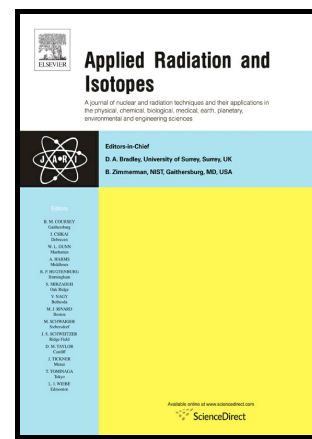


Author's Accepted Manuscript

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PII: S0969-8043(16)31065-X
DOI: <http://dx.doi.org/10.1016/j.apradiso.2017.07.003>
Reference: ARI7955

To appear in: *Applied Radiation and Isotopes*

Received date: 6 December 2016
Revised date: 22 March 2017
Accepted date: 4 July 2017

Cite this article as: Galina Yakubova, Aleksandr Kavetskiy, Stephen A. Prior and H. Allen Torbert, Applying Monte-Carlo simulations to optimize an inelastic neutron scattering system for soil carbon analysis, *Applied Radiation and Isotopes*, <http://dx.doi.org/10.1016/j.apradiso.2017.07.003>

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Applying Monte-Carlo simulations to optimize an inelastic neutron scattering system for soil carbon analysis

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Abstract

Computer Monte-Carlo (MC) simulations (Geant4) of neutron propagation and acquisition of gamma response from soil samples was applied to evaluate INS system performance characteristic [minimal detectable level (MDL), sensitivity] for soil carbon measurement. The INS system model with best performance characteristics was determined based on MC simulation results. Measurements of MDL using an experimental prototype based on this model demonstrated good agreement with simulated data. This prototype will be used as the base engineering design for a new INS system.

Keywords: Inelastic neutron scattering, soil carbon measurement, Monte-Carlo simulation, Geant4, MDL and sensitivity of INS system

Introduction

Inelastic neutron scattering (INS) for elemental analysis is based on detection of gamma lines that appear due to neutron-nuclei interactions. State-of-the-art nuclear physics methodologies and instrumentation, combined with commercially available portable pulse neutron generators, high efficiency gamma detectors, reliable electronics, and measurement and data processing software, have currently made it possible to apply INS methods for routine measurements in various fields of study. For example, the INS method is widely used today for threat material detection (explosives, drugs, and dangerous chemicals; Valcovich, 2016), diamond detection (Aleksachin et al., 2015), in planetary science applications for obtaining information on bulk elemental composition of unearthy objects (Parsons et al., 2011), archaeological site surveying and provenance studies (Miceli et al.,

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