ECPD 2021
European Conference on Plasma Diagnostics

CR-39 track detector calibration for low energy ions accelerated by laser using a Thomson Parabola spectrometer

V. Kantarelou [1], A. Velyhan[1], M. Rosiński[2], P. Tchorz[2], L. Giuffrida[1], P. Cirone[3] and D. Margarone[1, 4]

1) ELI-Beamlines, Institute of Physics (FZU), Czech Academy of Sciences, Prague, Czechia
E-mail : Vasiliki.Kantarelou@eli-beams.eu
2) Institute of Plasma Physics & Laser Microfusion (IPPLM), Warsaw, Poland
3) Southern National Laboratory (LNS), Istituto Nazionale Fisica Nucleare, Catania, Italy
4) Centre for Plasma Physics, School of Mathematics and Physics, Queen's University of Belfast, Belfast, United Kingdom

CR-39 nuclear track detectors are frequently used for the detection of ions accelerated by laser-plasma interaction [1, 2] because they are sensitive to each single ion and their efficiency is nearly 100%. Within this study, we present a calibration of CR-39 response for protons, alpha particles and silicon ions using CR-39 detectors placed in front of the imaging plate of a Thomson parabola spectrometer. We provide measurements of the ion track diameters for energies ranging from hundreds of keV to a few MeV, and for etching times between 2 and 9 h.

In the low energy region (below 1.5 MeV), two energies of protons or alpha particles correspond to one track diameter; therefore, in this energy range, it is not possible to distinguish the different ion energies using only the track diameters, thus the track depth, or the grey level of the track image should also be considered [3]. We propose a new methodology to solve this problem that relays on the different grow rate of the diameter corresponding to different energies during subsequence etching procedure.

Applications of our calibration on the characterization of laser-accelerated ions will also be presented.

References

[1] L. Giuffrida et al., Phys. Rev. 101, 013204 (2020).
[2] D. Margarone et al., Front. Phys. 8, 343 (2020).
[3] D. Xiaojiao et al., Nucl. Instr. Meth. Phys. Res. A, 609, 190 (2009)