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Report on the Mr. Joao Pedro Martins Godinho thesis
"Electro and thermal magnetotransport
in antiferromagnetic systems"
to be presented to obtain the degree of Doctor in Charles University, Prague.

The manuscript of the doctoral thesis of **Mr. Joao Pedro Martins Godinho** is centered on the control and detection of antiferromagnetic order in antiferromagnetic systems with PT symmetry. Antiferromagnetic materials (AFMs) and their unique magnetic properties offer the potential for improved performance, reduced power consumption, and enhanced stability in various spintronic applications. In this respect, the ability to control and manipulate the Neel order is the most important step in building the antiferromagnetic spintronics. However, detecting the direction of the Neel order parameter in antiferromagnets is challenging. Typically, this is done by electrical means for example, by electrical measurements of the anisotropic magnetoresistance which however can detect the axis of magnetization but not its direction. This thesis aims on finding ways to electrically identify the Neel vector reversal in PT symmetric systems, where additionally the anomalous Hall effects is zero. Thus, the topic is very timely and important from both fundamental and applied points of view.

The manuscript contains 7 chapters, including the motivation, introduction and conclusions. The chapters 1-4 are introductory. They are very well written showing extended knowledge of the subject. The main results are presented in chapter 5. It is important to note that the work considers three most important examples of antiferromagnetic materials: synthetic AFM (a multilayer Pt/CoNi/Ir/CoNi/Pt non-symmetric structure coupled with RKKY), bulk collinear AFM (CuMnAs) and non-collinear AFM (Mn_3SN). The candidate considered two methods of detection: electrical and thermo-electrical. In the case of the synthetic antiferromagnet, the author uses the second-order harmonic response of the magnetoresistance and the domains were imaged using MFM. In the case of bulk antiferromagnets, he argues that the thermoelectrical method, via the heated scanning probe microscopy, using the magneto-Seebeck effect, is very versatile in detecting the antiferromagnetic domain direction. The presented results provide strong and evidence to support this hypothesis. Using SNOM set-up, the motion of domain walls was also imaged.

Finally, Chapter 8 discusses some other possibilities for antiferromagnetic spintronics based on materials of this class: spin-orbit nano-oscillators and the possibilities to induce photocurrents And chapter 9 presents a good summary of the results and outlines the main concussions obtained in the thesis.

To summarize, the PhD thesis contains important and timely results which significantly contribute to the advancement of the antiferromagnetic spintronics. They are important not only for enriching our knowledge on antiferromagnets but can also open pathways for applications such as antiferromagnetic memories and neuromorphic computing.

Finally, I would like to underline that the thesis is exceptionally well written. The author's ability in articulating complex concepts and a deep understanding of the topic is evident. The results are original and the candidate clearly demonstrated his high potential and creative skills in addressing important scientific challenges.

I recommend Mr. **Mr. Joao Pedro Martins Godinho** for the defense of his thesis to obtain the degree of Doctor in Physics of the Charles University.

Yours truly,

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