

Fast Timing Detectors for Prompt Gamma Time Imaging

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We are developing a Prompt Gamma (PG) detector (TIARA, for Tof Imaging ARrAy) dedicated to the real-time monitoring of Particle Therapy treatments through the exclusive measurement of particle Time-Of-Flight. The current prototype consists of 8 gamma detection modules placed downstream the patient and read in time coincidence with a beam hodoscope placed upstream: the time elapsed between an ion trigger in the hodoscope and a gamma trigger depends on the PG vertex position and provides an indirect measurement of the ion range in the patient. The gamma modules developed are based on pure Cherenkov radiators (PbF₂) readout by SiPMs and therefore provide excellent time resolution and virtually perfect neutron rejection for SNR optimisation. The beam monitor is based on a fast plastic scintillator readout by SiPMs and provides sub-millimetric information on the beam position by charge sharing with only four electronic channels. We will show that the fast response of both detectors is crucial to improve the system accuracy on the ion range. The compactness of the system is conceived to cover the patient in 4 π while allowing beam irradiations from different sides.

We will present the design and characterization of the gamma and proton detectors developed, as well as the tests performed on phantoms with the full prototype at clinical accelerators.

Field

Detectors and electronics

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