Heating of matter and monitoring ultrafast processes with aberration-corrected refractive optics

Initiative: Forschung mit Freie-Elektronen-Lasern: Peter Paul Ewald-Fellowships am LCLS in Stanford

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Compound refractive x-ray lenses made of beryllium (Be-CRLs) have proven to focus XFEL pulses down to about 100 nm. This is crucial for achieving highest power densities and for matching the size of single particles. Ultimately, however, aberration-free optics are required for highest fluence values. One of the objectives of the project is the integration of an aberration-corrected set of nanofocusing Be-CRLs into the X-ray pump-probe instrument at the Linac Coherent Light Source (LCLS). Further, a diagnostic tool will be developed which is capable to monitor the focused wave field of individual XFEL pulses with high spatial resolution. With these newly developed tools, the ultimate goal of this project is to investigate double-core-hole states in iron and to study the formation and evolution of an X-ray induced plasma. For imaging the plasma the new seeded 'two-color' operation mode of the LCLS will be used. In this case, the usually inconvenient chromatic aberration of refractive optics is advantageous as it spatially separates the focal planes for the different X-ray photon energies involved. A spatial resolution of below 10 nm can be reached, demonstrating state-of-the-art X-ray imaging at an XFEL.

Projektbeteiligte

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Simultaneous 8.2 keV phase-contrast imaging and 24.6 keV X-ray diffraction from shock-compressed matter at the LCLS
Refractive Hard X-ray Vortex Phase Plates