^{152}Eu 3D scan of the S001 detector

AGATA Week – 3rd March 2021

Summary

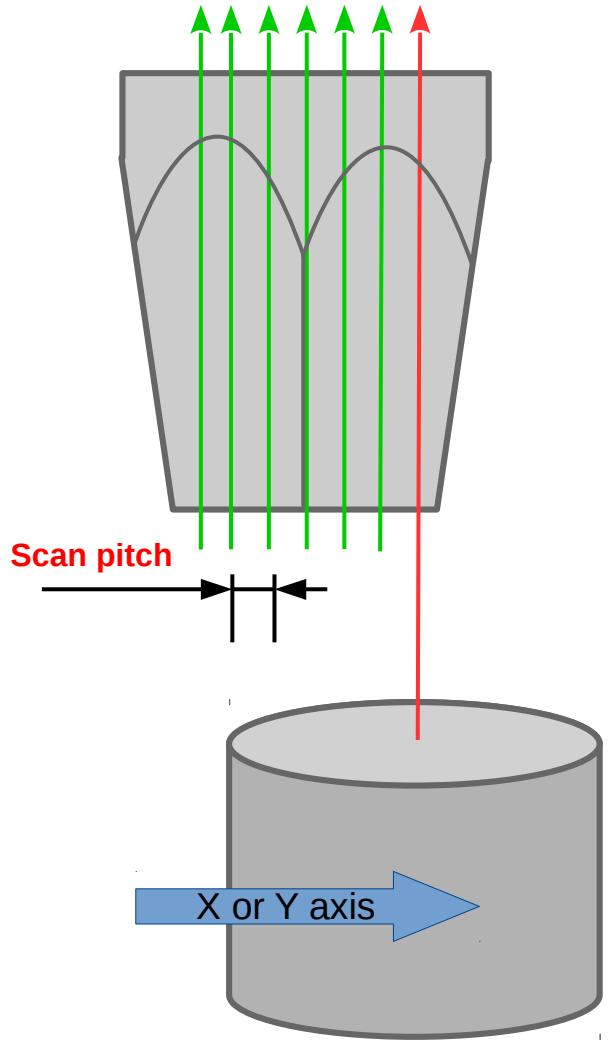
- 3D scans of S001 AGATA detector unit
- ^{137}Cs and ^{152}Eu source used
- For the first time a scan with a multi-energy gamma-ray source (^{152}Eu) is performed

PSCS technique

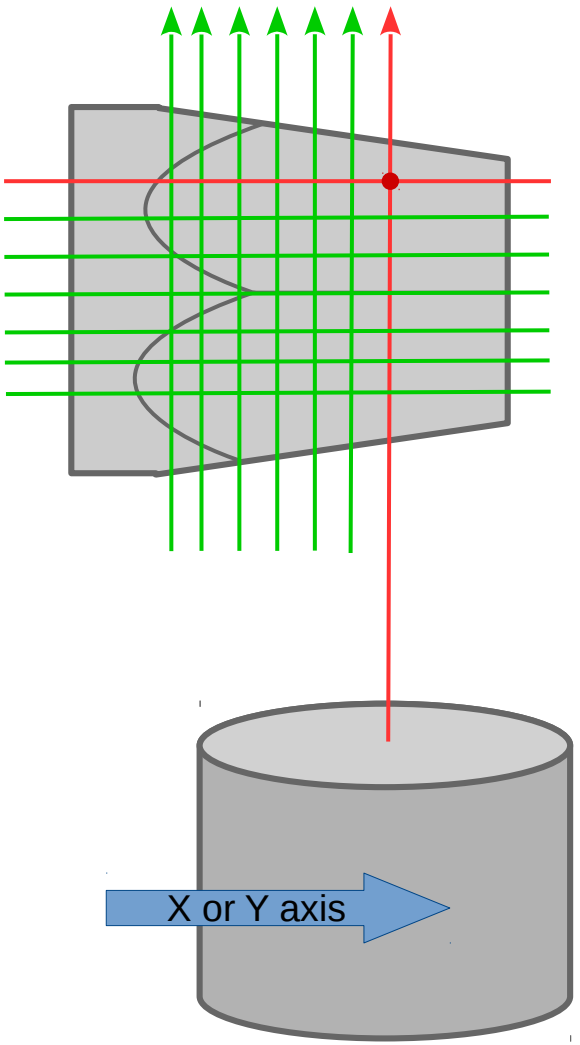
Pulse **S**hape **C**omparison **S**can (PSCS)

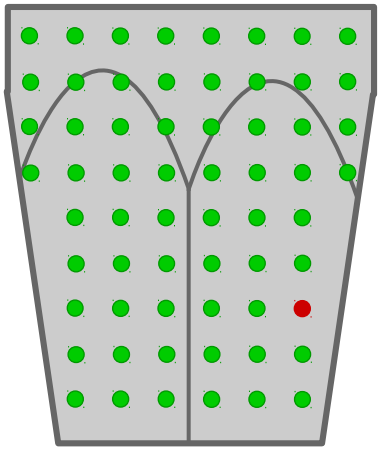
$$\chi^2 = \frac{1}{N} \cdot \sum_{ch=0}^{37} \sum_{i=0}^{100} \left(\frac{H_{i,ch} - V_{i,ch}}{\sigma_{ch}} \right)^2$$

VERTICAL CONF.



HORIZONTAL CONF.



