MIRION TECHNOLOGIES

Segmented Coaxial Detectors

Features

- For gamma tracking, polarimetry, Doppler effect correction, ß decay suppression
- Longitudinal and transversal segmentation of the outer contact by photolithography (up to 36 segments), on various N type crystal geometries
- No dead zone or absorbing material between segments
- Monolithic detectors
- No measurable crosstalk effects
- Increased granularity of multi-detector systems
- Localization of the interaction and gamma ray
- Tracking capability through coincidence between internal core signal and segment contact signals

Applications

- Nuclear physics:
  - Doppler effect correction (see also CLOVER detectors, Encapsulated detectors and Strip detectors)
  - Multiple site energy deposit and ß decay suppression
  - Polarimetry
  - Tracking (see also Encapsulated and Strip detectors)
- Compton cameras: Gamma ray sources location
- Compton suppression

CANBERRA's Segmented Coaxial HPGe Detectors employ segmentation techniques available on planar detectors since the eighties (see Gutknecht et al NIM A288 (1990) 13-18) to provide high quality information signals from each detector cell (segment), while taking advantage of the total detection volume (as available with usual coaxial detectors.

The segmented coaxial Germanium offers, in addition to the characteristics of coaxial detectors (High efficiency and excellent resolution), the potential for excellent granularity.

Granularity of segmented coaxial detectors qualifies the number of independent cells constituting this detector. Longitudinal and transversal crystal segmentation in two or four drastically increases the granularity (up to 36 output channels are possible).

Such detectors allow an important reduction of gamma ray broadening due to Doppler effect.

Moreover, the use of internal and external contacts of the crystal (in case of detector segmentation) provides interaction position information:

- Vertically and transversally by analyzing signals induced by mirror charges
- Radially, by performing a pulse shape analysis

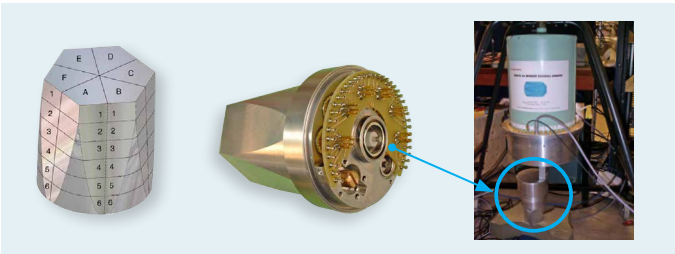
Accurate location of the interaction points allows not only reduction of the Doppler broadening, but also gamma ray tracking.

The external contact of a detector can be longitudinally or transversally segmented without dead zone generation. All segmentations are possible, on the front side (like a checker-board for example) and laterally (in one or two directions).

For a given n-segment detector, n+1 preamplifiers are used: one for each external segment plus one for the central contact. This design allows a better use of the full detection volume by AC coupling.

Segment separation is such that no cross-talk effect occurs between consecutive channels.

SeGA Detector Array

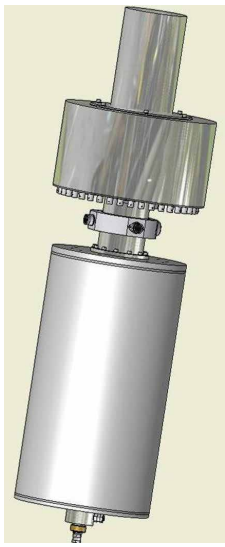


55% N type coaxial HPGe detector of tapered shape (EUROBall design) segmented in 36 folds. *By courtesy of Pr Nolan, Univ Liverpool UK*

Segmented Coaxial Detectors

Mars (Mini Array of Segmented detectors) detector at Legnaro National Laboratories (Italy): 80% N type detector segmented in 25 folds.

By courtesy of Pr Bazzacco – INFN Padova. See also "In-Beam experiment with gamma-ray tracking detector MARS" Kröll et al NIM A 586 (2008) 421–431

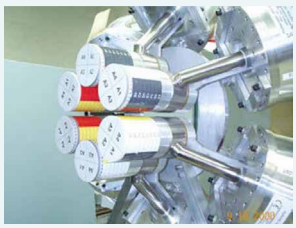


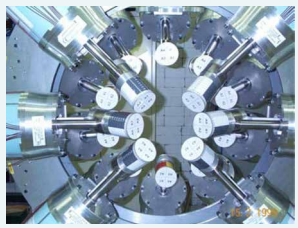
Coaxial 100% detector, segmented in 36 folds for tracking studies and pulse shape analysis.

By courtesy of Pr Reiter – IKP Univ Cologne (Germany)

The array consists of 18 segmented 70% detectors.
Each SeGA detector is segmented in 32 folds.

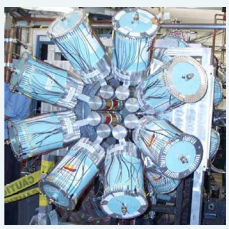
Different possible array shapes with the SeGA detector:





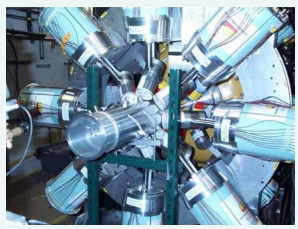
Left: Mini SeGA configuration

Right: Classic SeGA configuration



Beta SeGA configuration

Delta SeGA configuration



Plunger SeGA configuration

Photos by courtesy of Dr Weisshaar, MSU (USA)

More information: "Thirty-two fold segmented germanium detectors to identify gamma-rays from intermediatee-energy exotic beams" Müller et al, NIM A 466 (2001) 492–498

Segmented Coaxial Detectors

AGATA detector and the AGATA demonstrator at Legnaro consisting of the first five triplet detectors.

Hexagonal tapering – diam.: 80 mm – height: 90 mm – outer contact segmented in 36.

Photos by courtesy of the AGATA collaboration

CE

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