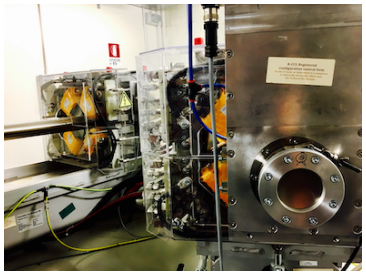

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Dose Profiler and MONDO characterisation with proton beams at the Trento proton beam line facility

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In Particle Therapy (PT) the nuclear interactions between the beam projectiles and the nuclei of the volume under treatment produce a large amount of secondary particles which can escape from the patient body and/or interact with the patient itself. In carbon ion therapy, the detection of the secondary protons resulting from the ion beam fragmentation can be exploited to spot possible range variations, as the fragments production yield is correlated to the density of the tissues crossed by the beam. Besides the charged fragments, an important secondary neutron component is also present, contributing to an undesired and not negligible dose deposition far away from the tumor region, enhancing the risk of secondary malignant neoplasies development after the treatment. An accurate neutron production characterisation (flux, energy and emission profile) is hence needed to significantly improve the evaluation of possible long-term complications.

The Dose Profiler (DP) and MONDO detectors are plastic scintillating fiber-based devices designed to detect and track respectively the secondary protons and neutrons produced in PT treatments. The DP is composed by 8 planes (20 x 20 cm^2) of scintillating fibers read-out by Silicon Photomutipliers. It is currently operating at CNAO (Centro Nazionale di Adroterapia Oncologica, Pavia, Italy) as a monitoring device for carbon ion treatments, in the framework of the INSIDE project. The DP sensitivity to range variation is under evaluation within a clinical trial (ClinicalTrials.gov Identifier:NCT03662373) started in July 2019. The MONDO detector consists in a matrix of scintillating fibres, arranged in x-y oriented layers (total active volume 16x16x20 cm^3) that are read-out by a dedicated SPAD sensor designed and produced in collaboration with FBK (Fondazione Bruno Kessler). The neutrons kinetic energy and direction are reconstructed tracking of the recoil protons produced in double-elastic scattering neutron interactions. The detector is currently under development at CREF, FBK and Sapienza “University of Rome”.

In 2017 the DP underwent to an intensive characterization campaign at the at the experimental cave of the Trento proton-therapy center. Proton beams at different energies have been used to measure the DP detection efficiency, the spatial and energy resolution . In the same campaign, a MONDO prototype consisting of a reduced-size fiber matrix read-out by a preliminary version of the SPAD-based sensor has been tested to evaluate the light response of the fibers using proton beams in the energy range of interest. In this contribution all the activities carried on at the Trento beam line facility will be summarised and the obtained results will be reviewed.

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