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Experimental tests of the scanner prototype for imaging with protons developed at IEM-CSIC

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Proton therapy requires precise knowledge of the patient's anatomy to guarantee an accurate dose delivery [1]. X-ray computed tomography (CT) images are used nowadays to calculate the relative stopping power (RSP) needed for proton therapy treatment planning [2]. Recent studies indicate that tomographic imaging using protons has the potential to provide a more accurate and direct measurement of RSP with a significantly lower radiation dose than X-rays [3].
The proton CT (pCT) scanner prototype developed at IEM-CSIC is composed of a tracking system of two double-sided silicon strip detectors, and the CEPA4 detector as the residual energy detector. Our pCT scanner prototype was tested at the Cyclotron Centre Bronowice (CCB) facility in Krakow, Poland during the first week of June 2021. The planar imaging capabilities of our pCT scanner prototype were studied using three different planar phantoms of aluminum and PMMA. Radiography images were reconstructed from pixelated detectors, and they were converted into continuous images by uniformly distributing the statistics of each pixel over the pixel area. The radiography images displayed great fidelity with respect to the shapes of the phantoms. The spatial resolution of this proton imaging scanner prototype is better than 2 mm and the MTF-10%=0.3 line pairs per mm [4]. Likewise, volumetric phantoms composed of cylindrical matrices made of PMMA with air, alcohol, and water structures were imaged at different angular positions. The reconstructions of the three-dimensional phantoms are being studied to determine the spatial resolution and the RSP resolution of our prototype. The resulting values of the RSP are compared with the experimental values reported in Ref. [5], and they display a good agreement. The continuation of this work includes a new experiment carried out in June 2022 at the CCB facility. This new experiment aimed to study more complex phantoms with proton beams with energies around 200 MeV.
At this conference, I will present the imaging capabilities of our pCT scanner prototype, alongside the status of the data analysis of the second test performed last June.

References

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Primary authors: NERIO AGUIRRE, AMANDA NATHALI (Instituto de Estructura de la Materia - CSIC); BRIZ MONAGO, José Antonio; GARCIA BORGE, Maria Jose (Consejo Superior de Investigaciones Cientificas (CSIC) (ES))

Presenter: NERIO AGUIRRE, AMANDA NATHALI (Instituto de Estructura de la Materia - CSIC)

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