Investigation of the damage threshold of optical components at the VUV TESLA FEL Phase I

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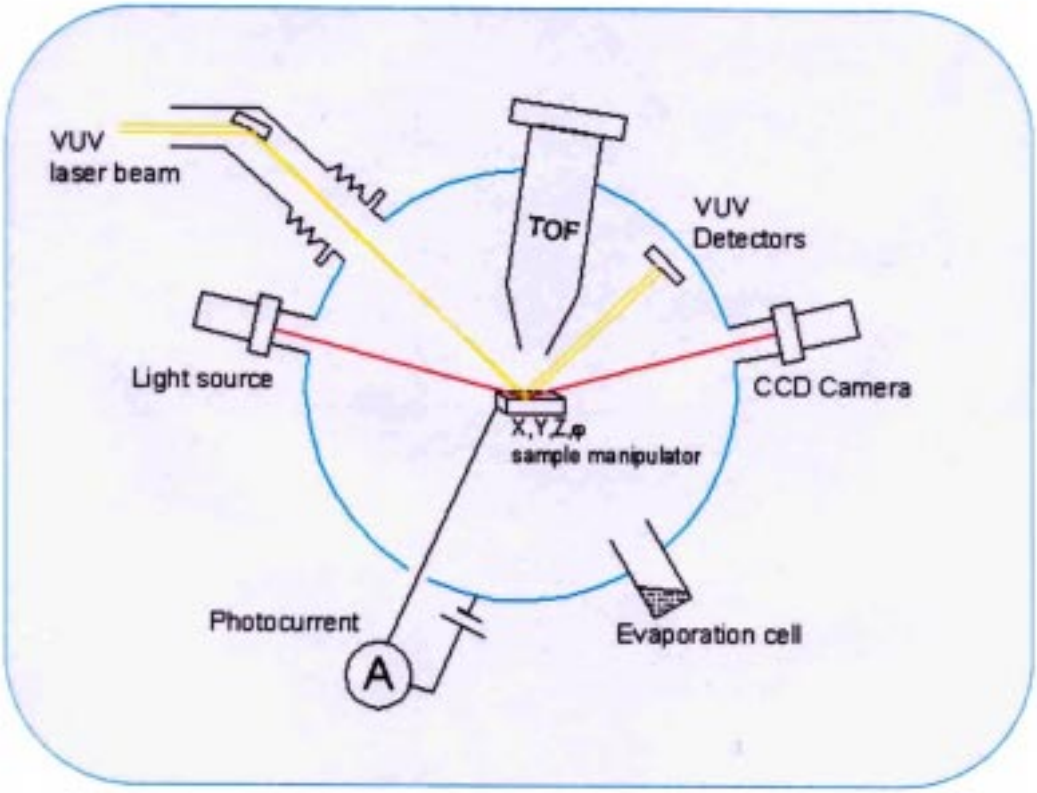
Experimental station - schematical layout

