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Compton background supression in environmental gamma spectrometry measurements

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Environmental radioactivity laboratories use HPGe detectors enclosed in lead shielding to reduce background radiation and improve the detection of low-intensity peaks. However, once samples are introduced in the measurement setup, the Compton continuum from higher energy peaks can obscure weaker peaks at lower energies.

Traditionally, the detector is surrounded with a large scintillator (NaI or BGO) to suppress Compton events. While effective, this introduces new challenges, including additional costs, electronics setup and increased background from added materials. An alternative approach investigates pulse-shape analysis of HPGe signals. This method examines not only pulse heights but also waveform features to characterize photon energy deposition including the number of scatters and their spatial separation.

Recent advances in multi-channel analyzer (MCA) digitizers enable storage of complete waveforms for each event, allowing the user to analyze the data in detail after measurement. In this study, simulations using Geant 4 were combined with experimental measurements performed on three HPGe detectors of different geometries. Results demonstrate the potential of waveform-based discrimination to reduce the impact of Compton continuum, enabling more accurate characterization of low-level radionuclide activity.

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