RUGGED GERMANIUM DETECTOR SYSTEMS & SOLUTIONS

MIRION
TECHNOLOGIES

Germanium Detectors

GERMANIUM DETECTORS REPRESENT THE BEST CHOICE WHEN HIGH RESOLUTION GAMMA SPECTROSCOPY IS REQUIRED FOR ACCURATE NUCLIDE IDENTIFICATION AND QUANTIFICATION.

However, some potential problems can compromise the use of these technologies when the spectroscopy system is intended to be used in harsh environments such as:

- Shock and vibration (transportation by trucks, separation of space launcher stages)
- Industrial use in sites where liquid nitrogen is not available/allowed for detector refilling
- Extreme climatic conditions (underwater operation, very high or low temperatures, etc.) in industrial or space environments
- High level of contamination – extreme radioactive doses.

The combination of Mirion's extensive experience with the evolution of new technologies (encapsulation, ultra high vacuum, waterproof design, shock absorption devices, electrical coolers, specific and pure materials) make us a world leader in scientific and special applications involving HPGe detectors.

Mirion's expertise allows our specialists to deliver outstanding and reliable detection instruments for the most demanding industries and research centers. Researchers have come to depend on these specialized instruments for their most critical experiments and studies.

Features are:

- Hardened design, shock and vibration resistant
- Adapted cooling devices (electrical fanless coolers)
- Multiple references in space missions (Integral, Mars Orbiter, Selene...)
- Encapsulation techniques allowing easy exchange of each individual detector when mounted in arrays or partial heat cycling.
- Dedicated shapes and materials for cryostats (hexagonal cutting, titanium lightweight capsules, telescope mount, etc.)
- Selected components towards impurities to limit any X-ray fluorescence of materials in the HPGe crystal vicinity.
- Large choice of N-type detectors and associated annealing accessories for on-site repair after radiation damage
- Ultra High Vacuum for the best reliability and heat thermal cycle free constraints.
- Waterproof design for outdoor use.
- Easy to decontaminate.
- Integrated complete solution easy to deploy with short time before it could be used

Applications are:

- Space
- Environment
- Deactivation & Decommissioning (D&D)
- Industry
- Emergency response

Examples Of Rugged Detector Solutions

A novel, ultra-compact, gamma spectroscopy detector for high count rates in confined spaces.

MicroGe detector with Supply Station, DSA-LX® MCA and Genie™ Software for Windows PC computer

The MicroGe detector is a compact electrically cooled, fan-less, lightweight High Purity Germanium detector. With a short cooling downtime, this state-of-the-art detector opens the possibility to do spectroscopic measurement in less than 30 minutes keeping the benefits of a laboratory grade detector. It implies an excellent energy resolution for gamma-ray energies from a few tens of keV up to several MeV. 'In addition, the MicroGe ultra-high vacuum technology provides a thermal cycle free detector. The detector can be switched on and off as needed, without going through an entire heat-cycle up to room temperature. This is an effective time-saving feature for optimize use of the MicroGe detector.

The MicroGe detector comes with a dedicated supply station that provides the electrical power needed for the cryocooler and detector temperature survey.

The MicroGe detector is typically operated with the DSA-LX® (or Lynx®) Multi-Channel Analyzer (MCA). The MicroGe detector system is fully compatible with the Genie™ analysis software. In addition, ISOCS™/LABSOCS™ characterization of the MicroGe detector can be proposed. A MCNP drawing of the detector is also provided upon request.

MicroGe™ Ultra-compact HPGe detector

A novel, ultra-compact, gamma spectroscopy detector for high gamma fluxes in confined spaces.

Features are:

- Compact and lightweight ideal for mobile applications
- Fanless electrically cooled germanium detector
- Straightforward start up and use with a short cooling down time
- Thermal cycle free
- Laboratory grade energy resolution

Design:

- Small HPGe crystal, suitable for high gamma-ray flux environments
- Miniature electric cooling system (lightweight, short cooling time, low power)
- Wide range of operating temperature: -20 °C up to +55 °C
- Perfectly adapted to challenging environment such as narrow space, high temperature or mobile/remote applications
- System design options:
  - Collimator
  - Watertight housing
  - Custom mounting interface depending on the application

Pelicase Protector Case to ease any storage/transportation

Examples Of Rugged Detector Solutions

continued

Sealed Probe Breakthrough for Harsh Environments Requiring HPGe Performance

Analyze soil and water in-situ with high energy resolution.

