Unveiling the Dual Nature of Altermagnetic Photoresponse in MnTe

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Abstract. At a fundamental level, the altermagnetic phase is characterized by collinear magnetism with zero net magnetization, revealing a unique spin symmetry that arises from the decoupling of spin and crystal space symmetries. MnTe serves as a prime example of such a material, and Spin- and Angle-Resolved Photoemission Spectroscopy (SARPES) has proven to be an effective tool for probing its altermagnetic electronic structure. Recent findings of spin-polarized band structures, along with the confirmation of zero net magnetization in this extensively studied semiconductor, validate the existence of this exceptional magnetic order [1]. Further comprehensive ARPES investigations suggest that MnTe—and potentially other collinear altermagnets—exhibit an unconventional photoresponse to polarized light that defies traditional photoemission selection rules. We demonstrate that this phenomenon applies to both surface-derived bands observed in UV-ARPES and bulk MnTe bands detected in the soft-X regime and can be effectively modeled using 1-step photoemission calculations.

[1] J. Krempaský *et al*, Altermagnetic lifting of Kramers spin degeneracy, Nature **626**, 517–522 (2024)