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Medium to high Z-ion beams from laser-plasma interactions

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Laser-driven approaches to ion acceleration are the focus of significant scientific attention in light of the beams'unique temporal properties as well as the compactness and versatility of the acceleration process.
Most of the experimental activity has focused so far on the acceleration of protons, through sheath acceleration processes acting at the rear of laser-irradiated foils, where ultra-high, spatially localized fields (>TV/m) accelerates protons present on the surface, e.g. in contaminant layers. Accelerating higher-Z ions from the target surface requires in-situ removal of contaminants which is a complex and often inefficient process.

Alternative acceleration mechanisms have recently emerged which act directly on ions located in the bulk of laser-irradiated targets, and have been employed for efficient acceleration of medium to high-Z ions. These include Radiation Pressure Acceleration, where the very large light pressure carried by an ultraintense laser pulse transfers momentum to the ions of a dense, opaque target plasma. Exploiting this process for efficient acceleration requires precise control of the parameters of the driving laser, as well as of the dynamics of the ionized target.
The talk will review results obtained so far with these techniques using the GEMINI and VULCAN lasers of the Central Laser Facility of the Rutherford Appleton Laboratory, with particular focus on the acceleration of carbon and gold ions. We will also discuss perspectives for further progress on the next generation of multi-Petawatt facilities, and for the applications that will be enabled by these developments.

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