

Seminar on Condensed Matter Theory

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

**on 10 December 2020 at 13:00
as an online webinar**

Contact K. Carva (carva@karlov.mff.cuni.cz) for the online access information.



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Ab-initio studies of electric-field-controlled magnetism

Magnetic/non-magnetic 2D heterostructures represent an ideal playground for spintronics, particularly in combination with the preparation of high-quality samples via MBE, and their characterization via inelastic spectroscopy techniques like XAS/XMCD [1] or SP-EELS [2].

Increasingly the challenge of their first principles study goes beyond the modelling of ground or excited state properties at equilibrium. Before approaching fully time-dependent scenarios, as in the context of i.e. even richer pump-probe experiments, the next step on the ladder is given by steady-state out-of-equilibrium conditions and in particular, from the practical prospective of possible new device concepts, how an applied electric field will couple to the electronic structure of the sample and manipulate some of its key magnetic features.

This talk will present for informal discussion methodological developments for the study of voltage-controlled proximity-induced spin magnetic moment in a conducting or insulating device layout, and resulting predictions and measurements for x-ray-based spectroscopy [3-6]. The same DFT foundations and retarded / lesser and greater KKR Green function formulation have also allowed to dip toes into the theme of voltage-controlled magnetocrystalline anisotropy (VCMA). More recently, still ongoing work has begun to examine the particular case of out-of-equilibrium collective spin excitations, or magnons, and how to try and devise an approximated but efficient extension beyond the first level of simple adiabatic treatment [6,7], in order to capture changes in both their group velocity and finite lifetime by means of an orthogonal external electric field perturbation.

[1] "Magnetic Dichroism Studies of Spintronic Structures" by W.Liu, Y.Xu, S.Hassan, J.Weaver, G.van der Laan, in "Handbook of Spintronics" by Y.Xu, D.Awschalom, J.Nitta (eds.), Springer (2016).

[2] "Probing magnons by spin-polarized electrons" by L.Zakeri, J.Kirschner, in "Magnonics: from fundamentals to applications", S.Demokritov, A.Slavin (eds.), Springer (2013).

[3] "X-ray Detection of Transient Magnetic Moments Induced by a Spin Current in Cu" by R.Kukreja, S.Bonetti, Z.Chen, D.Backes, Y.Acremann, J.Katine, A.Kent, H.Dürr, H.Ohldag, J.Stöhr, Phys.Rev.Lett.115, 096601



For more information follow: theory.kfkl.cz/seminars.php

If you wish to receive regular updates on forthcoming seminars, contact K. Carva (carva@karlov.mff.cuni.cz).

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(2015).

[4] "First principles calculations of steady-state voltage-controlled magnetism: application to x-ray absorption spectroscopy experiment" by A.Marmodoro, S.Wimmer, O.Sipr, M.Ogura, H.Ebert, Phys.Rev.Res. 2, 032067(R)(2020).

[5] "Microscopic Investigation into the Electric Field Effect on Proximity--Induced Magnetism in Pt" by K.Yamada, M.Suzuki, A.Pradipto, T.Koyama, S.Kim, S.Ono, T.Taniguchi, H.Mizuno, F.Ando, K.Oda, H.Kakizakai, T.Moriyama, K.Nakamura, D.Chiba, T.Ono, Phys.Rev.Lett. 120, 157203 (2018); "Perpendicular magnetic anisotropy and its electric-field-induced change at metal-dielectric interfaces" by S.Miwa, M.Suzuki, M.Tsujikawa, T.Nozaki, T.Nakamura, M.Shirai, Y.Masafumi, S.Yuasa, Y.Suzuki, J.Phys.D: Appl.Phys., 52,6 (2018).

[6] "Theoretical study on the electric field effect on magnetism of Pd/Co/Pt thin films" by E.Simon, A.Marmodoro, S.Mankovsky, H.Ebert, arXiv:2009.12941 (2020).

[7] "Ab initio calculations of exchange interactions, spin-wave stiffness constants, and Curie temperatures of Fe, Co, and Ni" by M.Pajda, J.Kudrnovský, I.Turek, V.Drchal, P.Bruno, Phys.Rev.B 64, 174402 (2001); "Exchange interactions and Curie temperatures in $Ni_{2-x}Mn_xSb$ alloys: First-principles study" by J.Rusz, L.Bergqvist, J.Kudrnovský, I.Turek, Phys.Rev.B 73,214412 (2006)

