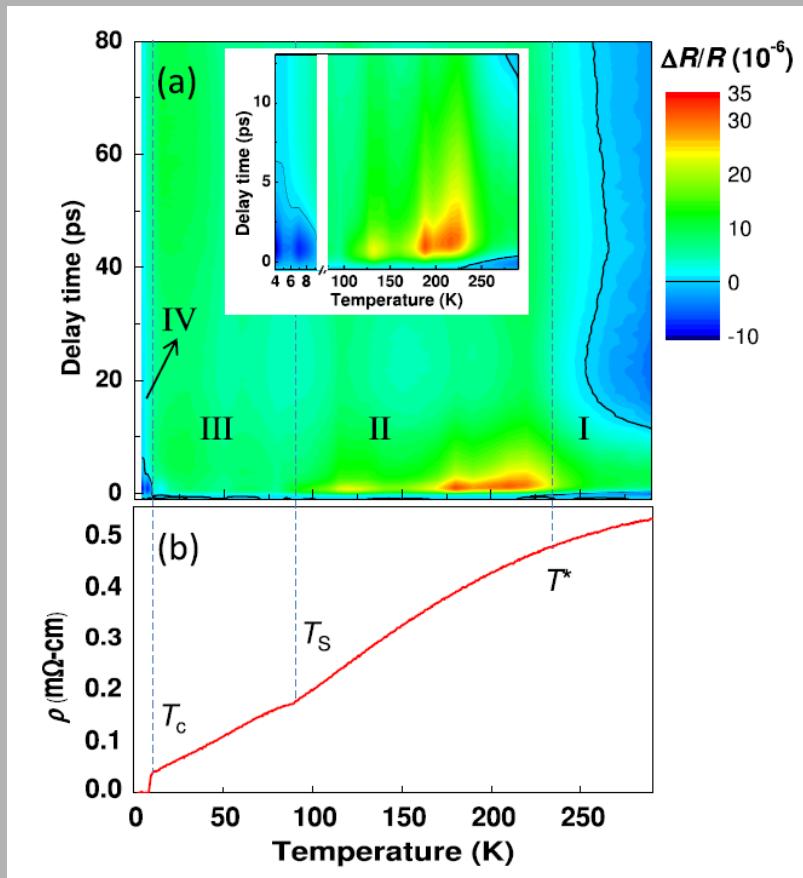
Specific heat studies

Low-temperature specific-heat $C(T)$ data identify both an isotropic s -wave and extended s -wave order parameters coexisting in a superconducting single-crystal FeSe with $T_c = 8.11$ K.



Femtosecond spectroscopy

Relaxation time analysis in FeSe exhibits anomalous changes at structural phase transition at 90 K and previously overlooked phase transition or crossover at 230 K.

