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Investigation of Secondary Processes by Interaction of Plasma Streams with Various Materials

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Outline

- Motivation and experimental setup
- Interaction of the laser-produced plasma with *W* and *Mo* targets
- The spectra of two-element laser-produced *PbMg*-plasma ions at different concentration of *Mg*
- The spectra of two-element plasma, generated on the surface of *SiC* targets under the action of laser radiation
- Emission of ions from the surface of *Al* target under the action of the laser radiation working in frequency mode
- Conclusions

Experimental setup

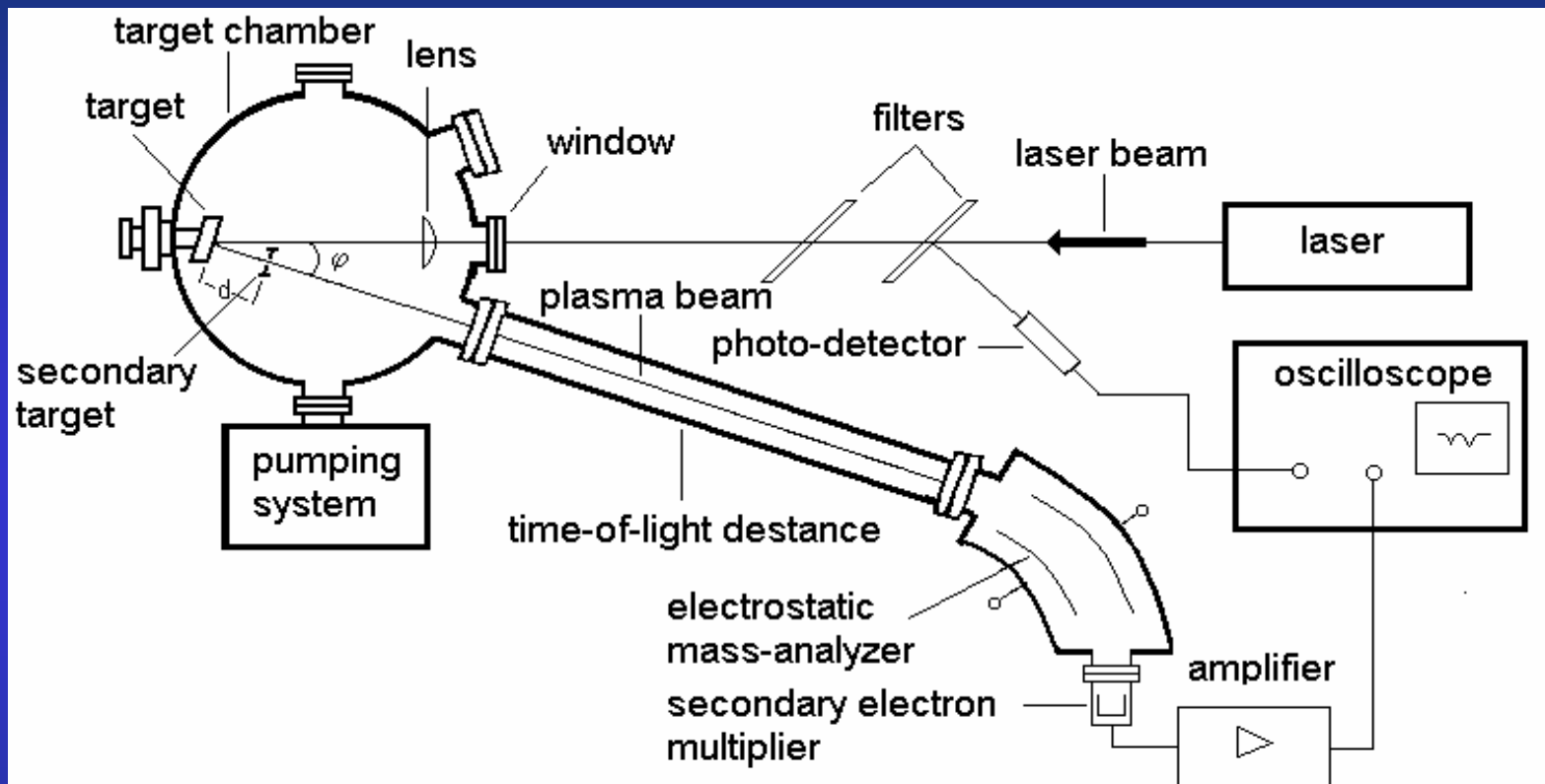
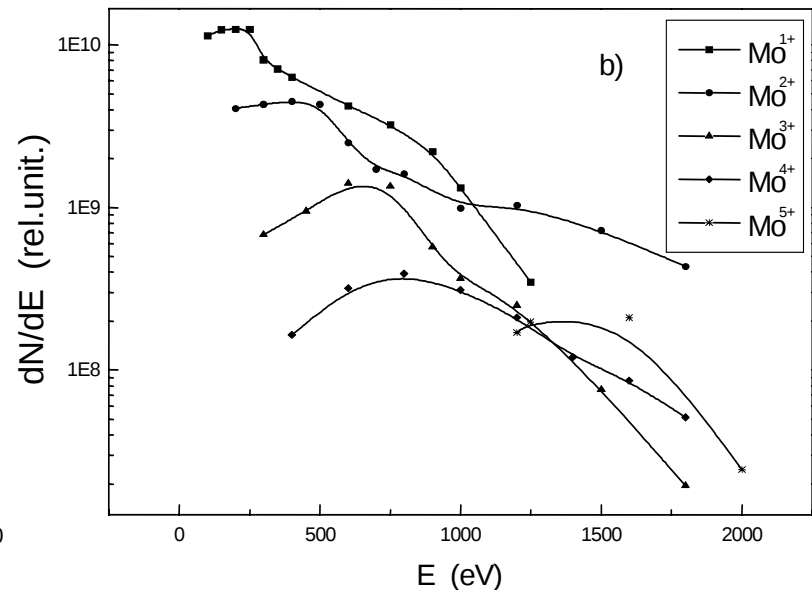
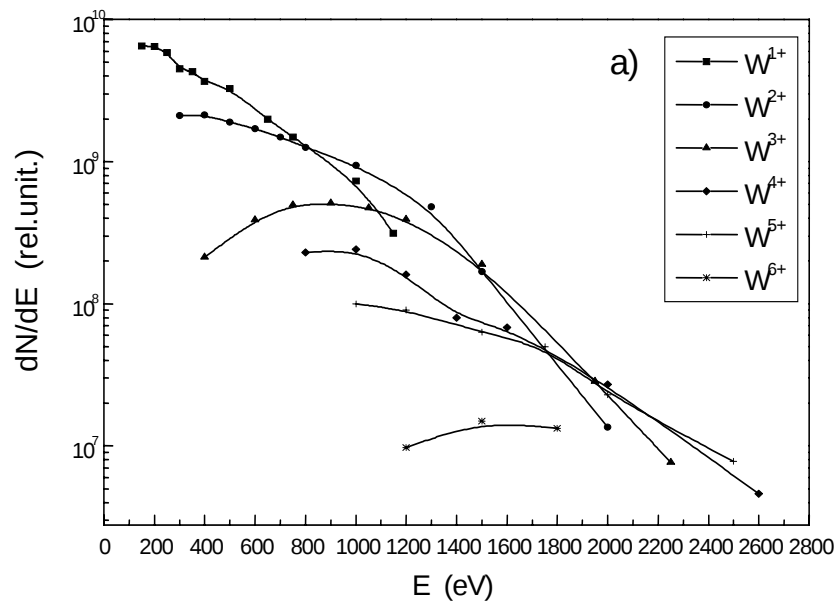


