

R&D on Novel Ge-detector Geometries for Ultimate Position Resolution and Efficiency

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Basic Element: Semi-planar Ge Detector

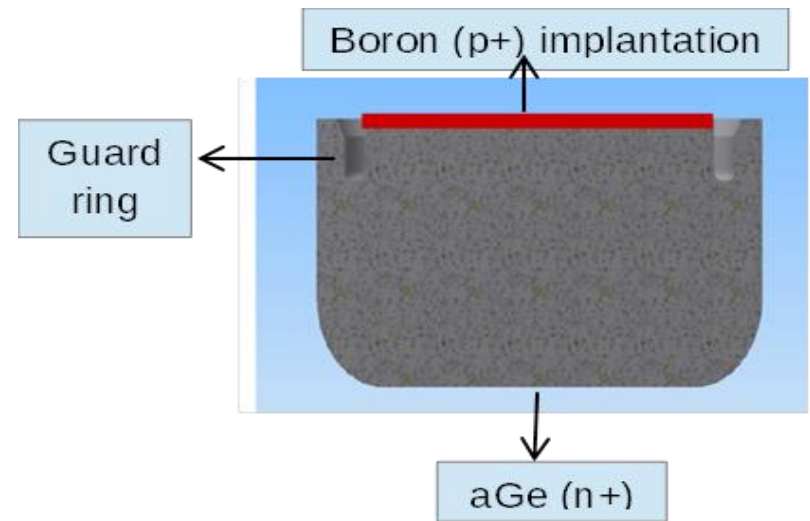


Non-segmented p-type HPGe crystal

