

Analysis of neutron scattering components inside a room with concrete walls

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Abstract

This paper describes the scattering corrections needed when neutron detectors are calibrated with a neutron point source at the center of a calibration room. The independence of scattering value from the geometric shape of the room was studied, which for more confidence in this case, two sets of rooms with same inner surface area were evaluated. The parameters that relate the air scattering part (A) and room-return part (R) with the additional contribution from scattered neutrons have been calculated for neutrons whose energy goes from 10^{-8} to 20 MeV. These parameters were calculated using Monte Carlo method for 150, 200, 300, 407, 500, 800 and 1000 cm-radius spherical cavity containing air. In the calculations, monoenergetic neutron sources were placed at the center of cavity, and then neutron fluences were determined at several distances of source to detector along the spherical cavity radius. The parameter R has been fitted as a function of surface area (or radius) of spherical room, and the related coefficient has been calculated for 16 monoenergetic neutron sources. It may produce a reasonable estimate (with difference $< 10\%$) for the contribution of walls scattering in any geometry of a calibration room.

Keywords: Scattering factor; Room-return; Air scattering; Monte Carlo

Introduction

In practical neutron measurements, the detector responds to both direct neutrons that came directly from a neutron source and scattered neutrons that came from surrounding materials. The contribution of scattered neutrons to the response of detector can be significant, so that in some situations, the detector's response can be completely dominated by the scattered neutrons [Eisenhauer, 1992; Vega-Carrillo et al., 2007; Sílvia et al., 2012; Nakamura, 2003]. To avoid this situation, the neutron calibration facility ideally should be in a vacuum and free of any neutron scattering surfaces; however, this is impossible in practice. Neutron detector calibrations are typically performed with both the source and detector at a certain height above the ground of

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