Contribution ID: **54** Type: **not specified**

Development of a fast Cherenkov detector dedicated to Prompt Gamma Time Imaging

Friday, June 3, 2022 12:00 PM (15 minutes)

We are conceiving a new imaging modality called Prompt Gamma Time Imaging (PGTI) to achieve the real time measurement of the proton range during particle therapy treatments. The goal of PGTI is to reconstruct an image of the vertex distribution of Prompt Gamma rays (PG) emitted from the patient, through the exclusive measurement of particle Time-Of-Flight (TOF). The start trigger is given by a diamond-based beam monitor measuring the proton arrival time, while the stop trigger is provided by a gamma detector. The spatial resolution on the PG vertices strictly depends on the system Coincidence Time Resolution (CTR) between the start and the stop triggers. From MC simulation [Jacquet et al. PMB 2021], we expect a spatial resolution of 1 mm (at 2σ) under the hypothesis of a CTR of 100 ps rms (235 ps FWHM).

In order to achieve these performances within the first (few) second(s) of the treatment, we are developing a dedicated gamma ray detector with a high detection efficiency (~1%) and an excellent time resolution. The TOF Imaging ArRAy (TIARA) will be composed of ~ 30 1×1×1 cm3 monolithic PbF_2 crystals read out by SiPMs isotropically arranged around the patient.

Two identical block detectors read-out by a dedicated preamplifier and irradiated in coincidence by gamma rays of ~1.25 MeV from a ^{60}Co source achieved a CTR of 278 ps FWHM. The module was also tested with PGs produced at a proton therapy facility using non-dedicated electronics: we obtained a CTR of 317 ps FWHM corresponding to a measured proton range precision of 4 mm (at 2σ) with only 600 events. More recently, the use of a new dedicated preamplifier has allowed us to reach a CTR of 235 ps FWHM under the same experimental conditions.

We will present the PGTI technique and the experimental characterisation of our block detector.

Primary author: JACQUET, Maxime

Co-authors: Mrs ANDRÉ, Adélie (LPSC); HOARAU, Christophe (CNRS); ANSARI-CHAUVEAU, Saba (CNRS); BOURSIER, Yannick; DUPONT, Mathieu (Centre National de la Recherche Scientifique (FR)); GALLIN-MARTEL, Laurent (LPSC/IN2P3 Grenoble); GALLIN-MARTEL, Marie-Laure (Centre National de la Recherche Scientifique (FR)); Dr HOFVERBERG, Johan-Petter (CAL); Dr HÉRAULT, Joël (CAL); MARCATILI, Sara (CNRS); Dr MANEVAL, Daniel (CAL); MURAZ, Jean-Francois (Centre National de la Recherche Scientifique (FR))

Presenter: JACQUET, Maxime

Session Classification: Clinical motivation for pushing TOFPET CTR resolution ≤100ps

Track Classification: Clinical motivation for pushing TOFPET CTR ≤ 100ps