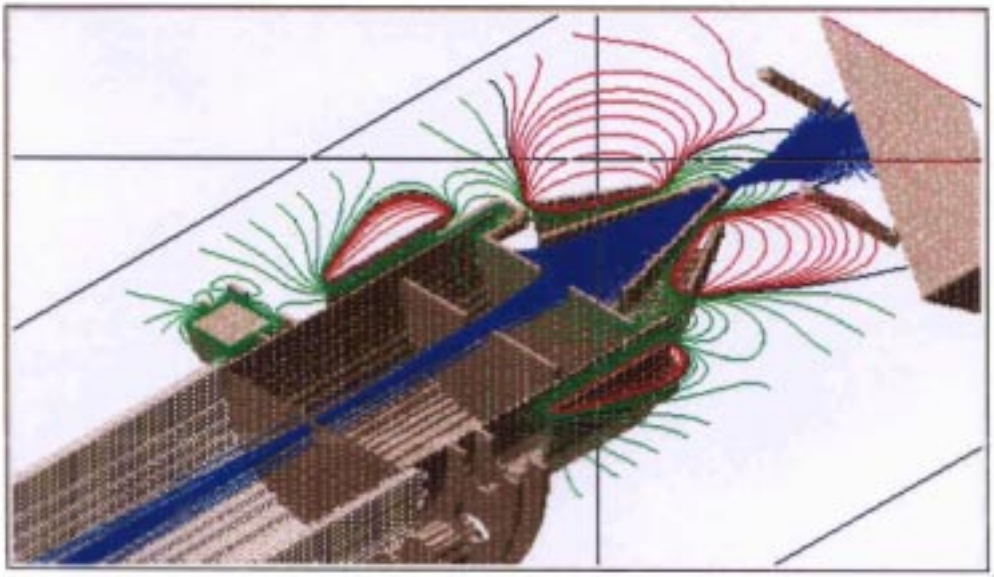


Photon beam parameters

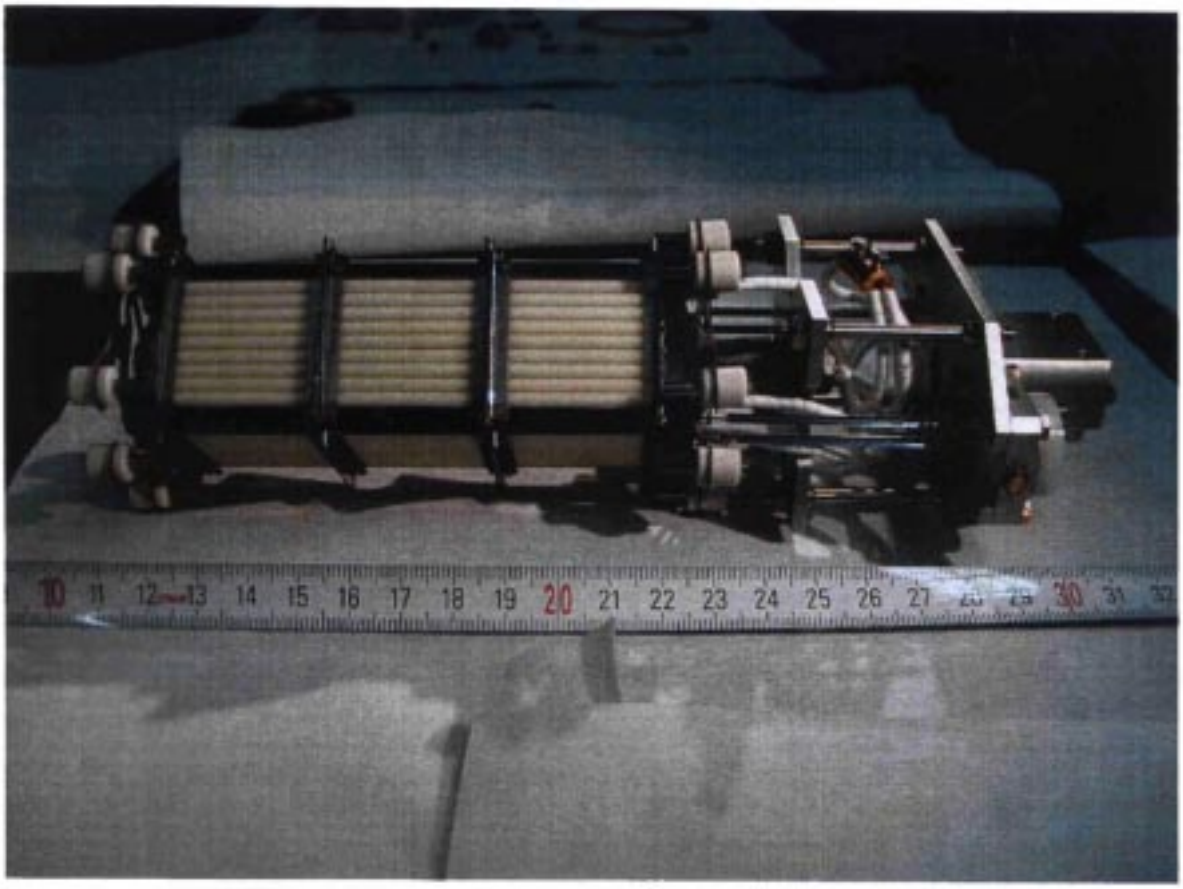
Pulse length	100 fs
Pulse energy	10-100 uJ
Number of photons	~10^13
Wavelength	98 nm
Spot size	100 um
Max. power density	~10^{13} W/cm^2

