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Relative Stopping Power measurement and metallic prosthesis artifacts reduction in proton Computed Tomography

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In hadron therapy a highly conformed irradiation field is delivered to the target by moving the beam and modulating its energy.
Treatment plans require precisely measured patients' Relative (to water) Stopping Power (RSP) maps, which are currently extracted from X-rays tomographies. This translation unavoidably introduces uncertainties in the determination of the RSP maps.
The employment of protons themselves for the tomographic imaging of the patients (proton Computed Tomography - pCT) could mitigate this source of errors.
Such an application basically needs a tracker, to trace the trajectory of each proton, and a calorimeter, to estimate its energy loss inside the patient.
The Prima-RDH-IRPT collaboration built a 5x20 cm2 field of view pCT apparatus, suitable for pre-clinical studies, composed of a microstrip silicon tracker and a YaG:Ce calorimeter. We have recently tested this apparatus using appropriate test objects (phantoms) at the Trento Proton Therapy center.
In this contribution, we present tomographies of an electron density calibration phantom and an anthropomorphous head phantom, together with an introduction of the experimental apparatus, the analysis method and the reconstruction algebraic algorithms.
A very good correlation between measured and expected RSP was obtained from the density phantom tomography, with discrepancies less than 1%.
Simultaneously, we produced tomographic sections of the anthropomorphous head, showing some of its anatomical structures.
Furthermore, in comparison with X-rays tomographies, we pointed out the drastic reduction of artifacts due to the presence of metallic prosthesis, which are visible in the anthropomorphous head tomographies.

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