Method and apparatus for pet in hadrontherapy

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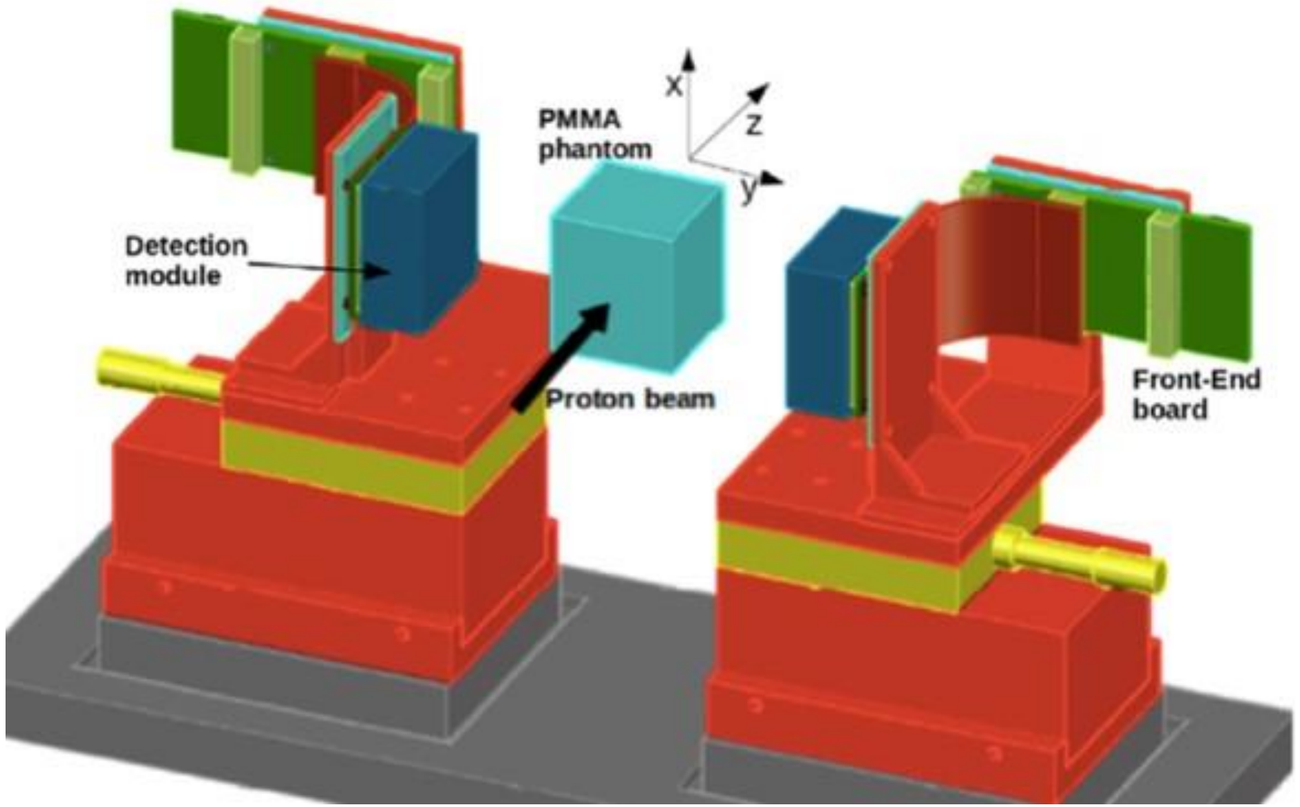
Invention

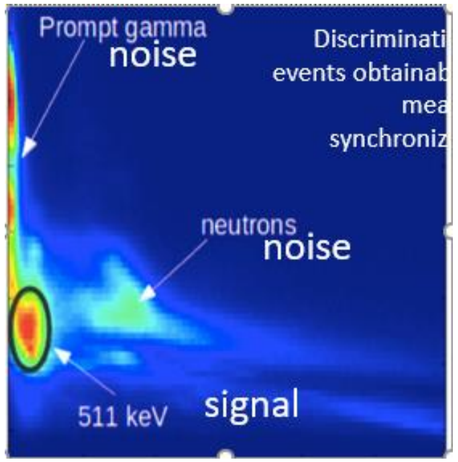
In hadrontherapy, light ion beams are accelerated to target and damage tumor tissue within the patient body while sparing surrounding healthy tissue. The invention relates to an original technique for **improving the quality of images** that are acquired during an **oncology hadrontherapy treatment**. This technique is based on a novel method of indirect synchronization of the acquisition system with the ion beam accelerator.

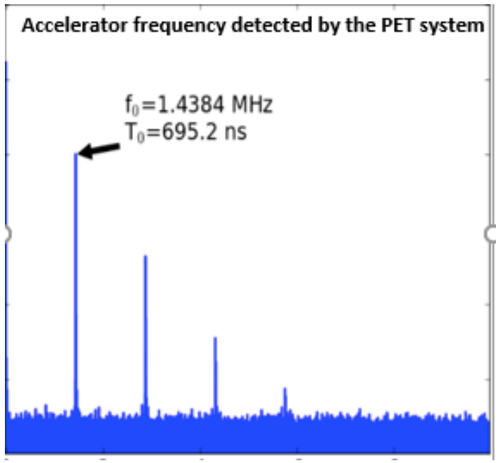
The new PET (Positron Emission Tomography) system, capable of **monitoring the range of an hadrotherapy beam during irradiation**, is composed of two detector heads arranged at about 50 cm from each other, orthogonal to the direction of the beam (image 1). The detectors are based on LYSO scintillating blocks and SiPM photosensors, read by an array of ASICs, in turn managed by an FPGA. The acquired data are **processed in real time** in the same FPGA and transmitted to a PC for further processing. A dedicated algorithm allows real-time filtering of the acquired events, **minimizing data loss** and **increasing the quality of the monitoring images** produced since the first moments of processing.

INFN - ISTITUTO NAZIONALE DI FISICA NUCLEARE is also a patent applicant.

Drawings
& pictures







Industrial applications

The invention has great potential for use in the **biomedical industry**.

In oncology medicine it could be used to study fast hadronic processes at low energies to improve the predictive power of treatment planning systems, i.e., to monitor the outcome of an oncology treatment or to control in real time the range of charged particles in patients.

ADVANTAGES

The invention enables:

- **high acquisition efficiency**;
- **reduction of safety margins** normally adopted in hadrontherapy (up to one cm around the tumour target);
- **reduction of toxicity** on healthy tissues, a peculiar aspect that all diagnostic and therapeutic techniques used today in oncology should refine;
- **less invasive monitoring operations** compared to current systems thanks to **high acquisition efficiency**.

Possible developments

The experimental activities on the new PET system were conducted in collaboration with the National Institute of Nuclear Physics (INFN, Pisa section).

Preliminary tests have been conducted in dedicated laboratories to verify the quality of the acquired data and the functioning of the system. Further implementations will be developed by the expert team in the field. The system has also been tested in specialized hadrontherapy Centers and may be tested in other centers for validation in the clinical setting.

Future partnerships to be undertaken to increase the potential and applications of the technique may be various, **from nuclear electronic application companies to medical-specialty cancer hadrontherapy centers**.

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