

Latest Development of the Specialty Ultra low Background Detector Manufacturing

D. Ralet, M. Ginsz, G. Ilie, V. Marian, J. Masseron
Mirion Technologies (Canberra) SAS

Mirion Technologies (Canberra) SAS., 1 Chemin de la Roseraie Parc des Tanneries, Lingolsheim Alsace 67380 France

Abstract

Mirion Technologies has developed detectors to cope with the requirements of low radioactivity measurement: the Specialty Ultra Low Background (S-ULB) detectors. For the construction of a S-ULB detector, each element that enters its composition must be selected carefully to reduce as much as possible the intrinsic radioactivity of the detector itself. The S-ULB detectors achieved a consistent intrinsic radioactivity of the order of a few hundred counts per day and per kg of Ge. Specific needs for low radioactivity measurements are addressed.

For example, the detector orientation of the BEGe unit can be changed and modified to have two detectors facing each other. This configuration increases the solid angle coverage by a factor and provides optimized efficiency for large sample measurement. Increase of the crystal diameter of the BEGe detector up to 105 mm leads to a large surface ideal for large sample measurements. The ratio of active volume over internal radioactivity becomes even better. For measurements of small volume samples, the SAGE™ Well detector with a well diameter of 21 mm provides close to 4PI solid angle coverage. Each detector can have a specific design, low radioactivity material, with similar standard HPGe energy resolution: 600 eV at 122 keV and 1.7 keV at 1332 keV for a 1.2 kg BEGe detector. For low radioactivity techniques, this led to better minimum detection activity or reduction of measurement time. The advantages and the performance of the latest developments of the Mirion S-ULB detectors are presented here.

Detector Performance

- Typical energy resolution
- Efficiency and well size configuration
- Background achieved with various detector in different underground lab around the world

