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Latest development of the specialty ultra-low background detector manufacturing

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Invented in the 1970s, High-Purity Germanium (HPGe) detection technology is still the reference for gamma-ray spectroscopy. Its excellent detection properties are unanimously recognized: in particular, its energy resolution performance is still unparalleled to this day. Despite its challenging operating conditions, HPGe detectors have become increasingly suitable for use in very diverse environments: controlled environments such as labs, in-situ, in industrial ones with challenging constraints (narrow spaces, vibrations, heat...) and even in extreme conditions (very radiative environments, in space...).

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 can be addressed. For example, a double preamplifier installation on a BEGe with AC decoupling capacitor compatible with low radioactivity component. Furthermore, the detector orientation of BEGe can be changed and modified to have for example, two detectors facing each other. This configuration increases the solid angle coverage by a factor and thus provides an optimized efficiency for large sample measurement. An increase of the crystal diameter of BEGe up to 105 mm leads to a large surface perfectly suited for large samples measurement. The ratio of active volume over internal radioactivity gets even more favorable. For the measurement of small volume samples, the SAGE Well detectors with a well diameter of 21mm provide a close to 4PI solid angle coverage. All the detectors can have specific design, low radioactivity material, with energy resolution like standard HPGe: 600eV@122keV and 1.7keV@1332keV for a 1.2kg BEGe. For low radioactivity techniques, this led to better minimum detection activity or reduce of the measurement time. The advantages and the performance of the latest development of Mirion Technologies S-ULB detectors will be presented here.

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