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# Angle-resolved photoemission for the investigation of topological materials

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Angle-resolved photoelectron spectroscopy (ARPES) is the premier technique for probing the electronic band structure of solids[1]. In this talk, we introduce ARPES through examples from topological materials, a class of systems that have attracted considerable interest in condensed matter physics due to their unconventional electronic and transport properties.

Three-dimensional (3D) topological materials host symmetry-protected electronic states with distinctive spin textures, making them promising candidates for future applications in spintronics and topological quantum computing.

We will discuss key aspects of ARPES, beginning with the fundamental three-step model, where conservation laws and the probing depth are important aspects. We will address the dipole approximation and selection rules, followed by the measurement of 3D band structures and Fermi surfaces. The role of surface states and resonances will be explored as well as many-body interactions and lifetime broadening. We will discuss spin polarization effects occurring in magnetic and nonmagnetic topological insulators.

Finally, we review ARPES investigations of various topological phases[2], including strong and crystalline topological insulators, magnetic topological insulators, and 3D Dirac, Weyl, nodal, and chiral semimetals, while also addressing the current status of correlated topological insulators.

**References**

1. Hongyun Zhang, T. Pincelli, C. Jozwiak, T. Kondo, R. Ernstorfer, T. Sato, Shuyun Zhou, Angle-resolved photoemission spectroscopy, Nature Reviews Methods Primers 2 (2022) 52, DOI: 10.1038/s43586-022-00133-7; arXiv:2207.06942
2. J. Sánchez-Barriga, O. J. Clark, O. Rader, Angle-resolved photoemission of topological materials. In T. Chakraborty (Ed.), Encyclopedia of Condensed Matter Physics, 2nd ed., Vol. 4, pp. 334-369. Elsevier, Amsterdam (2024), DOI: 10.1016/B978-0-323-90800-9.00274-2; arXiv:2501.00497 (2024).