MIRION TECHNOLOGIES

Radiation Safety. **Amplified.**

CosmicGuard™

Cosmic Veto Background Reduction System

Nuclear | Healthcare | Homeland Security & Defense | Labs and Education | Industrial and Manufacturing

FEATURES & BENEFITS

- Performs Cosmic background reduction that can't be done with lead shielding alone
- Typical background reduction by 15–40% resulting in lower MDA's and count times
- Turnkey solution that can be added to new or existing HPGe detector/shield configurations
- Compatible with most standard HPGe Lead Shields – split or solid top
- Electronics for Veto Guard Detector built into detector module – no NIM modules or other additional signal processing electronics required
- Single cable connection to the acquisition PC or network hub
- Simple software interface for set-up
- Requires Lynx® Digital Signal Analyzer and Genie™ 2000 or Apex-Gamma™ software of current firmware/software versions

DESCRIPTION

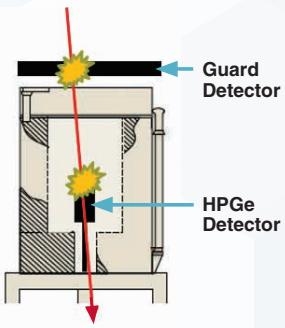
CANBERRA's CosmicGuard is a simple add-on to any new or existing High Purity Germanium (HPGe) counting system that includes a Lynx Digital Signal Analyzer and Genie 2000 or Apex-Gamma spectroscopy software. The fully self-contained guard detector/electronics module either mounts directly onto a lead shield with a solid 50.8 or 55.9 cm (20 or 22 in.) diameter circular lid or via a lift mechanism that clamps to the shield table for top-opening or non-circular shields. The system connects directly to the HPGe detector's Lynx DSA and a controlling Genie or Apex® computer – no NIM or other electronics is needed.

Why is cosmic background reduction important? Background in gamma spectroscopy systems comes from three main sources: Terrestrial Radiation, Internal Radiation and Cosmic Radiation.

Terrestrial Radiation is driven by K-40, Uranium, and Thorium decay products and is greatly reduced by passive lead shielding.

Internal Radiation can come from the HPGe detector components or from the sample itself due to incomplete energy deposition in the detector (scattering) and from some of the detector/shield components themselves. In many counting systems, the scattering component will be present, although Compton suppression solutions can be applied in some instances to reduce this form of background. CANBERRA detectors are already built using selected materials to minimize the detector's contribution to the radiation background. To further reduce this background component CANBERRA offers cryostat options like Remote Detector Chamber (RDC) or Ultra-Low Background (ULB) materials.

Cosmic Radiation consists of high energy charged particles (such as muons) originating from extraterrestrial sources. This form of background radiation cannot be significantly reduced by passive lead shielding. It is omnidirectional, but primarily vertically oriented. Therefore, a guard detector placed over an HPGe detector's shield and equipped with anti-coincidence logic can eliminate much of the cosmic contribution to background. In this case, radiation detected in both the guard detector and HPGe detector at the same time can cause those counts from the HPGe detector to be discarded, thus reducing the cosmic background contribution.



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Background reduction achieved by the CosmicGuard system ranges from 15 to 40 percent. In fact, a higher background reduction ratio is seen on HPGe detector systems that already have shielding, especially those that include ULB cryostat configurations and shields (like CANBERRA's 777). With other sources of background minimized, the cosmic component of the remaining background can only be reduced with a guard detector-type set-up.

CANBERRA's Cosmic Veto Solution

Cosmic Veto techniques have been around for decades. They were originally designed for counting applications that required extremely low backgrounds, such as for research and/or environmental sample analysis. These systems could be complicated and expensive to implement. They typically required a number of signal processing and logic modules strung together to perform properly timed anti-coincidence gating of the HPGe detector's signal upon detection of a cosmic pulse in the guard detector.

CANBERRA's CosmicGuard is easy to purchase, install and use, while also being versatile enough to add to most Genie 2000 or Apex-Gamma spectroscopy systems. CANBERRA developed two versions of the CosmicGuard: a lid mount and a frame mount model. Depending on the type of lead shield, the guard detector can be mounted directly to a solid shield lid, or it can be lifted out of the way for a split-top shield during sample loading/unloading.

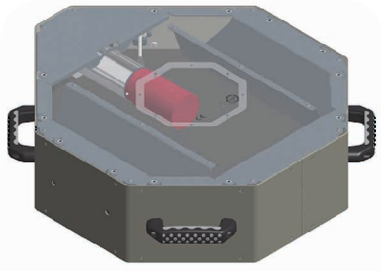
The Model CV SYSTEM-LM fits directly on CANBERRA 737, 747, 747E and 777 shields or most any shield with a solid, circular lid having a diameter of 50.8 or 55.9 cm (20 or 22 in.).

The Model CV SYSTEM-FM is designed for a CANBERRA 767 Split-Top shield or other shields not compatible with the direct lid mount option. The CV SYSTEM-FM has a frame that mounts to the shield table and allows the guard detector to be raised out of the way for sample handling. This configuration can also accommodate square shields as long as the frame can be mounted to the legs of the shield table. The frame is designed to fit 61 cm (24 in.) wide shield tables with 5 cm (2 in.) square tube legs.