Experimental station

TOF spectrometer



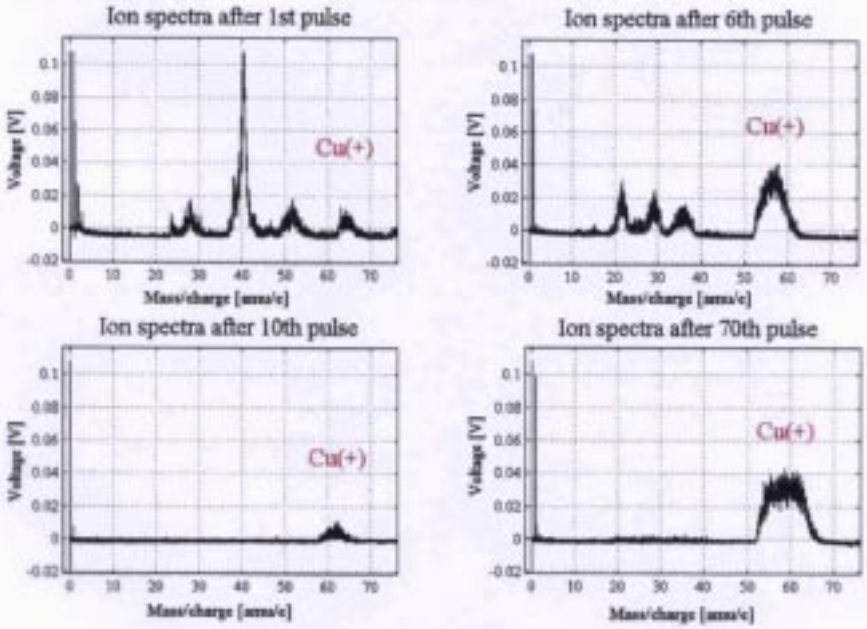
Sample holder



Experimental results

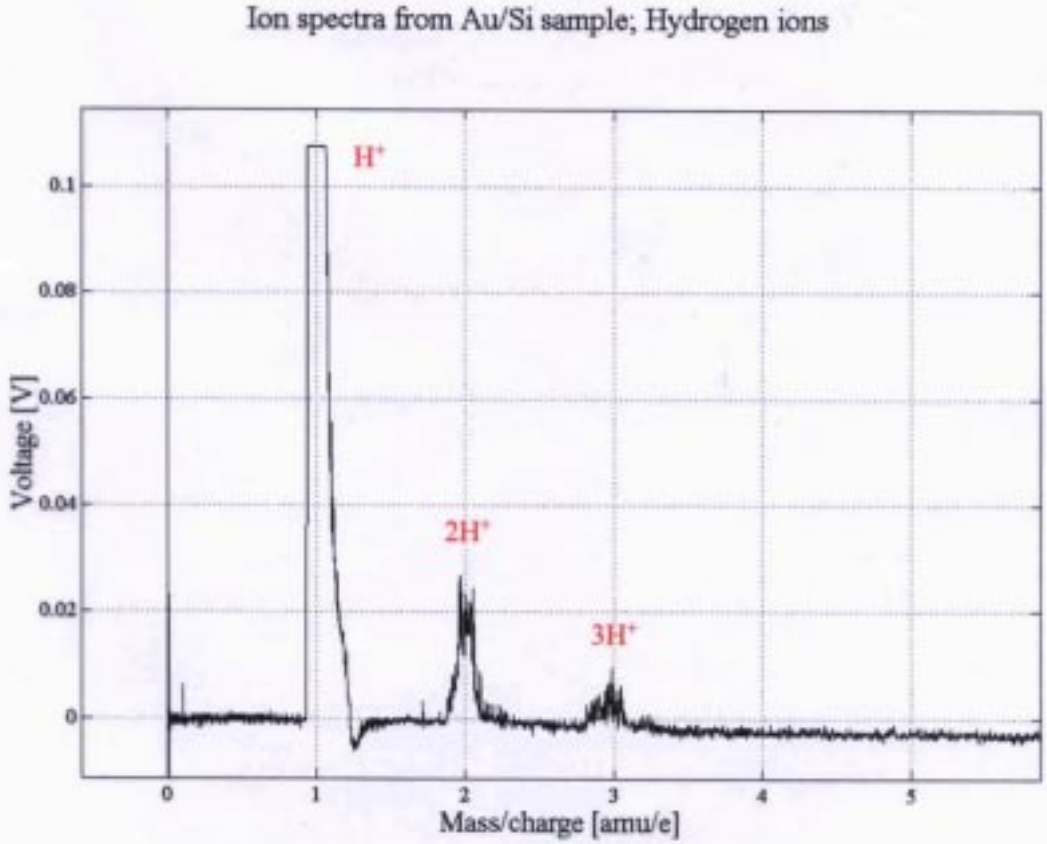
Ablation (Cu sample)

Ion spectra from Cu sample for different number of pulses.



