Sonderforschungsbereich 1277

Emergent Relativistic Effects in Condensed Matter -
From Fundamental Aspects to Electronic Functionality

SFB – Colloquium

Speaker: **Prof. Dr. Jan Minar**
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Date: Tuesday, 16.12.2025, 14:15, H34

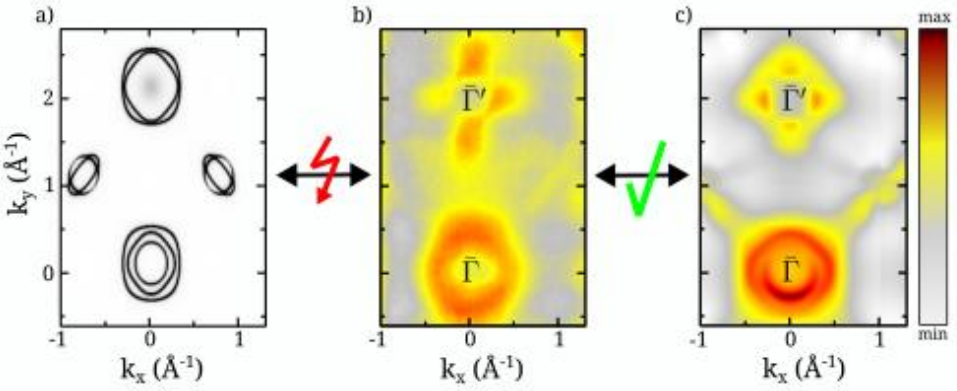
Topic: New frontiers of one step model of photoemission for quantum materials

Abstract:

Quantum materials feature intertwined electronic correlations, topology, and magnetism, requiring realistic treatments of spin-orbit coupling, interactions, and spin fluctuations. Spin- and time-resolved ARPES (STARPES) is a key probe of their electronic and spin structures, but its quantitative interpretation demands advanced theory. I will present a fully relativistic multiple-scattering Green function (KKR) [1] framework for spin-dependent photoemission that incorporates correlations via DMFT, spin fluctuations via the alloy-analogy model, and light-induced electronic excitations [2,3]. Applications include a one-step photoemission description of altermagnets such as RuO* and MnTe, where spin-ARPES reveals lifted Kramers degeneracy relevant for spintronics, and kagome magnets such as FeSn thin films, where persistent flat-band splitting and selective band renormalization expose strong correlation and topological effects. This framework provides a unified route to unravel spin dynamics in complex quantum materials [4,5,6].

[1] H. Ebert et al. Rep. Prog. Phys. **74**, 096501 (2011).
[2] J. Minár et al., Phys. Rev. B **102**, 035107 (2020).
[3] J. Braunet al., Physics Reports **749**, 1 (2018).
[4] J. Krempaský et al., Nature **626**, 517 (2024).
[5] A. D. Din et al., arXiv:2511.01690 (2025).
[6] Z. Ren et al., Nat. Commun. **15**, 9376 (2024).

Host: Prof. Dr. Jaroslav Fabian



Fermi surface of the high-temperature superconductor $Ba_{0.6}K_{0.4}Fe_2As_2$ as observed by ARPES (b) and modeled with (a) conventional ground-state theory and (c) advanced one-step photoemission modeling. (G. Derondeau et al. Sci. Rep. **7**, 8787, 2017)