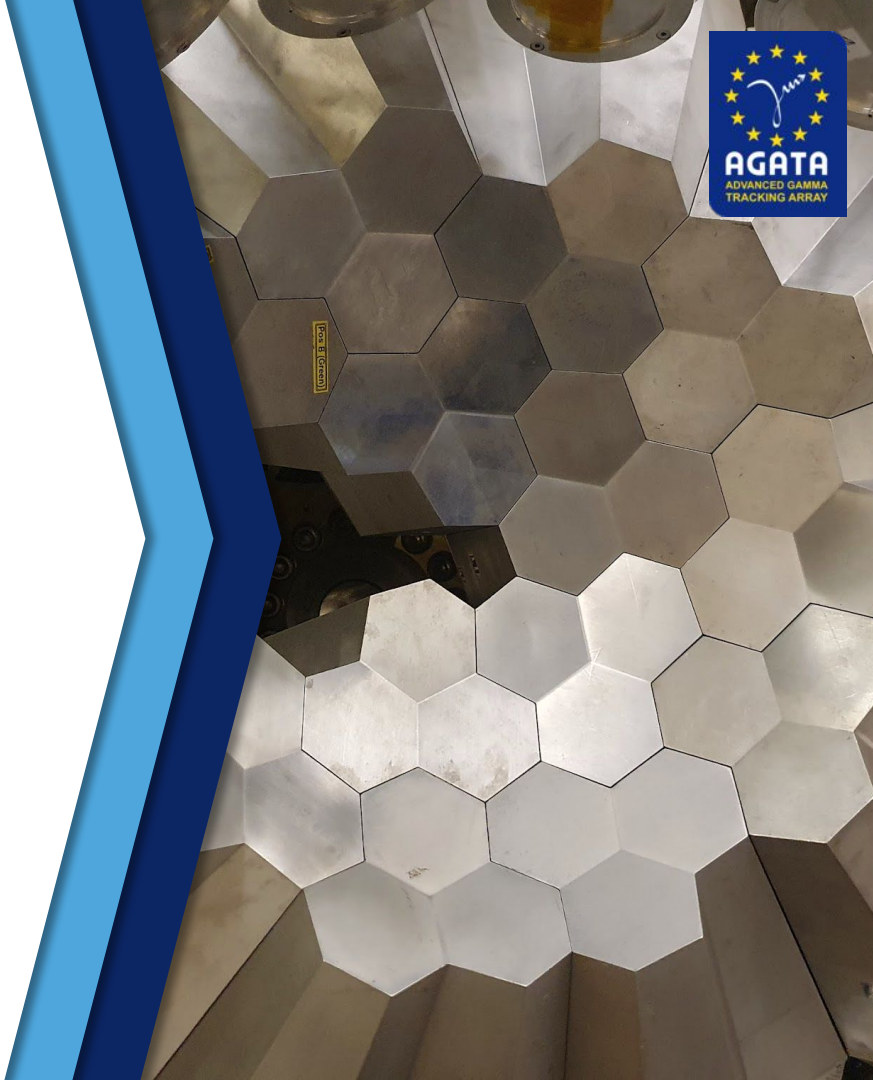
Performances at LNL

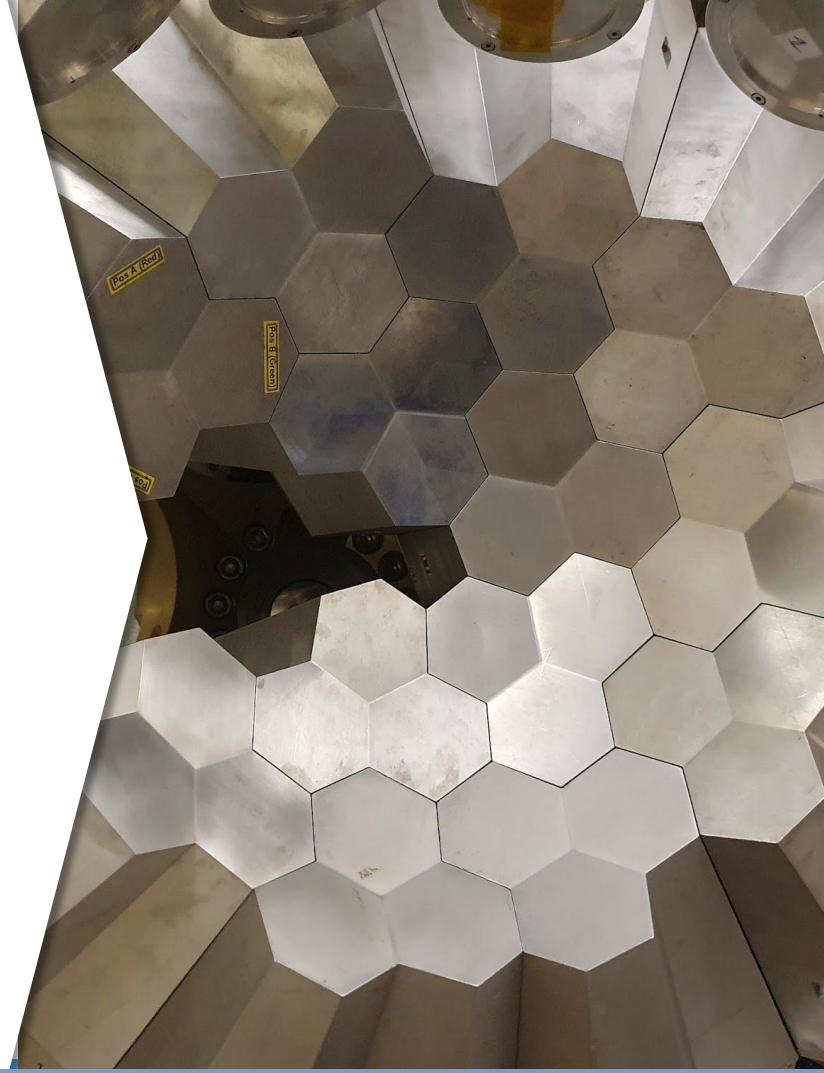
R. M. Pérez-Vidal
for the AGATA collaboration

