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PET range verification in proton therapy (research at U. Sevilla and CNA)

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In proton therapy, Positron Emission Tomography (PET) range verification, which is based on the detection of the short-lived (online monitoring) or the long-lived (offline monitoring) β+ emitters produced in the body of the patient, has been proved to be a well-suited technique to monitor the beam range. This technique requires the comparison of the observed activity distribution with Monte Carlo simulations, wich use as input the geometry of the patient and the detailed cross sections up to 200 MeV of the reactions resulting in the relevant β+ emitters. These are, mainly: 10C, 11C, 12N, 13N, 15O 29P and 38mK.

At Universidad de Sevilla and the Centro Nacional de Aceleradores (CNA), a new research line has been established to contribute to the implementation of PET range verification in proton therapy. The initial activities involved a series of experiments at CNA (Seville, Spain), WPE (Essen, Germany) and HIT (Heidelberg, Germany) to measure the complete set of reaction cross sections of interest, providing the first data ever for some reactions. Furthermore, in the framework of a collaboration with IFIC (C. Domingo et al.), actual β+ activity profiles resulting from irradiation of phantoms with proton clinical beams at HIT have been measured using the i-TED detection system as a PET scanner. Last, Monte Carlo simulations are being developed to assess the impact of the new data and establish the positron emitters mor relevant for the different implementations of PET range verification: on-line, in-room and off-line.

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