Contribution ID: **3** Type: **not specified**

Microdosimetry at the proton therapy facility of Trento

In the framework of the MICROBE_IT project funded by the 5th commission of INFN in the period 2021-2023, several microdosimetric measurements have been performed at the research beam lines of the proton therapy centre of Trento.
The detector employed is a new miniaturized Tissue Equivalent Proportional Counter characterized by a cylindrical sensitive volume of 1.0 mm in diameter and height designed to cope with high intensity beams such as those employed in clinical settings. With an overall external diameter of 1.53 cm and a water-equivalent thickness of approximately 0.79 cm, the detector is compact yet robust. It operates in a sealed mode, without the need for continuous gas flow.
The first measurement campaign has been carried out at the biological research line using the 148 MeV energy-modulated proton beam with the aim of performing a microdosimetric characterization of the radiation quality. The irradiation field had a diameter of about 6 cm, a modulation width of 2.5 cm and a range of about 13.5 cm. As a reference, at four depths along the depth-dose profile the response function of our detectors has been compared to the one of a commercial spherical microdosimeter, the LET-1/2"Spherical TEPC produced by Far West Technology. In another measurement campaign, we characterized the radiation quality of different monoenergetic beams of the physics research beam line and the results have been compared with Monte Carlo simulations with the microdosimetric application of the Monte Carlo code TOPAS. Finally, pairwise measurements were performed in which we used our detector and an ionization chamber to simultaneously measure the microdosimetric spectrum and the dose at the same position. A new calibration technique based on the dose has been investigated.
The results from these measurement campaigns have been analysed and discussed in terms of shape of the microdosimetric spectra, and the average values of the distributions were derived and compared to track and dose-averaged LET obtained from Monte Carlo simulations. The microdosimetric spectra have been also used to perform a microdosimetric assessment of Relative Biological Effectiveness (RBEμ). The dose distribution of lineal energy, d(y), has been weighted with Loncol's biological weighting function that was obtained by the convolution of the results of pairwise radiobiological and microdosimetric measurements.
The microdosimetric RBE has been used to calculate the RBE-weighted dose at different dose levels for the 148 MeV SOBP. From this analysis, it will be possible to observe the increase of the RBE-weighted dose at the end of the proton range especially when compared to the one weighted with a constant RBE equal to 1.1.

Primary authors: Dr BIANCHI, Anna (INFN Laboratori Nazionali di Legnaro (LNL), viale dell'Università 2, 35020, Legnaro, Italy); Dr SELVA, Anna (INFN Laboratori Nazionali di Legnaro (LNL), viale dell'Università 2, 35020, Legnaro, Italy); ROSSIGNOLI, Massimo (INFN Laboratori Nazionali di Legnaro (LNL), viale dell'Università 2, 35020, Legnaro, Italy); PASQUATO, Flavio (INFN Laboratori Nazionali di Legnaro (LNL), viale dell'Università 2, 35020, Legnaro, Italy); MINARELLO, Alessandro (INFN Laboratori Nazionali di Legnaro (LNL), viale dell'Università 2, 35020, Legnaro, Italy); CORDONI, Francesco (Department of Civil, Environmental and Mechanical Engineering, University of Trento, Trento, Italy); MISSIAGGIA, Marta (Department of Radiation Oncology, University of Miami, FL, US - INFN, Trento Institute for Fundamental Physics and Applications (TIFPA), Povo, TN, Italy); SCIFONI, Emanuele (INFN, Trento Institute for Fundamental Physics and Applications (TIFPA), Povo, TN, Italy); LA TESSA, Chiara (University of Miami, FL, US - INFN, Trento Institute for Fundamental Physics and Applications (TIFPA), Povo, TN, Italy)); TOMMASINO, Francesco (INFN, Trento Institute for Fundamental Physics and Applications (TIFPA), Povo, TN, Italy - Department of Physics, University of Trento, Povo, Italy); VERROI, Enrico (INFN, Trento Institute for Fundamental Physics and Applications (TIFPA), Povo, TN, Italy - Department of Physics, University of Trento, Povo, Italy); Dr CONTE, Valeria (INFN Laboratori Nazionali di Legnaro (LNL), viale dell'Università 2, 35020, Legnaro, Italy)

Presenter: Dr BIANCHI, Anna (INFN Laboratori Nazionali di Legnaro (LNL), viale dell'Università 2, 35020, Legnaro, Italy)