24rd AGATA Week | 12th September 2024



Outline

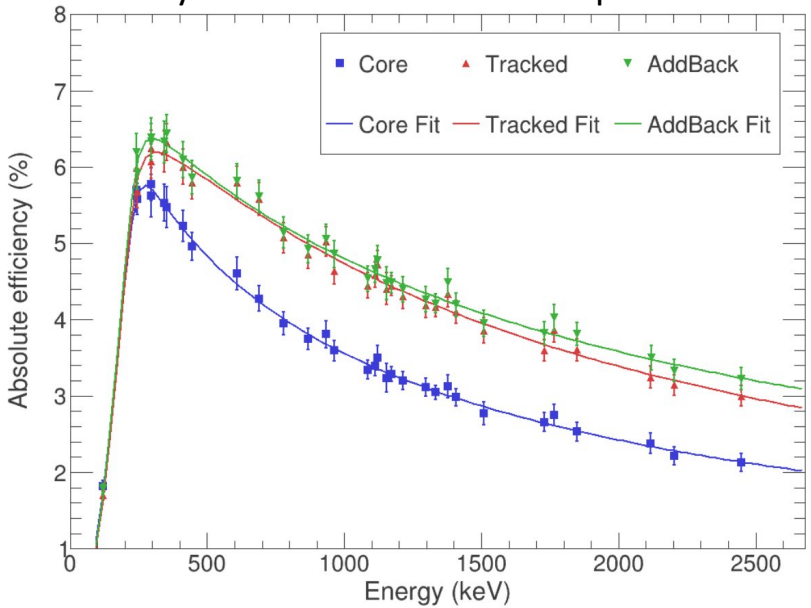
- Measurements (up to 5MeV)
- Status (end) July
- Data processing (reminder)
- Resolution (online)
- Efficiency (online)
- Summary



Measurements

How do the AGATA performances evolve at high energies?

Currently measurements: 226Ra up to 2.4 MeV



- Preparation of experimental proposals
- Analyses of γ-ray spectroscopic data
- Validation of GEANT4 simulations
- Optimization of the tracking algorithms

Analysis mode	Efficiency	P/T
Core	3.05(9) %	16.8(6) %
Tracked	4.16(12) %	32.9(9) %
Addback	4.21(13) %	28.6(8) %

@ 1.3 MeV

R. Pérez-Vidal et al., INFN-LNL Annual reports, vol. 56, 2022. (34 detectors)

Measurements

Performance up to 5MeV

1st PHASE:

^{56}Co γ-ray source measurement:

