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Detectors: specific challenges for medical applications (1)

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Since the middle of the last century nuclear detectors have been used in medical application as well for diagnostic or treatment, especially in cancer patient course.
Beside the conventional X-rays imaging for diagnostic, scintillators are used for single photon (SPECT: Single-Photon Emission Computed Tomography) or double photon (PET: Positron Emission Tomograpghy) 3D image reconstruction. In the last decade, liquid xenon detectors were developed for a 3-gamma image reconstruction.

The used of charged particle to treat cancer tumor was already proposed end of the 40'. It is a modality that is now widely used to treat specific types of cancer (mostly neck and head, or pediatric cancers). The incident energy is provided to the particle by nuclear accelerators (cyclotron or synchrotron). The beam quality is assessed by dedicated sensors, based on thin solid detectors (e.g.: scintillator) or gaseous detectors (e.g.: drift chamber).

Detectors are also used to assess quality of treatment planning system (TPS), as the reduction of TPS uncertainties is one of the major challenges in particle therapy. For example, the beam undergoes, beside energy losses, nuclear reactions, which have to be taken into account in the treatment planning system (TPS) before irradiation. Dedicated experiments were carried out to measure nuclear cross sections foreseen as input for the TPS. Furthermore, to limit uncertainties due to the computing of energy losses from X-rays imaging during TPS, a new idea raised up to use the same particle for diagnostic and for treatment. Thus, proton or carbon imaging [2] was developed in the last decade using solid detectors (e.g.: silicon or scintillator sensors).

In the lectures, the different detectors will be presented in the context of medical application.

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