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High current, high energy proton beams accelerated by a sub-nanosecond laser

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The sub-nanosecond laser system available at PALS center in Prague has been used in order to produce multi-MeV proton beams with typical current density approaching 1 A/cm^2. In spite of the relatively long pulse duration (0.3 ns) and low intensity (~10^{16} W/cm^2), far away from the forefront laser facilities used for advanced proton beam acceleration in the recent years (from tens of femtoseconds to few picoseconds), the obtained results are promising both in terms of maximum proton energy and fast proton current.

Real-time diagnostics systems, mainly in time-of-flight (TOF) configuration such as advanced ion collectors (IC) and semiconductor detectors, but also an electrostatic ion energy analyzer (IEA), have been used in order to estimate maximum and peak energy of the plasma fast proton component, peak current density, total number of fast protons and conversion efficiency of laser energy into accelerated fast proton total energy.

Optimization of the maximum attainable proton energy and current has been carried out by irradiating targets of different composition as well as varying the laser energy and the focal spot diameter. Experimental results are discussed and compared with literature data.