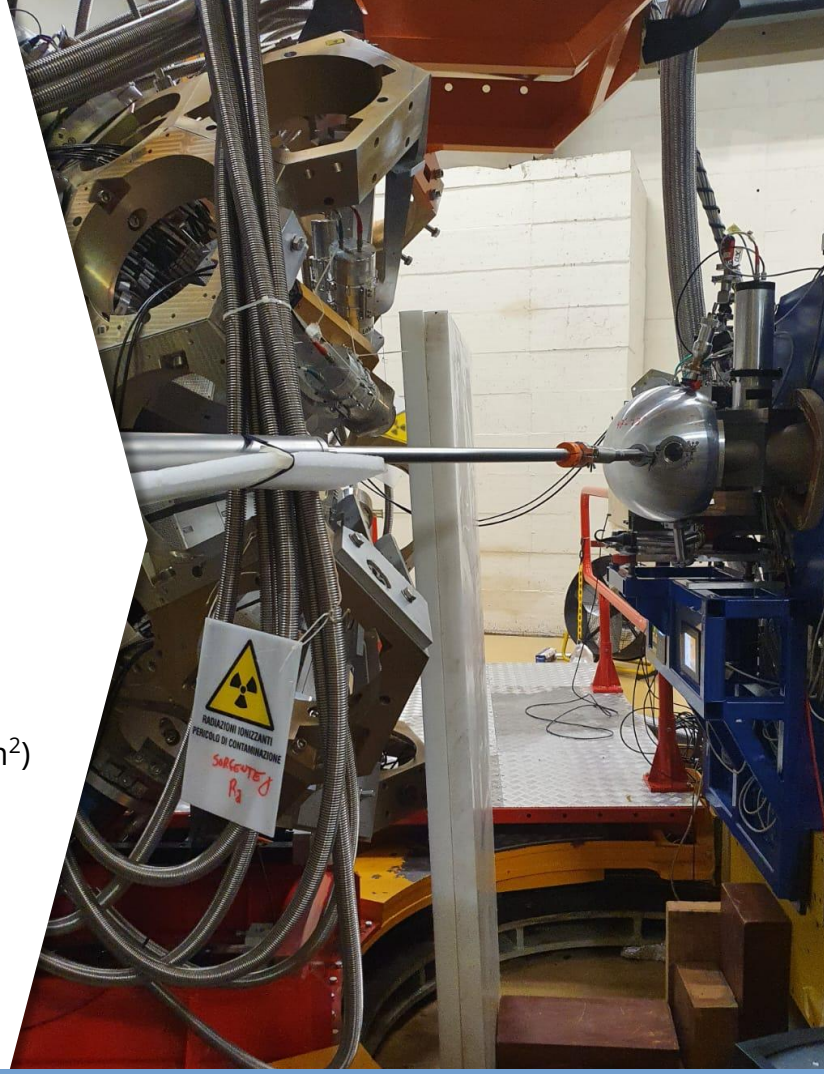
- Efficiencies up to 3.4 MeV
- Cancelled for now

2nd PHASE:

^{66}Zn(p,n) reaction:

- Efficiencies up to 5MeV
- E=13MeV (σ≈ **680 mb**)
- Target: Au (0.1mg/cm^2)+^{66}Zn (1.5mg/cm^2)+Au (1.5mg/cm^2)
- I_{beam}≈ **2-10 pnA**
- AGATA @ **back-most + paraffin wall**

26th-31st July 2024



M. Balogh, Md. S. R. Laskar, S. Bottoni, R.M. Pérez-Vidal, S. Pigliapoco
and the AGATA performance team collaboration

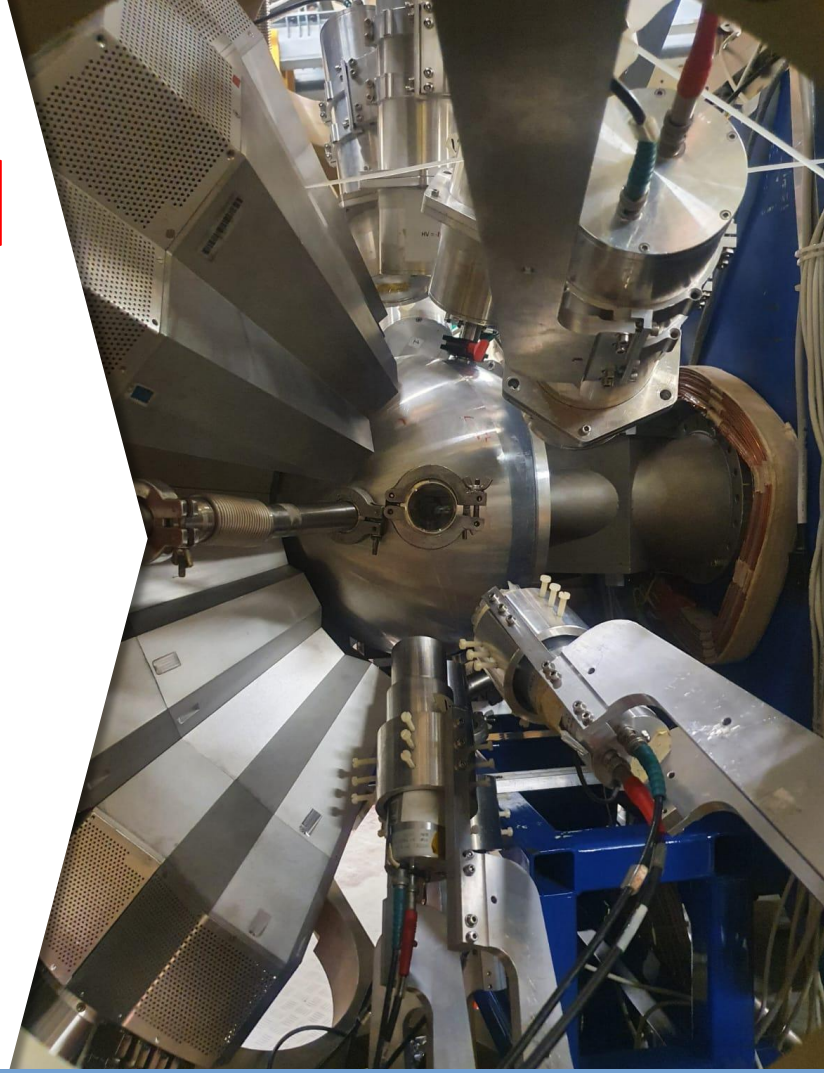
Measurements

Performance up to 5MeV

26th-31st July 2024

- AGATA position: Nominal (23.5 cm) and Close-up (18 cm)
- Closed chamber, Without absorbers
- 2.5μs

