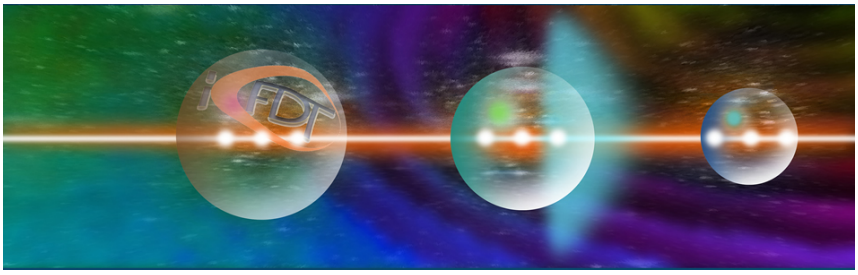

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Absolute calibration of Fujifilm BAS-TR image plate response to high energy protons in the range 10-40 MeV

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Imaging Plates (IPs), relying on photo-stimulated luminescence (PSL) are amongst the most popular and reliable detectors for laser driven particle acceleration experiments. IPs are composed of an active layer on top of a magnetic base [1]. The Fujifilm BAS-SR and BAS-MS brands of imaging plate also have a protective layer over the active layer, however the BAS-TR, which this presentation will focus on, does not. The active layer is usually composed of europium doped barium fluoride phosphor, BaFBr0.85I0.15:Eu2+. When ionizing radiation is incident on the active layer, the above molecule is promoted to an excited, metastable state which can persist for several hours. The state can decay either via spontaneous emission or by stimulated emission when irradiated by light at an appropriate wavelength. Image plate scanners use red laser radiation to 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, using a formula provided by Fujifilm [2], 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]. In this experiment, the response of Fujifilm BAS-TR image plates to high energy laser accelerated protons up to 40 MeV has been determined. These were calibrated using a Thomson parabola spectrometer and CR-39 solid state detector to determine absolute proton number in specific energy ranges determined through the use of iron or copper filters placed in front of the CR-39. This 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. Proton spectra were taken from the Thomson parabola spectrometer to compare the new calibration with a previous one. The two spectra were found to be in good agreement, confirming the validity of the technique.

[1] Bonnet et al. Rev. Sci. Instrum. 84, 013508 (2013)
[2] Fujifilm IP scanner user manual, page 52 (http://beamline.harima.-riken.jp/bl45xu/web_old/Info/BAS2500imgSpec.pdf)
[3] Mančić et al. Rev. Sci. Instrum. 79, 073301 (2008)
[4] Rabhi et al. Rev. Sci. Instrum. 88, 113301 (2017)

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