Volume: $33.2 \times 33.2 \times 15.5 \text{ mm}^3$

Carrier concentration $3.3 \times 10^9 \text{ atom/cm}^3$

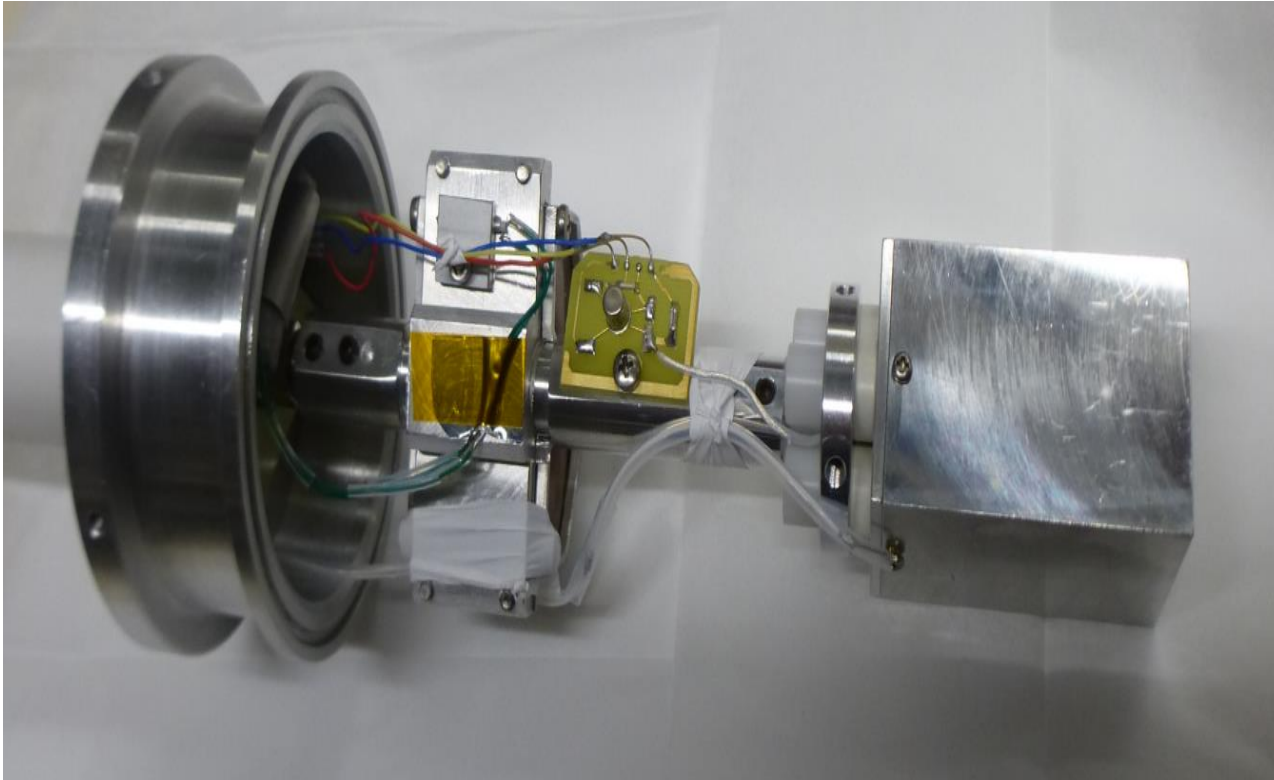
Crystal processed by SEMIKON FZ-Jülich



Amorphous Ge (aGe) blocking contact

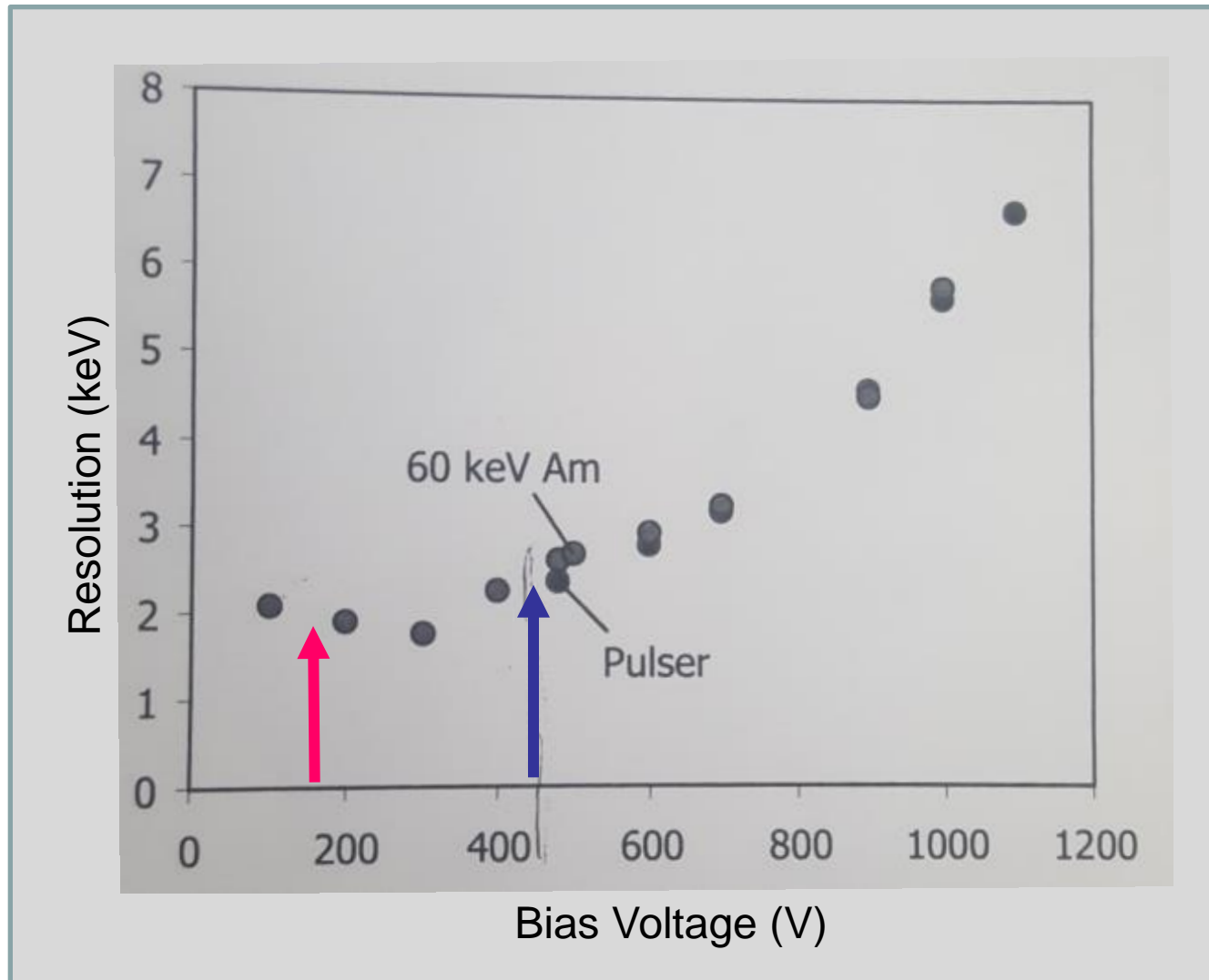
Negligible dead zone!

