MIRION TECHNOLOGIES

Low Background Detector Systems

INTRODUCTION

The term "low background" is used fairly indiscriminately in describing gamma analysis systems. The one common denominator for such systems is some form of shielding, but beyond this, anything goes. To bring some order to our own product line and to help customers distinguish the classes of systems, CANBERRA has chosen to categorize low-background gamma analysis systems as follows:

LOW-BACKGROUND

Ge detectors in a variety of cryostat types with lead shielding of 2-4 inch (5-10 cm) thickness. The only cryostats specifically excluded from this class are modular (convertible) types in which the molecular sieve adsorber is necessarily located near the detector element.

ULTRA LOW-BACKGROUND

Ge detectors in cryostats that are A: designed for shielding effectiveness and B: constructed from materials that are notably low in background. The complementary lead shields are also made from select, low-background materials and are at least 4-6 inches (10-15 cm) thick. CANBERRA uses the term Ultra Low-Background to describe standardized detectors and shields which are described in the following pages. These standard products offer performance normally associated with much more expensive custom systems.

SPECIALTY ULTRA LOW-BACKGROUND

Systems in this class are designed for the specific application at hand. This type of system usually involves user specified design and/or performance criteria and close collaboration between the user and CANBERRA throughout the project – from inception to installation.

It is this class of system where active shielding (cosmic guards or Compton suppression) is often used. CANBERRA has a wealth of experience in building such systems and we welcome your inquiries should standard Low Background or Ultra Low-Background systems not satisfy your needs.

Ask for our Application Note entitled Ultra Low-Background Detector Systems for more information.

TYPICAL RESULTS

The following 50 000 second background spectra were taken with detectors having 100% relative efficiency. Spectrum A was taken without shielding. Spectrum B was taken with the detector in a standard cryostat (7500SL) operating in a standard 4 in. thick Lead Shield (747). Spectrum C was taken with the detector in an Ultra Low-Background Cryostat (7915-30 ULB) operating in a 15 cm (6 in.) thick ULB (Model 777) Lead Shield.

Comparative Background Counts are given below:

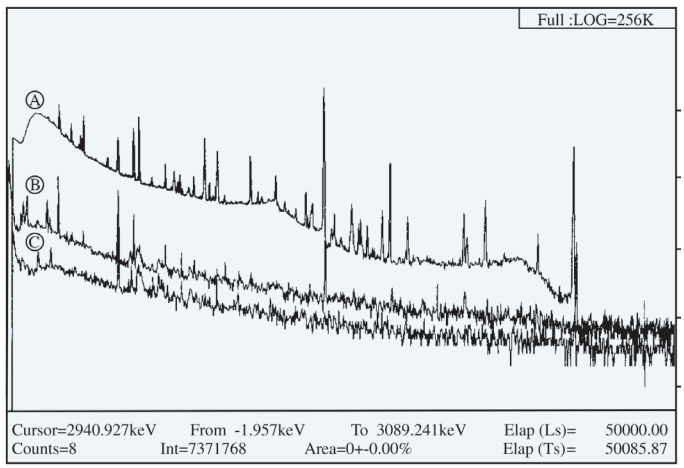
	Without Shield	Standard Cryostat and Shield	ULB Cryostat and Shield
Total Counts/Sec (50-3000 keV)	142.3	3.35	1.84
Peaks Found	78	31	13

Of the thirteen peaks found in the spectrum from the ULB system only one, the 2.614 MeV peak from ^{208}Tl is a normal background line. All the rest are attributed to cosmic ray interaction in the shield and detector.

A listing of these peaks and their means of production is given below:

Energy (keV)	Isotope/Origin	Remarks
53.4	^{73m}Ge	^{72}Ge (n,γ)
66.7	^{73m}Ge	^{72}Ge (n,γ) (sum 13.3 & 53.4 keV)
139.7	^{75m}Ge	^{74}Ge (n,γ)
198.4	^{71m}Ge	^{70}Ge (n,γ) (sum 174.9 & 23.4 keV
511	Positron ann.	Doppler broadened
569.7	^{207}Pb (n,n')	Originating from stable Pb in shield
595.8	^{74}Ge (n,n')	Broad assymetric, due to recoil summation
669.6	^{63}Cu (n,n')	
691.0	^{72}Ge (n,n')	Broad assymetric, due to recoil summation
803.1	^{206}Pb (n,n')	Originating from stable Pb in shield
834.0	^{72}Ge (n,n')	Broad assymetric, due to recoil summation
962.1	^{63}Cu (n,n')	
2614.5	^{208}Tl	Intensity about 0.1% of that of unshielded detector-believed to be shield penetration

Note: The fast and thermalised neutrons are of cosmic origin.



ISO 9001 SYSTEM CERTIFIED

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