# Dose Profiler: A Tracking Device for Online Range Monitoring in Particle Therapy

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**Abstract :** Accelerated charged particles, mainly protons and carbon ions, are presently used in Particle Therapy (PT) to treat solid tumors. The precision of PT exploiting the charged particle high localized dose deposition in tissues and biological effectiveness in killing cancer cells demands for an online dose monitoring technique, crucial to improve the quality assurance of treatments: possible patient mis-positionings and biological changes with respect to the CT scan could negatively affect the therapy outcome. In PT the beam range confined in the irradiated target can be monitored thanks to the secondary radiation produced by the interaction of the projectiles with the patient tissue. The Dose Profiler (DP) is a novel device designed to track charged secondary particles and reconstruct their longitudinal emission distribution, correlated to the Bragg peak position. The feasibility of this approach has been demonstrated by dedicated experimental measurements. The DP has been developed in the framework of the INSIDE project, MIUR, INFN and Centro Fermi, Museo Storico della Fisica e Centro Studi e Ricerche 'E. Fermi', Roma, Italy and will be tested at the Proton Therapy center of Trento (Italy) within the end of 2017. The DP combines a tracker, made of six layers of two-view scintillating fibers with square cross section (0.5 x 0.5 mm2) with two layers of two-view scintillating bars (section 12.0 x 0.6 mm2). The electronic readout is performed by silicon photomultipliers. The sensitive area of the tracking planes is 20 x 20 cm2. To optimize the detector layout, a Monte Carlo (MC) simulation based on the FLUKA code has been developed. The complete DP geometry and the track reconstruction code have been fully implemented in the MC. In this contribution, the DP hardware will be described. The expected detector performance computed using a dedicated simulation of a 220 MeV/u carbon ion beam impinging on a PMMA target will be presented, and the result will be discussed in the standard clinical application framework. A possible procedure for real-time beam range monitoring is proposed, following the expectations in actual clinical operation.

**Keywords :** online range monitoring, particle therapy, quality assurance, tracking detector
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