Test Set-up



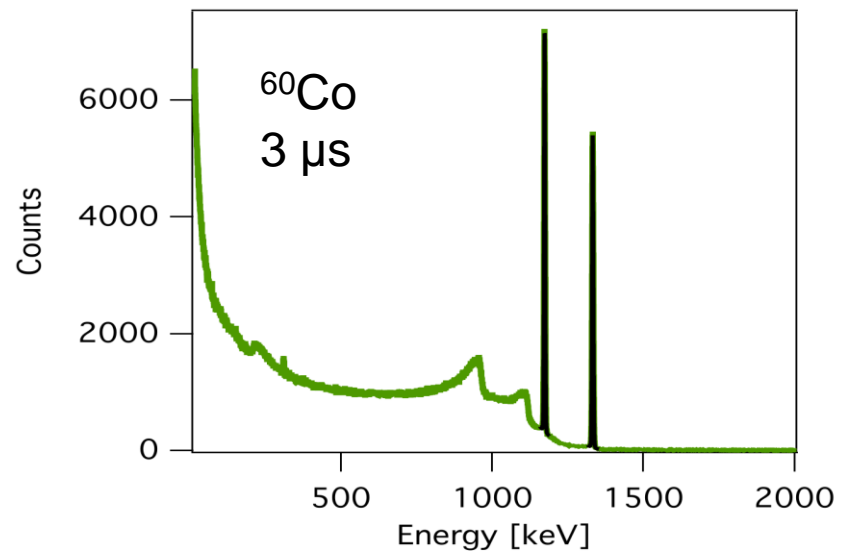
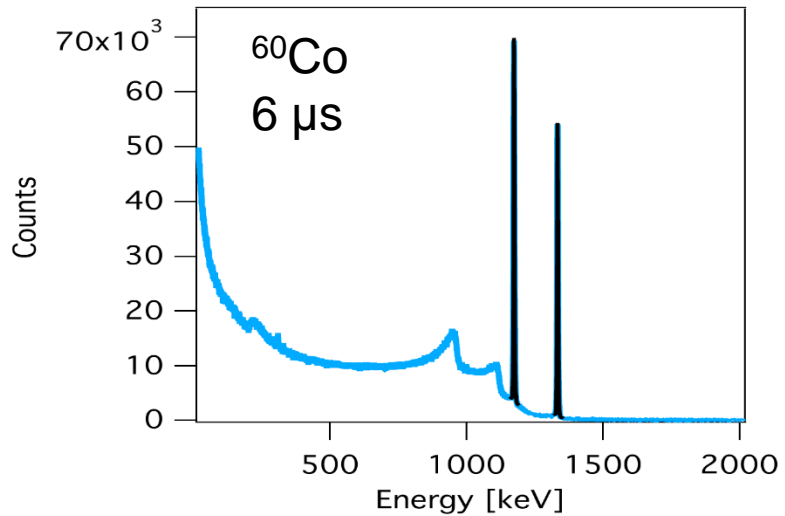
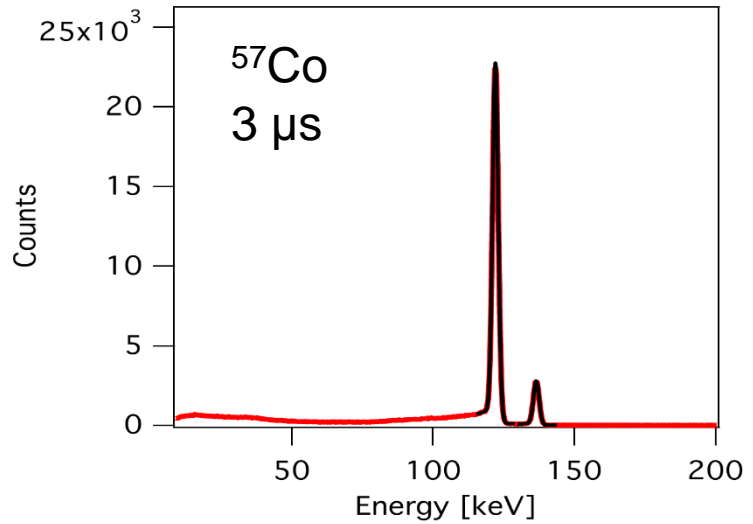
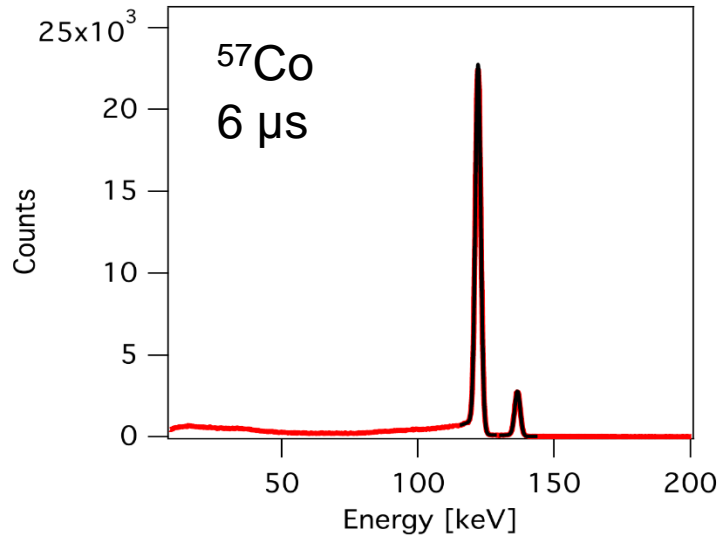
Crystal and pre-amp for installation in POPTOP assembly

Test Results



SEMIKON: AC-Coupling; 480V, 3nA; 2.59 keV @ 59.6 keV ^{241}Am
GSI: DC-Coupling; 160V, 1.2 pA

