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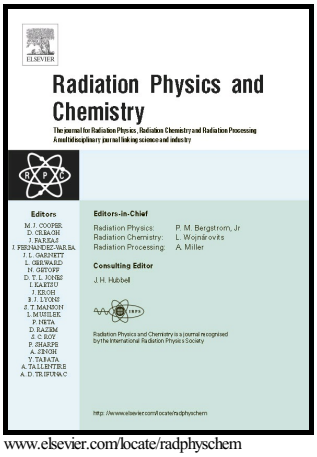

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Efficiency and calibration factors for continuous monitoring systems of airborne radioactivity in ducts: Monte Carlo, analytical and experimental approaches compared

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Abstract

In this work a set of calibration constants to measure the ^{18}F airborne activity in straight ducts with square section are computed by means of a Geant4 simulation and provided for different duct lengths. The calibration constants are compared with analytical calculations and experimental measurements. The simulated calibration constants provide a useful cross-check for the actual calibration of airborne monitoring systems in ducts, which is practically complex and can be affected by large uncertainties.

Keywords:Geant4, airborne radioactivity, ^{18}F, monitoring system, calibration

1. Introduction

In the last decade positron emission tomography (PET) has become a major tool for both diagnosis and staging in oncology. The increased use of PET requires the installation of dedicated facilities where the radiopharmaceuticals are synthesized. The most popular radionuclides used for PET are ^{11}C and ^{18}F, both with very short half lives: 20.3 min and 109.6 min respectively. Due to the short half life these radionuclides are preferably produced on site with a cyclotron and a satellite radiochemistry laboratory. The production is comprised of a multistep procedure including a variety of reactions taking place in different areas of the production site, and in most cases may produce radioactive gases [1,2]. Radioactive aerosol can also be produced by attachment of radioisotopes on suspended particles. A number of techniques to manage radioactive gases have been devised over the years, including filters [3], and procedures relying on the storage of effluents to allow for decaying; the latter has been variously effected, e.g.,