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The Marburg Ion beam Therapy Center

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Physical beam properties at MIT

The Marburg Ion Beam Therapy Center (MIT) is one of four European Hadron Therapy Centers that offer raster scanning for both proton and carbon ions. The synchrotron-based accelerator provides protons in the energy range of 48.08 MeV to 221.07 MeV and carbon ions from 86.22 MeV/u to 430.12 MeV/u. For each type of ion, 290 energy steps are commissioned. Each step corresponds to a 1 mm range difference in water. The spot sizes are commissioned at the isocenter, which is located 1.4 m downstream of the vacuum window in air. Due to multiple scattering, small energies result in rather large spot sizes. The spot sizes range from 8-32 mm FWHM for protons and 3.5-13 mm FWHM for carbon ions. The spot sizes for carbon ions can furthermore be adjusted in five focus levels for each energy. The spot position is monitored and controlled during the extraction and the maximum field size is 200 x 200 mm^2 at the isocenter. Extraction dose rates and spill structure are driven by a traverse RF knockout excitation, resulting in spill durations ranging from milliseconds up to eight seconds. The nominal intensities are commissioned in 13 intensity levels reaching from 1.3e6 /s up to 6.5e7 carbon ions per second and 5e7 –2.6e9 protons per second [1,2]. The accelerator can provide these extraction rates for up to eight seconds, resulting in 1e7 up to 5,2e8 carbon ions and 4e8 to 2e10 total number of protons. These extraction rates result in dose rates ranging from approximately 0.1 Gy/s to 10 Gy/s. For non-clinical experiments, the extraction dose rates can be adjusted in both directions. For UHDR purposes, it is possible to achieve dose rates of up to 150 Gy/s for protons and 200 Gy/s for carbon ions [3]. In terms of ultra-low intensities, it is possible to reduce the number of extracted ions down to 100 carbon ions per second and 2000 protons per second. These low intensities enable experiments in a completely different application spectrum, such as micro-dosimetric measurements.

Experimental Setup

The MIT has four treatment rooms, three of which have a horizontal beam outlet and one with a semi-vertical (45°) beam application. Each room is equipped with a robotic positioning system (6-DOF) and an X-ray online positioning system, which allows position verification in irradiation position.

“Minibeam”Application

Due to the fact, that the available spot sizes at the isocenter are in the order of millimeter up to centimeter FWHM a dedicated minibeam application is not possible. However, passive beam shaping devices can be used to achieve minibeam-like properties. One often used method makes use of 3D printed range modulators as presented by the Group of U. Weber [4].

Biological experiments

Biological experiments are possible for samples not exceeding RG2 and S1 (BioStoffV). In cooperation with the Philipps University Marburg there is a full-scale biological laboratory in the direct vicinity of the facility. Access for external researchers is possible.

References

[1] Krantz C. et al. (2018). Slow Extraction Techniques at the Marburg Ion-Beam Therapy Centre; Slow Extraction Techniques at the Marburg Ion-Beam Therapy Centre. IPAC 2018

[2] Scheeler U. et al (2016). Recommissioning of the Marburg Ion-Beam Therapy Centre (MIT) accelerator facility. IPAC 2016 - Proceedings of the 7th IPAC

[3] Derksen L. et al (2023). Dosimetric analysis of a synchrotron-based proton and carbon ion beamline for flash experiments. FRPT 2023 - Proceedings of the FRPT 2023

[4] Charuchinda, W et al (2023). 3D range-modulators for proton therapy. Journal of Physics: Conference Series, 2431(1).

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