Univerzita Karlova v Praze
Matematicko-Fyzikální Fakulty

Katedra Fyziky
Kondenzovaných látek

Dr. rer. nat.
Jeroen Custers

Ke Karlovu 5
121 16 Praha 2
Tel: +420 95155 1655
Fax: +420 95155 1061

custers@mag.mff.cuni.cz

Supervisor report on the doctoral thesis of Marie Kratochvílová, titled:

"The ground state properties of (RE,U)$_n$$TIn_{3n}$ intermetallic compounds"

Marie Kratochvílová started her doctoral study at the department of Condensed Matter Physics in September 2012. The investigation of the ground state properties of Rare Earth and Actinide intermetallic compounds which crystallize in the typical $HoCoGa_5$-type tetragonal structure is a continuation of her diploma studies where she discovered the compounds discussed in Chapter 3 of this thesis work, Ce_2PtIn_8, Ce_3PtIn_{11} and Ce_3PdIn_{11}.
The compounds belong to the $Ce_nT_mIn_{3n+2m}$ family which attracted much of attention in the past decade because of their unusual ground state properties, for instance the coexistence of superconductivity and long-range magnetic order. The origin of the rich diversity of ground states in these compounds can be found in the character of the 4*f*-electron and the subtle balance of multiple interactions the electrons are exposed to, like the long-range indirect RKKY exchange interaction, the on-site Kondo interaction and the CEF effect. This balance, as discussed by the candidate, can be altered by applying a magnetic field or hydrostatic pressure in favor of a new ground state. On the other hand, the ground state can as well be affected by exchanging the 4*f*-element by a 5*f*-element as presented in chapter 5. While in the cerium-based compounds the Kondo effect is most influential now CEF effects become more important with respect to the physical properties. In chapter 6 shows a series of experiments on RE_2CoIn_8. The substitution of cerium, which in this compound has an itinerant behavior, by elements with a stronger localized character of the 4*f*-electron leads to a magnetic ground state as a result of dominance of RKKY interaction.

The presented thesis contains a treasure of interesting novel and exciting results. New materials were discovered (Ce_2PtIn_8, Ce_3PtIn_{11}, Ce_3PdIn_{11} and U_2RhIn_8) with interesting new properties. In particular worth mentioning are Ce_3PtIn_{11} and Ce_3PdIn_{11}. These two compounds are the first known full inversion symmetrical stoichiometric heavy fermion materials based on Ce exhibiting coexistence of both

attributes, magnetism and superconductivity at ambient pressure. In addition both compounds posses two inequivalent cerium sites each characterized by distinct different Kondo scale. The interplay between two Kondo scales in one compound is yet uncharted terrain and makes Ce_3PtIn_{11} and Ce_3PdIn_{11} exciting compounds for future studies.

An important aspect of the thesis work was the synthesis of (new) compounds. Such work would not be possible without the rich knowledge of Marie Kratochvílová on sample preparation (Czochralski growth and flux growth technique) and sample characterization techniques such as powder x-ray diffraction and Laue backscattering, EDX and SEM. The importance of high quality samples has been discussed extensively in one of her publications [M. Kratochvílová et al., J. Cryst. Growth **397,** (2014) 14].
Besides sample growth and characterization, the work includes the measurement of several physical properties like the electrical resistivity, specific heat and magnetization. In addition to these in-house experimental methods the investigation of the physical properties required neutron experiments which were performed at ILL in Grenoble, BERII in Berlin and PANDA in Garching.

During her thesis work Marie has shown to be able to work independently in the field of condensed matter physics. She captured quickly new ideas in the field of heavy fermion physics and quantum criticality. Her thesis work is at the forefront of modern condensed matter physics. It has been in parts published in international peer-reviewed papers or is already on the verge of being published as well as been presented on several international conferences (ICM, SCES, JEMS, JdA, LT27).

In conclusion, the doctoral thesis work presented by Marie Kratochvílová is state of the art work. Additionally, she has shown that she is able to carry out scientific work independently. The work fulfils all requirements for a Ph.D degree.

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Dr. rer nat. Jeroen Custers
(supervisor)