Figure 1: Experimental setup

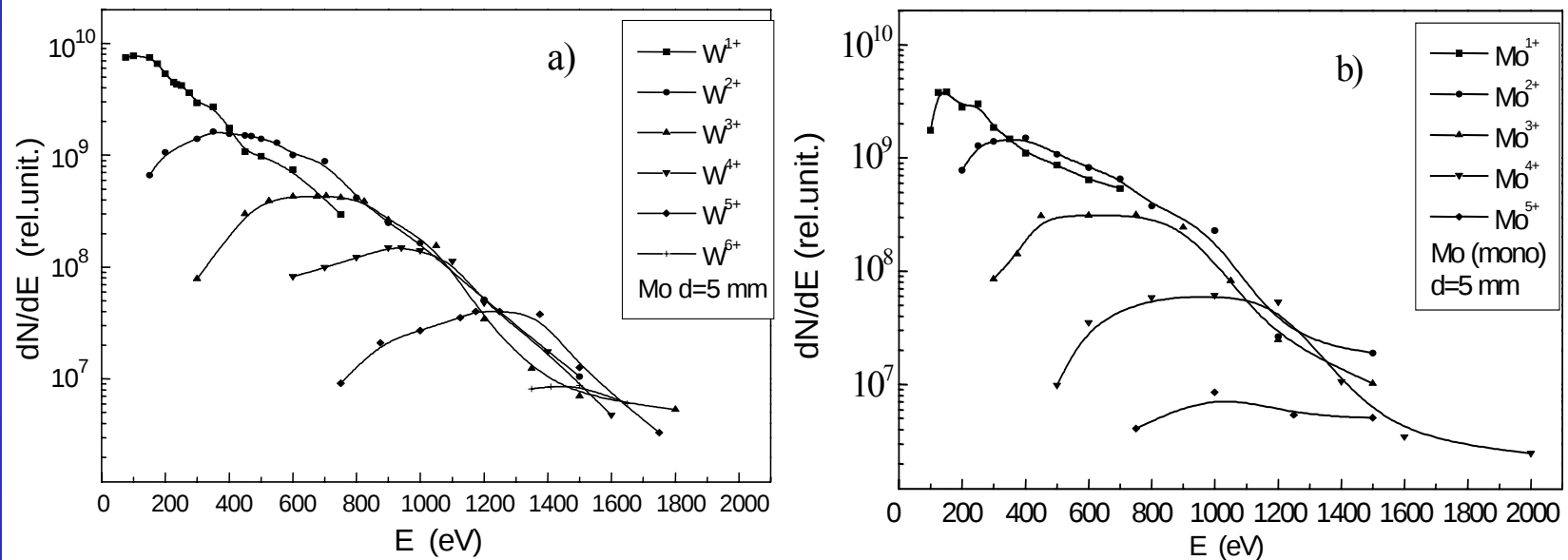
M.R. Bedilov, R.T. Khaydarov, etc. Kvantovaya elektronika (Rus. journal Quantum Electronics), **31** (2001) 321-324

Interaction of the Laser-Produced Plasma with *W* and *Mo* Targets



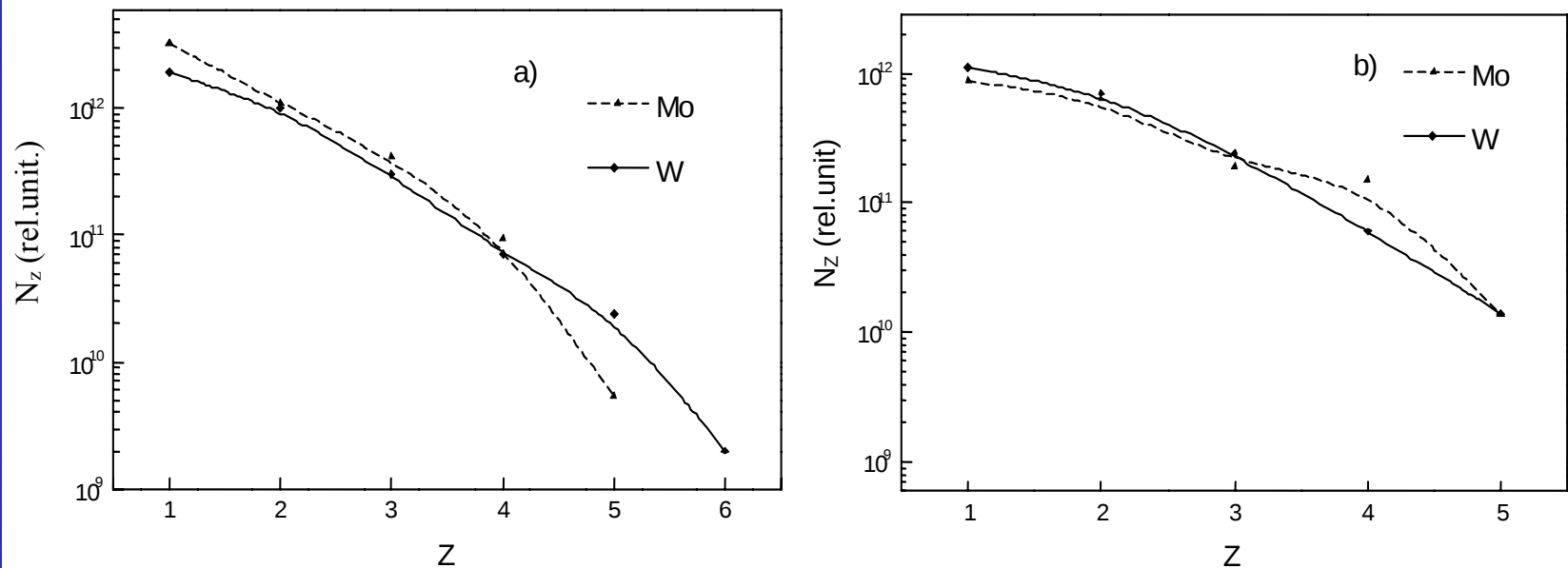
The energy spectra of *W* (a) and *Mo* (b) ions without the presence of the secondary target