Source	Position	Duration	Rate
60Co	Nominal	2.5h	1.5kHz
	Nominal Traces	1h ; 1.5h	
	Close-up	2h	2kHz
152Eu	Nominal	4h ; 2h	2kHz
	Nominal Traces	2h ; 1.5h	
	Close-up	3h ; 2h	3kHz
133Ba	Nominal	2.3h	2kHz
	Close-up	1.6h	2.7kHz
226Ra	Nominal	4h	1.6kHz
	Close-up	2h	2KHz
Target	Nominal	5.7h	1.8kHz
	Nominal Traces	2h	1.2kHz
	Close-up	6h	0.7kHz
	Close-up Traces	2h	0.45kHz & 1.5kHz
60Co	Far Traces	6h ; 6h	1kHz-0.8Hz



Measurements

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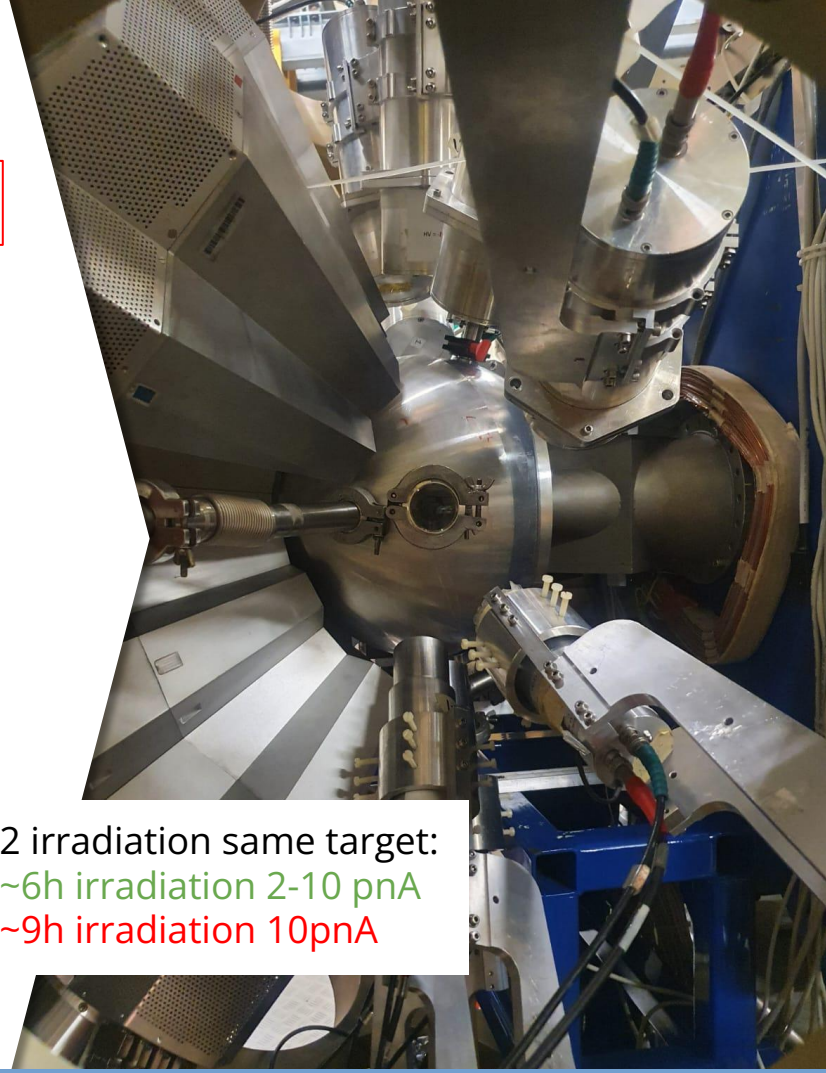

2 irradiation same target:
~6h irradiation 2-10 pnA
~9h irradiation 10pnA

Measurements

Performance up to 5MeV

26th-31st July 2024

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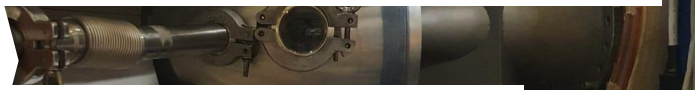
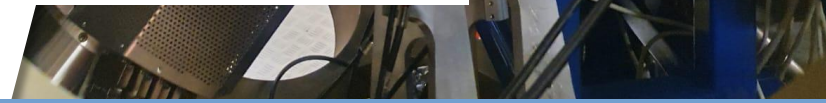
60Co for status/individual performances