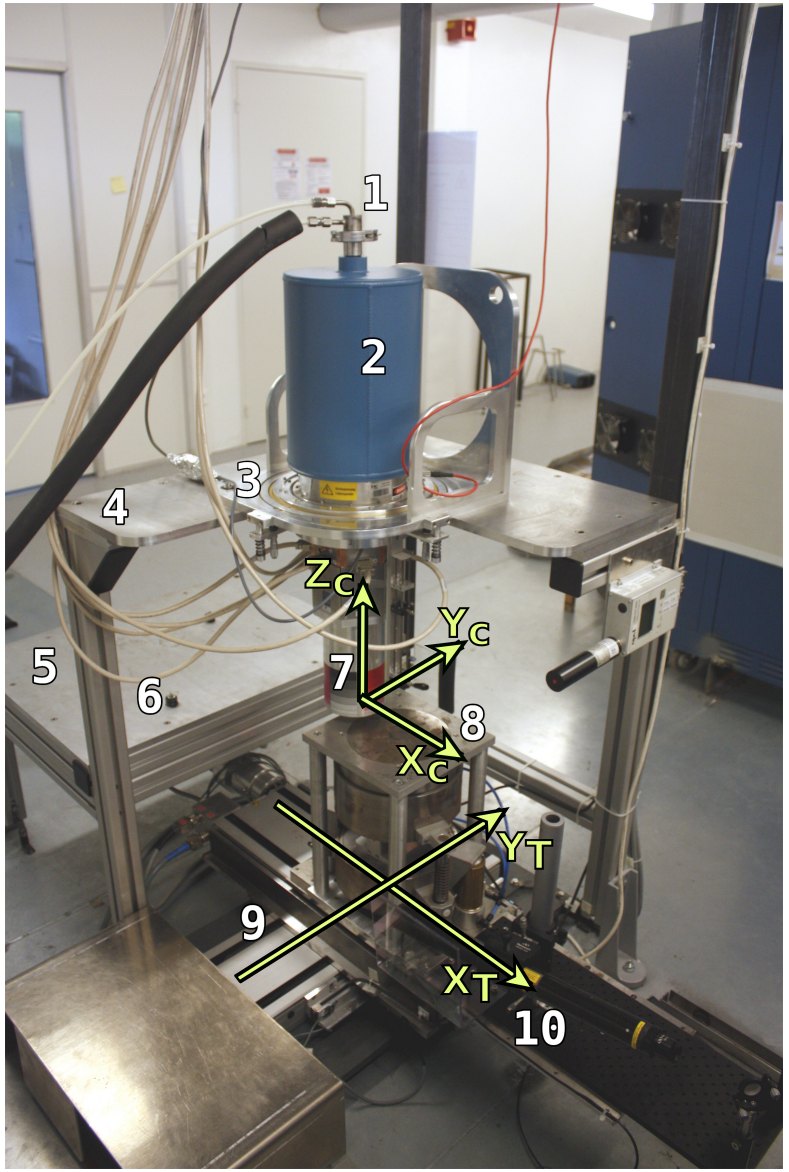


Comparison of two crossing datasets

Pulse shape at grid intersection (avg of ~150 best matching pulses)

Database built at the end of the procedure (~45000 points in 30 days)

The IPHC scanning table



(1) LN2 pipes

(2) test-cryostat Dewar

(3) adjustment frame

(4) holding plate for vertical positioning

(5) holding plate for horizontal positioning

(6) fixing studs

(7) end cap of the detector

(8) collimator (Ø 1.0mm 0.5mm 0.2mm)

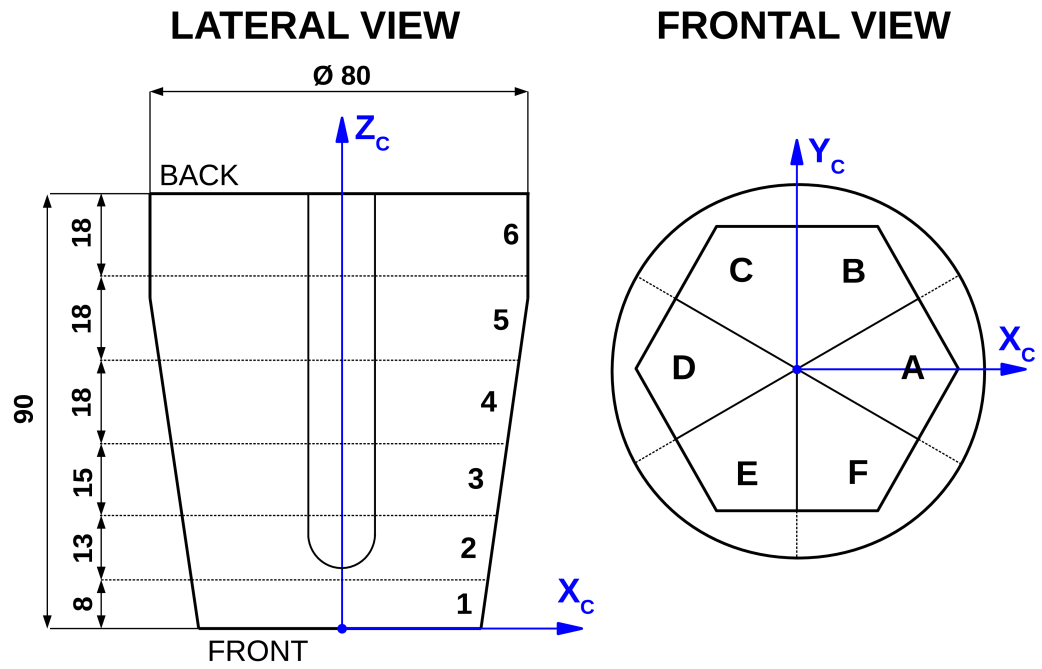
(9) scanning table motorized axes

(10) alignment laser

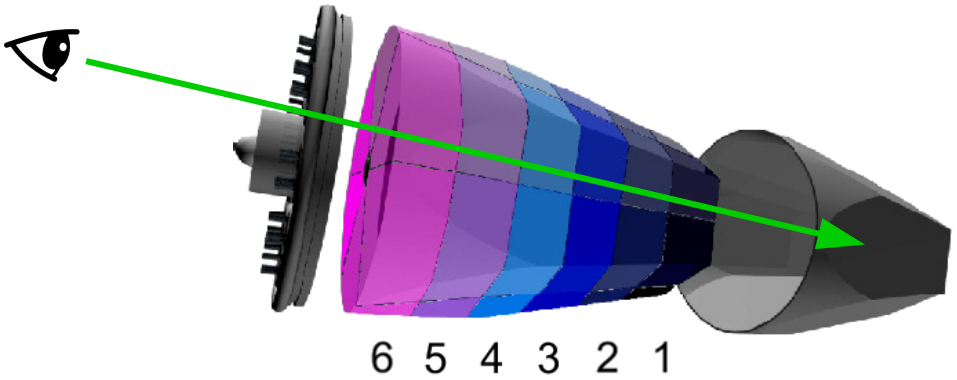
SOURCES: ^{241}Am [1.5 GBq], ^{137}Cs [1.85 GBq], ^{152}Eu [0.74 GBq]

