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## Hyperfine parameters of Fe atoms in superconducting FeSe as function of temperature, pressure and magnetic field.

A pressure, temperature and magnetic field effect was studied in the superconducting FeSe.

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Poster

### Summary

A pressure and temperature effect was studied in the Fe partial phonon density of states by  $^{57}\text{Fe}$  nuclear resonant inelastic scattering (NIS) in the superconducting Fe $_{1.01}\text{Se}$ . We found i) no pronounced changes across the tetragonal – orthorhombic phase transition and ii) a hardening of the phonon spectrum as a function of pressure in the superconducting phase. We conclude that the strong increase of  $T_c$  in Fe $_{1.01}\text{Se}$  with pressure [1] cannot be described in the framework of classical electron-phonon coupling, for instance, in the McMillan formalism. This result suggests the importance of both lattice and spin fluctuations in the observed superconductivity [2].

Mössbauer spectroscopic studies were done at ambient and high pressure. Temperature dependence of the Mössbauer-Lamb factor in Fe $_{1.01}\text{Se}$  was measured across the tetragonal-orthorhombic structural phase transition at ca. 95 K. It has been shown that the orthorhombic phase is slightly softer than the tetragonal one.

Among other factors which could be responsible for  $T_c$  enhancement in Fe $_{1.01}\text{S}$  under pressure is the behavior of electronic density of states at the Fermi level. Indirectly the information about the electronic density at the Fe sites bears the isomer shift on  $^{57}\text{Fe}$  nucleus. We observe a decrease in the isomer shift in the tetragonal phase of Fe $_{1.01}\text{Se}$  which corresponds to increase in s electron density at Fe nucleus under pressure. We discuss several mechanisms by which core electron contribution can be altered by pressure.

Mössbauer measurements in the external magnetic field below the transition to the superconducting state revealed zero electron spin density on Fe atoms in Fe $_{1.01}\text{Se}$  and FeSe $_{0.5}\text{Te}_{0.5}$ . Interpretation of Mössbauer spectra of Fe $_{1.01}\text{Se}$  and FeSe $_{0.5}\text{Te}_{0.5}$  in the Shubnikov phase will be discussed [3].

[1] S. Medvedev, T.M. McQueen, I. Trojan, T. Palasyuk, M.I. Eremets, R.J. Cava, S. Naghavi, F. Casper, V. Ksenofontov, G. Wortmann, C. Felser, *Nature Mater.* 8, 630 (2009).

[2] V. Ksenofontov, G. Wortmann, A.I. Chumakov, T. Gasi, S. Medvedev, T.M. McQueen, R.J. Cava, and C. Felser, *Phys. Rev. B* (accepted).

[3] V. Ksenofontov, G. Wortmann, T. Gasi, J. Deisenhofer, V. Tsurkan and C. Felser (in preparation).

**Primary author:** Dr KSENOFONTOV, Vadim (Johannes Gutenberg-Universität Mainz)

**Co-authors:** Prof. FELSER, Claudia (Johannes Gutenberg-Universität Mainz); Prof. WORTMANN, Gerhard (Universität Paderborn); Prof. CAVA, Robert (Department of Chemistry, Princeton University); Dr MEDVEDEV, Sergey (Max-Planck-Institute for Chemistry, Mainz); Ms GASL, Teuta (Johannes Gutenberg-Universität Mainz); Dr MCQUEEN, Tyrel (Department of Chemistry, Princeton University)

**Presenters:** Prof. WORTMANN, Gerhard (Universität Paderborn); Ms GASL, Teuta (Johannes Gutenberg-Universität Mainz); Dr KSENOFONTOV, Vadim (Johannes Gutenberg-Universität Mainz)

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