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Experimental and Simulated Spectral Gamma-Ray Response of a NaI(Tl) Scintillation Detector used in Airborne Gamma-Ray Spectrometry

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The objective of this work is to simulate the spectral gamma-ray response of NaI(Tl) scintillation detectors for airborne gamma-ray spectrometry (AGRS) using Monte Carlo radiation transport codes. The study is based on a commercial airborne gamma-ray spectrometry detector system with four individual NaI(Tl) scintillation crystals and a total volume of 16.8 l. Monte Carlo source-detector simulations were performed in an event-by-event mode with the commercial multi-purpose transport codes MCNP6.2 and FLUKA. Validation measurements were conducted using ^{241}Am, ^{133}Ba, ^{60}Co, ^{137}Cs and ^{152}Eu radiation sources with known activities and source-detector geometries. Energy resolution functions were derived from these measurements combined with additional measurements of natural Uranium, Thorium and Potassium sources. The simulation results are in good agreement with the experimental data with a maximum relative error in the full-energy peak counts of 10%. In addition, no significant difference between the two Monte Carlo radiation transport codes was found with respect to a 95% confidence level. The validated detector model presented herein can be adopted for angular detector response analysis and calibration computations relating radionuclide activity concentrations with spectral detector counts.