Study of the radiation produced by therapeutic He, C and O ion beams impinging on a PMMA target for beam range monitoring purpose in Particle Therapy

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Particle Therapy (PT) is an effective tool for cancer treatment that exploits the high localization of the dose deposition of the charged ions incoming radiation to increase the cancer cell death induction while sparing the surrounding healthy tissues. Besides protons, the most common ion beam type in clinical centers, there has been recently a growing interest in heavier ions beams (He, C, O) due to their increased Radio Biological Effectiveness, reduced multiple scattering and Oxygen Enhancement Ratio, in spite of the presence of nuclear fragmentation. The online monitoring of the deposited dose and of the beam range inside the patient, currently missing in clinical practice, would substantially improve the PT quality control: the high dose deposition conformity requires an improved control of the beam settings to avoid any potential harm resulting from patient mis-positioning and biological and anatomical changes occurred between the CT scan acquisition and the therapy treatment.

The range monitoring in PT [1] is performed using the secondary radiation produced by the interaction of the beam inside the patient body. The study and precise characterization of such radiation (beta+, prompt gamma, charged fragments) is the cornerstone of any R&D activity aiming for online monitoring development. In this contribution we present the measurements of the secondary radiation generated by He, C and O beams of therapeutic energies impinging on a beam stopping PMMA Target. Data have been collected at the Heidelberg Ion-Beam Therapy center (HIT). The experimental setup, as well as the analysis strategies will be presented. The detected particle fluxes, as a function of the emission angle with respect to the beam direction, and the spatial emission distributions will be reviewed and compared to other available measurements [2,3,4,5,6].

The implications for dose monitoring applications will be discussed in the context of the current and planned state-of-the-art detector solutions.

References

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