TNT2 cards: Digitizer (100MHz, 14bits) + Preprocess

S001 detector unit



2 mm pitch – $Ø_{coll}$ 1.0 mm



3D Scans

^{137}Cs [1.85 GBq]

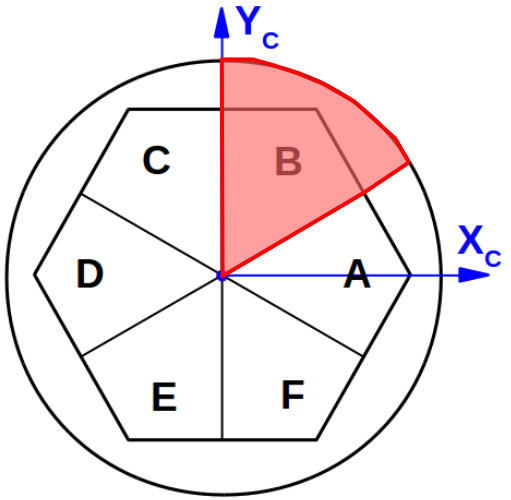
FULL VOLUME SCAN, $\varnothing_{coll}$ 1mm, 2mm pitch

1 DATABASE BUILT

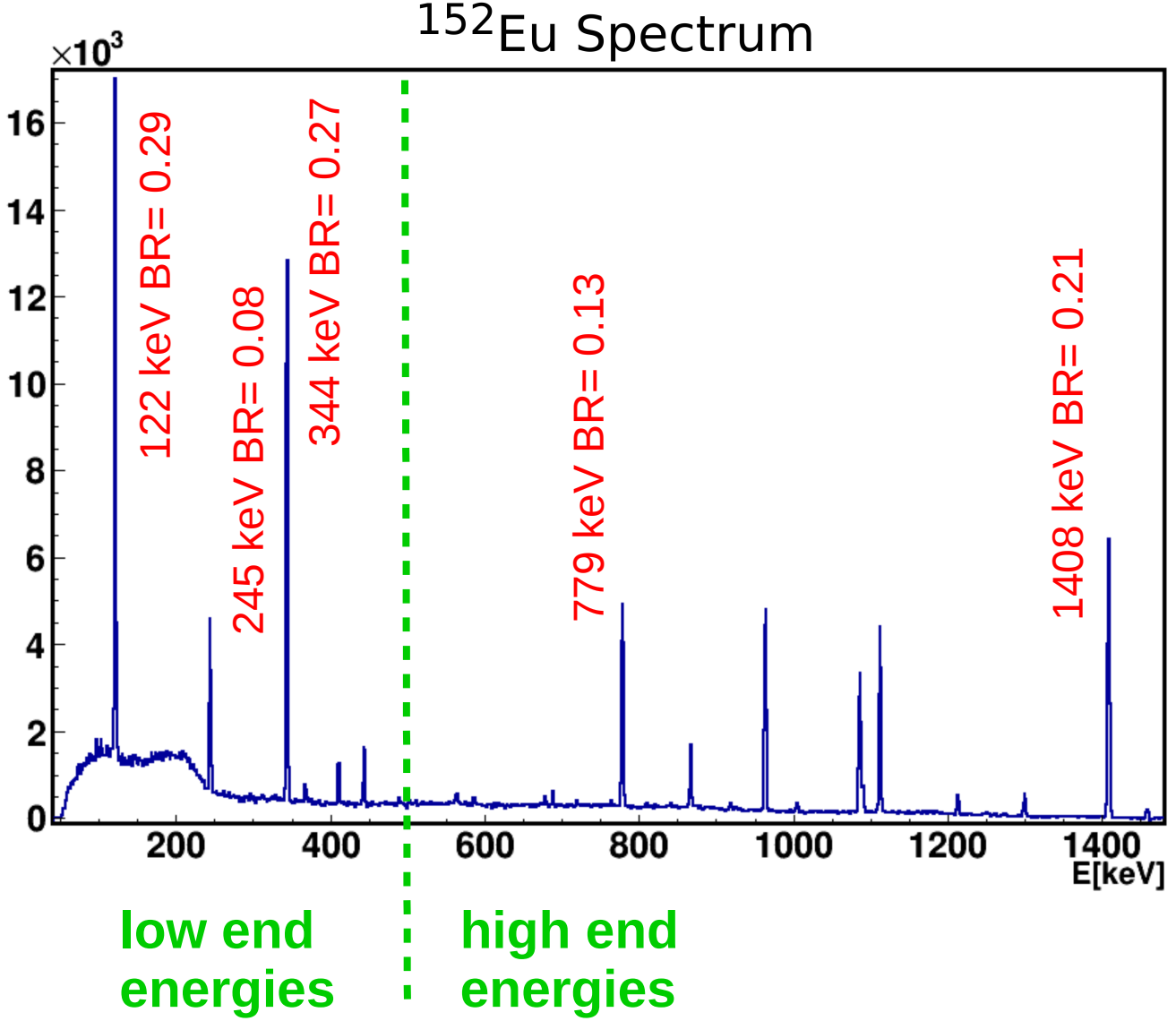
^{152}Eu [0.74 GBq]

