HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF

Universität Rostock

Characterizing Ionization Potential Depression in Dense Plasmas with High-Precision Spectrally Resolved X-ray Scattering

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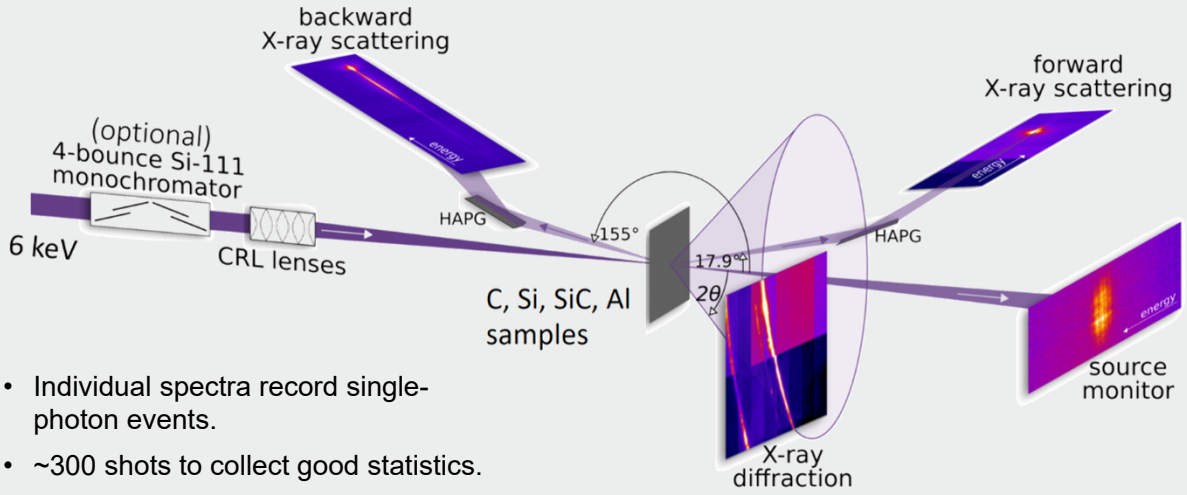
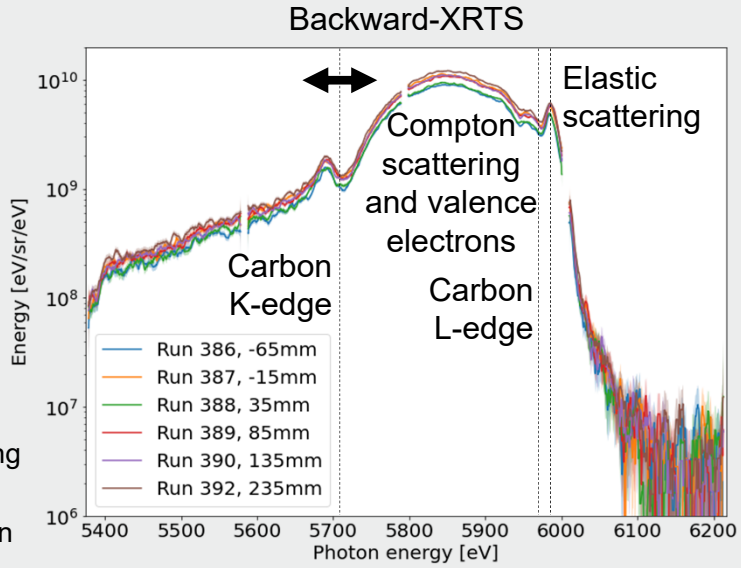
We present details of a recent experiment at the European XFEL, studying the ultrafast creation of dense plasmas by isochoric heating, and characterizing their properties. The high-precision X-ray scattering diagnostic used is particularly well-suited to probe the ionization potential depression as well as ionization and temperature. This approach has a high potential to resolve existing discrepancies on ionization potential depression models that are important for modelling celestial bodies like giant planets, Brown Dwarfs and stars as well as for several technological applications including intense laser matter interaction and radiation damage research.



- Individual spectra record single-photon events.
- ~300 shots to collect good statistics.
- Heating leads to changing ionisation energies, ionisation potential depression.
- Valence electrons access temperature during the pulse.
- Inelastic DOS is observed over orders of magnitude.
- Measure IPD as a function of temperature via scanning XFEL intensity.
- Higher-Z samples (e.g. Si) see increased heating
- Heating increases elastic scattering due to increased disorder.
- Deconvolution with source function accesses full electronic response.



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