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Measurement of the Energy Loss during proton therapy: a new treatment verification technique

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To overcome particle therapy limitations, several treatment verification techniques based on the detection of secondaries have been developed, but a clinical device to be included in the patient routine is yet to be available. Recently, we developed a reconstruction model to estimate the time-depth distribution of the prompt photon emission with a multiple Prompt-Gamma Timing (PGT) detector setup with which to assess the primary particle range. PGT relies on time-of-flight measurements, i.e. the difference between the detection time of the prompt photon and the delivery time of the primary proton. This time difference depends on the prompt photon production points, which are, in turn, related to the slowing down of primary particles inside the target. Therefore, information about the primary particle motion can be obtained. We present here, for the first time, an analytical approach to estimate one of the main critical parameters for treatment optimization: the stopping power of proton beams. Simulation results show an agreement within 2.8% between the reconstructed stopping power and the expected values from NIST, proving the potentiality of the technique.

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