Interaction of the Laser-Produced Plasma with *W* and *Mo* Targets



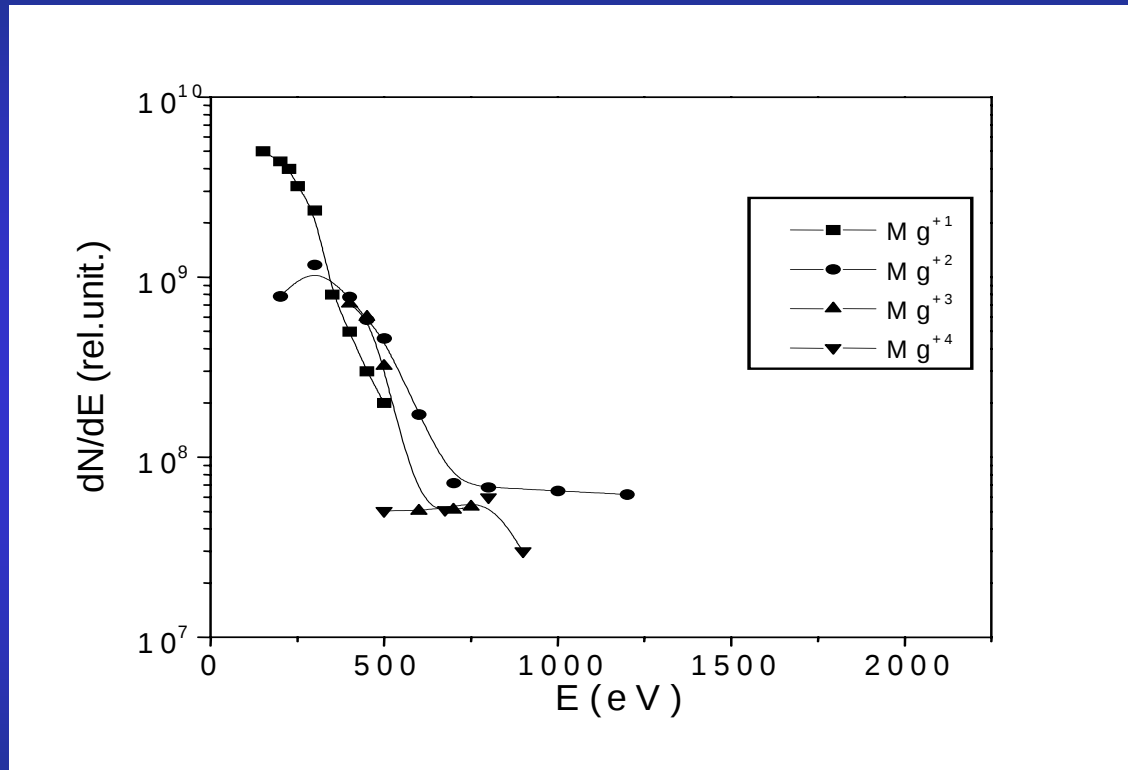
The energy spectra of *W* (a) and *Mo* (b) ions at the presence of the secondary *Mo* target at the distance $L=5$ mm

