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Development of an underground multidimensional gamma-spectrometer

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Content

Multidimensional gamma-spectrometry is a powerful technique for making low-level nuclear measurements in support of research studies as varied as the movement of environmental radioactivity to the nature of meteorites. A high-sensitivity system is being developed that comprises of two Broad Energy Germanium (BEGe) detectors surrounded by a segmented sodium iodide (NaI) shield situated in the underground low-background laboratory at Pacific Northwest National Laboratory (PNNL). The high-performance BEGe detectors combine the spectral advantages of low energy and coaxial detectors, with an energy range from 3 keV to 3 MeV and optimized energy resolution and efficiency. Novel coincidence measurements can be performed using the dual BEGe and NaI configuration, including the measurement of radionuclides that emit two or more gamma-rays in cascade (e.g. 60Co) or are positron emitters (e.g. 22Na, 26Al). Although detection efficiency is reduced using this configuration, selection of coincident or anti-coincident gamma-energies produces significant background reduction by a factor of up to 200. The NaI shield also enables the Compton suppression of scattered gamma-rays, and accurate measurement of fission products such as 111Ag, 91Y and 115Cd in the presence of multiple interferences. Powerful digital multichannel analyzer (MCA) electronics enable the simultaneous operation in both non-coincidence, coincident and Compton suppression modes, together with the acquisition of conventional histogram and high-fidelity time-sequence data. This maximizes the data obtainable from non-destructive measurement of environmental samples.

About the Presenter

Dr Jonathan Burnett is a senior scientist at PNNL with over 13 years' experience in environmental radioactivity from natural, civil and military sources. Throughout his career he has been extensively involved in supporting nuclear forensics and the Comprehensive Nuclear-Test-Ban Treaty. His research interests include the application of advanced gamma-spectrometry techniques for low-level radionuclide detection. This has included the development of next-generation Compton suppression, cosmic veto and coincidence systems.

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