ADRESS project at the Swiss Light Source: Beamline for soft-X-ray ARPES and RIXS studies on three-dimensional correlated systems

L. Patthey,1 V.N. Strocov,1 T. Schmitt,1 J. Raabe,1 T. Schmidt,1 U. Flechsig,1 C. Dallera,2 G. Ghiringhelli,2 A. Imhof,1 B. Jakob,1 C. Vollenweider,1 V. Schönherr,1 Q. Chen,1 R. Betemps,1 J. Krempaski,1 X. Wang,3 L. Braicovich,2 and M. Grioni,3

1) Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland
2) Politecnico di Milano, Italy
3) EPFL Lausanne, Switzerland

ARPES is a powerful tool to probe the electronic structure of correlated electron systems with resolution in **k**-space. However, in the VUV range this technique faces fundamental limitations due to its surface sensitivity and complicated final state effects, particularly important for three-dimensional (3D) systems. These limitations can be circumvented in the soft X-ray energy range. Enhanced escape depth, free-electron final states and improved intrinsic resolution in surface-perpendicular momentum k_z allowing reliable extraction of three-dimensional quasiparticle dispersions, and simplification of the matrix element effects. However, soft X-ray ARPES suffers from low photoexcitation cross section, which largely increases the data acquisition time and limits the energy resolution.

Here we present the ADvanced RESonant Spectroscopies (ADRESS) beamline at the Swiss Light Source, which allows pushing the soft X-ray ARPES experiment towards high flux and resolution. ADRESS uses a 3.5m long Apple-type undulator with 4 permanent magnet arrays and fixed magnetic gap. The undulator delivers high brilliance soft X-rays with variable polarization (circular and linear with variable polarization plane) between 0.4 and 1.8 keV. The beamline is designed to deliver an energy resolution up to 35 meV and photon flux up to $10e^{13}$ photons/sec/0.01% at a photon energy of 1 keV. The ARPES endstation is complemented by an endstation for Resonant Inelastic X-ray Scattering (RIXS) equipped with an ultra high-resolution soft X-ray spectrometer (~80 meV at 1 keV).

The flux parameters more than an order of magnitude higher compared to the existing soft X-ray ARPES beamlines, will help the notorious problem of low photoemission intensity and allow operation at higher energy resolutions. The ARPES endstation will be equipped with an angle multiplexing spectrometer delivering an angle resolution of 0.1 deg and energy resolution up to 25 meV at 1 keV kinetic energy. The manipulator will allow cooling down to 10 K, and sample rotation with three angular degrees of freedom. These flux, resolution and sample environment parameters offer unique possibilities for studying correlated systems, in particular with emphasis on three-dimensional quasiparticle dispersions.

User operation of the ADRESS beamline is expected early 2007 for the RIXS endstation, and late 2007 for the ARPES one.