Interaction of the Laser-Produced Plasma with *W* and *Mo* Targets



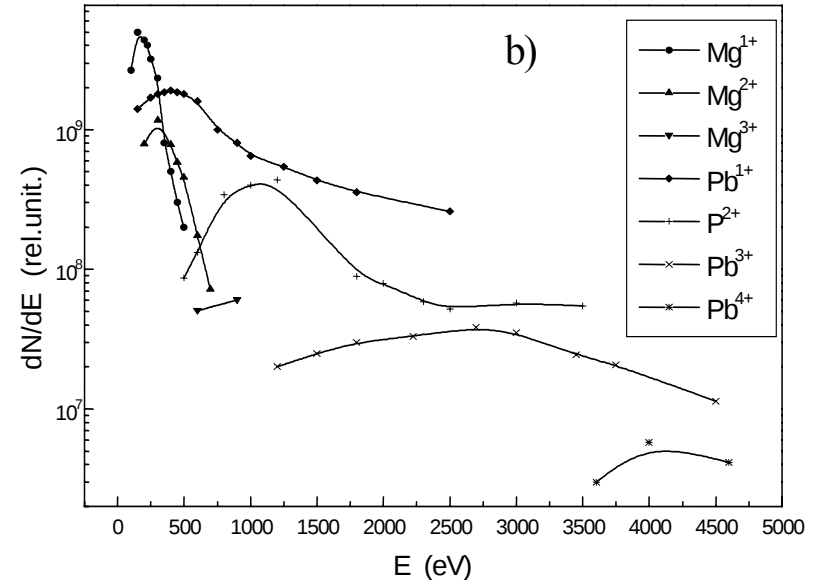
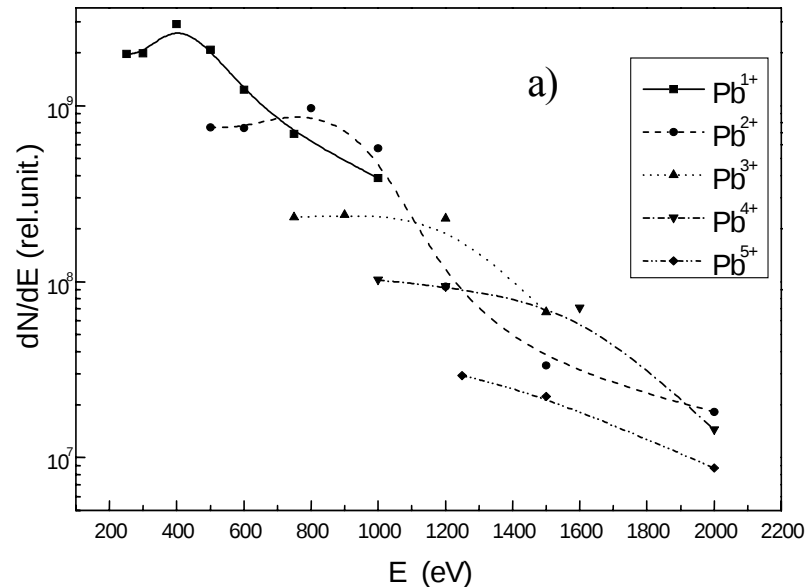
The dependence of total amount of *Mo* (dashed lines) and *W* (solid lines) ions on Z , when the secondary target (*Mo*) is placed at the distances $L=5$ mm (a) and $L=10$ mm (b)

The spectra of two-element laser-produced PbMg-plasma ions at different concentration of Mg