PARTIAL SCAN (Sector B), $\varnothing_{coll}$ 1mm, 2mm pitch

5 DATABASES BUILT



3D ^{152}Eu scan: energies of interest

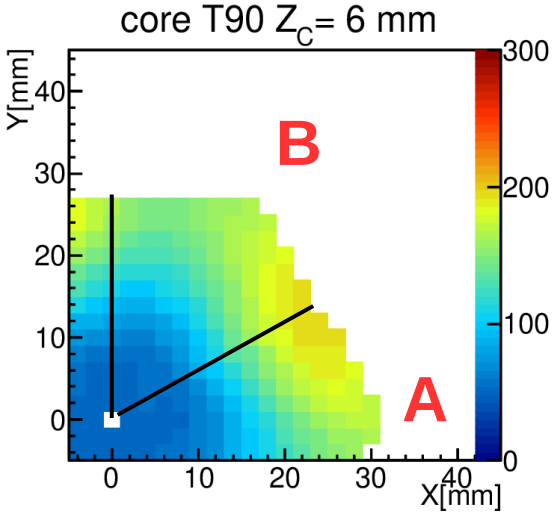


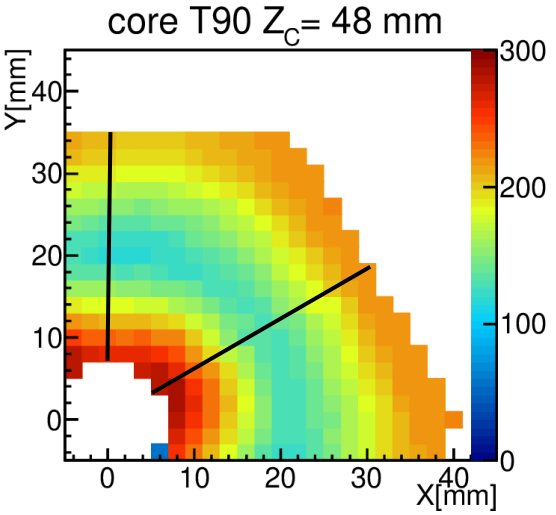
How do different energy databases compare?

