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ORIGIN, an EU project targeting real-time 3D dose imaging and source localization in brachytherapy: commissioning and first results of a 16-sensor prototype.

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The ORIGIN project (Optical Fiber Dose Imaging for Adaptive Brachytherapy), supported by the European Commission within the Horizon 2020 framework program, targets the production and qualification of a real-time radiation dose imaging and source localization system for both Low Dose Rate (LDR) and High Dose Rate (HDR) brachytherapy treatments, namely radiotherapy based on the use of radioactive sources implanted in the patient's body.
This goal will be achieved through a 16 fiber sensor system, engineered to house in a clear-fiber tip a small volume of the scintillator to allow point-like measurements of the delivered dose. The selected scintillating materials feature a decay time of about 500 μs and the signal associated with the primary γ ray interaction results in the emission of a sequence of single photons distributed in time. Therefore, the operation requires a detector with single-photon sensitivity a system designed to provide dosimetry by photon counting. The instrument being developed is based on Silicon Photomultipliers (SiPMs), with a solution fully qualified on a single fiber prototype and currently scaled-up relying on the CITIROC1A ASIC by WEEROC, embedded in the FERS-DT5202 scalable platform designed by CAEN S.p.A.
The paper presents the laboratory qualification of the system in terms of response uniformity, stability, and reproducibility. Moreover, the commissioning and assessment in a clinical environment, both for Low and High Dose brachytherapy will be discussed. The measurements performed in the laboratory using an X-ray cabinet show that the uncertainty due to fiber positioning, fiber non-uniformity, and geometry acceptance is less than 1 %. According to the laboratory measurements results and taking into account the fiber non-uniformity, the source position can be obtained from the measurements in the hospital with the precision required by ORIGIN's project specifications.

Collaboration

ORIGIN Project

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