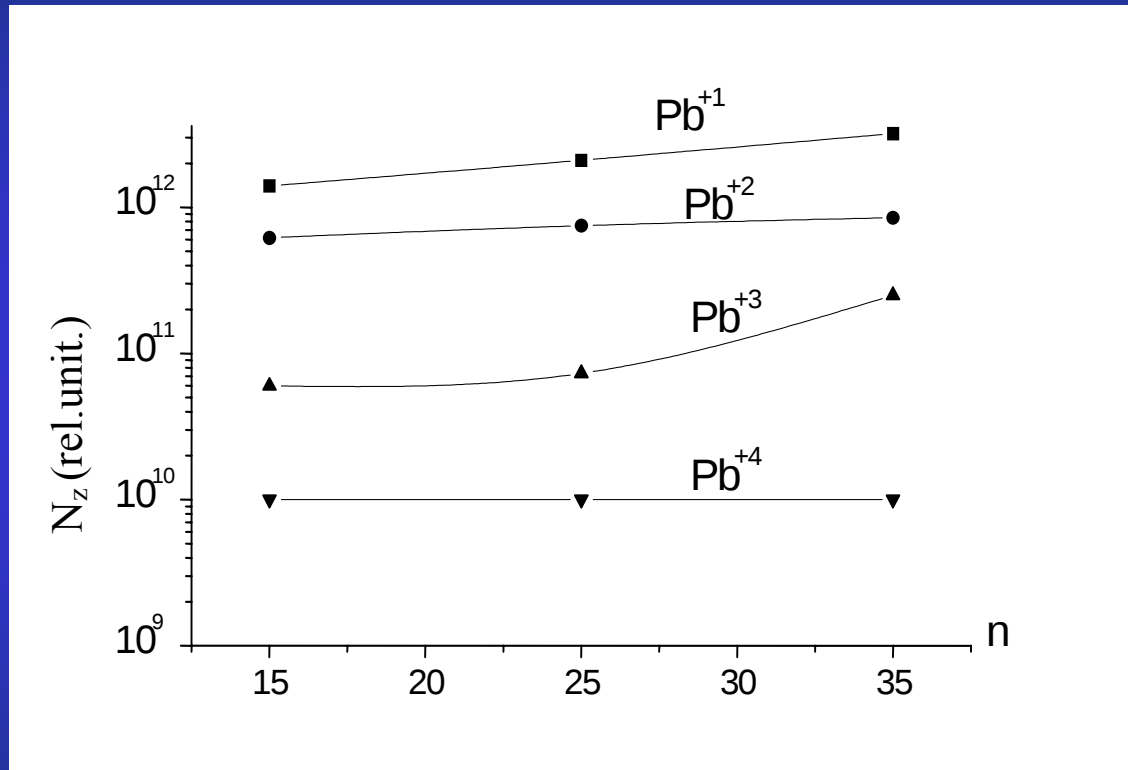
The energy spectra of *Mg*-plasma ions, obtained at power density of laser radiation $q = 5 \times 10^{10} \text{ W/cm}^2$

The spectra of two-element laser-produced PbMg-plasma ions at different concentration of Mg



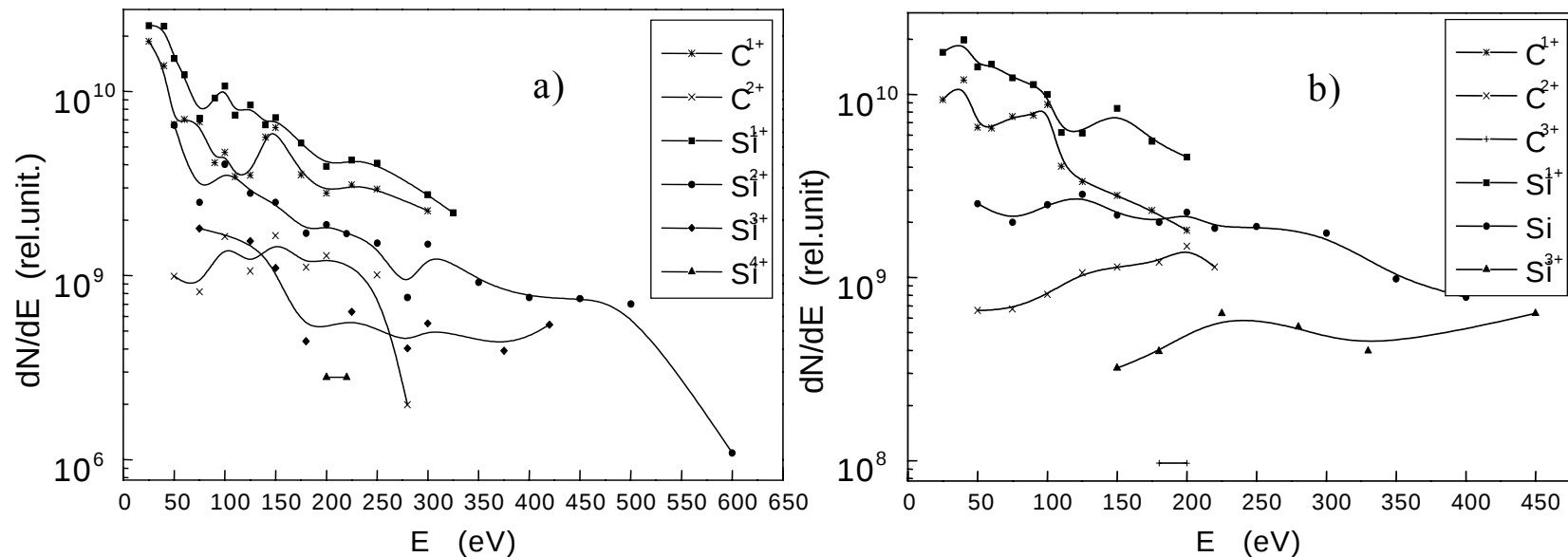
The energy spectra of mono- (*Pb*) (a) and two-element (*PbMg*) (b) plasma ions (the concentration of *Mg* is 35 %)

