GAMMA SPECTROSCOPY

MicroGe™

A novel ultra-compact HPGe detector for high flux and confined environments

The MicroGe detector is electrically cooled, fanless and lightweight. It comes fully equipped as a high-resolution gamma-ray spectroscopy detector.

MicroGe Detector

FEATURES

- Compact and lightweight
- Fanless electrically cooled germanium detector
- Straightforward start up and use with a short cooling downtime. The MicroGe detector is ready to be used in less than 30 minutes
- Thermal cycle free, the MicroGe ultra-high vacuum cryostat technology allows partial thermal cycles
- Laboratory grade resolution / High resolution spectroscopy with typical energy resolution* of 1.0 keV at 122 keV, 1.6 keV at 661.7 keV and 2.3 keV at 1332.5 keV
- Suitable for high gamma-ray flux environments
- Wide range of operating temperature: -20 °C up to 55 °C**
- Perfectly adapted to challenging environments such as narrow space and high temperature

DESCRIPTION

The MicroGe detector is a compact electrically cooled, fanless, 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.

Complete MicroGe system

*FWHM
**in <30% humidity environment

POWER-UP AND DATA ACQUISITION

The MicroGe detector comes with a dedicated supply station that provides the electrical power needed for the cryocooler. The operational readiness of the MicroGe detector is ensured by a temperature validation LED on the front panel of the supply station. A high-voltage shutdown protection is also integrated inside the supply station.

The MicroGe detector is typically operated with the DSA-LX® (or Lynx®) Multi-Channel Analyzer (MCA) that powers up the electronics and provides the needed digital signal processing for an optimal energy resolution, data throughput, and gain linearity. The MicroGe detector system is fully compatible with the Genie™ analysis software which ensures high reliability and remote-control data acquisition possibility. In addition, ISOCS™/LabSOCS™ characterization of the MicroGe detector can be proposed. A MCNP drawing of the detector is also provided upon request.

MULTI-APPLICATION DETECTOR

The germanium crystal size is a cylinder of 10 mm diameter and 10 mm height. Its volume of 0.78 cm^3 implies a relative efficiency of the MicroGe detector of 0.04% at 1332.5 keV (IEC 60973). The small detector efficiency provides a clear advantage for the measurement in extreme dose environments. As an example, the MicroGe detector equipped with specific electronics will be able to sustain a dose rate of up to 0.1 Gy/h.

MicroGe detector in use

The lightweight, small footprint and wide range of operating temperature make the detector perfectly suitable for measurements in extreme conditions. The MicroGe detector is aimed at reducing the human exposure to unnecessary dose. Among other applications the MicroGe detector is designed to be used in dismantling operations, nuclear ventilation monitoring, field measurement, nuclear waste cooling pool, environmental monitoring, glove box sample measurements, high activity sample measurement, nuclear reactor safeguard and monitoring, spent fuel measurement and non-destructive analysis of high activity samples in the nuclear medicine isotope production industry.

MicroGe integration on a rover

TRANSPORTABLE AND EASY TO SETUP

The complete system consisting of the MicroGe detector, the supply station, the DSA-LX MCA and the cable set are organized inside a protective case. The case dimension of 52.5 x 43.7 x 21.3 cm for a weight of ~9.4 kg makes the complete system robust and easily transportable. The full system requires only one main power supply to be powered up. By following the quick start-up manual, the system will be taken out of the protector case, cabled, cooled down and bias in less than one hour.

Compact system in protector case

SPECIFICATIONS

Cryogenic system

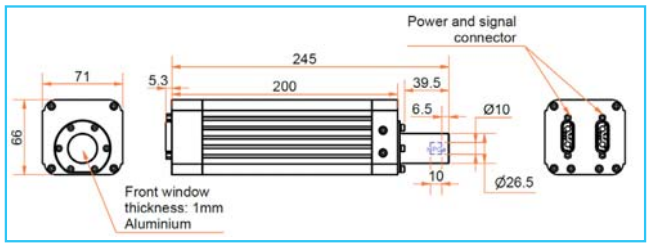
- Typical cool downtime: <30 minutes
- Ultra-High Vacuum
- Operational 24/7

Detection head characteristic:

