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Report on

The PhD thesis
Magnetic Properties of R_2TIn_8 and related tetragonal compounds
by Petr Cermak

This thesis is about electronic structure studies, in particular precise magnetic structure determination, on high quality single crystals of R_2TIn_8 (R: rare-earth, T: transition elements) by means of magnetic properties and specific heat measurements together with intensive neutron diffraction experiments. The crystal structure of R_2TIn_8 is one of the related structures of well-known heavy fermion compounds RTX_5 (R: rare-earth and actinide, T: transition metal, and X: In and/or Ga), where the relation between magnetism and superconductivity around quantum critical region attracts many researchers in the field of condensed matter physics.

The thesis is written as follows: in chapter 1, the author introduces the background of physics of strongly correlated electron systems and the way how to determine magnetic structures by means of neutron diffraction experiment. In chapter 2, detailed experimental methods used in this study are described and in chapter 3, current knowledge about electronic properties of R_2TIn_8, RTX_5 and other related compounds are reviewed. In chapter 4, author describes experimental results on studied R_2TIn_8

compounds especially magnetic structure determination using neutron diffraction and discusses their magnetic properties on the basis of magnetic phase diagram and magnetic structures with comparison to other related compounds. Finally, the study is summarized in conclusion section.

The thesis is written in a clear and concise way. To my knowledge, the complete magnetic phase diagram and magnetic structures of studied R_2TIn_8 compounds are new and important results. This information is indeed quite useful for understanding the physics of heavy fermion superconductivity. Here are several comments to author.

1) (page 29) Recently, the crystal structure of "127" compound was revised by Klimczuk et al. (DOI: 10.1088/0953-8984/26/40/402201).

2) (page 36-37) Please cite appropriate paper how to determine the crystal structural parameters (z_R, z_{In2}, and z_{In3}) of R_2RhIn_8 (R: Y, La, Lu) or describe a bit more detail for the calculation. It should also better to add a sentence "the positional parameters are calculated by DFT calculation" in the caption of Table 6.

3) (page 37-38) Change the order of Figure 9 and 10. In the text, Fig. 10 is explained first.

4) (page 42) Please distinguish the symbols from the present study and previous work obtained by [89, 90, 65, 67] in Fig 12.

5) (page 50) Please comment why AF2 phase boundary of Dy and Ho_2RhIn_8 shows strange shape in the magnetic phase diagram. It seems the system shows AF1-AF2-AF1-Para phase transition with increasing magnetic field at certain temperature, ex. 7.5 K in Ho case.

6) (page 52) Relation between '115' and '218' compounds with semi-2D system, and '122' compounds with 3D system is not clear. Please comment

more clearly about similarity and difference between those systems.

7) (page 52-) Are the yellow squares and blue diamonds in Figs. 20 – 23, 25 simulated spots or obtained signal? Please clarify.

8) (page 53) Please define "#" and "Δω" in Table 9.

9) (page 55-56) Indexing of signals on (-1 3 -4) and (-1 3 -3) might be wrong in Fig. 23 (and/or 24?). The blue diamond (-1 3 -4) peak in Fig. 23 can be (-1 3 -3) nuclear peak?

10) (page 78-79) Explanation of temperature dependence of integrated intensity on (1/2 0 1) in 3 T is unclear. Author claimed AF1 boundary in 3 T was not observed, but plotted in the phase diagram in Fig.42. Does it mean boundary between AF1 and AF2? It seems to me that the crossing of AF1 boundary (from paramagnetic state) is observed at around 9 K. Even the boundary between AF1 and AF2 is manifested at 8 K, where the integrated intensity becomes temperature independent.

The author has already published several papers in regular journals related to this study. In this thesis, he has clearly demonstrated his ability to do independent research. I think that he fulfills the requirements for the doctoral title. After the author addresses the comments above, I strongly recommend that he is awarded the title PhD in physics.

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