Contribution ID: **61** Type: **not specified**

Enhancement of laser-driven, cold X-ray sources through front side modification

Thursday, 30 January 2020 08:55 (25 minutes)

Analysis of dense plasmas, such as Warm Dense Matter (WDM), proves to be a challenging field. Due to near solid densities and relatively low temperatures (0.1-100 eV), active optical analysis or passive probing through emission spectroscopy is not possible. However, higher photon energies are able to penetrate the samples and can be used to study WDM through scattering and absorption experiments, such as X-ray Thomson scattering (XRTS) or X-ray Absorption Near Edge Structure (XANES)[1]. The development of bright X-ray sources is thus fundamental for the study of WDM states generated in the laboratory.
Experiments using microstructured targets have shown an enhanced energy conversion between laser and target [2]. In particular, the number of heated electrons and subsequent X-ray emission was increased when compared with unstructured targets. Using a microstructured front surface with a secondary layer of copper on the backside of the target uses the enhanced electron distribution to generate X-ray emission from the cold secondary material. Satellite line emission from higher ionization states, as are common in front surface X-ray sources, are suppressed while the Kα-emission is increased when compared with indirectly driven backlighting sources.
The talk will present findings from experiments performed at the PHELIX laser facility using the two-layer targets at high intensities. Further possibilities through modifications of the secondary layer will be discussed. The analysis of the spectral data presented is supported with FLYCHK calculations to derive the electron temperature and density [3].

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Session Classification: High-Intensity Lasers and Applications in HED Science III