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Absolute calibration of Fujifilm BAS-TR image plate response to laser driven protons in the range 10-40 MeV, and gold ions up to 1GeV

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Imaging Plates (IP's), relying on photo-stimulated luminescence (PSL) are amongst the most popular and reliable detectors for laser driven particle acceleration experiments. Fujifilm BAS-TR IP's are composed of a phosphor active layer on top of a magnetic base [1]. When ionising radiation is incident on the active layer, the phosphor molecule is promoted to an excited, metastable state which can persist for several hours. Image plate scanners stimulate the emission of a 400nm photon, which is then detected and recorded in the scanner as a pixel value. This pixel value can be converted to a parameter known as the PSL value. The PSL value at any point is related to the type of ionising radiation, as well as the energy and number of particles incident at that point. The response of protons to this brand of IP has been previously calibrated up to 20 MeV in laser driven acceleration experiments [3], and from 80-200 MeV using a conventional linear accelerator [4]. The response to heavier ions has also been investigated in the past for carbon [5] and titanium [6] ions, however the response for extremely heavy ions, such as gold, has not yet been reported in the literature.

In this experiment, the response of Fujifilm BAS-TR IP's to high energy laser accelerated protons up to 40 MeV, and gold ions up to 1 GeV, has been determined. These were calibrated using a Thomson parabola spectrometer and CR-39 solid state detector to determine absolute ion number in specific energy ranges. This proton calibration fills the gap in the literature which has existed for energies between 20 and 80 MeV and is in agreement with the previous works. The gold ion calibration is the first reported instance of an IP calibration for extremely heavy (A~200) ions.

References

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