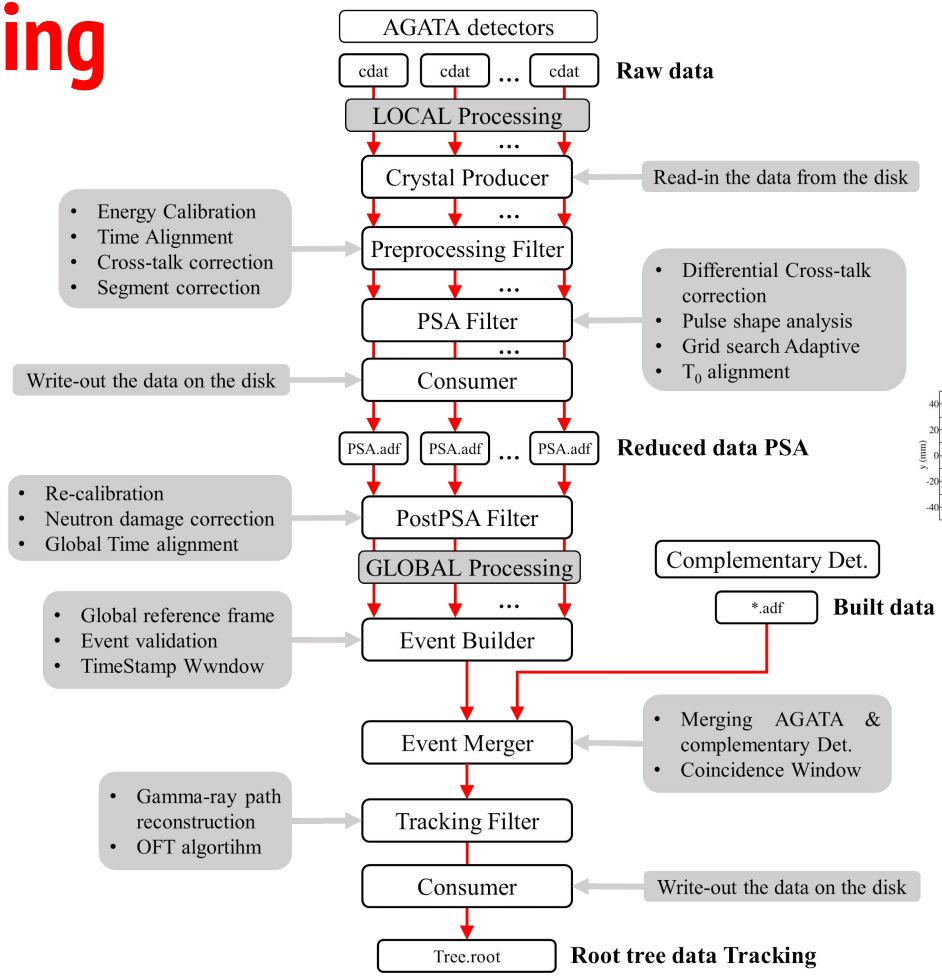
152Eu for Efficiency normalization

2 irradiation same target:
~6h irradiation 2-10 pnA
~9h irradiation 10pnA

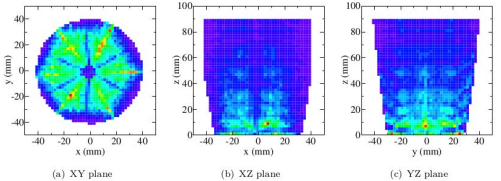


Data Processing

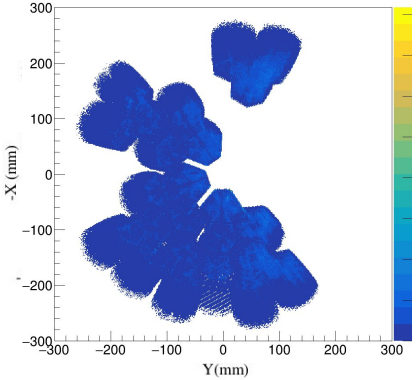
Narval Actors



Pulse Shape Analysis



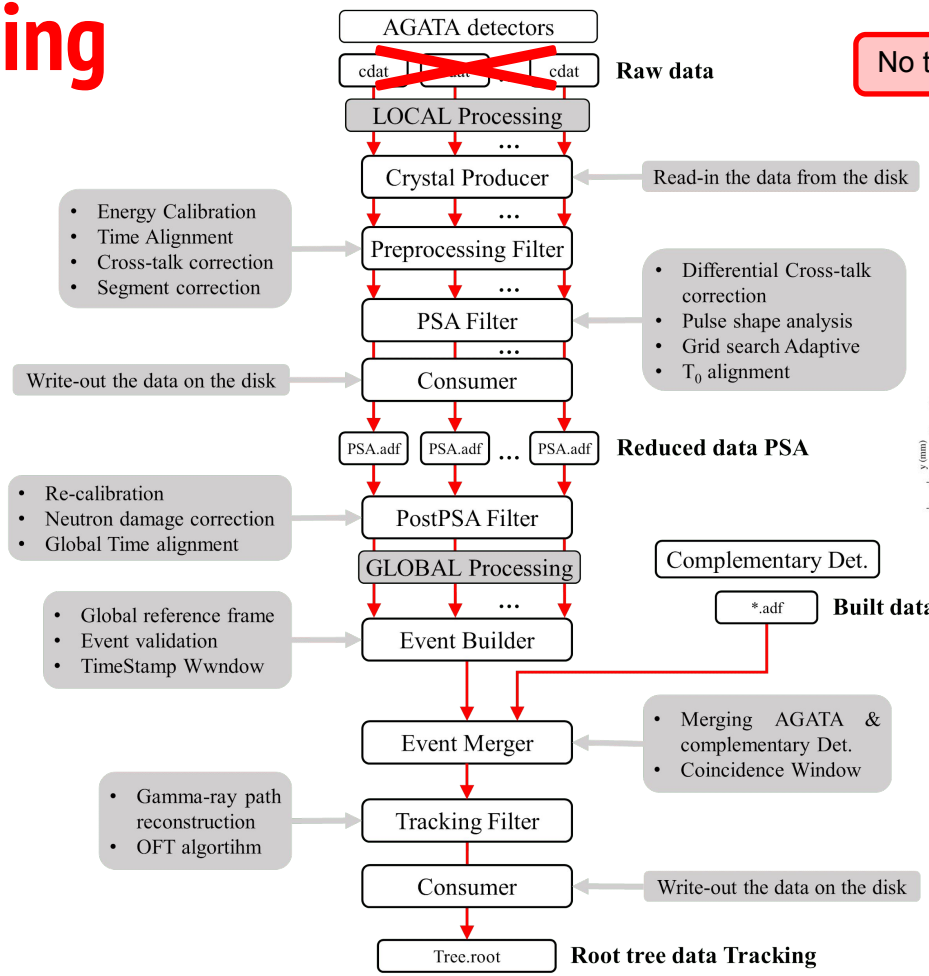
Tracking



First Interaction pattern

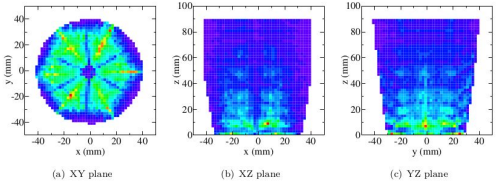