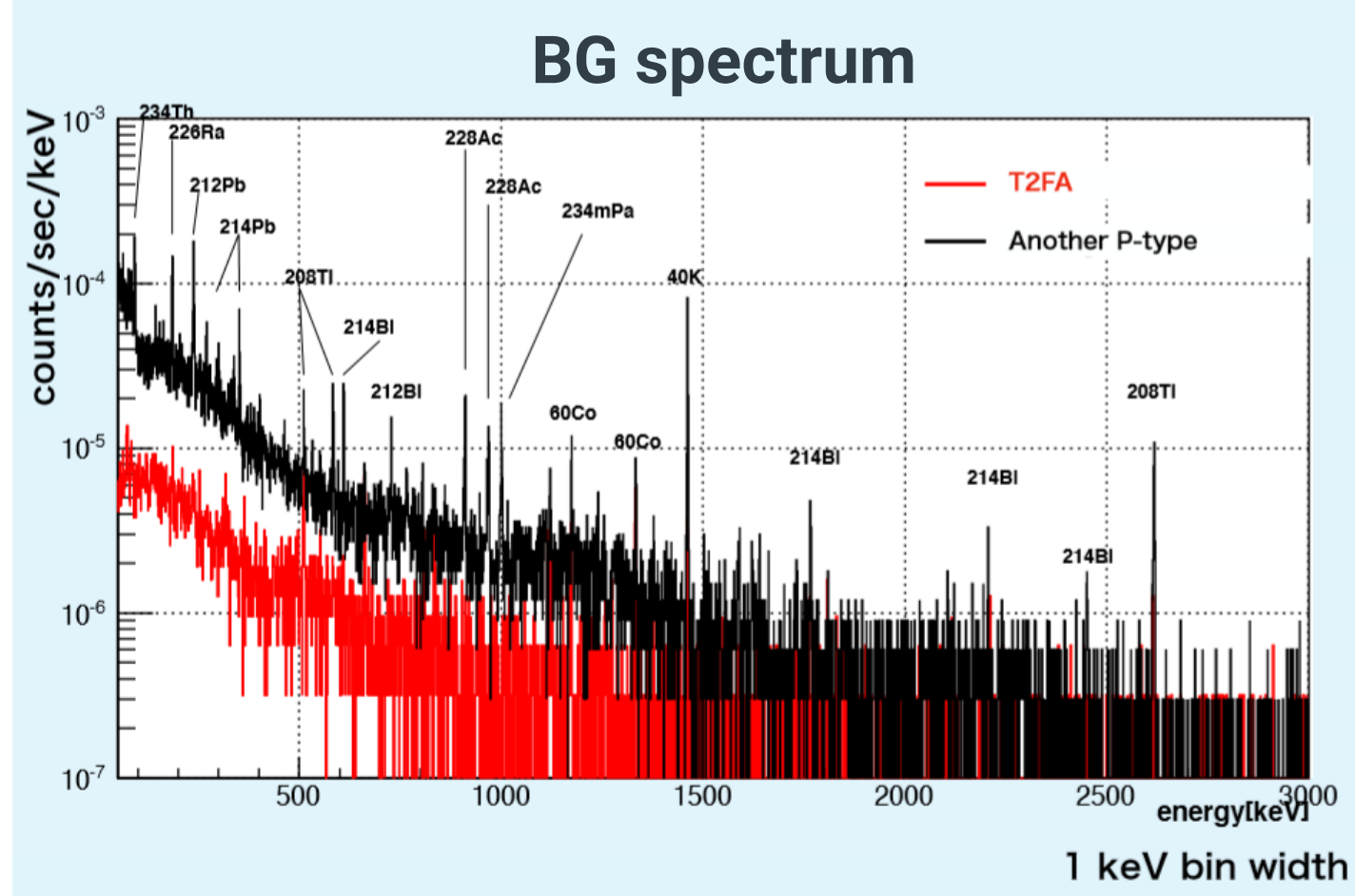
Detector	Crystal size (mm)	Weight (kg)	Location Lab	122 keV FMHM (keV)	1332 keV FWHM (keV)	Background 40/60 to 2700 keV (counts per kg per day)
EGMP 90- 30 BEGe detector	90 x 30	1.03	Boulby	0.63	1.73	130 [2]
EGMP 90-33 BEGe detector	90 x 33	1.13	SURF	0.61	1.75	X
EGMP 100-35	100 x 35	1.48	CANADA	0.66	1.72	X
P21 400CC Well detector	80 x 85	2.13	Canfranc	0.69	1.91	64 [5]
P21 400CC Well detector	80 x 85	2.13	Modane	0.74	1.87	505 [3]
P21 250CC Well detector	80 x 63	1.33	HADES	0.68	1.88	795 [6]
EGPC 80-185 P-type Coaxial detector	75 x 73	1.68	KAMIOKA	0.85	1.9	81 [4]
5x EGPC 120-215 P-type coaxial detector	84 x 84	2.44	CHINA	0.93	1.98	From 108 up to 229 [7]
EGPC 160-240	90 x 90	3,7	LSM	1,13	1,98	73 [8]

References:

- [1] D.S. Leonard et al. NIM A 989 (2021) 164954
- [2] P.R. Scovell et al 2024 JINST 19 P01017
- [3] Courtesy P. Sabatier, University Savoie Mont Blanc
- [4] K Ichimura, Prog. Theor. Exp. Phys. 2023
DOI: 10.1090/ptep/ptad136

- [5] G. Zuzel, and A. Biondi, TAUP2025 presentation, Jagiellonian University
- [6] Courtesy M. HULT, JRC-Geel
- [7] J. Chen et Al. arXiv:2511.16704
- [8] P. Loaiza, AIP Conf. Proc. 2015

Manufactured of Specialty Ultra Low Background Detectors



Background spectra obtained for
S-ULB coaxial detector [4]



Two EGMP 90-33 for coincidence measurement

Material selection and screening of components to reduce mass and intrinsic background of critical components:

- Electronic components
- Soldering material
- Cable
- Screws

Metal selection: aluminum and/or copper with 0.1 ppb U+Th

ISOCS™ characterization available

Electrically cooled detector

- Specific configuration :
- Double preamplifier
 - Array of HPGe inside a single cryostat
 - HPGe + Sili telescope for charge particle measurement in coincidence with gamma-ray

Cryostat design with various possibility:

- Arm length
- Detector head configuration
- Crystal size and diameter
- Multi germanium detector configuration
- Electrically segmented crystal



EGMP 100-35: large diameter crystal in S-ULB cryostat with Carbon entrance windows