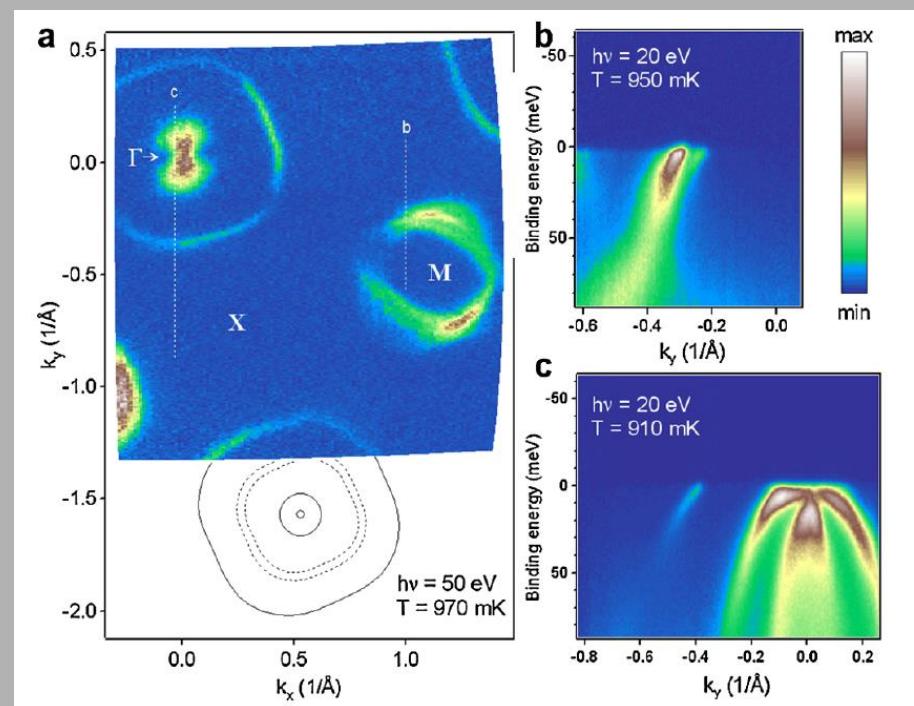
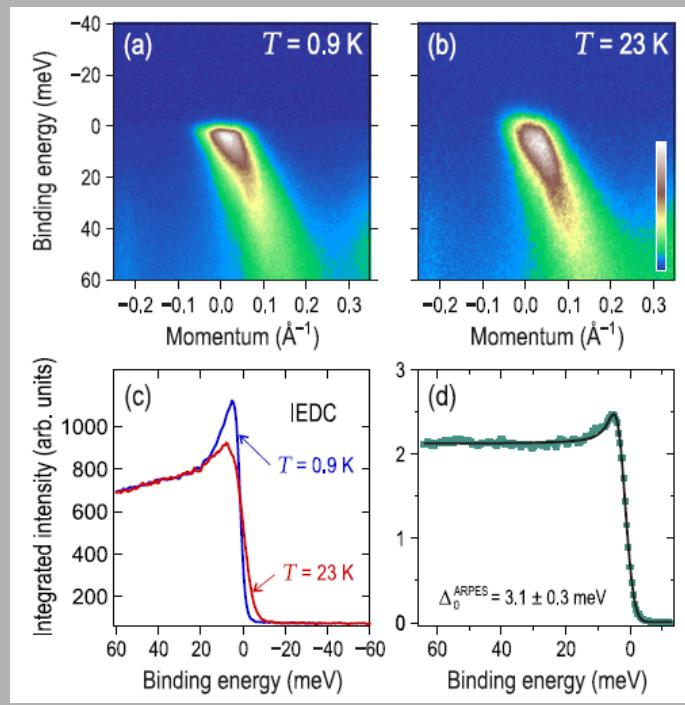


C.W. Luo, et al., Phys. Rev. Lett. 108, 257006 (2012)

C.W. Luo, New Journal of Physics 14, 103053 (2012)

SANS & ARPES studies IFW

LiFeAs SANS rocking curves indicate single isotropic SC gap $\Delta_0 = 3.0 \pm 0.2$ meV, which agrees with the ARPES value of $\Delta_0^{\text{ARPES}} = 3.1 \pm 0.3$ meV and corresponds to the ratio $2\Delta/k_B T_c = 4.1 \pm 0.3$, approaching the weak-coupling limit predicted by the BCS theory.

