# SEMINARIUM Z MAGNETYZMU I NADPRZEWODNICTWA

Uprzejmie zawiadamiamy, że w **środę**

## 27 marca 2024 r., o godz.10:00

odbędzie się seminarium **w sali 203, budynek I**

na którym


## Dr hab. Carmine Autieri, prof. IFPAN

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wygłosi referat na temat:

# "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)*


**Wykład będzie prowadzony w języku angielskim w sali 203, dostępna będzie również transmisja ZOOM - link podany jest na stronie IF PAN.**

**Serdecznie zapraszamy**

**Roman Puźniak / Andrzej Szewczyk / Henryk Szymczak**