P65 - DESY's new beamline for applied XAFS spectroscopy

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X-ray absorption fine structure spectroscopy (XAFS) is an analytical method which is finding widespread use in many fields of applied science like catalysis and energy storage research, material sciences and environmental and geochemical applications. Almost all of these applications do not require the high brilliance provided by today's 3rd generation synchrotron sources, but a stable mm^2 sized beam, a broad and continuous spectrum for long X-ray photon energy scans and moderately high photon flux. The number of beamlines that can provide such a beam is decreasing, because it turns out to be difficult to use the radiation from bending magnets or other broadband sources like wigglers at modern high brilliance storage rings, which on the other hand provide unique new possibilities for numerous other synchrotron based experimental methods.

The new XAFS beamline P65 at the PETRA III storage ring in Hamburg, Germany follows a unique concept. The beamline was designed with the goal to provide a beam that is optimised for routine XAFS applications which require a robust set-up and a stable mm sized beam at a high brilliance undulator beamline. The design is based on a water cooled double crystal monochromator (Si 111 and Si 311) and a short (11 periods) undulator. Two plane mirrors in front of the DCM act as low pass filters and decrease the power load on the first DCM crystal. Key parameter are a working range of 4 keV – 44 keV, a monochromatic photon flux of up to 10^{12} s^{-1}, and an energy resolution of 1.4 * 10-4 (Si 111) and 0.6 * 10-4 (Si 311). The experimental hutch provides the infrastructure for all kinds of in-situ experiments which are one of the main applications at P65. We will present the set-up and motivate the design goals by a short overview about the science case. Results from beamline commissioning and selected examples from user beamtimes will demonstrate the performance of the beamline.

The final part of the presentation will be devoted to the future development of P65. New or upgraded storage rings will aim at ever higher brilliance up to the diffraction limit; at the same time the availability of low brilliance beamlines is becoming smaller. It is therefore important to develop beamline concepts that provide the experimental conditions for analytical methods like EXAFS spectroscopy. DESY is planning to upgrade the PETRA III storage ring into a diffraction limited storage ring with 10 nmrad emittance. Ray tracing results show that the beam properties of a beamline similar to P65 and installed at PETRA IV would not change significantly. Actually the fundamental parameter like flux, energy resolution and energy range would be comparable to the present situation. The size of the unfocused beam would be approximately 0.5*0.5 mm² (1st undulator harmonic) and the flux density grow accordingly. Such a beamline would mainly profit from the higher stability of the storage ring and optics and should offer focusing optics to meet also the demand for a smaller beam on the sample.