Test Results

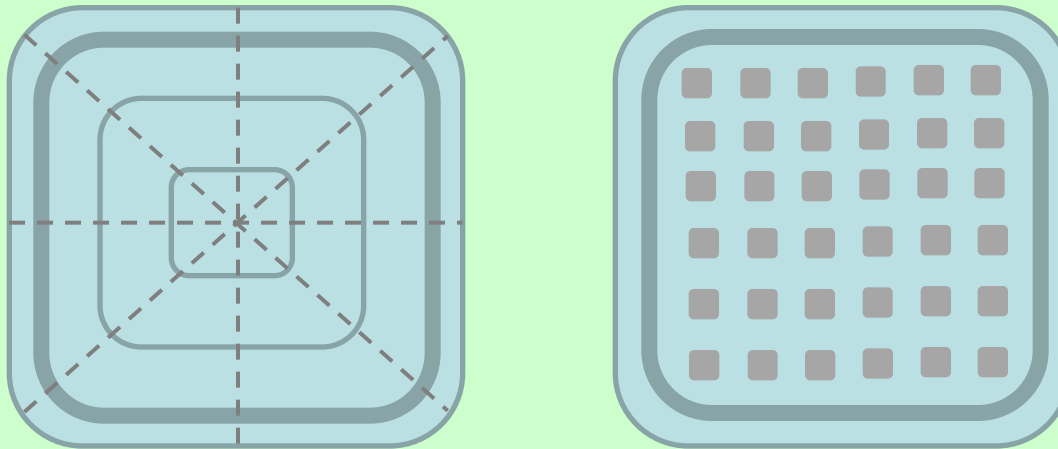


Test Results

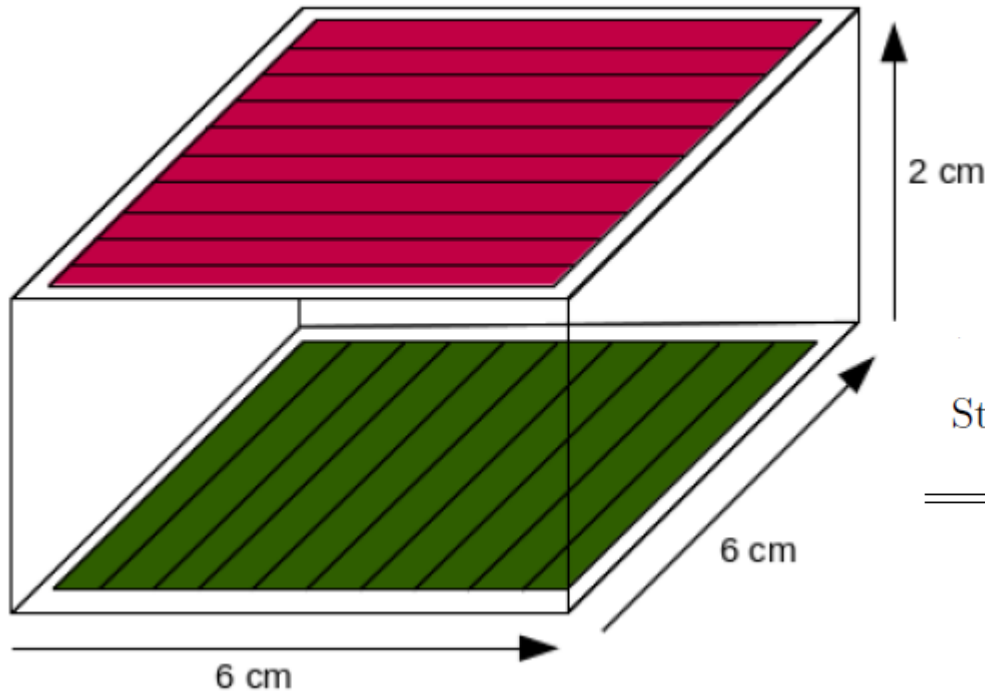
Shaping time (μs)	3	6
Energy (keV)	122	122
FWHM (keV)	2.13(1)	2.35(1)
Energy (keV)	1332	1332
FWHM (keV)	4.53(1)	4.32(1)

Next steps

- Investigate different coupling and read-out
- Scan the detector to obtain position dependent pulse shapes
- Determine from pulse shapes the field distribution and compare with simulations
- Decide on the segmentation scheme:



