

Posudek školitele na disertační práci

(Supervisor's report on the doctoral thesis)

Kay Condie Erb:

„Algebraic Approaches to Elementary Excitations in Media with Broken Spatial or Time-reversal Symmetry“

Předkládaná práce „Algebraické přístupy k elementárním excitacím v prostředích s narušenou invariancí vůči prostorové nebo časové inverzi“ přináší především systematickou analýzu možností narušení krystalografické symetrie v souvislosti se strukturními a magnetickými fázovými přechody v krystalech.

Práce je podána v angličtině a proto si dovoluji přejít do jazyka práce.

The manuscript of the thesis of Kay Condie Erb has the usual format with an introduction, few chapters describing the background, and methodology, in this case devoted to the developed software tools. Major results are explained three core chapters, preceeding the final conclusion section outlining the significance and possible future development of the work. The content was partly published (1 paper published, 1 accepted, 1 in ArXive) and the few related presentations of by KC Erb given at several conferences (5th International Workshop on Topological Structures in Ferroic Materials in Prague– and 7th International Symposium on Integrated Functionalities in Dublin, to mention a few) received a very positive welcome by the scientific community.

My collaboration with KC Erb has started when my attention was attracted by his poster presented at March meeting of the American Physical Society in early 2017. The work here presented there included several inspiring thoughts about metrology of space and time and related algebraic and geometric questions. Knowing that the physics of crystal lattices has been inspiring many particle physics theories, I always wondered to which extend the abstract theories are also changing our perception of the everyday solid state physics world. On the one hand, the concept of spacetime in modern physics is largely interconnected with the matter, and on the other hand, when we neglect their discreteness, the real crystalline lattices can be viewed as media with an extremely rich options of possible combinations of macroscopic symmetries. Our discussions about these analogies resulted in an idea of a PhD project focused on systematic examination of the macroscopic symmetry breaking in crystals.



In the field of this subject, I have previously done a preliminary work alone and with my colleagues Václav Janovec, Jana Přívratská and Petr Ondřejkovič. However, this preliminary work did not make the workflow of this thesis a boring, straightforward technical task. The goals were several times updated based on the progress, the difficulties encountered, and on the level of our understanding. KC Erb often came with some original solutions of the problems we discussed previously and he had many times courage to make suggestions for possible next steps that I did not thought about. Our discussions with KC Erb about his progress were thus often quite tough but I have appreciated them a lot. In retrospective, I must say that I am impressed how quickly KC Erb has been dealing with various technical problems and how efficient and productive was his work on this thesis.

It is worth to emphasize that for the amount and quality of the technical results presented in this thesis, it was extremely important that KC Erb turned out to be a highly motivated, open-minded and unusually responsible student, and that he remained enthusiastic about the subject even when the work did not progressed as expected. Last but not least, it should be stressed that this work would hardly been completed without his professional experience and talent with the object-oriented language programming. In either case, the numbers of various possibilities of symmetry breaking considered in this thesis is challenging. Therefore, the set of software tools allowing a fully algorithmic generation of the multiple output tables listed in the thesis and papers was probably the only way to avoid the errors in the results.

From my perspective, I can say that Kay Condie Erb in his thesis had definitely brought a major contribution to the systematic studies of macroscopic symmetry breaking in crystallography of structural and magnetic phase transitions and that he demonstrated clear abilities to perform independent scientific research. In summary, I am convinced that the candidate deserves the Ph.D. degree and it is my pleasure to recommend the thesis of Kay Condie Erb to be defended in front of the respected examination board.

Práci vřele doporučuji k obhajobě.

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