- High purity germanium crystal
- Dimension: cylinder of 10 mm diameter x 10 mm long
- Typical high volage: <1000 V (negative)
- Typical energy resolution at FWHM:
  - 1.0 keV at 122 keV (0.82%)
  - 1.6 keV at 661 keV (0.24%)
  - 2.3 keV at 1332 keV (0.17%)
- Energy range: from ~10 keV up to 3 MeV
- Relative efficiency of 0.04% at 1332.5 keV (defined by IEC 60973)

Dimension and weight:

- 200 x 71 x 66 mm
- Weight: 1.7 kg



Typical MicroGe external housing dimensions

Housing:

- Material: aluminum

Multi-Channel Analyzer:

- DSA-LX or Lynx MCA
- Provide digital signal processing for Pulse Height Analysis
- Connection to a computer via USB (ethernet and USB for the Lynx MCA)
- Remote control of the data acquisition

Supply station:

- LED status of the cooler
- Universal AC adapter with 100–240 V, 50-60 Hz input
- Power consumption: up to 25 W during cooling. 15 W when stationary situation is established (at 25 °C)
- Generation of the high-voltage shutdown security signal in case the detector is warming up
- Electromagnetic compatibility with other system

Cables and connectors:

- Standard 3.5 m long
- Multi-purpose connector for signal, low voltage, high voltage, temperature sensor and cryo-cooler power

Transport:

- Protector case for easy transportation (typical dimension of 52.5 x 43.7 x 21.3 cm)
- Complete system is 9.4 kg

Standards:

- Conforms with RoHS directive (2002/95/CE)
- Conforms to CE requirements
- EMC conformity

AVAILABLE OPTIONS

The MicroGe detector has a set of options that are available upon request. Please consult us for additional customization.

General Options

- ISOCS/LabSOCS characterization
- MCNP drawings
- Cable length (standard is 3.5 m)
- Cable and connector can be customized
- Customize gain
- High count rate electronics to cope with dose rate of up to 0.1 Gy/h
- Highly embedded digital acquisition system
- Rover installation for remote access
- Battery operated with adaptation of the MicroGe supply station
- An IPXX certification can be proposed

Housing Options

- Watertight housing
- Shockproof and ruggedize housing
- Collimator and electronic shield for high cumulated dose and dose rate higher than 0.1 Gy/h
- Specific mounting points
- Robotic arm manipulation
- OEM integration possibility

Parameters	Value
HPGe crystal	0.04% relative effciency at 1332.5 keV (10 mm diameter x 10 mm long)
Overall dimensions for housing	245 x 71 x 66 mm (without cable connectors)
Probe weight	1.7 kg
Housing	Aluminium
Cooling	Fully automatic electrical cryocooler (no LN_2)
Power Consumption	<10 W (20 W during cooling phase)
Time to reach temperature of operation	<30 minutes
Energy resolutions (typical)	1.0 keV at 122 keV
2 µs Gaussian shaping time	1.6 keV at 661 keV
Count rate: 1 kcps	2.2 keV at 1332 keV
Count rate capability	$>10^5$ counts per second at 662 keV. Customized collimator could be provided for high flux environment.
Preamplifier	Included in the probe housing. Resistive feedback. Gain 200 mV/MeV (adjustable on request)
Alarm card	For automatic HV shutdown
Typical high voltage	<1000 V (negative)
Connections	Two bulkhead connectors to interface signal processing and power supplies. Connectors and cables can be customized on request.
Cable length	10 m maximum (can be adjusted on request)

Portable Detector

On-Field Robotic Measurement with Germanium Detectors

The development of the ultra-compact HPGe MicroGe™ detector opens the way towards new applications for germanium detectors such as robotic on-field gamma-ray spectroscopy measurement.

MicroGe detector integration on robotic machines

With its rugged design and its innovative cooling system, Mirion Technologies' newly developed MicroGe detector allows for on-site gamma-ray spectroscopy measurements with laboratory grade performance. Lightweight and compact, this state-of-the-art detector can easily be embedded on mobile vectors such as robots or UAVs, opening the way to new various applications for germanium detectors as the use of robots for fine radiological reconnaissance in hazardous or confined environments. The use of robotic machines also avoids human exposure, thus improving radiation protection. Mounted on a robotic arm, the MicroGe detector will allow to search and identify hot spots but also to characterize them (involved radioisotopes, dose rates...).