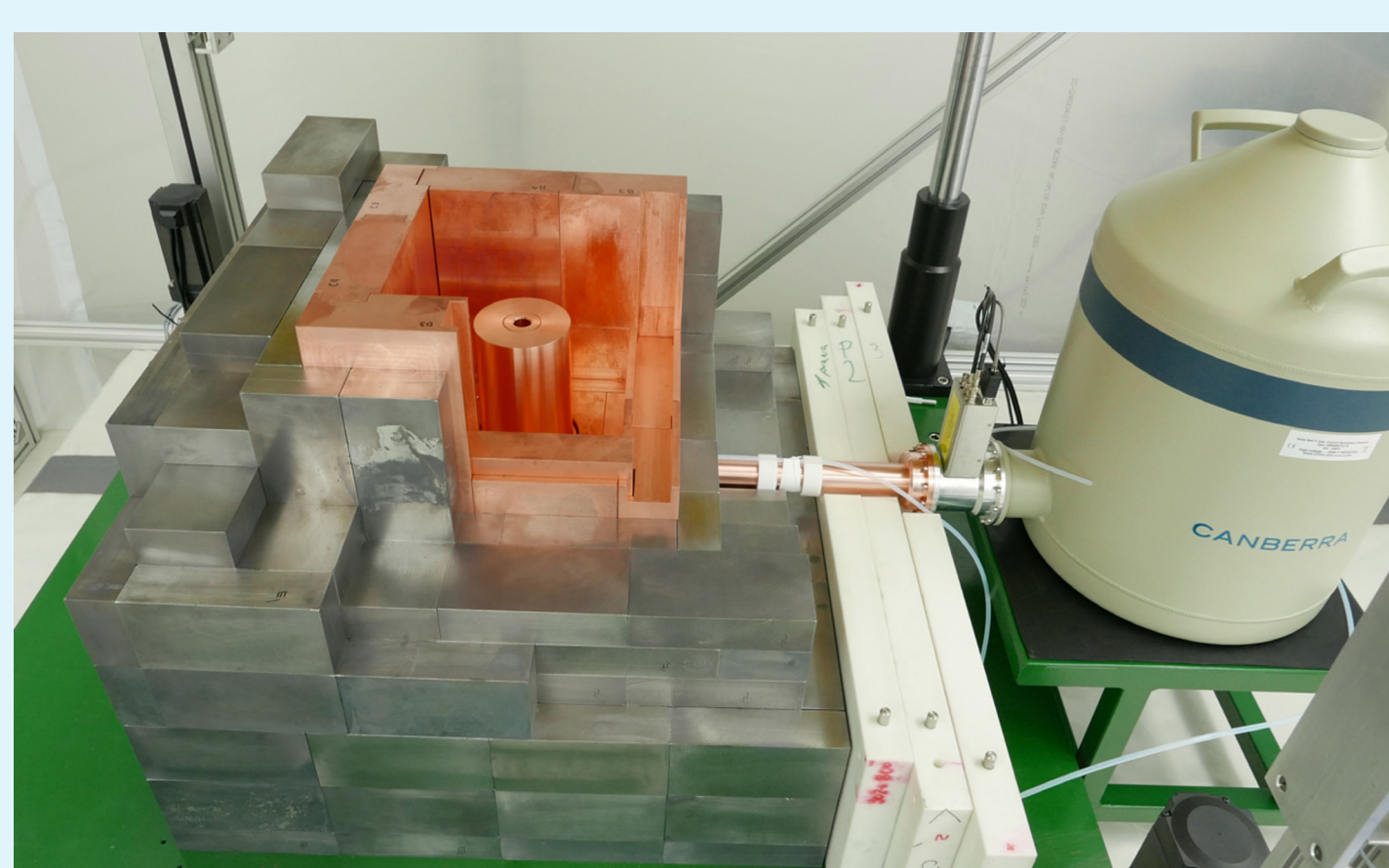
HPGe crystal selection to reduce cosmogenic activation with underground storage 700 mwe and no plane transportation



Underground cave near Lingolsheim



Detector array[1] operated by CUP, IBS.
Image copyright CUP, IBS, 2017.



400CC P21 SAGe Well detector made with
highly selected copper
[GeRysy, Courtesy of Dr. Grzegorz ZUZEL]



SAGe Well detector installed inside a lead castle



MIRION
TECHNOLOGIES

www.mirion.com