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Ion Acceleration from ultra thin foils on the Astra GEMINI facility

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Laser driven ion acceleration is an area receiving increasing interest in fundamental research due to the continuous progression in high power laser technology and to its possible applications, including proton radiography, production of warm dense matter, fast ignition of fusion targets, biomedical applications and nuclear and particle physics.

Two experiments were carried out on the Astra GEMINI laser system at Rutherford Appleton Laboratory, STFC, United Kingdom. The ion beams were generated by focusing a single beam of Astra GEMINI with an f/2 parabola onto ultra-thin carbon and plastic targets (thicknesses ranging from 2.5nm to 100nm). A quarter waveplate controlled the polarisation of the laser pulse. Thomson parabola (TP) spectrometers, radiochromic film (RCF) stacks and CR-39 stacks were used to gather information on the quantity, type, energy and distribution of ions produced. The effect of laser light polarisation on the acceleration of ions from ultrathin foils was investigated to determine the optimum configuration for acceleration processes.

The highest energies for both carbon ions and protons (~30MeV) were obtained for 10nm targets and circularly polarised light. The beam profiles obtained show significant differences between circular and linear polarisation. These features are supported by particle-in-cell (PIC) simulations.

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