Fabian Natterer

University of Zurich

Combining Sparse Sampling and Parallel Spectroscopy for rapid quasiparticle interference imaging

Abstract: The advent of novel quantum materials requires advanced mapping schemes that provide insight into their electronic structure. However, experimental conditions such as high magnetic fields, ultra-low temperatures, and field-effect devices might exclude the use of the prime tool angle resolved photoemission spectroscopy (ARPES). Fortunately, the complementary quasiparticle interference imaging with the scanning tunneling microscope operates well in such conditions. It provides insight into the band-structure from the scattering of electronic states, but it is also very slow because QPI requires the measurement of a large number of local density of states that can occupy an instrument for days. We demonstrate exponentially faster mapping through our combination of sparse sampling and parallel spectroscopy. Using the model systems Au(111) and Bi2Sr2CaCu2O8 (Bi2212), we exemplify our concepts for quasiparticle interference imaging. We reveal the straightforward implementation into existing scanning tunneling microscopes and discuss possible ways for further speed-ups.

Bio: Fabian Natterer is the head of the group and a SNSF Professor at university of Zurich since October 2018. He earned his PhD in Physics from EPFL in 2013 for his work on graphene, hexagonal boron nitride, and molecular rotations of hydrogen. His postdoctoral research at NIST focused on the properties graphene devices, such the confinement of electrons in whispering gallery modes. His postdoctoral work at IBM research Almaden concentrated on STM based electron spin resonance and single atom magnets. In his following Ambizione project at EPFL, he built an ESR enabled STM for which he developed spin-polarized tips made from antiferromagnetic materials. His team develops novel protocols for advanced STM measurements, such as compressive sensing enhanced quasiparticle interference, and pump-probe and pulsed-ESR spectroscopy for time-resolved measurements.