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NOVEL COMPTON SUPPRESSION EQUIPMENT IN LOW-LEVEL GAMMA-RAY SPECTROMETRY WITH LIST MODE DATA ACQUISITION

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ABSTRACT

COSSU has been developed at the Radiation and Nuclear Safety Authority of Finland to improve the sensitivity of the measurement in the Gamma Laboratory. COSSU is a multi-detector gamma coincidence device that is used for the analysis of routine environmental monitoring samples. In addition, it can be used in the studies of more complex cases, for example, samples that have low activity concentrations of several anthropogenic radionuclides. COSSU has a large coaxial germanium detector with a two-piece scintillator detector surrounding it. The device is enclosed by a heavy-duty lead shield to reduce background.

COSSU is a Compton suppression system utilizing gamma-gamma anticoincidence, but it operates as a full coincidence system. Specific software has been developed for the sorting, visualization and analysis of list mode data produced by the multi-detector list-mode devices in the Gamma Laboratory. By utilizing the software, the coincidence data can be accessed and the true-coincidence losses of photo-peaks of multiple gamma-ray-emitting nuclides restored in the analysis. This simplifies data analysis and further increases the sensitivity of the device in low count-rate gamma spectrometry.

A detailed Geant4 simulation model of the device was developed. Simulations were used to optimize the device as well as to support calibrations and complex analysis tasks.

The setup has been integrated to current laboratory information management system used in the Gamma Laboratory. Compton suppression reduces the continuous background seen by the high-purity germanium detector by a factor of 3 –10, in addition to comparable reduction in the Compton continuum of any peaks in the spectrum. A comparison with the results of conventional gamma-ray spectrometry is presented.

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