# Wavefront propagation simulations for a hard x-ray split-and-delay unit at the European XFEL

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For the High Energy Density Instrument (HED) at the European XFEL a hard x-ray split-and-delay unit (SDU) is built covering photon energies in the range between 5 keV and 24 keV. This SDU enables time-resolved x-ray pump / x-ray probe experiments as well as sequential diffractive imaging on a femtosecond to picosecond time scale. The set-up is based on wavefront splitting that has successfully been implemented at an autocorrelator at FLASH. The x-ray FEL pulses will be split by a sharp edge of a silicon mirror coated with Mo/B4C and W/B4C multilayers. Both partial beams then pass variable delay lines. For different wavelengths the angle of incidence onto the multilayer mirrors is adjusted in order to match the Bragg condition. Hence, maximum delays between +/- 1 ps at 24 keV and up to +/- 23 ps at 5 keV will be possible. In order to evaluate the influence of the device on experiments with focused hard x-ray pulses, time-dependent wave-optics simulations have been performed by means of Synchrotron Radiation Workshop (SRW) software for SASE pulses at hv = 5 keV. This software tool has recently been applied to assess the capability of the SDU to measure the temporal coherence properties of hard xray FEL-pulses. For this earlier study, diffraction at the beam splitter and a one-dimensional cut through the surface profile was taken into account. At the HED instrument, the XFEL radiation will be focused by means of compound refractive lenses (CRL) in order to perform experiments with intense, focused hard x-ray pulses. The results of these experiments severely depend on the fluence and the spatial shape of the beam that is obtained in the focal area. Therefore, in this paper the impact of wave-front distortions on the spatial intensity profile in the focus is analyzed. For this purpose, the entire optical layout of the SDU, including diffraction on the beam splitter edge and the two-dimensional surface profiles of all eight mirrors are taken into account. The XFEL radiation is simulated using the output of the time-dependent SASE code FAST. For the simulations diffraction on the beam splitter edge as well as height and slope errors of all eight mirror surfaces are taken into account. The impact of these effects on the ability to focus the beam by means of compound refractive lenses (CRL) are analyzed.

## Biography

Victor Kärcher has completed his Bachelor's in Physics from the University of Münster, Germany. He works on the simulation of x-ray optics in the Group of Helmut Zacharias at the University of Münster.

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