Benefits are:

- Increase your survey productivity:
  - shorter measurements
  - thermal cycle free
- High mobility and small footprint
- Easy to clean and to decontaminate
- LN_2 free
- Submersible in water
- Highest energy resolution

Applications:

- Harsh conditions or contaminated environments
- Decontamination and Decommissioning
- Emergency response for safety and security
- Mining and well logging
- Underwater and oceanography

Examples of sealed probe applications:

Spent Fuel Pool Spectroscopy Applications

- Customized industrial solution
- Special shape to fit available footprint
- IP68 water tightness and decontaminable
- Specific interface
- Complete embedded Mirion solution
- ISOCS characterization

Underwater Applications

Electrical cooled HPGe detectors of various sizes in special pressure housing certified for underwater applications (fuel storage pools or river/lake/sea). Different depths can be addressed even with a complete system including an MCA and a PC with Genie software.

Whole Body Counter (WBC) for Mobile Lab

- Electrical cooled detectors for a mobile WBC system with new CP5-Linear™ (CL5) Cryo Electric cooler.
- The new CP5-Linear (CL5) cooler requires the same room as a Big MAC cryostat and is therefore adapted to the upgrade of an existing system with room constraints. CL5 cooler will accommodate high ambient temperature through a specific water cooling chiller.

ANTARES: Deep Underwater Gamma-ray measurement – Project NuMerEnv

- HPGe detector embedded in a Titanium pressure housing with Lynx MCA for gamma spectroscopy at a 2500 m depth in the Mediterranean Sea complementary to the Cosmic Neutrino Experiment (ANTARES).
- Use of Mirion electrical cooler with a proven high reliability due to limited access twice a year.

Hardware overview of the Mirion airborne system consisting of two cabinets (detector cabinet and acquisition system cabinet)

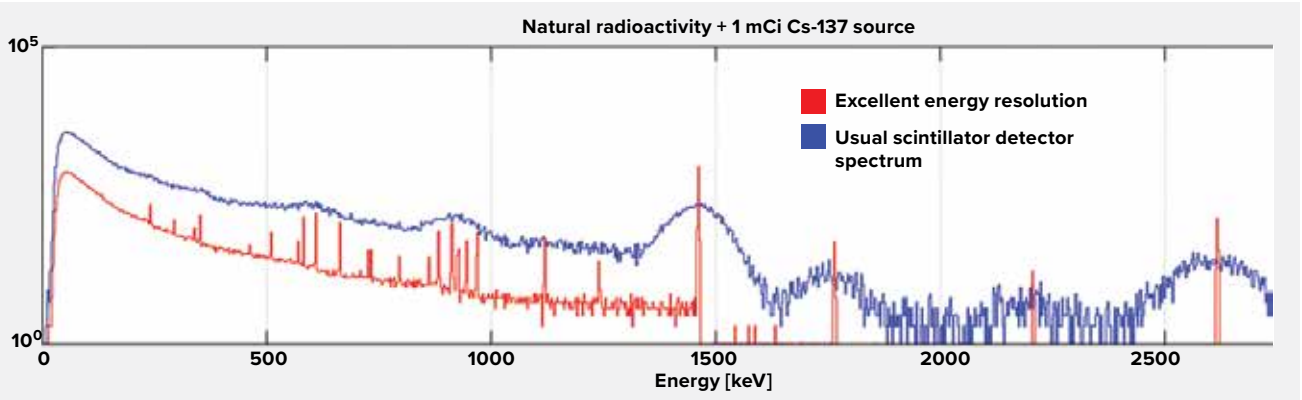
View of detector cap through a hole in aircraft cabin. Each colored circle shows the location of an individual coaxial detector within a common cryostat

Ground Contamination Spectroscopy Systems with HPGe Detectors

A novel, compact, gamma spectroscopy array detector for airborne survey with highest spectroscopy response.

