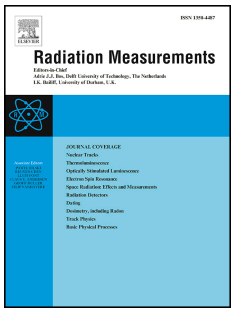
Accepted Manuscript



A semi-empirical approach to estimate the parameters determining the LR-115 detector response in radon measurements

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Title: A semi-empirical approach to estimate the parameters determining the LR-115 detector response in radon measurements

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Abstract:
One way to estimate the calibration factor (CF) of an LR-115 detector within a diffusion chamber by Monte Carlo (MC) simulation requires as input parameters the energy window (ΔE), the dependence of critical angle with energy [$\theta_c = f(E)$] or mean critical angle ($<\theta_c>$), and the air fraction of ^{218}Po atoms (f_1). Using simulated tracks and MC techniques, it was demonstrated that $<\theta_c>$ can replace $\theta_c = f(E)$ relatively accurate. Results of numerical examples validate the correct performance of developed MC code. A semi-empirical approach to estimating the parameters E_{min}, E_{max}, $<\theta_c>$, and f_1 is presented. The method is based on the calculation of the CFs by means of MC simulations (S_{sim}) for the range of expected input parameters values and their comparison with the experimental CF (S_{exp}). Parameters that minimized the deviations between S_{exp} and S_{sim} were obtained through successive iterations. $<\theta_c>$ was the parameter with the most marked and differentiated tendency to converge. The energy window and mean critical angle for our etching conditions, track counting method, and environmental conditions during exposure of LR-115 detectors were [1.5±0.3, 4.0±0.2]MeV and (56.1±6.6)°, respectively. The air fraction f_1 was found to be 0.1 for most of the used diffusion chambers. The comparison of radon concentrations obtained with the reference and test monitors, using in the latters the CFs simulated with the mean values of found parameters, demonstrate that the proposed method is applicable if uncertainties around 20% are accepted.

Taxonomy:
Selected topics
- Environmental Dosimetry
- Radiation Measurement Design
- Radiation Measurement Performance
- Solid State Nuclear Track Detector

Keywords:
critical angle; diffusion chamber; energy window; LR-115 detector; Monte Carlo simulation; radon

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