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M3eta: An extensible metadata scheme for advanced momentum microscopy in the age of big data

Monday 4 November 2024 12:25 (20 minutes)

The electronic structure determines many of the macroscopic physical properties of a material. Photoelectron momentum microscopy (MM) has matured into a powerful tool for the detailed characterization of the exciting electronic properties of novel quantum materials. By applying the principles of high-resolution imaging modern instruments simultaneously capture hundreds of tomographic slices of an electronic structure in a high-dimensional parameter space. Despite the rapid worldwide adoption as a universal tool for material characterization, there is currently no common scheme to describe the highly diverse parameters that define a MM experiment. M^{3}eta aims to establish an extensible and sustainable metadata scheme for momentum microscopy, which will be stored in a structured file together with the measured data voxels. This will be the basis for a standardized work-flow that interprets the stored metadata and to reconstruct views of the multidimensional electronic structure of a material.
As a test bed for the handling of multidimensional electronic structure information, we have created a set of tomographic slices through the Fermi surface of the noble metal palladium. By use of linearly polarized synchrotron radiation with photon energies between 34eV and 200eV the perpendicular crystal momentum coordinate (k_z) is scanned over the entire first Brillouin zone, while the transverse momentum (k_x,k_y) is simultaneously recorded by the momentum microscope setup at different binding energies (E_B). The resulting 4D data volume (k_x,k_y,k_z,E_B) serves as a prototypical example of multidimensional Photoemission data and allows us to test data/metadata structures for an analysis and visualization workflow.
Representation of such rich data sets and connection with experiment specific meta data will be discussed don the example of the NeXus format. The format will allow to enrich the measured data voxels with information for their physical interpretation and allow work flows to extract and visualize electronic structure information.

Please specify ”other”

In addition, please add 3 to 5 keywords.

momentum microscopy, photoemission, multidimensional, visualization, physical representation

Please specify ”other”

For whom will your contribution be of most interest?

Researchers

Please assign yourself (presenting author) to one of the following groups.

Researchers

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