Spatially resolved x-ray spectroscopy of high energy density plasmas at the European XFEL

X. Pan[1,2], M. Šmíd[1], R. Štefaníková[1], C. Baehtz[3], T. Preston[3], L. Wollenweber[3], U. Zastrau[3], T. Cowan[1,2], K. Falk[1,2,4]

[1] *Helmholtz-Zentrum Dresden-Rossendorf, 01328 Dresden, Germany*

[2] *Technische Universität Dresden, 01069 Dresden, Germany*

[3] *European XFEL, 22869 Schenefeld, Germany*

[4] *Institute of Physics of the ASCR, 18221 Prague, Czech Republic*

In high energy density physics experiments, dense plasmas with large, one-dimensional gradients in temperature, density and ionization state can be created by the intense laser irradiation. Measurements of these plasma parameters are essential to investigate equation of state (EOS) and transport properties in astrophysically relevant matter. Spatially resolved x-ray spectroscopy is a powerful technique for diagnosing the internal conditions of inhomogeneous high energy density plasmas. A multipurpose imaging x-ray crystal spectrometer is developed at the HED instrument of European XFEL, providing high-resolution, space-resolved spectral measurements for x-rays in the energy range of $5-10$ keV. The preliminary results are present from a isochorically heated Cu experiment using the XFEL beam, demonstrating the high spatial and spectral resolution properties of the spectrometer. Other potential applications, such as x-ray Thomson scattering (XRTS) measurements for radiative shocks in dense plasmas [1], x-ray emission spectroscopy for the isochoric heating of wire targets with the RELAX laser [2], are discussed as well.

References

[1] E. J. Gamboa, et al., High Energy Density Physics **11**, 75-79 (2014)

[2] A. Laso Garcia, et al., High Power Laser Science and Engineering **9**, E59 (2021)