JOINT MEETING OF POLISH SYNCHROTRON RADIATION SOCIETY MEMBERS
AND SOLARIS CENTRE USERS

EXPLORING SPIN TEXTURES IN WSe_2 AND AU(111) BY SPIN-RESOLVED ARPES

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Spin-resolved angle-resolved photoemission spectroscopy (SARPES) provides direct access to the spin texture of electronic states and is a key technique for investigating materials with strong spin–orbit coupling. Reliable spin-resolved measurements require well-characterized reference systems with robust and reproducible spin polarization. Transition metal dichalcogenides and Rashba systems are among the most important benchmark materials, representing two distinct classes of spin-polarized electronic structures arising from strong spin–orbit interaction and broken inversion symmetry.

Here, we investigate monolayer WSe_2 and the Au(111) surface as archetypal representatives of these material classes. Monolayer WSe_2 exhibits spin–valley locking, whereas Au(111) hosts the prototypical Rashba-split Shockley surface state. Their well-established electronic structures and characteristic spin textures make them ideal reference systems for evaluating SARPES performance.

Using SARPES, available at the URANOS beamline, we directly probe the spin polarization of both materials while calibrating and characterizing the double VLEED spin detector. The excellent agreement with the expected spin characteristics demonstrates the reliability of the measurements and confirms the performance of the spin detector. In addition, we present its key performance parameters, including the energy, angular, and spin resolution, as well as the Sherman function and figure of merit (FOM).

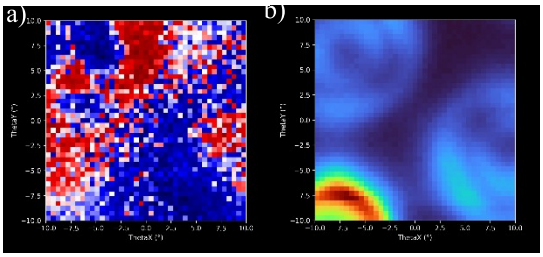

Fig. 1. (a) Spin-resolved k_x–k_y map of the out-of-plane spin polarization component, S_z, of monolayer WSe_2, measured at a photon energy of 50 eV using horizontally polarized light. The map was acquired at a constant energy of 0.8 eV below the Fermi level. (b) Sum of the $S_z^{+\leftrightarrows}$ and $S_z^{-\leftrightarrows}$ spin-resolved intensities.

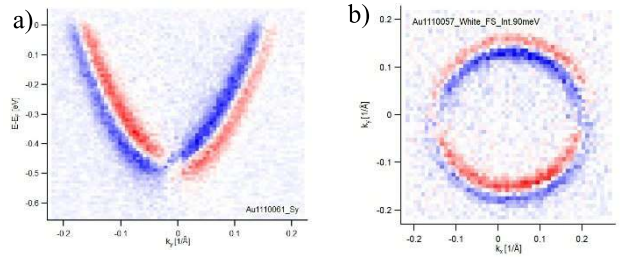

Fig. 2. S_y spin polarization of the Rashba-split surface state of Au(111), measured as (a) a k_y spectrum and (b) a constant-energy k_x–k_y map acquired at 0.1 eV below the Fermi level.