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First 2D microdosimetry maps in proton therapy with new silicon 3D-microdetectors

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The present work demonstrates the capability of performing microdosimetric characterization 2D-maps in a proton therapy facility by means of a new silicon 3D-microdetector array. The device consists of a matrix of 121 independent silicon-based detectors that have 3D-cylindrical electrodes of 25 µm diameter and 20 µm depth, resulting each one of them in a well-defined micrometric radiation sensitive volume etched inside silicon.

Measurements were performed at different equivalent depths of solid water with proton beams generated in the Orsay Proton Therapy Center (ICPO). The microdosimetry spectra were obtained at different positions of the Bragg curve by using a water-equivalent phantom. They showed the variation of the lineal energy in 2D with depth along the Bragg curve with a distance between them of 200 µm. Results were crosschecked with Monte Carlo simulations.

We present here the first 2D maps of the linear energy transfer ever obtained in situ during irradiation at a clinical facility. The clinical implementation of these measurements would allow for the RBE optimization of proton therapy treatments.

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