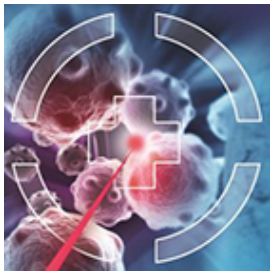

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Production cross section of the short-lived β^+ emitters ^{12}N, ^{29}P and ^{38m}K for online PET verification in proton therapy

In proton therapy, in-vivo PET range verification requires a comparison of the measured and expected β^+ activity distribution produced by the proton beam by means of nuclear reactions on the most abundant elements in the body of the patient: C, O, N and, to a lesser extent, P and Ca. The accuracy of the expected activity distributions depends on the accuracy of the Monte Carlo simulations, dominated by that of the underlying cross sections data [1]. These are not available in the full energy range of interest (up to 230 MeV) and, when they are, there are sizable discrepancies between data sets. Several studies [2,3] confirm the need for more and better measurements, especially for the short-lived nuclides, for which there are no data whatsoever above 55 MeV [4].

In this context, we intend to improve the knowledge of the production yields of the long- and short-lived β^+ emitter isotopes of interest. Focusing on the short-lived ones (half-life shorter than the 19 s of ^{10}C), an experiment has been carried out at KVI-CART (The Netherlands) to measure the most copiously produced isotopes: ^{12}N ($t_{1/2}$=11 ms) on C, ^{29}P ($t_{1/2}$=4.14 s) on P and ^{38m}K ($t_{1/2}$=924 ms) on Ca [3]. The set-up (fig. 1) is designed to measure the production yield at four different energies for each selected primary beam energy. The targets are placed between 3 mm layers of aluminium, which degrade the beam energy and convert the positrons into 511 keV photons which are detected in coincidence by pairs of $LaBr_3$ detectors. The experimental setup, simulations and preliminary results of the production cross sections ^{12}C(p,n)^{12}N, ^{31}P(p,p2n)^{29}P and ^{40}Ca(p,2pn)^{38m}K below 150 MeV are presented herein.

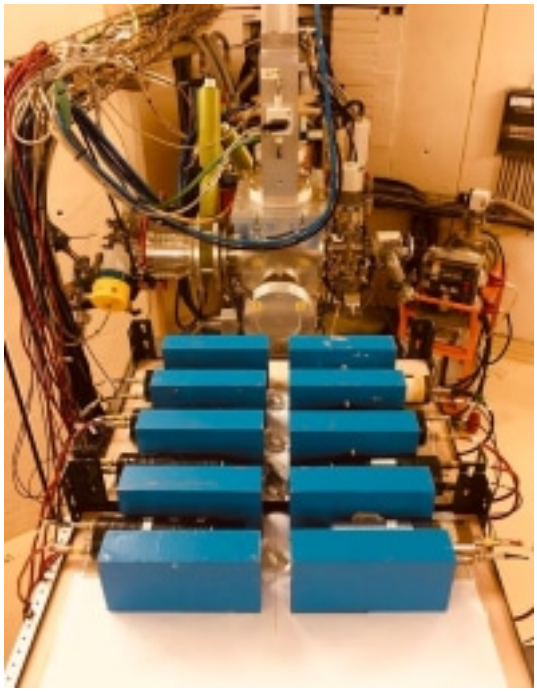

Figure 1: Figure 1. Set up for the measurement of proton induced short-lived β+ emitters at KVI-CART.

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