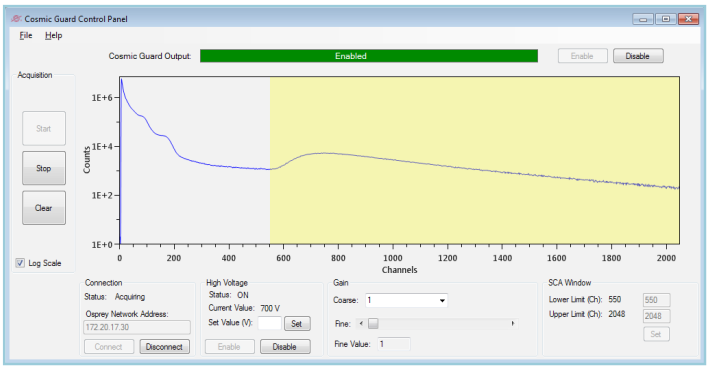
Each of the mentioned models includes the guard detector with built in electronics, appropriate mounting hardware (lid or frame), cabling and a software application compatible with Genie 2000 and Apex-Gamma for setting up and managing operation of the system.

The cabling is minimal: two BNC cables to connect to the HPGe detector's Lynx DSA and an Ethernet and USB cable, one of which is used to interface to a Genie or Apex computer. This cable also powers the guard detector. Power-over-Ethernet (PoE) is required if the Ethernet interface is used, and a PoE single port injector is provided for this purpose.

The heart of the guard detector, which is an optimally designed plastic scintillator detector with photomultiplier tube, is CANBERRA's Osprey® Digital MCA Tube Base. The Osprey powers the detector and provides a gate signal to the Lynx whenever it sees a pulse. This simple interface is what eliminates the cost and complexity compared to most traditional Cosmic Veto systems. The supplied CV-CONTROL APP software allows the user to control, set up and monitor the overall system. However, once operational, the only user control that is routinely needed is to turn on or off the cosmic suppression for a sample as desired. System health is automatically monitored. Additionally, both the suppressed and unsuppressed spectra are available for review.



Guard detector assembly showing the plastic scintillator, PMT and Osprey MCA.



Screenshot of the CosmicGuard control application.

Typical Background Reduction Results

Testing was performed using the CANBERRA CosmicGuard system with a variety of shield and cryostat configurations. As was stated earlier, the system's greatest impact is on detector/shield combinations that make use of remote detector chambers which position the HPGe preamplifier outside the shield and also special low background shielding materials. However, benefits were seen even for relatively standard configurations used more routinely in counting laboratories.

Shield/Cryostat	Suppression Factor*
7500SL Slimline Cryostat ULB Ultra-Low Background Hardware RDC-6 Remote Detector Chamber 6-inch 777 (6-inch) shield 777-3 Split Backshield	40%
7500SL Slimline Cryostat RDC-6 Remote Detector Chamber 6-inch 777 (6-inch) Shield 777-3 Split Backshield	35%
7500SL Slimline Cryostat 747/767 (4-inch) shield CFE-4 Cold Finger Extension & 7X7-2 Backshield	25%
7500SL Slimline Cryostat 747/767 (4-inch) shield No 7X7-2 Backshield	15%

(*) Ratio of suppressed (CosmicGuard activated) counts over unsuppressed counts measured between 100 keV and 2500 keV for an environmental background in laboratory conditions at near sea level (Meriden, CT, USA).

SPECIFICATIONS

PERFORMANCE

- Octagon shaped Plastic Scintillator 49.5 x 49.5 x 5 cm (19.5 x 19.5 x 2 in.).
- See previous paragraph for typical background reduction results.

PHYSICAL

DETECTOR ASSEMBLY

- Octagon footprint – 63.5 cm (25 in.) diameter.
- Height – 16 cm (6.3 in.).

LID MOUNT

- Compatible with 50.8 and 55.9 cm (20 and 22 in.) diameter shield lids.

FRAME MOUNT

- Fits to 61 cm (24 in.) wide shield tables with 5 cm (2 in.) square tube legs.
- Requires 11.4 cm (4.5 in.) of clearance behind the shield table.

INPUTS/OUTPUTS

POWER AND COMMUNICATIONS –

- USB 2.0.
- Ethernet – RJ45.

GATING OUTPUT TO MCA

- BNC-female.

START/STOP OUTPUT TO MCA (STATE OF HEALTH)

- BNC-female.

MINIMAL SOFTWARE/FIRMWARE REQUIREMENTS

- Genie 2000 – V3.4.
- Apex-Gamma – V1.4.
- Lynx DSA – V1.3 firmware.

ENVIRONMENTAL

Refer to Osprey DTB specification sheet for environmental constraints of the CosmicGuard detector assembly.

ORDERING INFORMATION

- CV SYSTEM-LM
  COSMIC VETO SYSTEM – LID MOUNT

  Complete CosmicGuard system to mount on shield lid. Includes the detector assembly, with plastic scintillator, Osprey DTB, mounting hardware, cable set and software application.
- CV SYSTEM-FM
  COSMIC VETO SYSTEM – FRAME MOUNT

  Complete CosmicGuard system to mount to shield table. Includes the detector assembly, with plastic scintillator, Osprey DTB, frame, mounting hardware, cable set and software application.

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