Development of *H-T* phase diagrams in *U*-based intermetallics using ultrasound method

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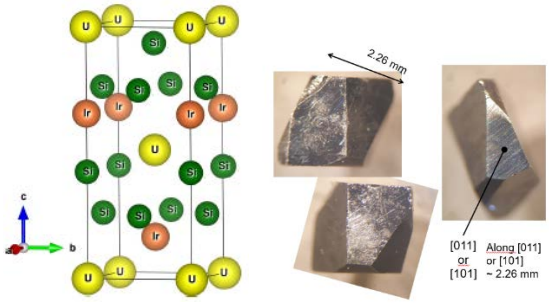
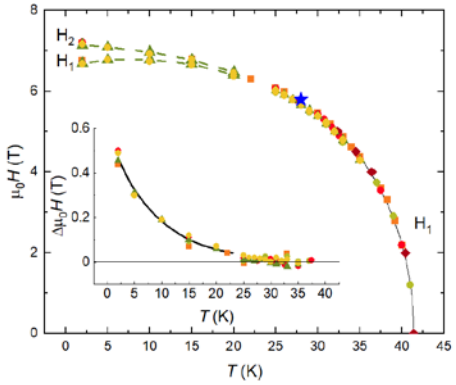
Strong correlation between structural, magnetic, and electric properties makes studies of the elastic properties of solids an important direction of experimental condensed-matter physics. Studies of elastic properties provides information about lattice distortions, spontaneous and field-induced phase transitions, crystal-electric-field schemes, and multipole interactions. Data obtained from temperature and field dependencies of elastic moduli makes it possible to map out or to complement existing *H-T* phase diagrams. In MGML laboratory (open access research infrastructure, www.mgml.eu), ultrasound is a newly introduced technique, complementary to well-established thermal expansion and magnetostriction. One of the main research areas in the MGML is *U*-based intermetallics (which includes $UIrSi_3$, UAu_2Si_2, UCoGe, UIrGe, UTe_2 families). The laboratory has capabilities to grow high-quality single crystals, carry out measurements of a number of physical properties in magnetic fields up to 19.5 T and perform calculations. Modifications in acoustic mounting procedure and redesign of the sample holder are needed for the experiments with the *U*-based intermetallics. As an example $UIrSi_3$ elastic properties were recently studied in static magnetic fields up to 19.5 T [2]. Some pronounced spin-lattice effects were found and a theoretical model explaining them was proposed.



$UIrSi_3$ tetragonal structure and the polished single crystalline sample[1].



$UIrSi_3$ phase diagram complimented with acoustic data[2] (grey color existing diagram [1]).

The work will consist of the *U*-based single crystalls orientation via Laue difractometer and polishing plan-parallel sides along main crystalographic axis and planes. One would learn the mounting procedure of fragile submillimeter-size samples (transducers, bond, sample mounting, screening, etc.) as well as performing the ultrasound measurements using the pulse-echo technique(PPMS option). A number of experiments to be performed to measure field and temperature dependencies of relative change of sound velocity.

References:

[1] J. Valenta, F. Honda, M. Vališka, P. Opletal, J. Kaštil, M. Míšek, M. Diviš, L. Sandratskii, J. Prchal, and V. Sechovský, PRB **97**, 144423 (2018).

[2] T. N. Haidamak, J. Valenta, J. Prchal, M. Vališka, J. Pospíšil, V. Sechovský, J. Prokleška, A. A. Zvyagin, and F. Honda, PRB **105**, 144428 (2022).