Cross talk with planar Ge strip detectors

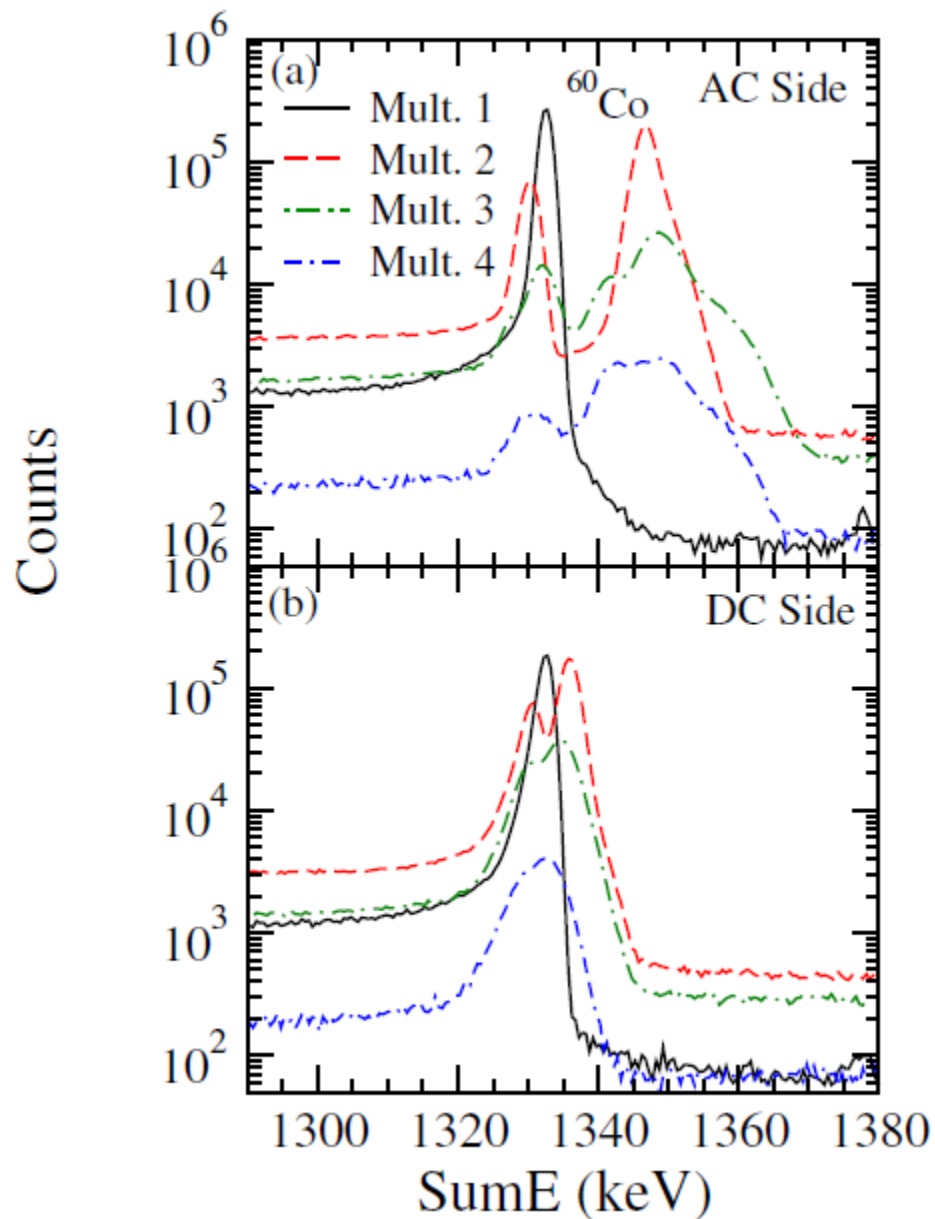


Canberra EPGS type
-1900 V

Strip	DC side		AC side	
	FWHM (keV)	Centroid (keV)	FWHM (keV)	Centroid (keV)
1	2.40	1332.58	2.49	1332.81
2	2.51	1332.54	2.29	1332.58
3	2.76	1332.7	2.29	1332.56
4	2.72	1332.26	2.35	1332.56
5	2.68	1332.24	2.36	1332.5
6	2.70	1332.39	2.36	1332.55
7	2.69	1332.45	2.33	1332.54
8	2.69	1332.68	2.33	1332.64
9	2.54	1332.38	2.29	1332.58
10	2.44	1332.44	2.42	1332.55