Data Processing

Narval Actors

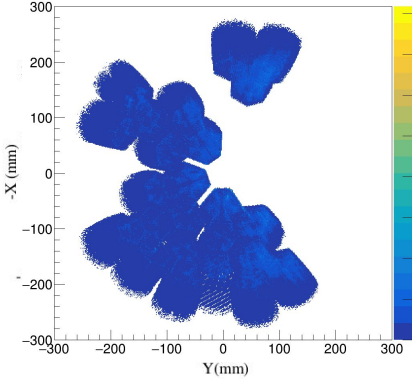


No traces stored during LNL campaign

Pulse Shape Analysis



Tracking

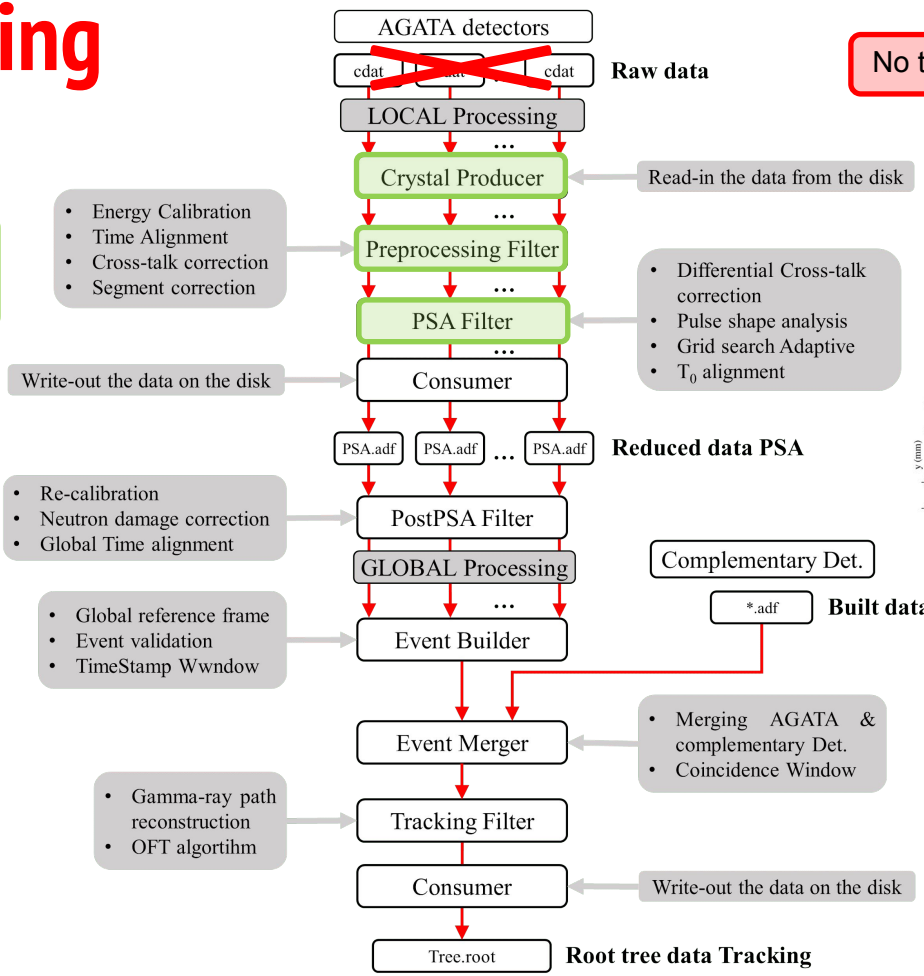


First Interaction pattern

Data Processing

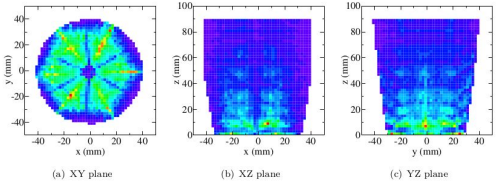
Narval Actors

Operations up to the PSA need to be carefully prepared before the experiment and checked online

