Contribution ID: **62** Type: **Poster**

Low beam intensity raster scan measurements with the Timepix3 at CNA

Monday 1 July 2024 18:08 (1 minute)

With an increasing number of applications, the Timepix [1] technology is also currently studied as a possible radiation monitor [2] within the scope of Radiation to Electronics activities at CERN. During a calibration campaign at CNA 3 MV tandem facility [3], its capabilities as a beam monitor for ion beams emerged. The investigated proton and hadron beams leave multi-pixel tracks in the Timepix3 sensor, and after reconstructing the full clusters, the beam shape, size and its movement could be measured, as seen in Fig. 1.

In particular, the default instruments at the irradiation chamber that was used at CNA can only detect particle currents above 106 particles/(cm2 s). Nevertheless, the beamline has been designed including a scanning system to allow the irradiation of large areas. Although this is limited by the sample holder dimensions (16×20 cm2), depending on the beam features the full scan can be further increased. Then, by raster scanning of the beam through magnetic deflection, the current density can be dramatically decreased, to an average ion flux to the order of 102 particles/(cm2 s). The Timepix3 Radiation Monitor successfully measured such low fluxes, as well as confirming the raster scan procedure.

[1] T. Poikela et al., Timepix3: a 65k channel hybrid pixel readout chip with simultaneous ToA/ToT and sparse readout, in Journal of Instrumentation 9 (2014), pp. C05013–C05013. url: https://doi.org/10.1088/1748-0221/9/05/c05013.
[2] D. Prelipcean et al., Towards a Timepix3 Radiation Monitor for the Accelerator Mixed Radiation Field: Characterisation with Protons and Alphas from 0.6 MeV to 5.6 MeV. in Applied Sciences. 2024; 14(2):624.url: https://doi.org/10.3390/app14020624.
[3] Y. Morilla et al., Progress of CNA to become the spanish facility for combined irradiation testing in aerospace, in 2018 18th European Conference on Radiation and Its Effects on Components and Systems (RADECS), IEEE, 2018, url: https://doi.org/10.1109/RADECS45761.2018.9328656

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Session Classification: Poster Session