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True-coincidence-summing corrections of natural and artificial radionuclides for very low background gamma-ray spectrometry systems with active shielding using Monte Carlo simulations.

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The development of very low background γ-ray spectrometers has led to multidetector systems, such as Mazinger. Mazinger is an array of two HPGe detectors and two NaI(Tl) anti-Compton rings in anticoincidence configuration. The detector shielding combines passive shielding, composed of three layers of iron, lead and copper and active shielding, consisting of two anti-muon veto detectors in addition to the previously mentioned anti-Compton rings. High efficiency and background reduction are achieved for low-level activity measurements, approaching the limit of the technique. However, true-coincidence-summing (TCS) effects become a drawback in Mazinger due to its specific anticoincidence configuration. This occurs because any simultaneous triggering of
more than one of the four detectors within the coincidence window results in the event being rejected. Following the implementation of Mazinger in the Monte Carlo simulations with Geant4, TCS correction factors were calculated, reaching values as high as 1200 % in some cases. This work presents the successful results obtained for both natural and artificial multi-γ-emitting radionuclides, including 228Ac, 133Ba, 214Bi, 139Ce, 134Cs, 60Co, 152Eu, and 209Tl.

Abstract

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