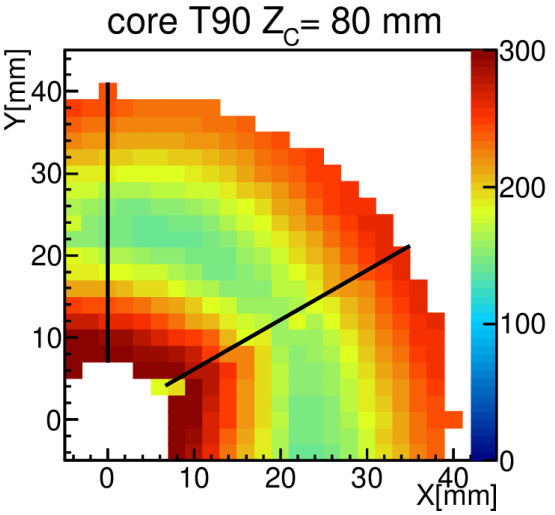
662keV vs 779keV: T_{10}^{90}

1 grid unit (2mm) thick database slices

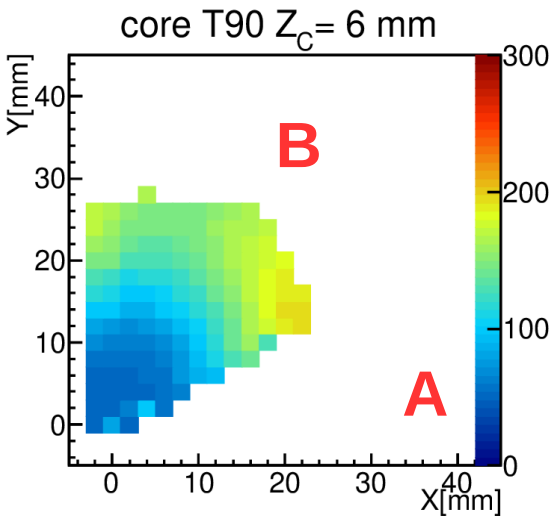
662 keV

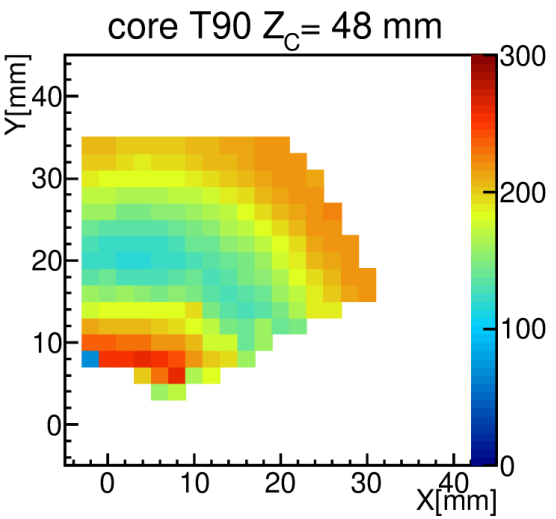


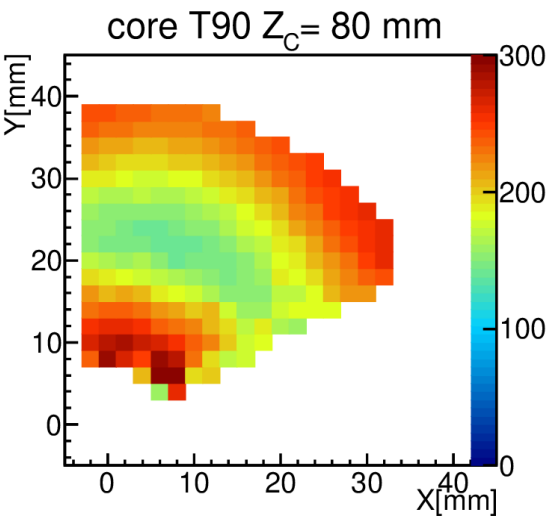




779 keV





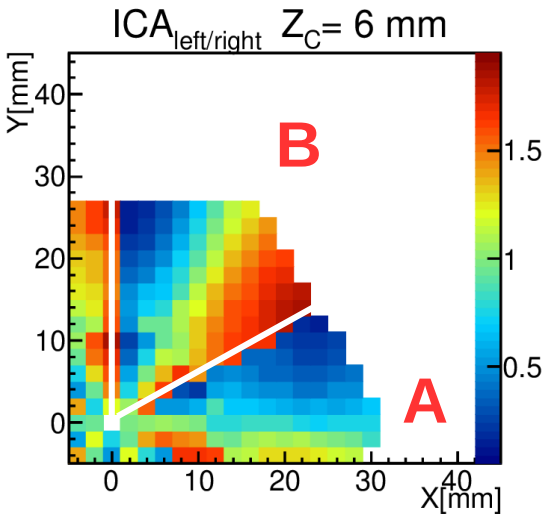


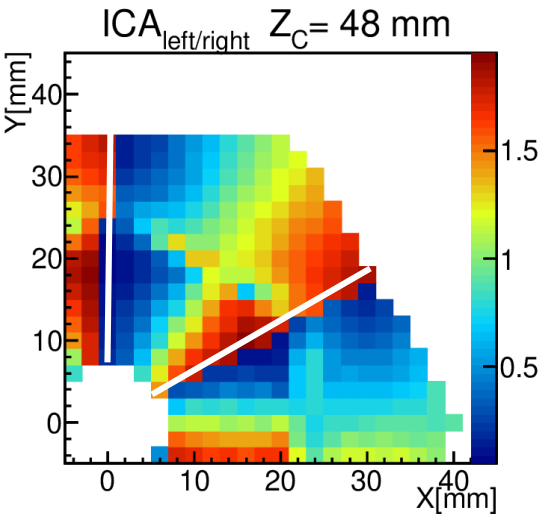
662keV vs 779keV: left/right ICA

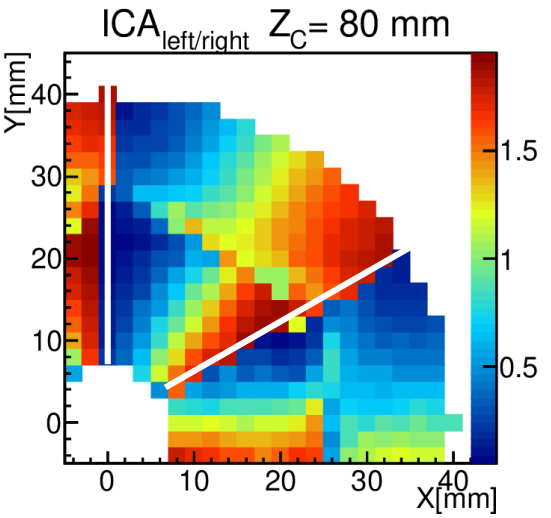
$$ICA_{left/right} = \frac{I_{left} - I_{right}}{I_{left} + I_{right}} + 1$$

