

Thesis Review

Faculty of Mathematics and Physics
Charles University, Prague

- Supervisor's Review Referee's Review **
 BSc. Thesis MSc. Thesis

Author: Antonín Baďura
Thesis title: Thermo-transport effects in Antiferromagnets
Study program: Physics
Submitted: 2020

Supervisor/Referee: João Pedro Martins Godinho
Affiliation: Fyzikální ústav AV ČR, v. v. i.
E-mail: godinho@fzu.cz

Thesis quality (technical field and expertise):

- excellent very good standard substandard nonconforming

Objective accuracy (error appearance):

- nearly perfect standard frequent, but minor serious errors

Thesis results:

- original both original and compiled productive compilation copied

Thesis size:

- large standard just acceptable insufficient

Thesis quality (style and grammar, and graphic arrangement):

- excellent very good standard substandard nonconforming

Misprints:

- negligible acceptable number very frequent

Overall thesis quality:

- excellent very good standard substandard nonconforming

** Copy and paste this check box, , if it is applicable.

Supervisor's/Referee's Comments:

In his work, the student studied the magnetotransport and thermotransport properties of the different magnetic phases of Mn_5Si_3 . This material undergoes through two phase-transitions, it transitions from non-collinear to collinear antiferromagnet and it becomes paramagnetic at the Néel temperature. The thesis focused on identifying the phase-transitions based on the transport properties, particularly the different Hall effects and their thermal counterparts. Furthermore, a thermal scanning technique was also used in an attempt to imagine the magnetic domains.

The student briefly describes the family of phenomena which will be present in the results, proceeds to describe the techniques which were used, and lastly the main results are shown and discussed. Despite a few minor typos, I think it is well written in a succinct and detailed way conveying the main conclusions from the data.

The work was developed in the active field of non-collinear antiferromagnetic spintronics and interesting results were observed. Two of the main results of this work were the observation of the Nernst effect in Mn_5Si_3 and the Hall response in the collinear phase, which was ascribed to the recently proposed crystal Hall effect.

Regarding the thermal gradient microscopy, the experiments did not yield positive results. With the lack of strong evidences of a thermal signal originating from the magnetic order, the student proceeded to investigate via numerical modelling the possible artefact arising in such a type of experiment.

To conclude, the student employed already established techniques in the literature, in order to study a new material and its properties, obtaining his own new and original results. He understood the basic concepts of the scientific field to carry out his experiments and draw valid conclusions from the data.

Questions raised (and to be answered by the author during the Thesis Defence):

- 1) With the figure 1.3 in mind, in a schematic way what would be the difference between anomalous Hall effect and spin Hall effect? Would the spin Hall effect generate a transversal voltage?
- 2) Besides the measurements of susceptibility as a function of temperature (fig. 2.2), has it been also measured the remnant magnetization as a function of temperature? Maybe this could also give us some insight into whether or not there are ferromagnetic inclusions.
- 3) In the thermal gradient microscopy scans shown on fig. 3.10, where on the device was the scan done? If the dashed lines highlight the borders of the device, then was the scan performed in a region not in-between by the transversal contacts, V_{xy} ? If so, was any transversal signal to be expected?

Supervisor's/Reviewer's recommendation on Thesis rating:

excellent very good standard reject

Done in Prague
Date 1/7/2020

Name João Pedro Martins Godinho

Signature