

Position sensitive detectors in proton therapy: online monitoring of the beam position

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In the last decades, the number of Proton Therapy centers has increased substantially in Asia, in the US and lately in Europe. The characteristics of the Bragg-peak allows precise longitudinal confinement of the prescribed dose to the tumor. Laterally, this is achieved by using narrow pencil beams to scan the tumor volume. This however requires precise control of the position in the plane perpendicular to the beam axis (by means of scanning magnets), enabling high treatment quality.

The Center for Proton therapy at PSI operates a strip ionization chamber (position sensitive detector) to monitor the pencil beam position for safety reasons as one of the final beamline elements. Emphasis of the PSD design was on high robustness due to quasi-continuous usage, but low in maintenance –a detector breakdown is a showstopper for daily patient treatments. Using online beam position monitoring as a safety feature, fast signal generation, processing and transfer to the control system are required.

The beam position detector in one of our Gantries operated stable and well for almost ten years, but the now outdated front-end electronics and dwindling stock parts call for maintenance work. This is an opportunity to upgrade our position detector with a new chip (ADAS from analog devices), adding new features to the detector (sampled readout, online gain control). The task brings a challenging replacement procedure along, as this is the first maintenance work since its commissioning ten years ago.

This contribution intends to give an introduction into one of the proton therapy facilities at PSI. The main topic covers the task of online beam monitoring with a planar strip ionization chamber in a clinical environment and the imposed demands with emphasis on detector design and signal processing. Eventually, upgrading and exchanging this position detector in our clinical environment will be detailed.

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