

Reaction Cross Sections of the Short- and Long-lived β^+ Emitters of Interest in PET Range Verification in Particle Therapy

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Abstract

In PET-based beam range verification for particle therapy, new measurements and evaluations of the reaction cross-sections producing β^+ emitters are required in order to compare the measured and simulated activity distribution in the patient.

We have conducted a comprehensive experimental campaign at several facilities using different ion beams in the therapeutic energy range and different PET imaging technologies to detect short-lived (online PET monitoring) and long-lived (offline PET monitoring) radionuclides. The following experimental data will be presented:

- a) The proton-induced production of the long-lived ^{11}C ($t_{1/2}=20$ min), ^{13}N ($t_{1/2}=9.9$ min) and ^{15}O ($t_{1/2}=2$ min) isotopes produced in the main elements of the human body (C, N and O), measured at the Spanish National Center of Accelerators (CNA) up to 20 MeV, and at the West German Proton Therapy Center (WPE) from 30 up to 200 MeV.
- b) The proton-induced cross-sections of the short-lived ^{12}N ($t_{1/2}=11$ ms) in C, ^{38}mK ($t_{1/2}=0.92$ s) in Ca and ^{29}P ($t_{1/2}=4$ s) in P up to 200 MeV and the carbon-induced cross-sections of ^{12}N and ^{10}C ($t_{1/2}=19$ s) in C up to 400 MeV/u, measured at the Heidelberg Ion-Beam Therapy Center (HIT).

The relevance of the new data and future work to improve PET range verification will be discussed.

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