*In collaboration with
TIFR Mumbai, India*

Cross talk with planar Ge strip detectors



Signal amplitude depends on strip multiplicity

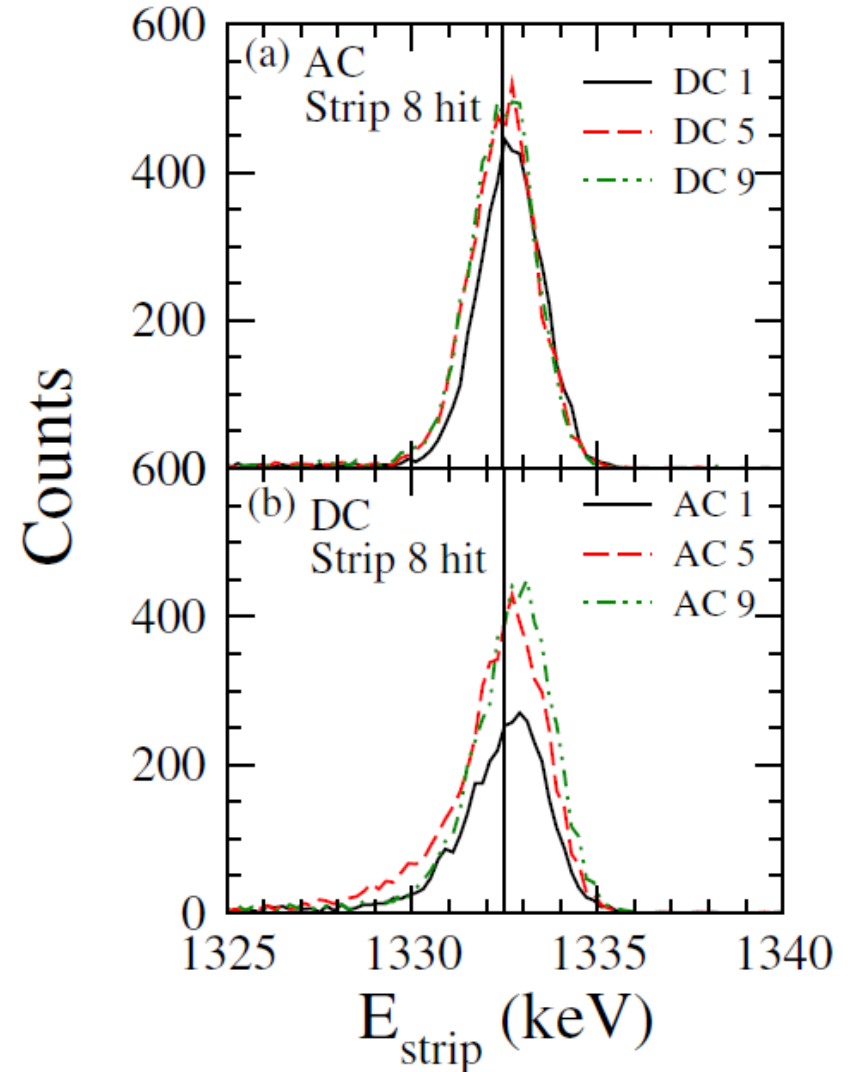
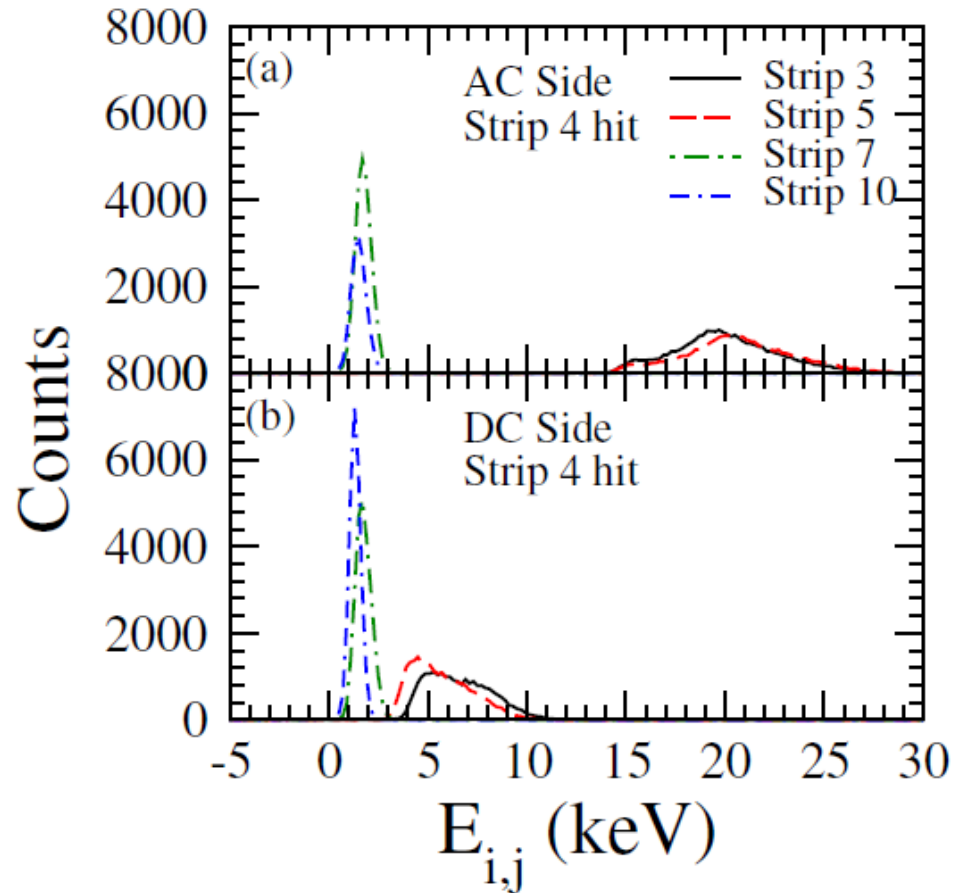
-> Cross talk

Linear correction (as for AGATA)!

