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4P75 - Laser-driven acceleration of titanium ions from ultrathin targets and the calibration of the ion beam diagnostic

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A super-intense laser pulse, incident on a thin foil target, can create plasma structures with accelerating fields on the order of TV/m, accelerating ions to multi-MeV energies. The 10^{20} W/cm^2, linearly polarized Texas Petawatt Laser (TPW) facility was employed to accelerate high energy titanium ions from ultrathin (60 to 200 nm) planar titanium foil targets. A clear optimum target thickness is observed, with Ti^{20+} ions reaching 18 MeV/nucleon from 80 nm targets. Two Thomson parabolas, spectrometers that separate ions by their charge-to-mass ratio, were aligned to target normal and close to the laser propagation axis. In the spectrometers, BAS-TR image plates were used to detect the ions. A plastic grid of CR-39 was mounted in front of the image plates to measure absolute counts from the deposited titanium ions. This calibration enables the extraction of absolute energy spectra of the titanium ions. Established analytical models, such as target normal sheath acceleration (TNSA) and radiation pressure acceleration (RPA) are applied, along with the fully relativistic 2-D particle-in-cell code EPOCH, to provide insight into the underpinning physics responsible for ion acceleration in this ultrathin target regime.

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