The spectra of two-element laser-produced PbMg-plasma ions at different concentration of Mg



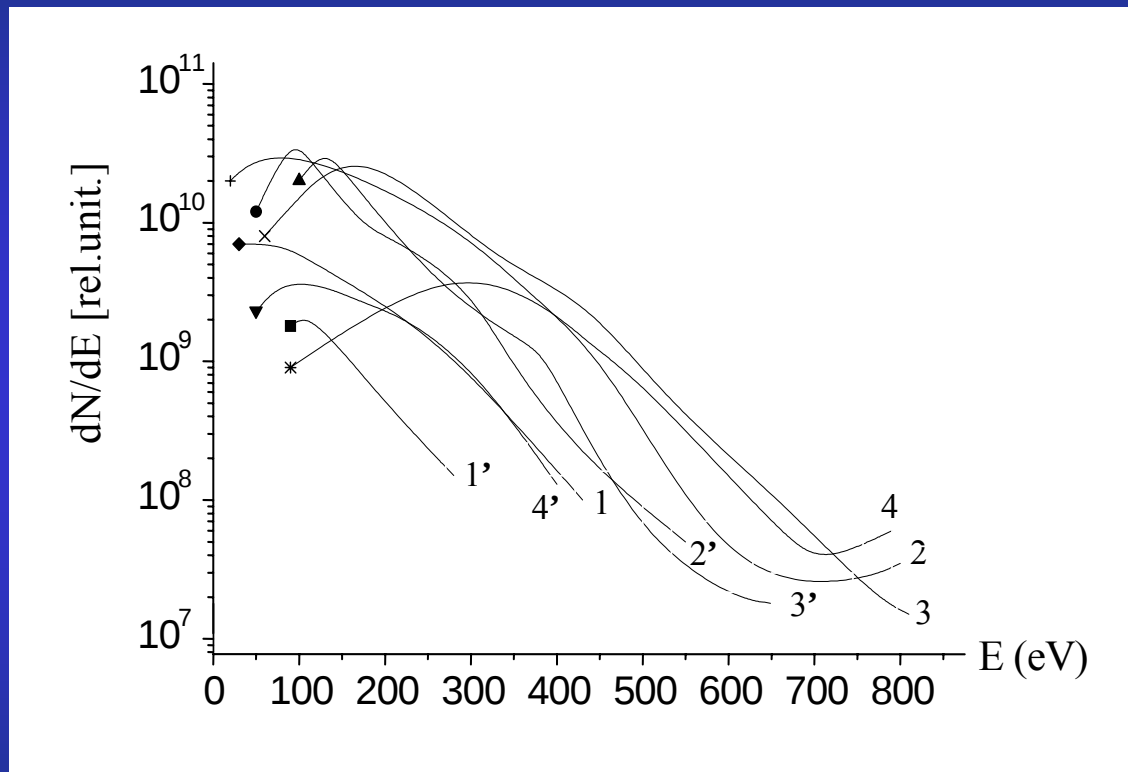
The dependence of total amount of *Pb* ions on concentration of *Mg* ions (n), obtained at power density of laser radiation $q = 5 \times 10^{10} \text{ W/cm}^2$

The spectra of two-element plasma, generated on the surface of SiC targets under the action of laser radiation



