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# REAL-TIME DETECTION OF FAST ION BEAMS ACCELERATED BY A SUB-NANOSECOND LASER

## Abstract


Relativistic intensity laser-plasma acceleration represents a novel technique which will revolutionize the way to accelerate light ion streams for various purposes: biolology, chemistry, solid-state physics, nuclear physics, hadrontherapy, etc. Thus, in the next future, in order to demonstrate the capability of laser-plasma accelerators in replacing the expensive conventional systems, not only the maximum ion energy should be optimized but also the quality of the beam in terms of luminosity, divergence, energy spectrum and reproducibility.

Although in few years the dramatic rise in attainable laser intensity will bring to values exceeding $10^{23}$ W/cm$^2$, e.g. the future ELI (Extreme Light Infrastructure) femtosecond-laser facility in Czech Republic, the beam characteristics cannot leave aside a detailed study and understanding of the relativistic laser-matter interaction even at lower laser intensities. In fact, laser parameters (prepulse and peak laser intensity, laser focal spot quality, focus position, contrast, degree of polarization, and shot-to-shot reproducibility) as well as the target properties (structure, mass, density, shape, and thickness) are fundamental for the optimization of the accelerated beam. Therefore, investigations carried out by using relatively long-pulse laser systems (0.1÷1 ns) can provide up-to-date results in the production of very high gradients for ion beam acceleration.

Multi-MeV light ion beams have been produced by using the 300 ps, kJ-class iodine laser, operating at PALS Centre in Prague. Real-time ion detection was performed through standard ion collectors (IC) and new prototype of large-gap semiconductor detectors (single-crystal diamond and SiC detectors) in time-of-flight configuration (TOF). The ICs have been shielded with different Al foils in order to cut the long photopeak contribution and to analyze the ultrafast particle signal.

Processing of the obtained experimental IC-TOF data, including deconvolution processes of the TOF signals, UV/soft-x-ray photopeak absorption, and ion transmission calculations for different metallic filters, is shown.