IGFAE workshop on technologies and applied research at the future Galician proton-therapy facility



Contribution ID: 24

Type: Oral contribution

Online beam monitoring detector for FLASH irradiations

Wednesday 10 May 2023 12:45 (20 minutes)

Introduction: FLASH effect is deeply influenced by the beam pulse structure (instantaneous dose-rate, doseper-pulse or number of pulses) as it modifies the cell's exposure to free radicals, so fast and accurate monitoring of the time structure of the beam is vital for FLASH treatments [1]. However, high dose rate plans or very short proton bunches may pose problems to current beam monitor systems. Therefore, there is an increasing demand for real-time proton beam monitoring with high temporal resolution, extended dynamic range and radiation hardness. In this context, plastic scintillators coupled to optical fiber sensors have great potential to become a practical solution towards clinical implementation. In this work, we evaluate the capabilities of a very compact fast plastic scintillator with an optical fiber readout by a SiPM and electronics sensor which has been used to provide information on the time structure at the nanosecond level of a clinical proton beam [3].

Materials and methods: A $3 \times 3 \times 3$ mm³ plastic scintillator (EJ-232Q Eljen Technology) coupled to a 3×3 mm² SiPM (MicroFJ-SMA-30035, Onsemi) has been characterized with a 70 MeV clinical proton beam accelerated in a Proteus One synchrocyclotron at Quironsalud protontherapy center (Madrid). The signal was read out by a high sampling rate oscilloscope (5 GS/s). By exposing the sensor directly to the proton beam, the time beam profile of individual spots was recorded.

Results: Measurements of detector signal have been obtained with a time sampling period of 0.8 ns. Proton bunch period (16 ns), spot (10 μ s) and interspot (1 ms) time structures could be observed in the time profile of the detector signal amplitude.

Conclusions: The proposed system was able to measure the fine time structure of a clinical proton accelerator online and with sub-ns time resolution. The system will be tested next in an X-ray based preclinical irradiator with FLASH capabilities [4]. Its potential to measure absolute dose is also being studied.

- [1] Espinosa-Rodriguez A, et al. Int J Mol Sci. 2022;23(21):13484
- [2] Gómez F, et al Med Phys. 2022;49(7):4705-4714

[3] Díez, M. G., et al Med Phys 2023, 1-7

[4] Espinosa-Rodriguez, et al Radiat. Phys. Chem. 2023, 206: 110760.

Authors: GARCÍA DÍEZ, Miguel (Universidad Complutense de Madrid); ESPINOSA-RODRÍGUEZ, Andrea (Universidad Complutense de Madrid); Dr SÁNCHEZ-TEMBLEQUE, Víctor (Universidad Complutense de Madrid); Dr SÁNCHEZ-PARCERISA, Daniel (Universidad Complutense de Madrid); VALLADOLID, Víctor (Universidad Complutense de Madrid); VERA, Juan Antonio (Quironsalud); MAZAL, Alejandro (Quironsalud); Prof. FRAILE, Luis Mario (Universidad Complutense de Madrid); Prof. UDÍAS, José Manuel (Universidad Complutense de Madrid)

Presenter: Dr IBÁÑEZ, Paula (Universidad Complutense de Madrid)

Session Classification: M2: Treatment Monitoring