1 grid unit (2mm) thick database slices

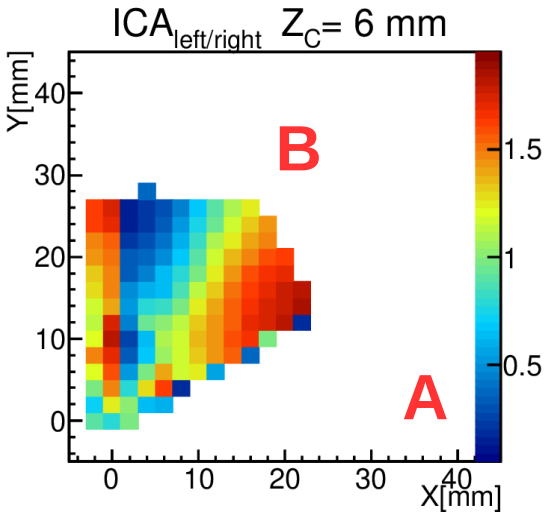
662 keV

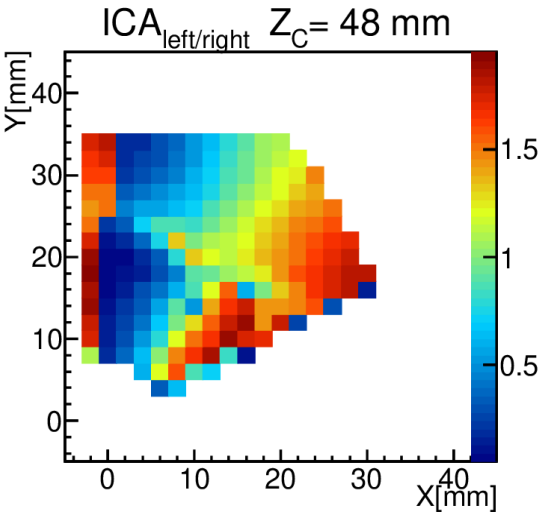


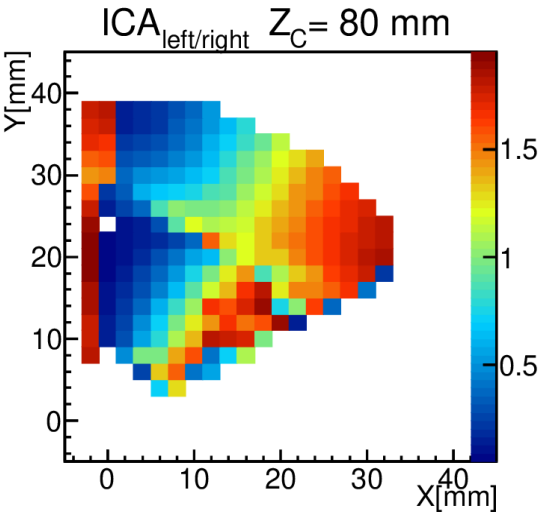




779 keV



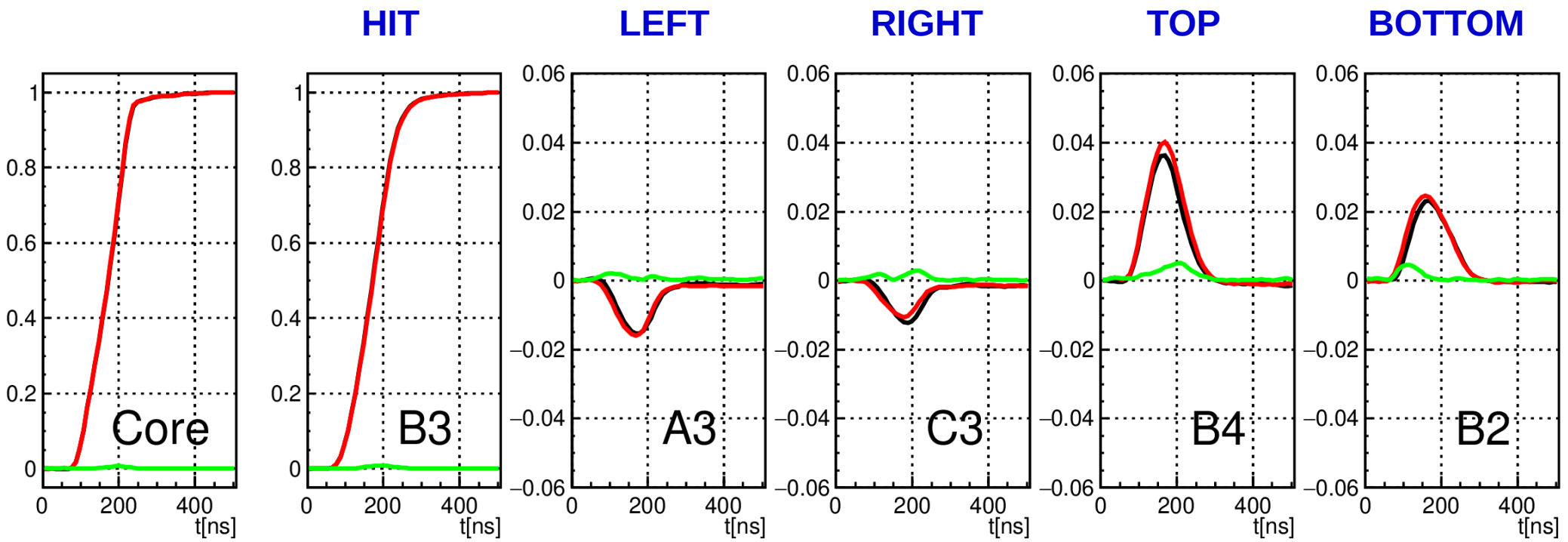




662keV vs 779keV: residuals

662 keV
779 keV
Residual

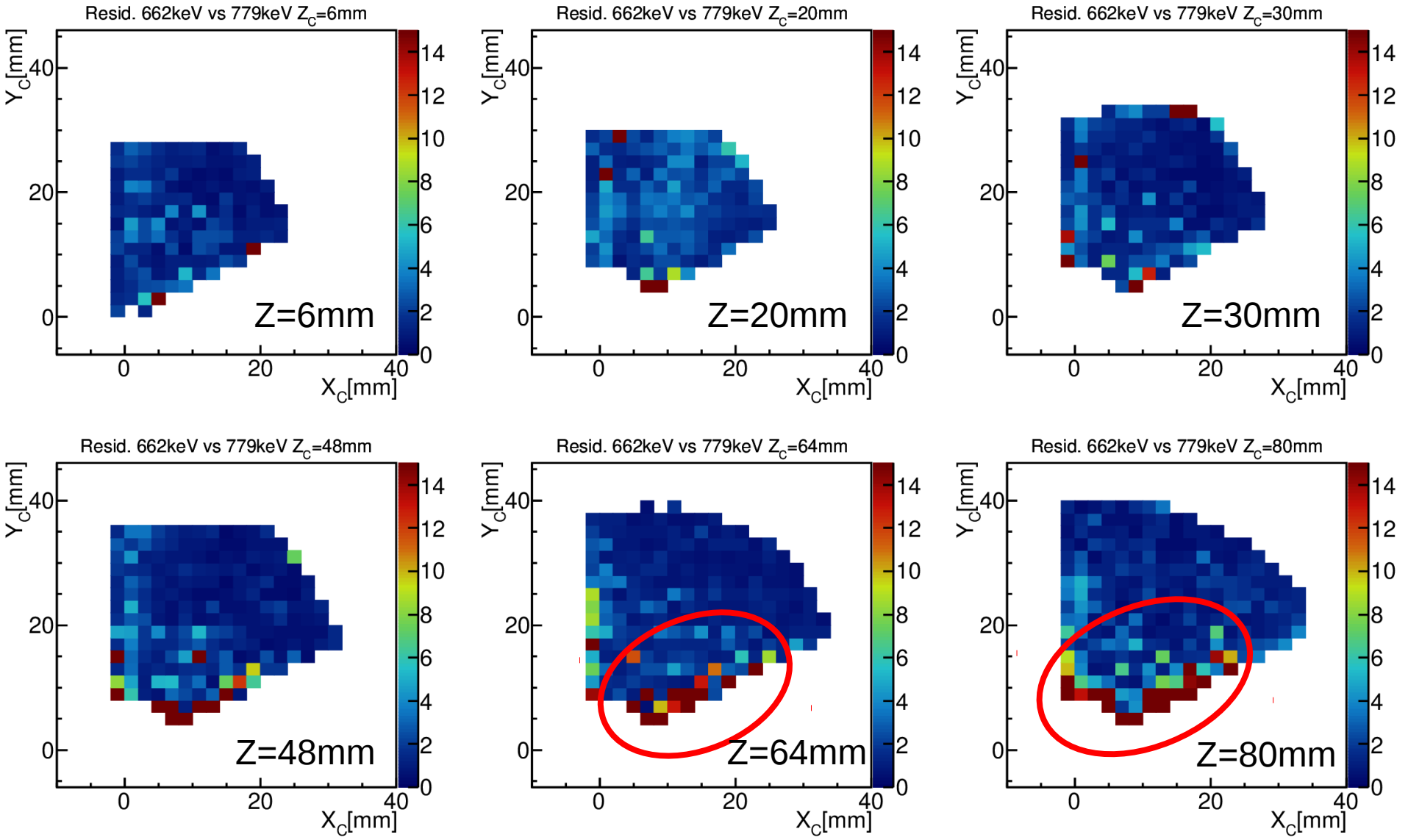
X=10mm, Y=20mm, Z=30mm
(Bulk of seg B3)