Fields of application:

- Defense and homeland security
- Response to radiological emergencies
- Radioactive waste management
- Nuclear industry (power plant, nuclear fuel cycle)
- Decontamination and decommissioning
- Production of medical radioisotopes

The MicroGe detector embedded on the Spot robot (Boston Dynamics)

MicroGe detector integration on a rover

Link to MicroGe detector presentation video

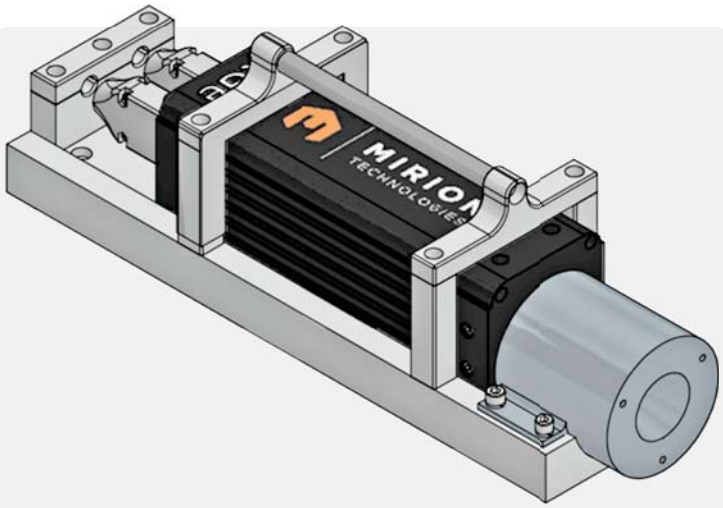
MicroGe Ultra-compact HPGe detector

Lab HPGe spectroscopy performance brought to the field

Features:

- Compact and lightweight complete HPGe spectrometer
  - Weight: 1.7 kg (Probe) – 6.1 kg (Complete system)
  - Dimensions of the probe without connectors: 245x71x66 mm
- Fanless electrically cooled germanium detector
- Thermal cycle free (i.e. the detector can be switched on and off without going through an entire heat-cycle up to room temperature)
- Can be operated on batteries
- Low power consumption: ~ 10 W - max. 25 W (cooling)
- Wide range of operating temperature: -20 °C to 55 °C
- Ready for use in less than 30 min
- Typical lab grade performance
- Suitable for intense gamma-ray flux environments
- A collimator can be added to perform measurements in extreme radiation flux
- Options: Watertight housing, IPXX certification, etc.

MicroGe detector



MicroGe detector with its collimator for extreme flux measurements

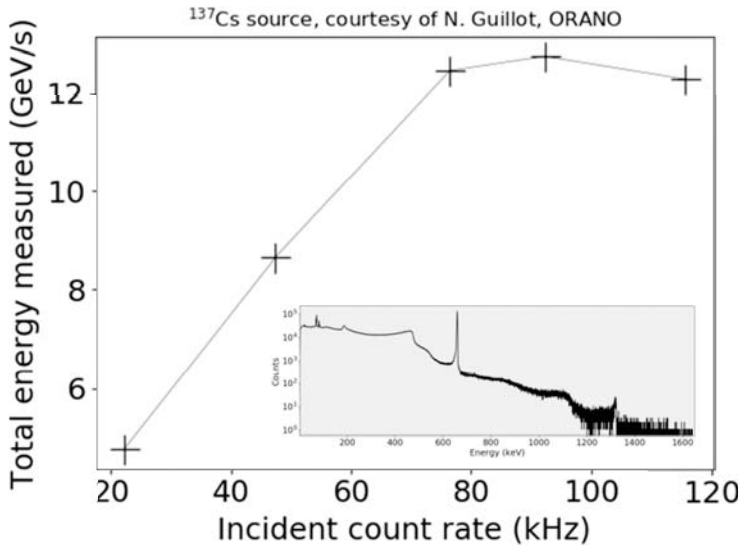
Complete MicroGe system

Detection Features:

- Energy range: 10-2000 keV
- Energy resolutions (typical):

