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Ion acceleration driven by high intensity, multiple beams at Arcturus Laser System

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Here, we report novel experimental results on topic ion acceleration in ultra-high intensity regime using multiple beams. The experiments have been performed at Arcturus laser facility (Heinrich Heine University, Düsseldorf) using both arms of ultra-short 200TW beams and a 10 TW probe pulse. The main interaction beams (energy up to 6J and pulse duration 30 fs) were focused at intensities $>10^{20}$ W/cm² and spatially overlapped onto thin Ti foil. The system allows relative temporal delay between pulses and independently control pulse contrast by means of the separate plasma-mirror setups. The ion beams accelerated on the target rear side were monitored by two Thomson spectrometers (0° and 10°). Depending on the relative delay between the beams, different interaction regimes can be accessed and recognized in the enhancement of the ion energy and/or modulation of the energy spectrum. For example, at the relative temporal delay of 250 ps, the proton energy was enhanced up to 50%. Furthermore, enhancement of heavy ion (e.g. C⁺⁴) energies and increase in flux near the cut-off energies were also observed at different delays. The dynamic of the expanding plasma was monitored by high resolution spectral interferometry and reflectometry.

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