

# New developments in germanium detector technologies

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Germanium detectors are an excellent tool for high accuracy activity measurements on photon emitting radioactive material or nuclear reactions. In order to optimize a detector for a special application it is possible to choose from a wide range of different detector models and different ways to cool it down to its operational temperature. It is also possible to use special shapes or segmentation of crystals to gain more information from one measurement. Here some examples are given.

In combination with electrical cooling and a special cryostat it is possible to such detectors in rivers, in mining or even in space applications.

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## ***Improvement in resolution***

Based on new technologies for contacts of Ge-detectors and improved quality of the Ge-crystal for some detectors the resolution was improved by a factor of 2.

Additionally for some applications with Doppler-broadened peaks the segmentation technique allows to analyse the history of each photon including position of the decay and the velocity of the decaying nucleus. Thus the correction for Doppler-broadening can be performed.

## ***Improvement in background conditions***

In many cases gamma spectrometry can be used in applications where very small contributions from the investigated source have to be found in a radiation field of the environment. It is possible to use special low-background material to build up a detector and shielding, use segmentation technologies with improved electronics and software algorithm or even use a combination of bolometry and spectrometry. These approaches are used in retrospective dosimetry, search for neutrinoless double beta decay and search for weak interacting massive particles.

## ***Improvement in electrical cooling***

In the past, electrical coolers were large in size, power consuming and had a high failure rate. Additionally, mechanical movements in the hardware produced vibrations, resulting in microphonics induced peak broadening. A first step for an improvement was done by introducing stirling motor cooling and a second one by using the pulse tube technology with lower power consumption and better vibration performance.

## ***Improvements in ruggedness***

Germanium detectors are very delicate instruments that are operated with liquid nitrogen, vacuum and high voltage. Thus there is a large probability to damage a detector by mishandling or to disturbed operation by environmental conditions. The use of the encapsulation technique allows the detector to survive strong mechanical shocks and special resistance against humidity and dust.