Characterization of Laser Heated Targets for UNILAC Beams

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An enhanced energy loss of heavy ions in laser produced plasmas compared with cold gas targets has been observed and studied at GSI for several years [1]. A thorough spectroscopic investigation of the properties of these plasmas was essential and first experiments have been carried out during the last two years [2]. The use of CF_2 targets instead of carbon enabled the application of spherically bent mica crystal spectrometers, which provide spatial and high spectral resolution [3], but an additional measurement of energy losses for carbon and CF_2 was pending to compare the behavior of the two materials.

Previous measurements used foils of 2 μm thickness or less. As CF_2 is available with a minimum thickness of 5 μm only, comparable shots with carbon and CF_2 could only be performed after an upgrade of the nhelix laser, which was completed during the year 2000. Table 1 shows the current performance of the upgraded laser.

Table 1: Data of the upgraded nhelix laser system

front end	Continuum Powerlite 8000 200 mJ @ 10 Hz
pulse width	12 ns
wavelength	1064 nm
number of amplifiers	5
number of spatial filters	4
energy	50 J
repetition rate	1-2 shots/hour
I_{max}	10^{12} W/cm^2

The comparison of CF_2 targets with 5 μm thickness and carbon targets with 1 mg/cm^2 ($\approx 4.5\,\mu$m) showed an almost identical values of carbon and CF_2. Although the measurements have an error level of about 10% both temporal evolution and signal amplitude show the same behaviour (Fig. 1).

The X-ray spectra show a high abundance of He-like and H-like Ions. While the H-like ions are concentrated in the hot region of interaction, the He-like ions can be observed throughout the jet-like expanding plasma [2]. The simultaneous observation of the X-ray emission from both front and rear surface by two seperate spectrometers enabled a further distinction of the homogeneity of the target plasma. It was shown, that similar properties are generated on both sides of the plasma (Fig. 2).

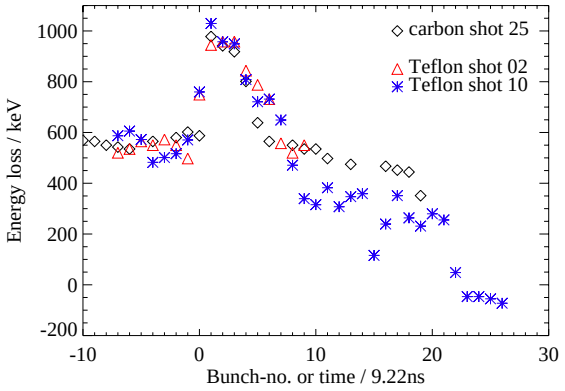

Figure 1: Comparison of different shots with carbon and CF_2 (Teflon) foil targets.

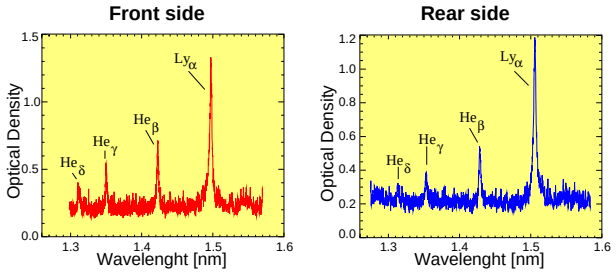

Figure 2: The comparison of X-ray spectra achieved on the front and rear surface shows similar conditions throughout the target.

References

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