Reviewer´s report of the habilitation thesis by RNDr. Jiří Pospíšil, PhD.:

„The role of single crystals in materials research".

The submitted thesis summarizes the work which has been done in last ten years focusing on experimental studies of magnetic and transport properties of predominantly 5f electron uranium intermetallic systems. Phase diagrams of various representatives have been constructed using temperature, magnetic field, pressure, and concentration as external parameters. Rigorous investigations of the phase diagrams ultimately required single crystals of high quality due to strong magnetocrystalline anisotropy of the studied materials.

The vicinity of the investigated systems to so-called Hill´s limit in the corresponding phase diagram, when subtle alternation of the structure may lead to novel physical scenario, make them very attractive for fundamental research. This fact may be documented by e. g. still not fully clarified existence of unconventional superconductivity in URu_2Si_2, coexistence of antiferromagnetism and superconductive phases in UPd_2Al_3 compounds and even coexistence of ferromagnetism and superconductivity in UGe_2, URhGe, and UCoGe under appropriate conditions. Apparently, the investigated materials represent topical and physically very interesting objects.

The thesis itself begins with Introduction in which author in clear and concise way describes his field of research and formulates a motivation for the studies. Subsequent three chapters are devoted to the discussion of the obtained results; each chapter is focused on a different group of uranium materials. More specifically, properties of the studied ternary orthorhombic uranium compounds are summarized in Chapter2. The results obtained in the investigation of the compounds of hexagonal ZrNiAl-structure type are summarized in Chapter 3. Chapter 4 is focused on the novel U_2Rh_2Pb compound. Unlike the Introduction, these three chapters are in my opinion more difficult to read since the text seems to be too dense regarding the information. This feature results from obvious effort to present all the relevant facts while keeping reasonable length of the chapters. The 5th chapter addresses validity of spin fluctuation theory to selected uranium, neptunium, plutonium and 3d compounds suggesting that the itinerant nature of the 5*f* electrons in the actinide ferromagnets can be understood within the used theory. Chapter 6 is focused on author´s contribution in growing high-quality single crystals of novel ternary uranium compounds. In addition, the attention is also devoted to the growth of single crystals of the metastable β-Ti alloys, which have high application potential. The obtained results are summarized in Conclusions.

The quality of the obtained results is very well demonstrated by 18 attached scientific papers from peer-reviewed journals, 9 of them accepted in Phys. Rev. B, 2 in Acta Materialia. Mentioning all results is not straightforward as they concern uranium materials from various groups. For TiNiSi type compounds the confirmation of strong hybridization of the 5*f* states with the electronic states of surrounding *d*-metals of the various bandwidth deduced from different pressure response of UCoGe, URhGe, and UIrGe represents one interesting example. In addition, failure of one-electron theory in the effort to understand rather complex magnetic behavior of ZrNiAl-structure type compounds was revealed by the formation of stable ferromagnetic zone in $UCo_{1-x}Ru_xAl$ system, where ferromagnetism diminishes for both parent compounds UCoAl and URuAl, respectively. Successful preparation of the high-quality single

crystal of the first lead material U_2Rh_2Pb enabled the investigation of the phase diagram characterized by antiferromagnetic transitions with and without hysteresis.

During the work in the field the author benefited from high level of his domestic laboratory in which well-developed infrastructure provides samples of excellent quality enabling to perform top experimental research with valuable local theoretical support. Yet, the author succeeded in pronounced improvement of the technology of preparation of intermetallic single crystals, which enabled him to address previously inaccessible topics. The effort was accompanied by improving author´s foreign experience as well due to his study stays in distinguished laboratories abroad. Last, but not least, the author will offer the obtained skills and knowledge also to students in the form of the new course "*Preparation of single crystals for materials research*".

Generally, the submitted thesis and publication record clearly confirm author´s high expertise, both technological and physical, in studying various classes of uranium intermetallic systems. The citation response on the published papers is sound and confirms the interest of scientific community in the obtained results. The contribution of the author on the published papers is substantial and well documented. In this context, the level of coincidence found by system Turnitin may be considered fully acceptable given that the thesis represents the survey of the results which have been already published.

In summary, the author of the habilitation thesis proved his high scientific level with strong involvement in technology of growing single crystals which makes him more versatile scientist. The submitted thesis is of excellent quality and, in my opinion, exceeds the requirements to be accepted as a habilitation thesis. Consequently, after successful defense procedure, I unambiguously support RNDr. J. Pospíšil, PhD. to be awarded by the title "Associate professor".

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Košice 23. 2. 2022

prof. Ing. M. Orendáč, DrSc.