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Diagnostical methods for high energy resolution spectroscopy of the target and projectile X-ray-uorescence

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Intense uranium beams that will be available after commissioning of the new synchrotron SIS100 in Darmstadt can be used for volumetric heating of any type of material and the generation of extreme states of matter with Mbar pressures and some eV of temperature [1]. One of the main goals of the plamsma physics program at FAIR is the investigation of the EOS. Due to a high level of parasitic radiation at the experimental environment, new diagnostic methods and instruments have to be developed to characterize the extreme states of matter expected at FAIR.

Summary

Intense uranium beams that will be available after commissioning of the new synchrotron SIS100 in Darmstadt can be used for volumetric heating of any type of material and the generation of extreme states of matter with Mbar pressures and some eV of temperature [1]. One of the main goals of the plamsma physics program at FAIR is the investigation of the EOS. Due to a high level of parasitic radiation at the experimental environment, new diagnostic methods and instruments have to be developed to characterize the extreme states of matter expected at FAIR.
A very important input parameter for numerical simulations of the hydrodynamic response of the target on deposited energy is the precise knowledge of the energy density distribution of the U-beam on the target. Therefore we propose to use the target and heavy ion beam X-ray
uorescence to investigate
the energy density distribution [2, 3] for imaging of the target expansion and mapping of the heavy ion beam distribution in the interaction region with a high spatial resolution of at least 100 micrometers.
First pilot experiments on measurements and characterization of the heavy ion and target
uorescence
using pinholes, X-ray pin-diodes and dispersive systems have been carried out in 2016 at the UNILAC Z6 experimental area.
The interaction of 6.5 MeV/u Au ions with a few micrometer thin Al, Cu and Ta foils has been investigated using x-ray spectroscopy in those experiments. We observed intense radiation of ionized target atoms (K-shell transitions in Cu at 8-8.3 keV and L-shell transition in Ta as well as Doppler shifted Balmer transitions of Au projectiles passing through foils in the photon energy region of 10-20 keV. This radiation can be used for monochromatic (dispersive element) or polychromatic (pin-hole) X-ray mapping of the ion beam intensity distribution in the interaction region.
Using data obtained by a CdTe x-ray spectrometer and a faraday cup, we could estimate the number of Au L-alpha photons per 1 C of the Au-charge passing through Al, Cu and Ta foils, per micrometer target thickness in 4pi. This number allows us to conclude, that 10-100 fold amplication of the signal is required in order to apply this method for U-beam intensities between 1010 ⊠ 5 1011 particles/pulse.
The obtained results can be scaled to high heavy ion energies available at SIS18 and SIS100 [4].
For the development of new diagnostic methods, setup of a new lab at Goethe University is in progress.

A x-ray source up to 15 kev will be used to characterize dierent detectors like imaging plates, x-ray lms and semiconductor detectors. Furthermore a system using either lenses or optical bres to transport an image from a scintillator to a semiconductor detector will be developed and characterized.
Experiments have been performed in the frame of the B

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