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Using XFELs for Probing of Complex Interaction Dynamics of Ultra-Intense Lasers with Solid Matter T.E. COWAN, HZDR, TU Dresden, T. KLUGE, HZDR, C. GUTT, DESY, L.G. HUANG, HZDR, SIOM, J. METZKES, HZDR, U. SCHRAMM, HZDR, TU Dresden, M. BUSSMANN, HZDR — Hard x-ray FELs provide revolutionary new techniques for investigating HED matter. Particularly exciting is to probe the interaction of ultra-intense lasers with solid-density plasma, in order to improve our understanding and ability to predictively model the very complex interaction dynamics. Important processes include the electron acceleration at the target surface, return current generation by rapid ionization, relativistic electron transport, resistive magnetic fields in filaments and at interfaces, and the bulk plasma response; which are important for applications such as ion acceleration, attosecond harmonics, and isochoric heating,. XFELs extend optical techniques into the x-ray regime – Faraday rotation, phase contrast imaging, interferometry. Coherent diffraction allows to directly measure the electron-electron correlations inside the solid plasma with few nm-resolution on the fs time scale [1]. Absorptive coherent diffraction tuned to bound-bound transitions of a particular ion charge state is proposed as a probe of the termporal and spatial evolution of the laser-driven ionization dynamics.

[1] T. Kluge et al, arXiv:1306.0420

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