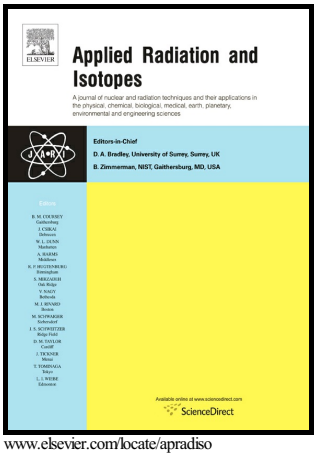

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Characterisation of the secondary neutron field generated by a compact PET cyclotron with MCNP6 and experimental measurements

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Abstract

The production of the most common used PET radioisotope Fluorine-18 with commercial cyclotrons is obtained from the $^{18}O(p,n)^{18}F$ nuclear reaction when ^{18}O-enriched water is bombarded with a proton beam. We present the characterization of the secondary neutron field spectra produced by this reaction in different locations around the cyclotron, through a comparison between MCNP6 Monte Carlo simulation results and experimental data obtained with Neutron Activation Analysis (NAA) of thin target foils of different materials.

Keywords

Cyclotron, gamma spectrometry, Monte Carlo simulations, neutron activation analysis, neutron spectrum, Positron Emission Tomography

1. Introduction

During the last fifteen years, PET (Positron Emission Tomography) has become a widely used functional imaging technique for determining biochemical and physiological processes in vivo by using radiopharmaceuticals labeled with positron-emitting radio-nuclides such as ^{11}C, ^{13}N, ^{15}O and ^{18}F and by measuring the annihilation radiation using a coincidence technique. The radioactive substances administered to the patients are mostly produced by commercial cyclotrons. These PET isotopes have short half-lives directly produced at health centers or at least nearby. During isotopes