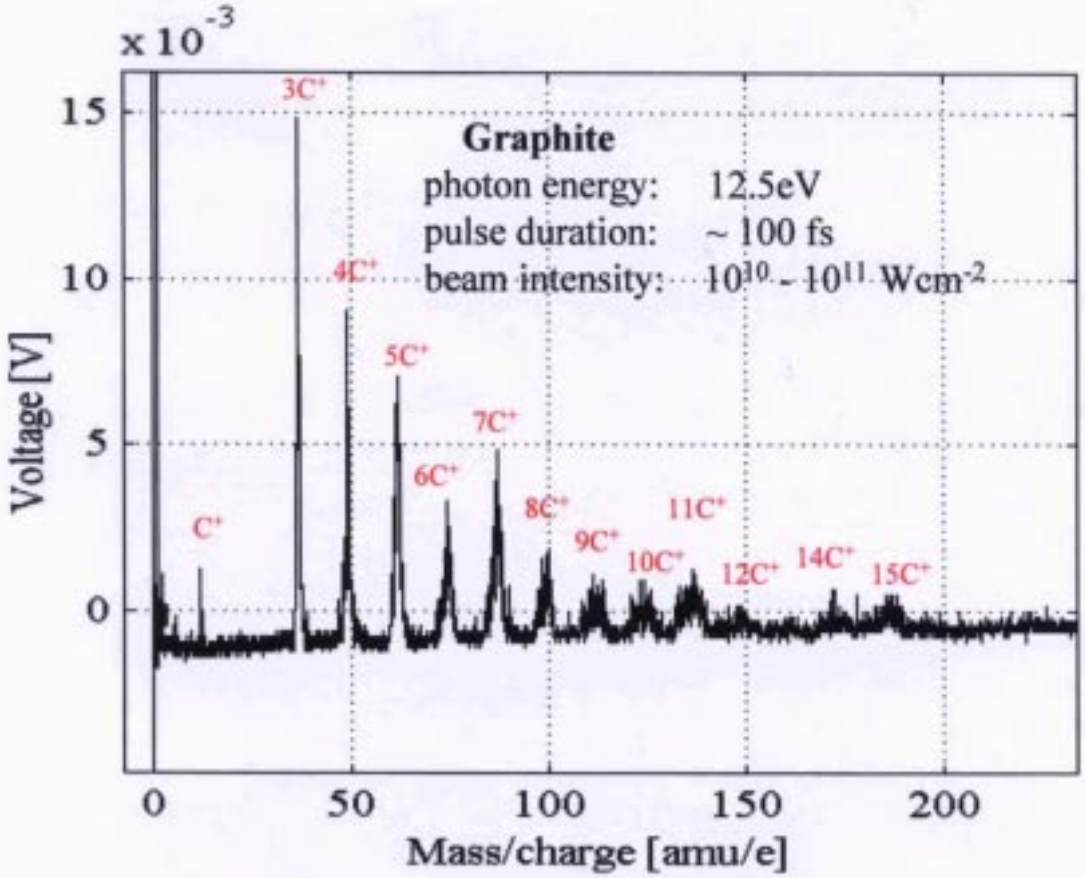
Experimental results

Single shot spectra



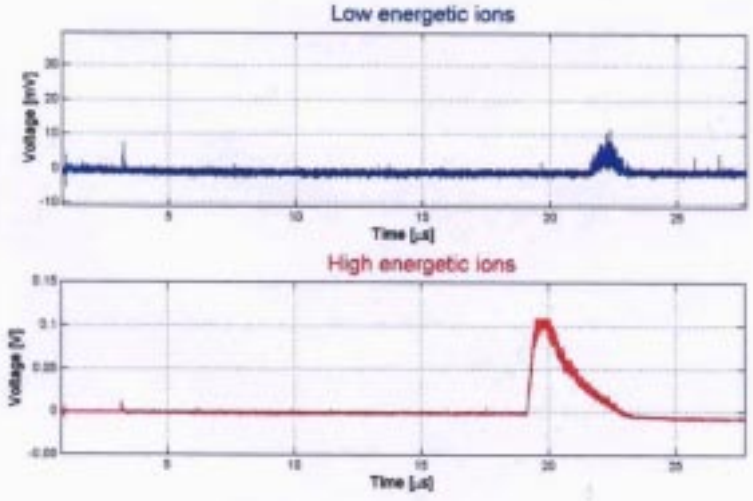
Experimental results

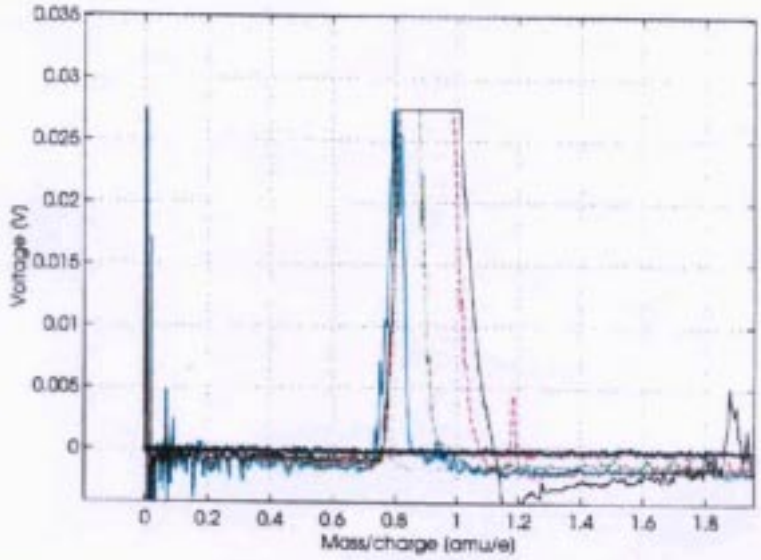
Single shot spectra



Experimental results

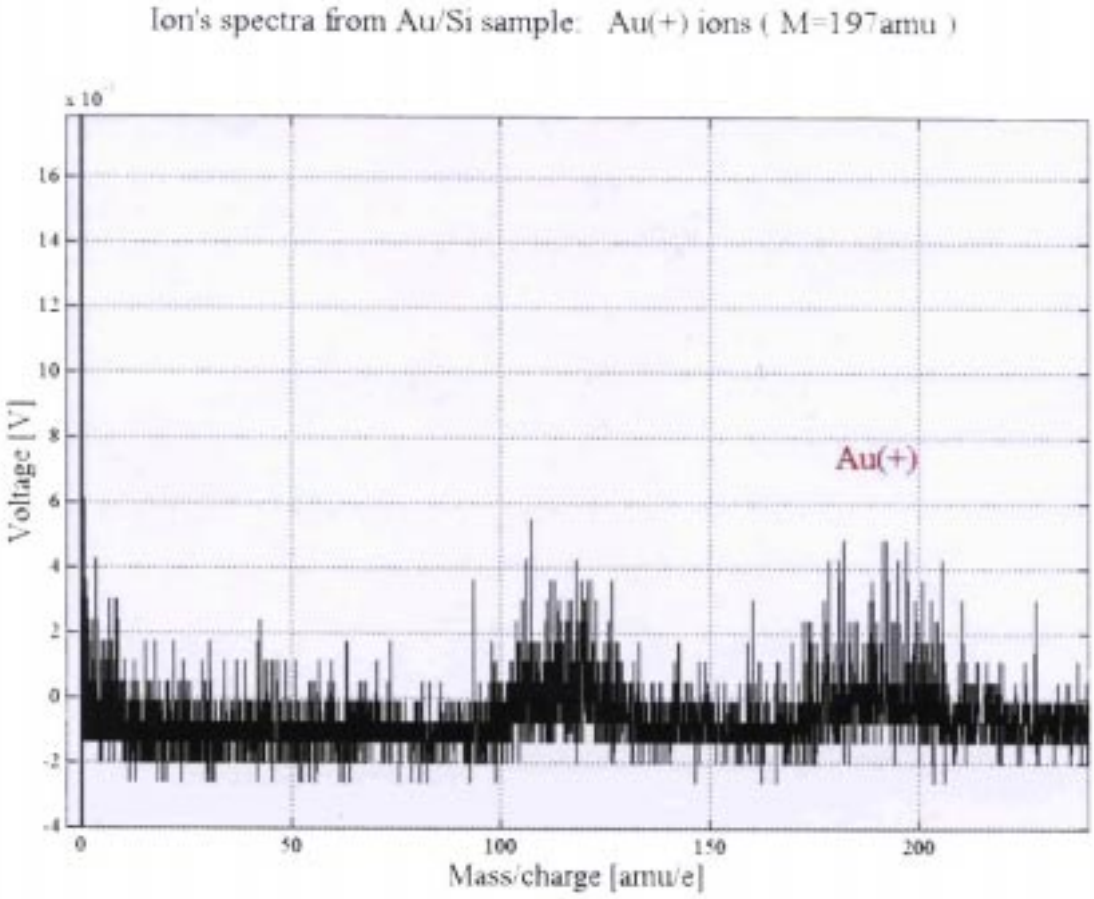
High energetic ions





Experimental results

Ablation (Au sample)



Summary:

- For a first time ablation of metals, semiconductors and insulators caused by ultra-short VUV pulses has been observed
- Single shot ion spectra were analysed with TOF detector
- Damage thresholds (ranging between 0.05 and 0.5 J/ cm^2) has been estimated
- Single charged charged ions and clusters of energy of order 100 eV has been measured for fluencies two - three times larger than the damage threshold
- There is no good explanation for the origin of high energetic ions production. Simulation done according to Two Temperature Model and Plasma State Equation predict only few eV ions.
- Future experiments (planed in December - January) and theoretical efforts are needed to understand the interaction of intense VUV pulses with solids