Upcoming soft x-ray photoemission and scattering imaging beamline at NSLS-II

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The soft x-ray photoemission and scattering imaging, i.e., the **ARI**, beamline combines the **A**ngle-resolved photoemission spectroscopy (ARPES) and the **R**esonant inelastic x-ray scattering (RIXS) with an **I**maging capability. It features a ~100 nm x-ray beam for both the ***Elektra*** (electron-out) and ***Phaos*** (photon-out) endstations that are bridged with one vacuum transfer system, therefore enabling the spatial mapping of the same sample with both photoemission and x-ray scattering techniques. Specifically, the ~100 nm x-ray beam is obtained through a pair of Kirkpatrick-Baez (KB) mirrors, distinct from the zone-plates commonly used in existing nano-APRES beamlines. This optical set-up provides the **ARI** beamline with same order of magnitude of photon flux as those ARPES [1] and RIXS [2] beamlines with the 1~10 μm spot sizes. The ***Elektra*** endstation (40eV~600eV*) is equipped with a Momentum Microscope [3] (KREIOS 150 MM from the SPECS) that can perform the spatial mapping in both real- and momentum- space from the emitted electrons, and the ***Phaos*** (200eV~1000eV*) adopts the Hettrick-Underwood optical design [4] to disperse the scattering x-rays in energy to achieve the analysis of x-rays from the inelastic scattering process. Based on the principles of two endstations, many secondary techniques, such as XAS, XPS, inverse XAS, photoelectron diffraction, fluorescence and more, are also available. With these functionalities, the **ARI** beamline will facilitate the investigation of correlations between the electronic, magnetic, atomic and chemical structures of materials with ~100nm spatial variation, shedding light on novel physics/chemistry in technologically relevant fields and confinement induced quantum effects emerging in prospective devices.

In this talk, I will present the details of the **ARI** beamline, including the optical design, current status, etc., and also briefly discuss the potential scientific opportunities unleashed by this new beamline at NSLS-II.

[1]J. Avila, S. Lorcy, and P. Dudin, "ANTARES: Space-resolved electronic structure", J. Electron Spectrosc. Relat. Phenom. 266, 147362 (2023).

[2]I. Jarrige, V. Bisogni, Y. Zhu, W. Leonhardt, and J. Dvorak, "Paving the Way to Ultra-High-Resolution Resonant Inelastic X-ray Scattering with the SIX Beamline at NSLS-II", Synchrotron Radiat. News 31, 7 (2018).

[3]Specs Group website: https://www.specs-group.com/specs/products/detail/kreios-150-mm/

[4]Dvorak, J., Jarrige, I., Bisogni, V., Coburn, S. & Leonhardt, W. "Towards 10 meV resolution: the design of an ultrahigh resolution soft X-ray RIXS spectrometer", Rev. Sci. Instrum. 87, 115109 (2016)

* Both endstations can receive the x-ray photons from 40eV to 1000eV energy range but are optimized over the smaller ranges because of the reduced flux for x-ray photons outside of the ranges.