Abstract

Proton range verification is a critical aspect of proton therapy. By precisely verifying the location of the proton beam, it ensures that the target is met, while minimizing exposure to healthy tissue. One of the techniques used for this purpose is Positron Emission Tomography (PET) imaging, which allow to produce a 3D map of the beam's shape in tissues. The HadronPET is a benchtop PET scanner is being developed specifically for proton beam quality assurance. It can be easily placed in the treatment room for a quick range verification, minimizing the signal loss due to phantom transport. This system has already shown promising results in imaging the interaction of clinical proton beams in phantoms. To further improve image quality, this work aims to include time-of-flight (TOF) capabilities into the PET scanner.

Two systems for data acquisition were studied for data readout from detector blocks were studied. The PETsys TOFPET2 evaluation kit was studied alongside a 25 x 6 array of 1x1x20 mm^3 LYSO crystals coupled 1:1 to SIPMs, a high spatial resolution detector block designed for usage in the iPET system also currently being developed in the lab. This setup was able to achieve a coincidence time resolution of 523 ps for single crystals, and 719 ps for the whole array. A substitution for these SIPMs is currently being studied, more suitable for TOF applications.

The other data acquisition system was the FastIC ASIC, this system was tested with single 2x2x3 mm^3 crystals of LYSO and BGO for which it was able to obtain timing resolutions of 90 ps and 320 ps respectively. Such results are promising but this system is still early in development.

Results of the experimental work done so far will be presented and discussed in detail.