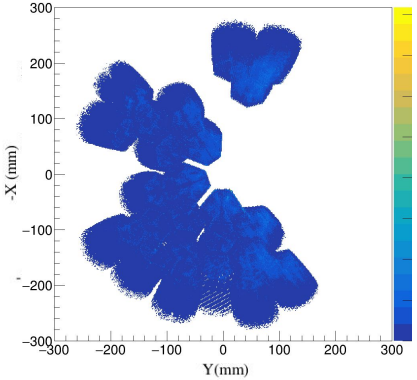


No traces stored during LNL campaign

Pulse Shape Analysis



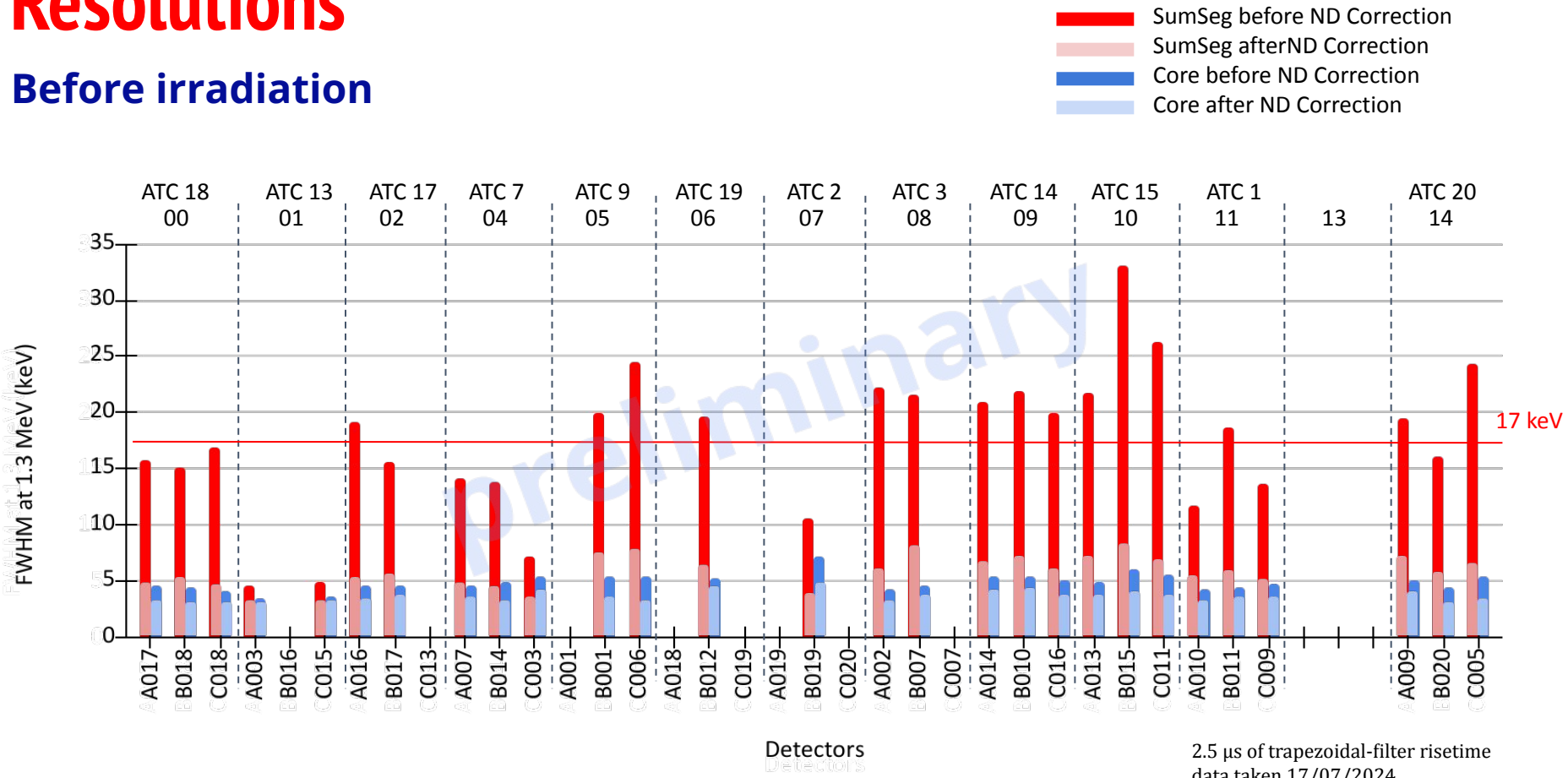
Tracking