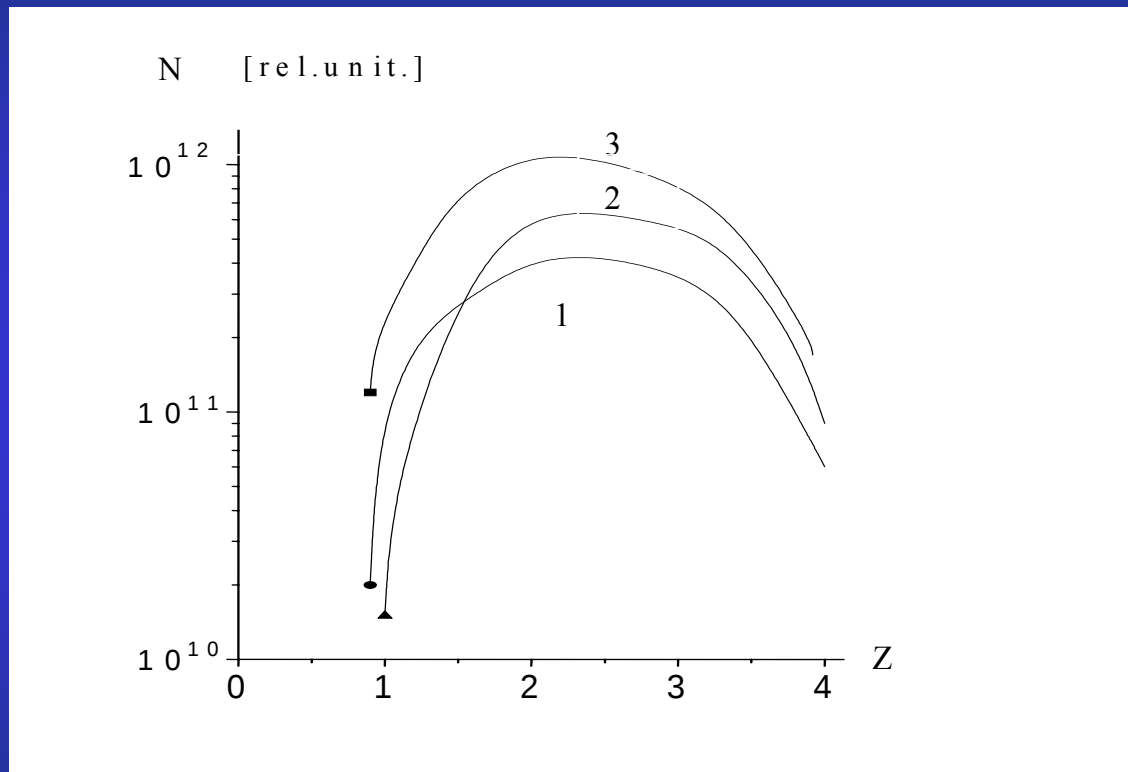
Typical energy spectra of SiC ions obtained at power density of laser radiation $q = 5 \times 10^{10} \text{ W/cm}^2$ from α -SiC target (a) and from the SiC film of 40 μm on the Si substrate (b).

Emission of ions from the surface of *Al* target under the action of the laser radiation working in frequency mode



Typical energy spectra of multiply charged *Al* ions with the charge $Z=1-4$ are given for $\nu=5$ and 12 Hz, and $q=5 \cdot 10^{10}$ W/cm².
Where 1-4 (12Hz) and 1'-4' (5Hz) - the charge Z .

Emission of ions from the surface of *Al* target under the action of the laser radiation working in frequency mode



The dependency of amount of *Al* ions on Z at different values of the laser frequency: 1 Hz (1), 3 Hz (2), 5 Hz (3) Hz.

$\alpha=0^\circ$ and $q=5 \cdot 10^{10} \text{ W/cm}^2$

Conclusions

- we studied the interaction of laser produced plasma with the surface of *Mo* and *W* targets and found that the interaction of *W*, *Mo* plasma with the surface of secondary target changes the parameters of the plasma, gives essential contribution in formation of energy distribution of multiply charged ions in all stage of inertial expansion of the plasma. These changes also influence on the dynamics of the formation of mass-charge and energy spectra of multiply charged ions;
- in order to control parameters of plasma ions we investigated physical properties of multiply charged plasma ions, formed under the action of laser radiation on two-element (*PbMg*) targets at different concentration of *Mg*. The experimental results show that the maximal energy of *Pb* ions increases more than two times when we included the second *Mg* element into the target, which is due to the energy exchange between light and heavy ions. We also found that the increase of energy range occurs as the concentration of *Mg* increases, which is one of main characteristics and can be used to control the charge and intensity of ions;

Conclusions

- We studied interaction of laser radiation with the surface of SiC targets, which are considered as one of main elements for thermonuclear power engineering based on inertial confinement fusion. It is found that parameters (energy, charge, etc) of plasma ions formed from α -SiC target are different compared to the plasma ions generated from the SiC film, which shows the importance of target nature in formation of plasma ions;
- We also studied the interaction of laser radiation with the surface of Al target, when the laser worked in the frequency mode. We found that the ions of all charge have larger intensity and larger energy at large values of the frequency of the laser radiation, which was explained by the change of focusing condition on the surface of the target.

Thank you for your attention