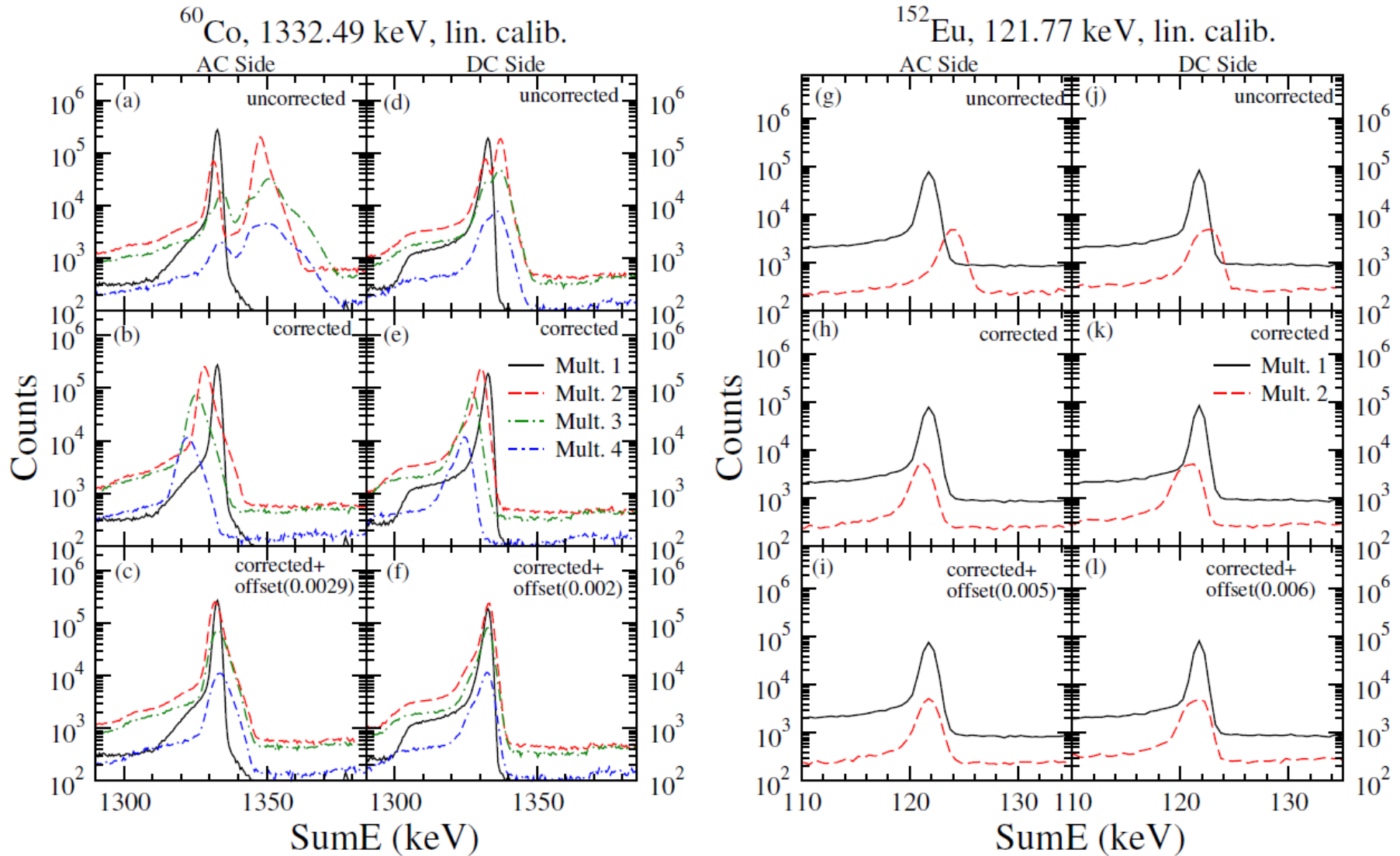
$$\begin{pmatrix} E_1^m \\ \vdots \\ E_{10}^m \\ E_{11}^m \\ \vdots \\ E_{20}^m \end{pmatrix} = \begin{pmatrix} 1 & \cdots & \delta_{1,10} & \delta_{1,11} & \cdots & \delta_{1,20} \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ \delta_{10,1} & \cdots & 1 & \delta_{10,11} & \cdots & \delta_{10,20} \\ \delta_{11,1} & \cdots & \delta_{11,10} & 1 & \cdots & \delta_{11,20} \\ \vdots & \ddots & \vdots & \vdots & \ddots & \vdots \\ \delta_{20,1} & \cdots & \delta_{20,10} & \delta_{20,11} & \cdots & 1 \end{pmatrix} \begin{pmatrix} E_1^t \\ \vdots \\ E_{10}^t \\ E_{11}^t \\ \vdots \\ E_{20}^t \end{pmatrix}$$

