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Multidimensional photoelectron spectroscopy of solids in non-equilibrium states

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Recent developments of photoelectron spectrometers based on time-of-flight techniques using multi-dimensional delay-line detectors such as k-TOFs and momentum microscopes are fueling the emerging field of multidimensional photoemission spectroscopy (MPES) [1]. It enables a rapid volumetric mapping of the electronic band structure of materials and naturally incorporates the extension to further dimensions such as ⊠⊠ dispersion, spin or pump-probe time. I discuss four-dimensional time- and angle-resolved photoelectron spectroscopy (trARPES) employing a momentum microscope detector combined with a 500 kHz extreme-ultraviolet (XUV) light source operating at 21.7 eV probe photon energy [2], which allows us to measure the out-of-equilibrium electronic band structure of solids (including excited states) in the entire Brillouin zone [3,4]. On the basis of exemplary data on inorganic and organic semiconductors, I will discuss technical aspects of this approach as well as the prospect of establishing an open experimental electronic structure database as generic benchmark for electronic structure calculations.

References:
[1] K. Medjanik et al., Nature Materials 16, 615 (2017).
[2] M. Puppin et al., Rev. Sci. Inst. 90, 023104 (2019).
[3] C.W. Nicholson et al., Science 362, 821 (2018);C.W. Nicholson et al., Phys. Rev. B 99, 155107 (2019).

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