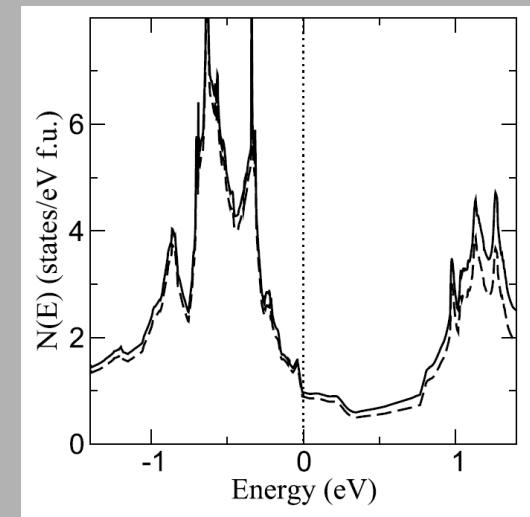
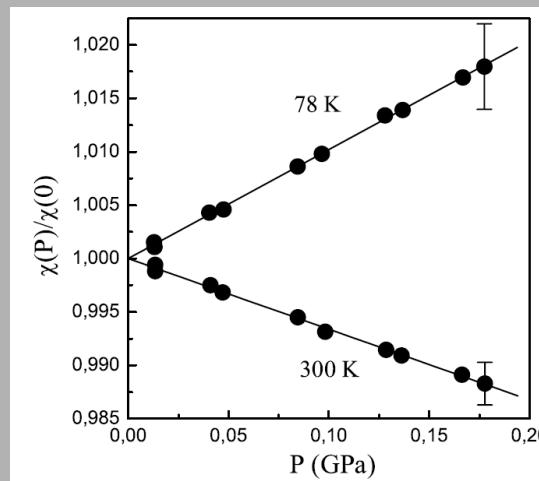
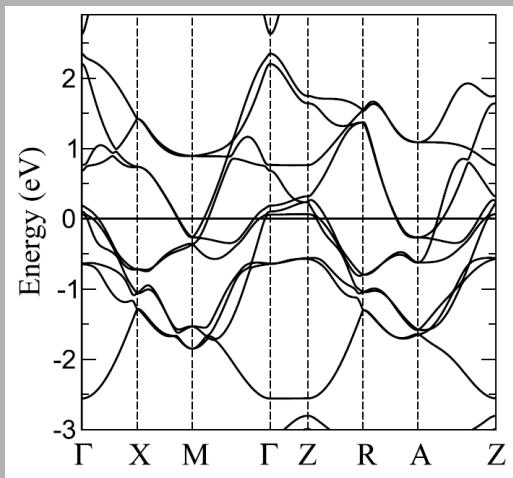


D.S. Inosov, et al., Phys. Rev. Lett. 104, 187001 (2010).

