Shielding of Portable High Purity Germanium Detectors for Use in Stand Alone Configuration

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❖ A low weight, portable High Purity Germanium detector, n-type, 55% efficiency has been tested and characterised for the purpose to evaluate its use in an OSI field laboratory. This detector has been already proved reliable and robust in field conditions and the use of a lead shielding has been investigated in order to improve its performances in a laboratory like configuration.

The Protocol to the Treaty, Part. II, paragraph 69 c) and d) for on-site inspection (OSI) activities and techniques allows for gamma analysis of environmental samples in a OSI laboratory.

During IFE14, high resolution gamma-ray detectors were installed and used to carry out the inspection tasks, whose main objectives were:

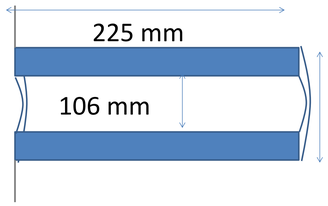
- ✓ high throughput of samples;
- ✓ accurate measurement and analysis;
- ✓ clear reporting to joint area and working area for inspection team (IT) assessment .

The workflow in the IFE14 gamma lab was good but some equipment failure occurred during the period and it was quite difficult to fix them. The set up of the detector system was rigid and need time to be changed. A portable gamma detector was temporarily used as back up solution (without any shielding) to augment the workflow of the samples. In order to better investigate the opportunity to use a portable High Purity Germanium detector in the OSI gamma laboratory, we designed and tested a stand alone configuration.

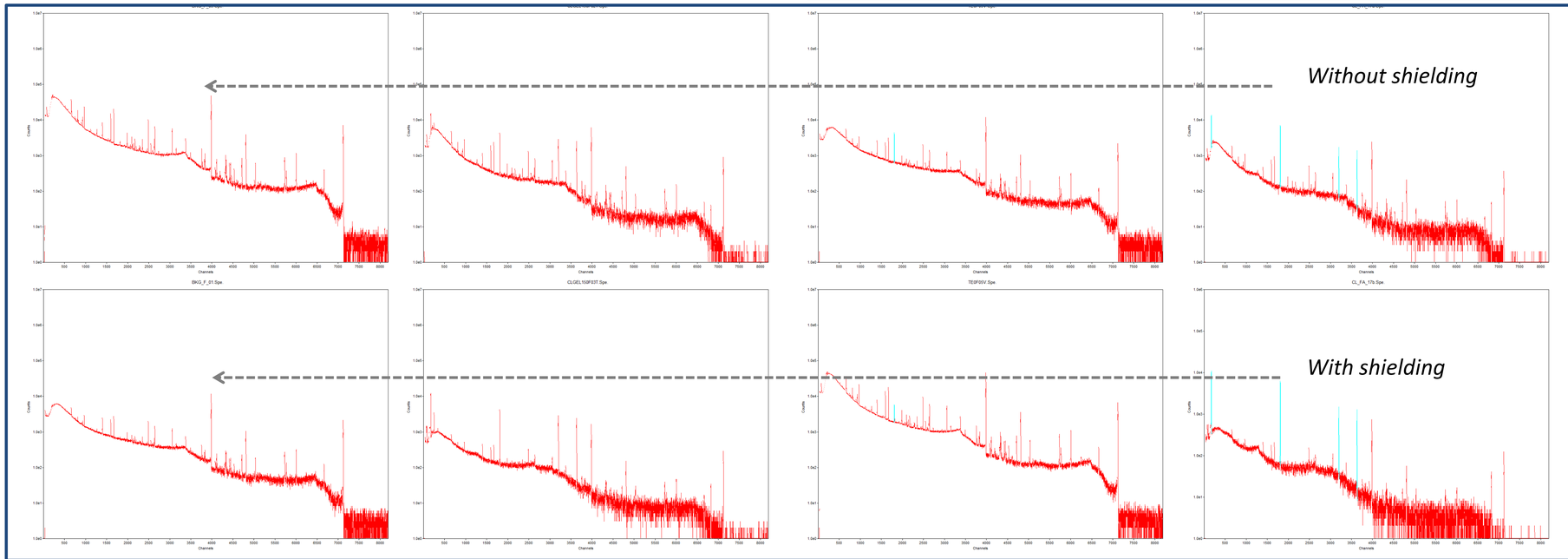
Commercial, robust portable High Purity Germanium detectors are available on the market and they already have been proved to be ….

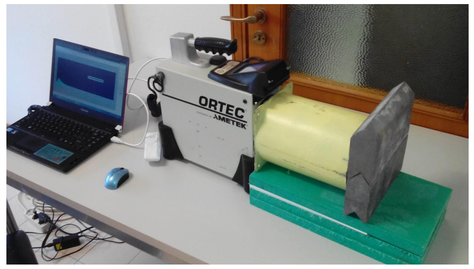
- HPGe n-type
- MCA Energy Range: 40 keV - 7 MeV
- Relative efficiency (^{60}Co): 55,69%
- Resolution (FWHM, 1.33 MeV, ^{60}Co): 2,17 keV
- Stirling-cycle cooler (no Liquid Nitrogen)
- Cooling time < 12 ore (a 25°C)
- Autonomy/battery life ~ 3 ore (a 25°C)

One main aspect to be considered is the need of a dedicated shielding in order to achieve a lower background signal and to identify even small activities in the samples. A cylindrical shielding has been made with internal and external iron layers and 2 cm lead insert between them. Two lead bricks have been put at the bottom of the cylinder to close the cavity.



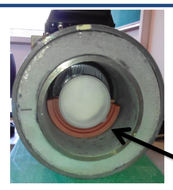
ENEA Lead shielding





The shielding structure has been initially designed and implemented in a horizontal configuration and the performances of the detectors have been measured using different samples: background, standard reference source, standard gel and soil samples. The lowering of the background and the better resolution of the principal lines are evident.

QCY gel sample *(better horizontal geometry)*



Soil sample

QCY reference sample

Different sample holders were used the test the suitability of this configuration for the OSI field laboratory.

❖ The proposed configuration, consisting in a portable HPGe detector and lead shielding, could be valuable for the design of the new OSI gamma laboratory, as it facilitates and speeds up the set up of the field laboratory and adds more flexibility.

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