Seminar on Condensed Matter Theory

Group of Theoretical Physics at the Department of Condensend Matter Physics
of Charles University has a pleasure to invite you to attend the seminar

on 10 October 2019 at 14:00

at Faculty of Mathematics and Physics of Charles University, Ke Karlovu 5, 121 16 Praha 2

Lecture hall F2

Dr. Ján Rusz

Department of Physics and Astronomy, University of Uppsala, Uppsala, Sweden

First principles calculations of electron beam deflection by microscopic magnetic fields in crystals: magnetic differential phase contrast imaging at atomic scale

Emergence of exotic magnetic behavior at nano-scale calls for magnetic characterization techniques capable to measure magnetism with sufficient spatial resolution. Scanning tunneling microscopy allows to measure magnetism with atomic spatial resolution, enabling fascinating insights into the atomic scale magnetism [1], however, this method is restricted to detection of properties of surface layers of atoms. Transmission electron microscope (TEM) appears to be a natural choice of an instrument to study magnetization inside materials, at atomic scale: it allows to focus illuminating electron probe to sub-atomic areas, while transmitting it through the sample. It is thus having the potential to obtain atomic-scale information from the bulk of the sample.

We will describe – from a theoretical perspective – a new technique with a potential to provide atomic-scale information about magnetism in samples. The technique is based on differential phase contrast imaging (DPC) at atomic resolution [2]. Recent simulations utilizing the Pauli multislice equation [3], which includes the interaction of the electron beam with microscopic magnetic field inside the sample, show that the diffraction patterns (ronchigrams) carry information about the projected microscopic magnetic fields at atomic scale [4]. Considering that EMCD signals [5] of strength about 1% have been detected [6] in the electron energy loss spectra, magnetic DPC at atomic resolution, which utilizes most of the elastically scattered electrons, could be a viable alternative for magnetic studies at atomic resolution.

[1] A. Khajetoorians et al., Nature 467, 1084 (2010).
[2] N. Shibata et al., Nature Physics 8, 611 (2012).
[3] A. Edström, A. Lubk, J. Rusz, Phys. Rev. Lett. 116, 127203 (2016).
[4] A. Edström, A. Lubk, J. Rusz, Phys. Rev. B 99, 174428 (2019).
[5] P. Schattschneider et al., Nature 441, 486 (2006).
[6] J. C. Idrobo et al., Adv. Struct. Chem. Imaging 2, 5 (2016).

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For more information follow: theory.kfkl.cz/seminars.php
If you wish to receive regular updates on fothcoming seminars, contact K. Carva (carva@karlov.mff.cuni.cz).