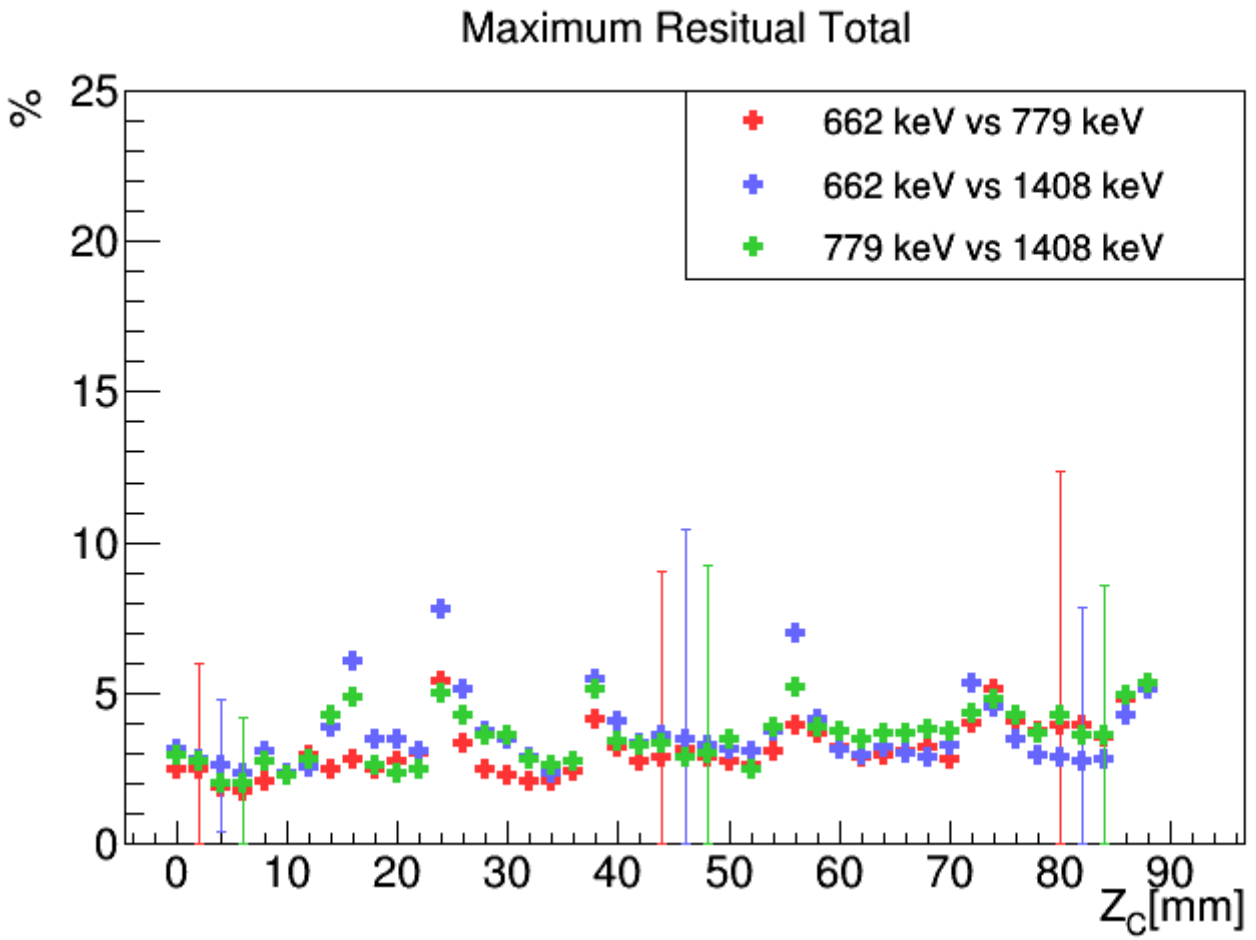
662keV vs 779keV: residuals

- Maximum residual distributions

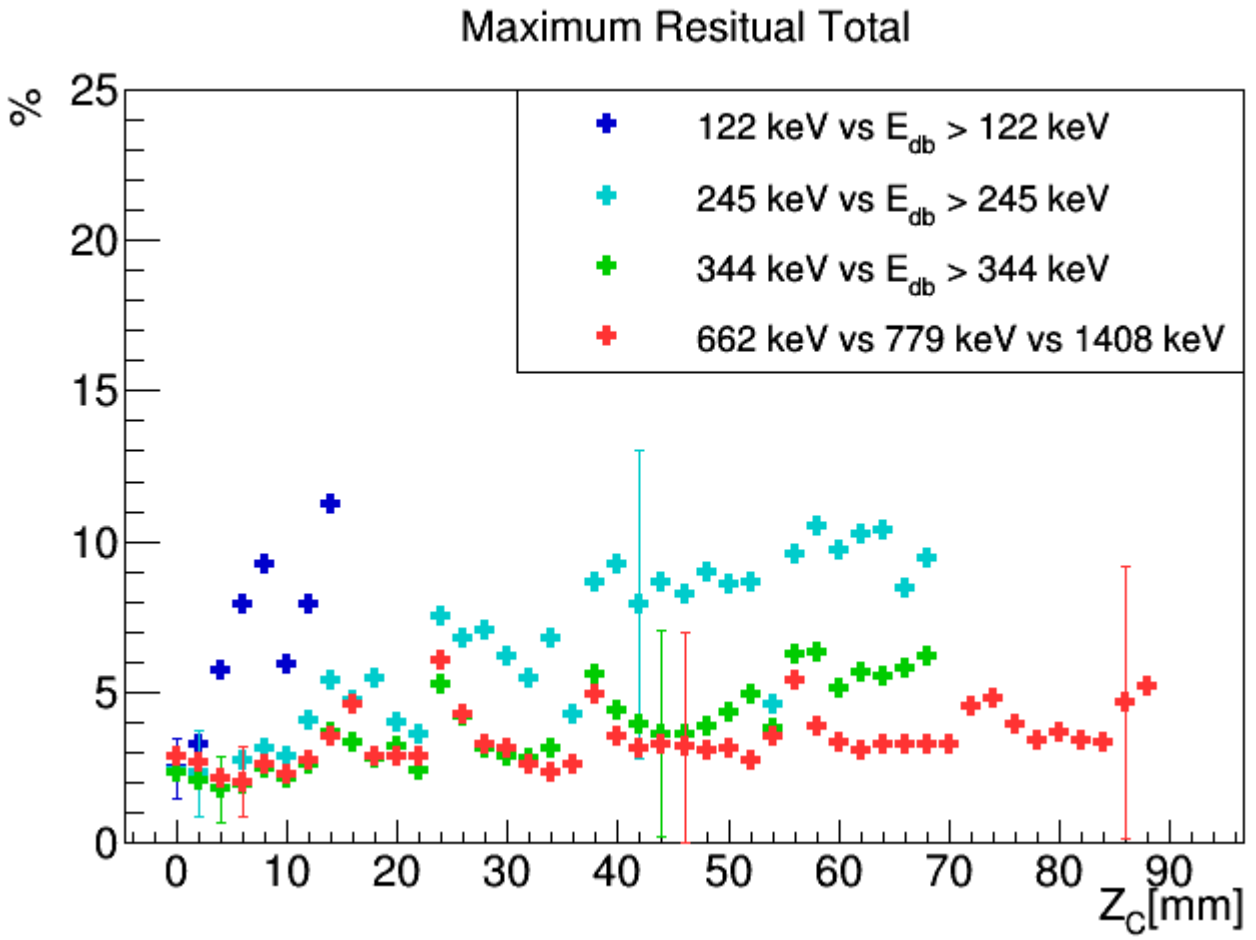
1 grid unit (2mm) thick database slices



Average database-slice residuals (High end energies)



Average database-slice residuals



(i.e.: 344keV vs 662keV, 779keV and 1408keV)

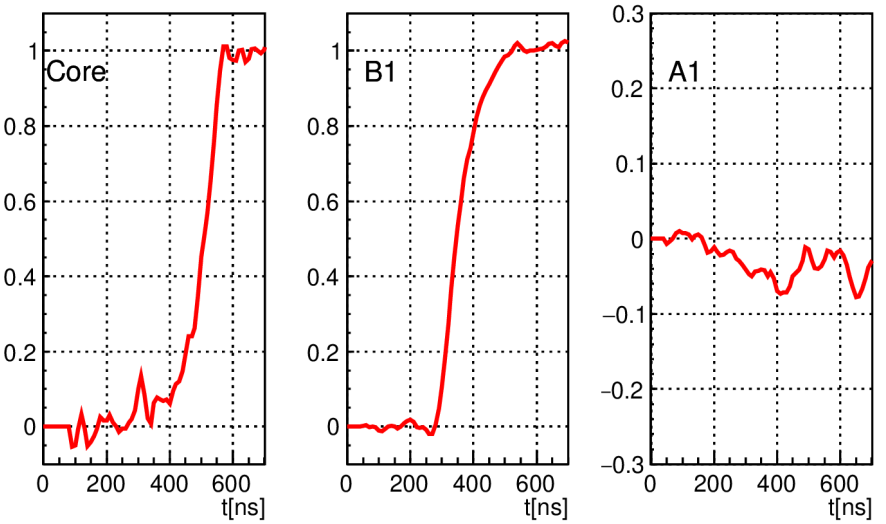
3D scans: remarks

Discrepancies are most likely due to PSCS limitations

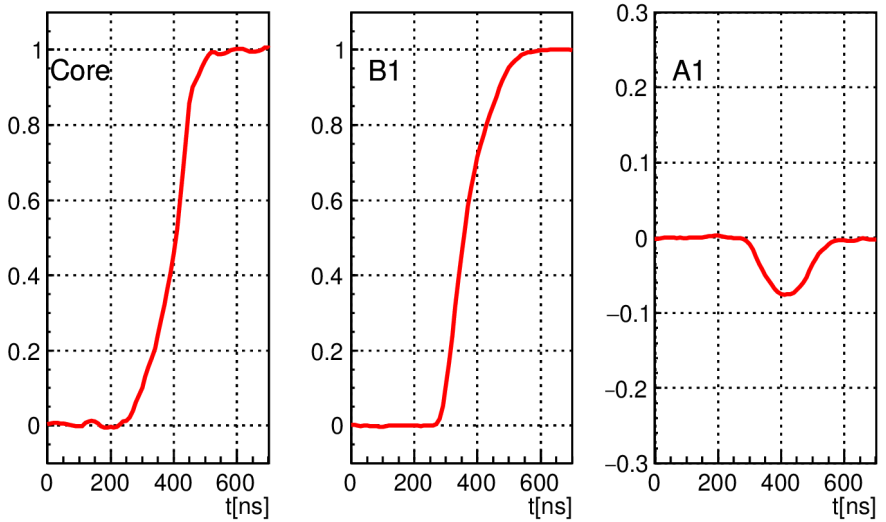
- Too much noise on low E signals?
- Less statistics toward the back of the detector?

Most likely PSA algorithms used for AGATA analysis suffer the same issues at low energies.

122 keV



1408 keV



Conclusions and perspectives

- The PSCS can be performed with a multi-energetic source.
- The results seem to confirm that different energy databases are comparable...
- ...although discrepancies appear below 500keV due to PSCS technique limitations.
- Do the AGATA PSA suffer the same limitations?
- Paper on ^{152}Eu scan results submitted