$$\delta_{i,j} = \frac{E_{i,j}}{E_\gamma}$$

Cross talk correction

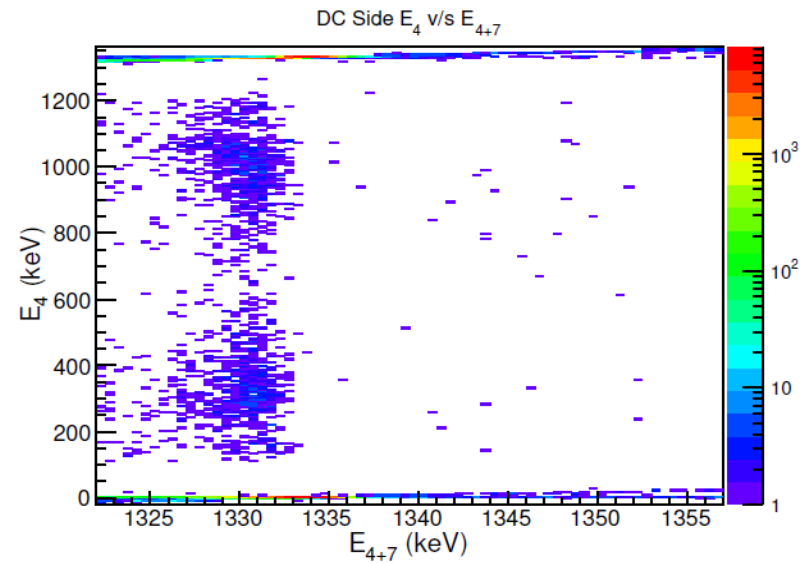
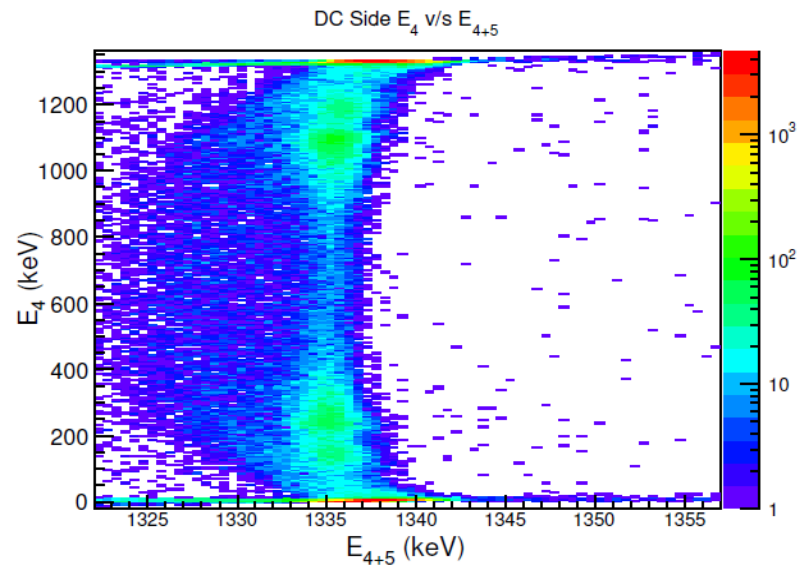
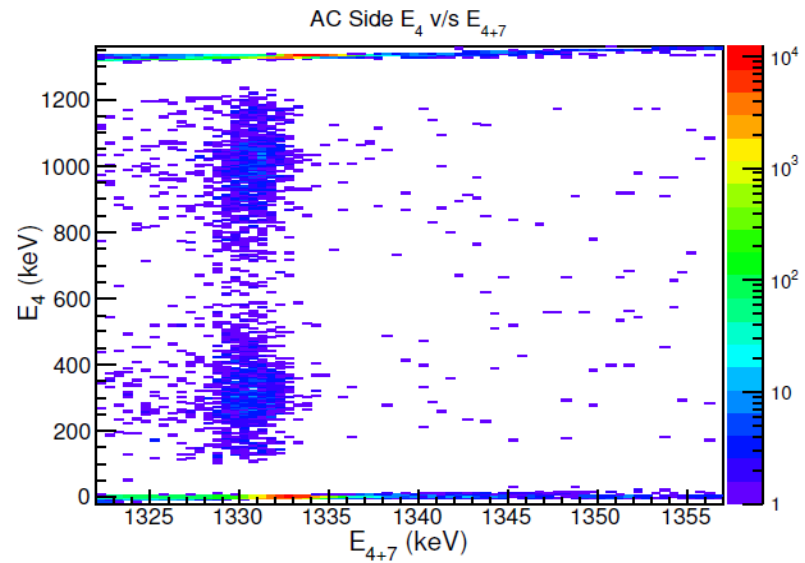
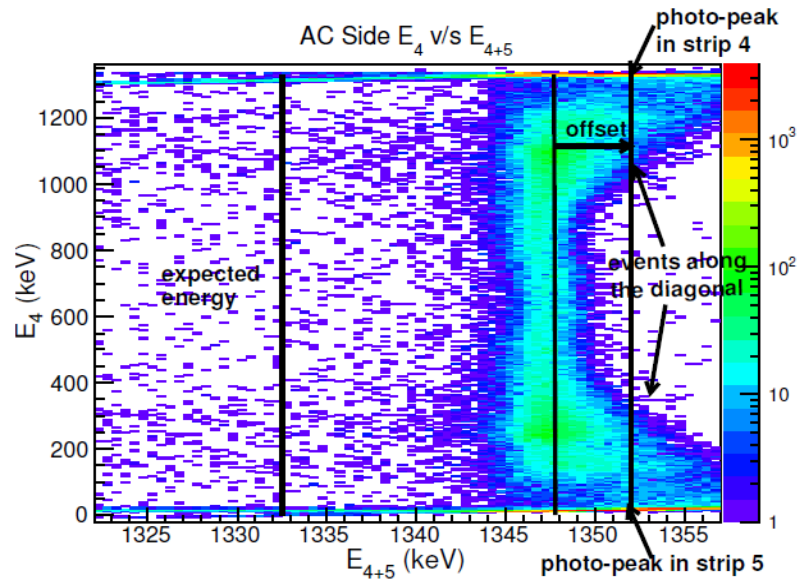


Cross talk correction



The linear correction seems to overcompensate the cross talk
An additional damping offset optimizes the correction

Cross talk correction



Analysis of the offset shows dependence on Compton energy distribution

Cross talk conclusions

- Planar Ge strip detectors show pronounced cross talk effects similar to segmented AGATA detectors
- Sum energies of events with multiplicity 2 to 4 events can be recovered with linear correction coefficients
- Additional non-linear (energy-dependent) components are observed
- Further improvement of the energy resolution of higher multiplicity events is achieved by damping the correction coefficients with offset parameters