

Multi-Dimensional Momentum Microscopy on Correlated Materials

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Rapidly increasing developments of light sources and detectors have brought photoemission spectroscopy to a new prominence in data acquisition. Data streams resolving each individual photoelectron event enable the correlation of each detected electron to the full state of the experimental apparatus, allowing drift and jitter corrections. This increases the quality and control over the data acquired at the cost of complexity in data post-processing and data size.

We developed a distributed workflow pipeline [1] which takes advantage of single-event resolution to correct and calibrate Multi-Dimensional Photoemission Spectroscopy (MPES) data and to generate an open-source data structure ready for analysis and storage with complete metadata description.

The structure of the single-event data-frames (SED) allows this pipeline to be applied to different experimental setups, from table-top to large scale facilities. This kind of flexibility enables and encourages the sharing of advanced analysis and data visualization methods within a large community, firmly aligned with the F.A.I.R. [2] principles of scientific data management.

Preliminary results of our photodoping experiments on La_2CuO_4 , the parent compound of high- T_c superconducting cuprates, demonstrate the effectiveness of the full workflow applied to the data acquired with the time-resolved momentum microscope HEXTOF [3] installed at FLASH (DESY, Hamburg).

By adapting this workflow to HAXPES data instead, the 4D energy-momentum dispersion in the valence band region of the Kondo compound YbRh_2Si_2 could be reconstructed by exploiting the high energy X-ray photon energy. This allowed us to study the temperature dependent fermi surface, revealing changes in the electronic structure far above the Kondo transition temperature. [4]

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[2]. Wilkinson, M. D. *et al. Sci. Data* **3**, 160018 (2016).

[3]. Kutnyakhov, D. *et al. Rev. Sci. Instrum.* **91**, 013109 (2020).

[4]. Agustsson, S. Y. *et al. J. Phys. Condens. Matter* **33**, 205601 (2021).