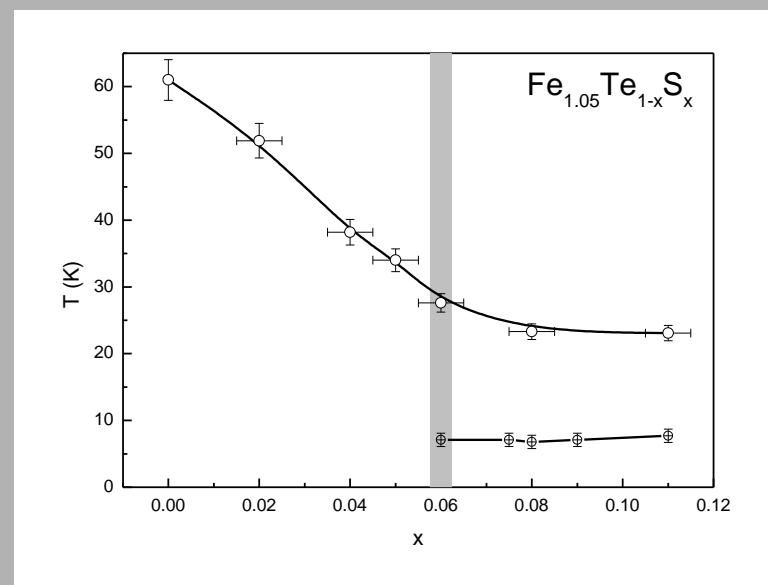
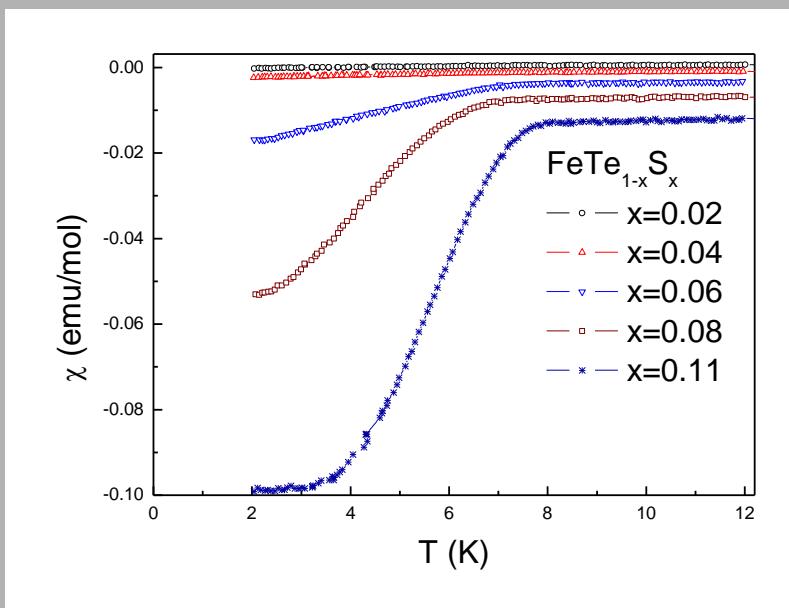
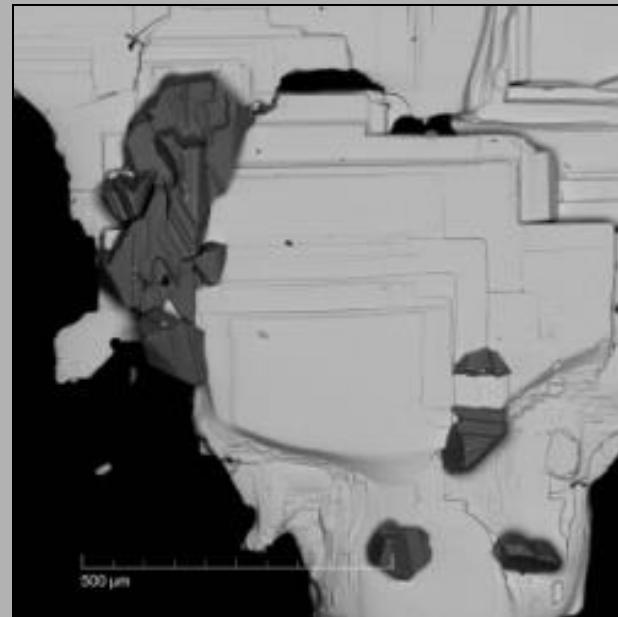
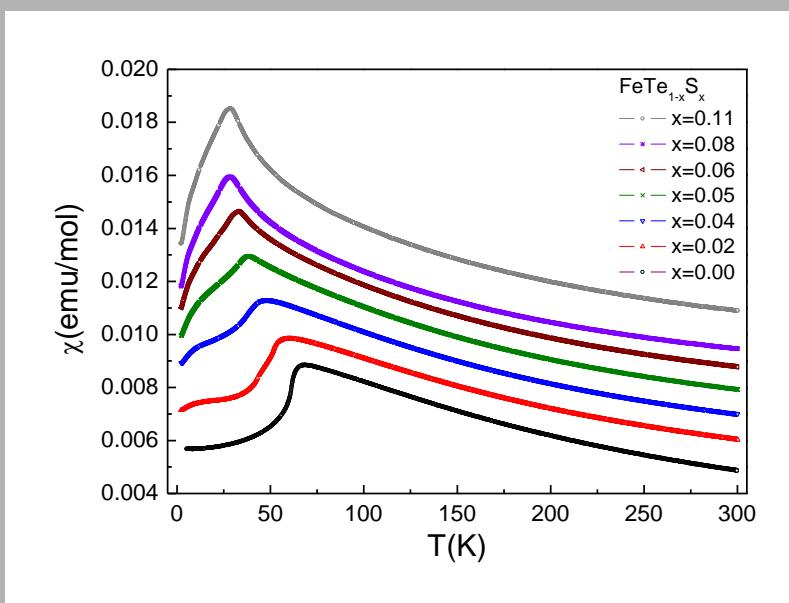
S.V. Borisenko, et al., Phys. Rev. Lett. 105, 067002 (2010).

High pressure studies FTINT

Ab initio calculations indicate that FeSe is close to magnetic instability, with dominating enhanced spin paramagnetism. The calculated paramagnetic susceptibility exhibits a strong dependence on the unit cell volume and especially on the height Z of chalcogen species from the Fe plane.



Magnetism & Superconductivity in $\text{Fe}_{1.05}(\text{Te}_{1-x}\text{S}_x)$



Thanks for attention!

Danke schön!

Щиро дякую!

Спасибо за внимание!