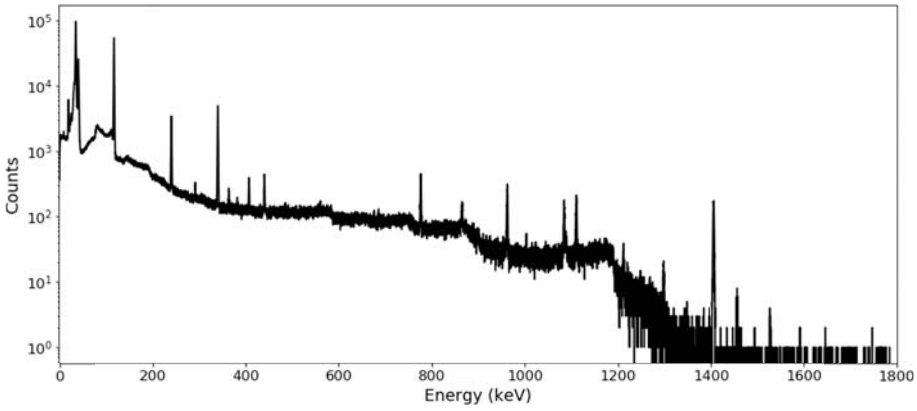
Energy (keV)	MicroGE (% - keV)	CZT (% - keV)
122.1 keV	0.82 % - 1.0 keV	2.87 % - 3.5 keV
661.7 keV	0.24 % - 1.6 keV	1.71 % - 11.3 keV
1332.5 keV	0.17 % - 2.3 keV	~ 1% - 13 keV

- Sensitive volume: 10x10 mm high purity germanium crystal
- Relative efficiency: 0.04% at 1332.5 keV
- Suitable for intense gamma-ray flux environments:
  - Count rate capability:
    - 100 000 counts per second at 662 keV
    - 50 000 counts per second at 1.33 Mev
  - Dose rate: up to 0.1 Gy/h without collimator.

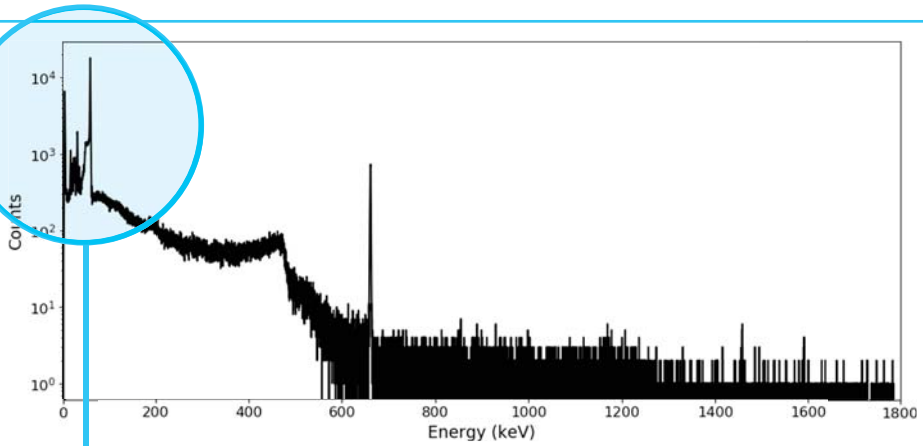


High flux measurement capability of MicroGe detector

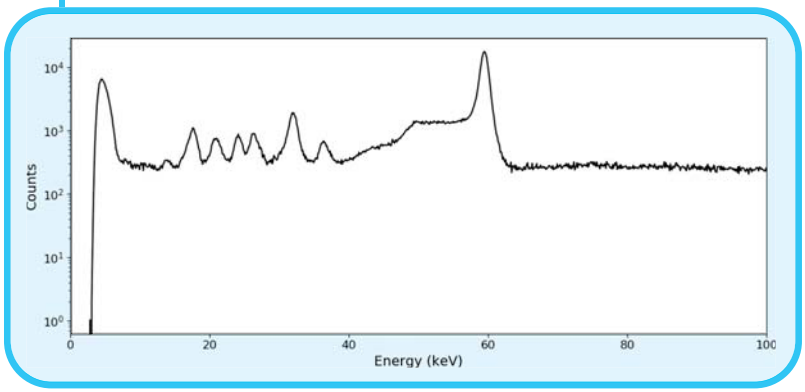
- The MicroGe detector was tested with MGA™ and FRAM™ software (isotopic abundance determination) and good agreement with standard calibration was obtained.
- Examples of spectra:



^{152}Eu source spectrum



^{137}Cs and ^{241}Am sources spectra



Focus on the 0-100 keV area

Coming Soon:

- X-ray dedicated version (available before end of 2021)

Demonstration unit of the MicroGe detector available on demand

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