

SEMINAR ON MAGNETISM AND SUPERCONDUCTIVITY

We kindly inform You that on **Wednesday**

March 27th at 10:00

there will be a **seminar in room 203, building I**

where

Dr hab. Carmine Autieri, prof. IFPAN

*(International Research Centre Magtop, Institute of Physics, Polish Academy of Sciences,
Aleja Lotników 32/46, PL-02668 Warsaw, Poland)*

will deliver a lecture on:

“Altermagnetism: from the non-relativistic spin-splitting to the staggered Dzyaloshinskii-Moriya interaction”

The Kramers' degeneracy was born in the field of spectroscopy for systems with time-reversal symmetry. Under the additional condition of the inversion symmetry was applied also to the field of the solid-state physics for non-magnetic systems. Recently, it was shown that the extension of the Kramers' degeneracy to the antiferromagnetic systems has some limitations. Without spin-orbit coupling, some antiferromagnets does not present Kramers' degeneracy but a large non-relativistic spin-splitting due to the breaking of time-reversal symmetry. This antiferromagnetism without Kramers degeneracy was named altermagnetism. Altermagnetic compounds behave as conventional antiferromagnets in the real space and as ferromagnets in the k-space paving the way for new technological applications [1,2].

The presence of the altermagnetic phase strongly depends on the magnetic space group[3,4]. We investigate the altermagnetic properties of strongly-correlated transition metal oxides analyzing the Mott insulators Ca_2RuO_4 and YVO_3 . In both cases, the orbital physics is extremely relevant in the t_{2g} subsector with the presence of an orbital-selective Mott physics in the first case and of a robust orbital-order in the second case [5]. I will briefly mention how the nonsymmorphic[6] symmetries and the dimensionality[7] affect the properties of the altermagnetic phase.

Including the spin-orbit coupling, we study the effect of Dzyaloshinskii–Moriya interaction (DMI) in centrosymmetric and noncentrosymmetric altermagnets. Once time-reversal symmetry is broken in altermagnets, the DMI can produce weak ferromagnetism or weak ferrimagnetism from a purely relativistic effect[8]. The DMI that generated weak ferromagnetism in altermagnets has a staggered structure and the DMI can be enhanced by adapting to the staggered geometry the same strategies used to increase DMI in ferromagnetic multilayers[9]. The weak ferromagnetism from a purely relativistic effect is a property exclusively of the altermagnets that is not found in either ferromagnets or conventional antiferromagnets.[8]

[1] L. Šmejkal, J. Sinova, and T. Jungwirth *Phys. Rev. X* **12**, 040501(2022).

[2] C. Autieri, *Nature* **626**, 482 (2024).

[3] G. Cuono, R. M. Sattigeri, C. Autieri, T. Dietl, *Phys. Rev. B* **108**, 075150 (2023)

[4] M. J. Grzybowski, C. Autieri et al., Accepted in *Nanoscale* arXiv:2309.06422

[5] G. Cuono, R. M. Sattigeri, J. Skolimowski, C. Autieri *J. Magn. Magn. Mat.* **586**, 171163, (2023)

[6] A. Fakhredine, R. Sattigeri, G. Cuono, C. Autieri, *Phys.Rev. B* **108**, 115138 (2023)

[7] R. M. Sattigeri, G. Cuono, C. Autieri, *Nanoscale*, **15**, 16998 (2023),

[8] C. Autieri et al. <https://arxiv.org/abs/2312.07678> Submitted to *PRB* (2024)

[9] A. Fakhredine, A. Wawro and C. Autieri *J. Appl. Phys.* **135**, 035303 (2024)

The seminar will be given in English on-site in room 203 and the ZOOM transmission will be available too - the link is provided on the IP PAS website.

We sincerely invite You

Roman Puźniak / Andrzej Szewczyk / Henryk Szymczak