Imaging spin-filters and spin-resolving momentum microscopy

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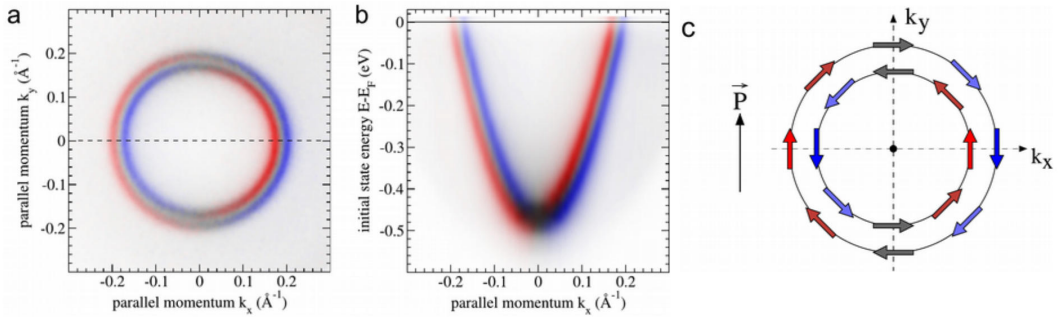
By using a photoelectron emission microscope (PEEM) we commonly look at strongly magnified images of a sample's surface in the real space on length scales ranging from a few 100nm to several μm. Likewise, a momentum microscope utilizes the principles of electron microscopy to form a high resolution image of the distribution of electronic states in reciprocal (i.e., momentum-) space [1]. Such two dimensional (k_x,k_y) maps of the photoelectron distribution represent sections through the valence electronic states in the full surface Brillouin zone, and give a comprehensive and intuitive access to the electronic properties of a material.

Of particular importance is the spin of the electron, that gives rise to phenomena like ferromagnetism, superconductivity, spin-polarized surface states, and recently, the discovery of new material classes with complex spin textures like topological insulators. With the introduction of imaging spin analyzers the efficiency of spin-resolved measurements experienced a tremendous boost, such that the electron spin now becomes routinely accessible in momentum microscopy (see figure below).

We will discuss applications and prospects, including spin-textures in the presence of large spin-orbit interaction [2], the interplay of spin-orbit- and exchange-interaction in ferromagnets [3], and rapid band structure mapping by time-of-flight momentum microscopy [4].



a) Measured spin-resolved intensity map at E_F of the Au(111) surface state. (b) Spin resolved dispersion along the horizontal (k_y=0) axis. (c) Schematic model of the spin texture of the Rashba surface state. Arrows indicate the spin direction, the color corresponds to the observed P_y spin component. [1]

References

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