Features are:

- High efficiency assembly with large detectors (modular size)
- Modular detector design for easy maintenance
- Add-back enhanced relative efficiency up to 1300% at 1.33 MeV
- Full embedded system with Electrical cooling and digital MCA
- Typical MDA 50 µCi @100 m height at a 180 km/h speed for ^{137}Cs
- Excellent energy resolution see spectrum in red below – in blue typical scintillator detector spectrum

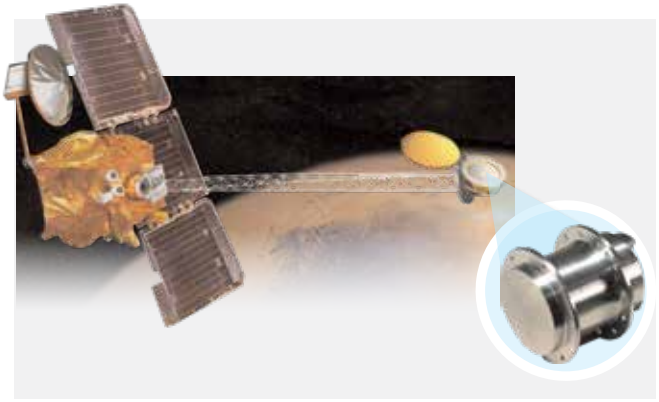


HPGe Detectors for Space

Encapsulated Ge detectors

Encapsulation offers sealed ultra-high vacuum conditions, therefore long life and the possibility to anneal the detector from radiation damage without pumping or opening to the deep space environment.

The technology developed also offers lightweight sensors, a very important criteria for devices in space. The use of titanium offers another important asset: aluminum would conflict with gamma rays of interest.



The Mars Odyssey Mission

(ref.: Intespace - Toulouse, NASA, Univ Arizona)

- The goal of this mission consisted of launching a satellite in 2002 to detect the presence of water (ice) on the planet Mars by using (n,γ) reactions. Mission lifetime: successful two year mission with extended operations until 2017.

Detector Types:

- Coaxial HPGe
- N-type, titanium encapsulated efficiency 50%
- Vibration specifications 50 g

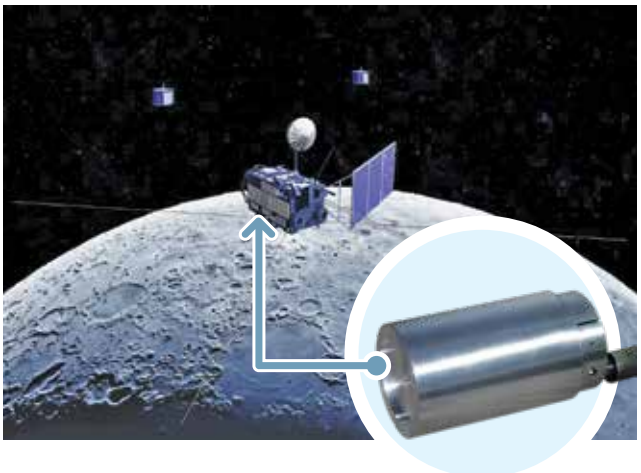
Integral SPI Project

(ref.: Intespace - Toulouse)

- This mission launched in 2002 consists of the equipment for a satellite in orbit around the Earth to study supernova, black holes, and other emitters of gamma bursts.

Detector Types:

- Compact array of 19 encapsulated coaxial HPGe detectors 40% efficiency each. Special mount with coded mask allowing an accurate cartography of gamma emitters.
- Vibration level 50 g on the three axis.



The Selene Mission

(ref.: JAXA - ISAS - NASDA)

- Lunar orbiter mission “KAGUYA”
- Mission duration: one year
- The GRS had an excellent energy resolution 20 times superior to those used in past lunar missions

Detector Types:

- Encapsulated coaxial HPGe detector for the GRS.
- Detector size: 60% efficiency.

Who we are, where to find us

Mirion Technologies is a leading provider of innovative products, systems and services related to the measurement, detection and monitoring of radiation.

The company delivers high quality, state-of-the-art solutions that constantly evolve to meet the changing needs of its customers. Every member of the Mirion team is focused on enhancing the customer experience by delivering superior products, exceptional service and unsurpassed support.

Headquarters

- Atlanta, GA Corporate Headquarters

International Offices

- Please visit the website for a complete listing.

Sales Offices

- Mirion sales and service capability exists in virtually every country in the world.

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