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INVITATION

Department of Condensed Matter Physics

Is pleased to invite you to the lecture

Introduction to Altermagnetism and Anti-Altermagnetism: From Spin Symmetries to Experiments

by

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Time: **11:00**

Venue: **Lecture room F1, Building 6, Faculty of Science, Kotlářská 2, Brno**

Symmetry plays a crucial role in physics, shaping how particles and forces interact. The concept of spontaneous symmetry breaking, where a system that initially follows certain symmetry rules naturally shifts into a state that no longer does, has proven useful in many areas of physics, from particle physics to superconductors.

In this talk, we introduce our recent classification of magnetic symmetry breakings using spin symmetries, which involve pairs of operations in spin and lattice space. This approach led us to discover two new types of magnetic quantum phases: altermagnets and anti-altermagnets. These expand on the well-known categories of ferromagnets (which have a net magnetization) and antiferromagnets (where atomic magnetic moments cancel each other out) [1-3]. What makes altermagnets and anti-altermagnets special is their unique spin arrangement. Unlike traditional magnets, they form compensated yet spin-polarized states, which break specific lattice symmetries while preserving certain combinations with spin rotations [1-3].

We will explain how these discoveries were motivated by our earlier prediction and observation of an unusual Hall effect[4], where an electric field generates a transverse Hall current in a compensated magnet. We will also discuss recent experiments confirming altermagnetism in materials like MnTe and CrSb, using photoemission techniques guided by our first-principles calculations [5]. Finally, we will explore how altermagnets could be used in spintronics, magnonics, topological materials, and multiferroics, paving the way for faster, smaller, and more energy-efficient nanoelectronics [1,6].

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References

[1]https://www.economist.com/science-and-technology/2024/01/24/scientists-have-found-a-new-kind-of-magnetic-material, https://www.science.org/content/article/researchers-discover-new-kind-magnetism
[2]PRX **12**, 031042 (2022).
[3]arXiv:2309.01607v3 (2024).
[4]Science Adv. **6**, 23 (2020), PNAS **118** 42 (2021), Nature Commun. **15**, 4961 (2024).
[5]Nature **626**, 517 (2024), Nature Commun. **15**, 2116 (2024), Nature **636**, 348 (2024).
[6]PRX **12**, 011028 (2022), PRL 131, 256703 (2023), arXiv:2309.02355 (2023), arXiv:2411.19928 (2024).

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