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Time-of-flight technique for detection of fast ions accelerated by high power lasers

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Time-of-flight (TOF) technique is a possible approach for laser-plasma ion beam diagnostics since many years. In fact it provides time-resolved measurements which are fundamental for a detailed study and understanding of basic ion beam parameters, such as kinetic energy, ion species and charge states, current, total charge, shot-to-shot reproducibility, etc.

Multi-MeV beams of light ions have been produced using the 300 ps, kJ-class iodine laser, operating at PALS facility in Prague. Real-time ion diagnostics was performed by the use of various TOF detectors: standard ion collectors (IC) with and without absorber thin films, new prototypes of single-crystal diamond and SiC detectors, and an electrostatic ion spectrometer.

In order to cut off a long photopeak contribution and avoid the overlap with the signal from ultrafast particles, e.g. protons, the ICs have been shielded with different Al foils. Otherwise, the use of large-band-gap semiconductor detectors (> 3 eV) also ensured cutting of the long plasma photopeak and additionally high sensitivity to the very fast proton/ion beams. Finally, complementary measurements realized by the use of an ion-energy-analyzer (IEA) spectrometer have been carried out in order to recognize different ion species and charge states in the expanding laser-plasma.

Processing of the obtained experimental TOF data, including estimation of the plasma fast proton maximum and peak energy, ion peak current density, total number of fast protons, as well as deconvolution processes and ion transmission calculations for different metallic filters used, is shown. Maximum attainable proton energy and current has been optimized varying the target composition, laser energy and focal spot diameter. Experimental results are presented, discussed and compared with literature data.

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P26.

Advanced X-ray and XUV optics for plasma spectroscopy

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In the last decade, much effort has been given in development of modern dedicated XUV and x-ray free electron lasers with unique properties. Femtosecond laser plasma sources provide ultra-short x-ray pulses of high peak brilliance and can thus be complementary x-ray sources to the undulator based sources. All these modern x-ray sources need dedicated x-ray optics for diagnostics and applications, respectively.

The availability of femtosecond XUV pulses from free-electron lasers such as FLASH in Hamburg (Germany) opens up new possibilities to study dense plasmas. These states of matter are characterized either by XUV

self-emission of XUV Thomson Scattering. In any case, high resolution XUV spectrometers are highly desired. Additionally, these diagnostics have to be flexible, comparatively small and highly efficient in order to serve various dedicated experiments.
X-ray spectroscopy is one of the most important diagnostics of plasmas in the context of laser fusion. Depending on the aims of these experiments (i) monochromatic x-ray images or (ii) high resolution spectra combined with either spatial or time resolution can be obtained. Sophisticated monochromatic imagers with up to 10 toroidally bent crystals have been developed to study the implosion processes in laser fusion experiments; time-resolved maps of plasma parameters were evaluated from the data.
High-power femtosecond lasers provide a practical, relatively inexpensive, powerful x-ray flash source. Information on production efficiency, the energy distribution and transport of hot electrons is needed to maximize x-ray output in desired K-shell emission lines or continuum ranges so that peak brilliances comparable to those of synchrotrons may be feasible. Combining these new sources with bent crystal optics enables diffraction experiments on sub-picosecond time scales. Laser-pump x-ray-probe experiments have shown evidence of structure changes in several crystals within 250 fs.
These x-ray optics have been designed in our institute using raytracing and Bragg reflection codes for the 1D or 2D bent crystals or combinations thereof. In the preparation process, extreme care has been taken over crystal perfection, selection of optimum reflections, precision bending, measurement of imaging and reflection properties. X-ray topographic cameras and diffractometers are used to check the relevant properties of the analyzer crystals.

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Spectral identification of tissue's malignant changes

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Early detection of malignant transformation is a goal of modern medicine and to this end there is an impressive number of approaches from the scientific field that tries to identify early changes preceding malignant transformation in order to establish a correct diagnosis. This work aims is to combine the optical and biochemical techniques for identifying the changes in membrane dynamics of growth and development of experimental solid tumours. During the purpose has been used experimental Walker 256 carcinoma graft in Wistar rats, followed from day 7 up to day 24 from inoculation of tumour cells. Optical techniques were used fractalometry laser polarization in the preclinical diagnosis of pathological changes and degenerative-dystrophy of experimental tissue, and in terms of biochemical tumour tissue was determined the reaction of lipid peroxidation monitored by the malondialdehyde (MDA), the end product assays of reaction. In addition were followed also the total antioxidants as a response of the endogenous defences systems. The results indicate a rising profile of the processes investigated by the 14th day after tumour graft, following a decrease due to lack of substrate enzymatic reactions, specifically the double links of polyunsaturated fatty acids in the membranes change during tumour development. These data are consistent with the changes of the optical investigated parameters.
It is shown that in all the cases the linear dichroism appears in bio tissues with the cancer disease the magnitude of which depends on the tumour growth of the cancer process development. The phenomenon of the linear dichroism formation has a selective character: maximum values Δ are observed in the area λ=410÷430 nm and in the area λ=500÷530 nm, for the wavelength λ<300 nm and λ>750 nm Δ is almost zero or zero.
The linear dichroism magnitude depends on the thickness of samples that's why at thicknesses d=10÷12μm when the transmission is 80% and more, it doesn't become apparent at the measurements on the spherical photometer, in this case it is better to conduct the transmission investigation in the direct beam. As the linear