

IFMP Seminar

Date Tuesday, January 17, 2023, at 14:50

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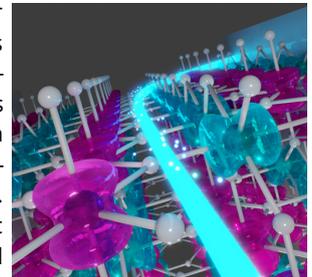
Speaker **Libor Šmejkal**

*Johannes Gutenberg University, Mainz and
Academy of Sciences of the Czech Republic, Prague*

Title **Altermagnetism and Spintronics**

Abstract

Different phases of matter can be distinguished by symmetry, order parameters and topological properties [1]. In this talk I will discuss the classification of magnetically ordered crystals according to recently studied spin symmetries [2]. Spin symmetries consider pairs of operations in spin and crystal space and remarkably reveal a non-traditional magnetic class. This unconventional class, called altermagnetism, is distinct from ferromagnets and antiferromagnets. It is characterized by an unusual alternating spin order in electronic momentum space in the d, g, i -wave form that breaks time reversal symmetry and is spin-compensated and anisotropic [2]. We show that the ordering in momentum space can arise from ordered and anisotropic spin densities in real space (see figure) as described for a typical ruthenium dioxide altermagnet [2,3,4,6].



In the second part of the talk, I will discuss theoretically proposed unconventional and promising applications of altermagnetism in spintronics, including giant magnetoresistance and anomalous currents [3-7]. I will explain that the recently reported unconventional anomalous Hall current in ruthenium oxide provides experimental evidence for the theoretically predicted altermagnetic effect [3,6,7]. Finally, I will discuss emerging avenues for the study of altermagnetism [2].

[1] Šmejkal, L., Mokrousov, Y., Yan, B., and MacDonald, A.H., *Nature Phys.* **14**, 242–251 (2018)

[2] Šmejkal, L., Sinova, J., and Jungwirth, T., *Phys. Rev. X* **12**, 031042 and 040501 (2022)

[3] Šmejkal, L. *et al.*, *Science Advances* **6**, eaaz8809 (2020), arXiv:1901.00445

[4] Mazin, I.I *et al.*, *PNAS* **118** (42) e2108924118 (2021)

[5] Šmejkal, L., *et al.*, *Phys. Rev. X*, **12**, 011028 (2022)

[6] Feng, Z., Zhou, X., Šmejkal, L. *et al.*, *Nat. Electron.* **5**, 743 (2022)

[7] Šmejkal, L., MacDonald, A.H., Sinova, J., Nakatsuji, S., and Jungwirth, T., *Nat. Rev. Mater.* **7**, 482 (2022)

Host: A. Mackenzie