First Interaction pattern

Resolutions

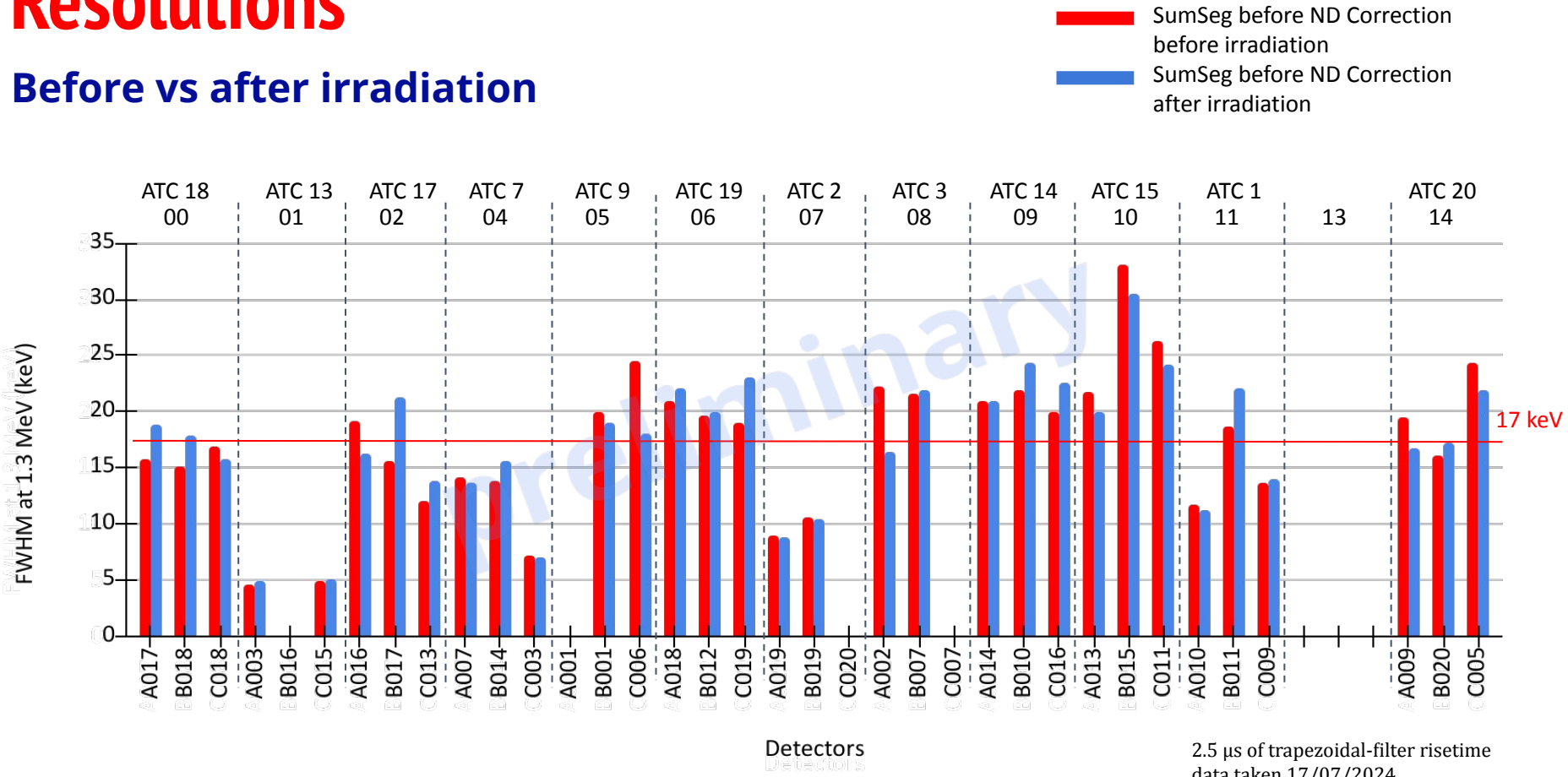
Before irradiation



2.5 µs of trapezoidal-filter risetime
data taken 17/07/2024

Resolutions

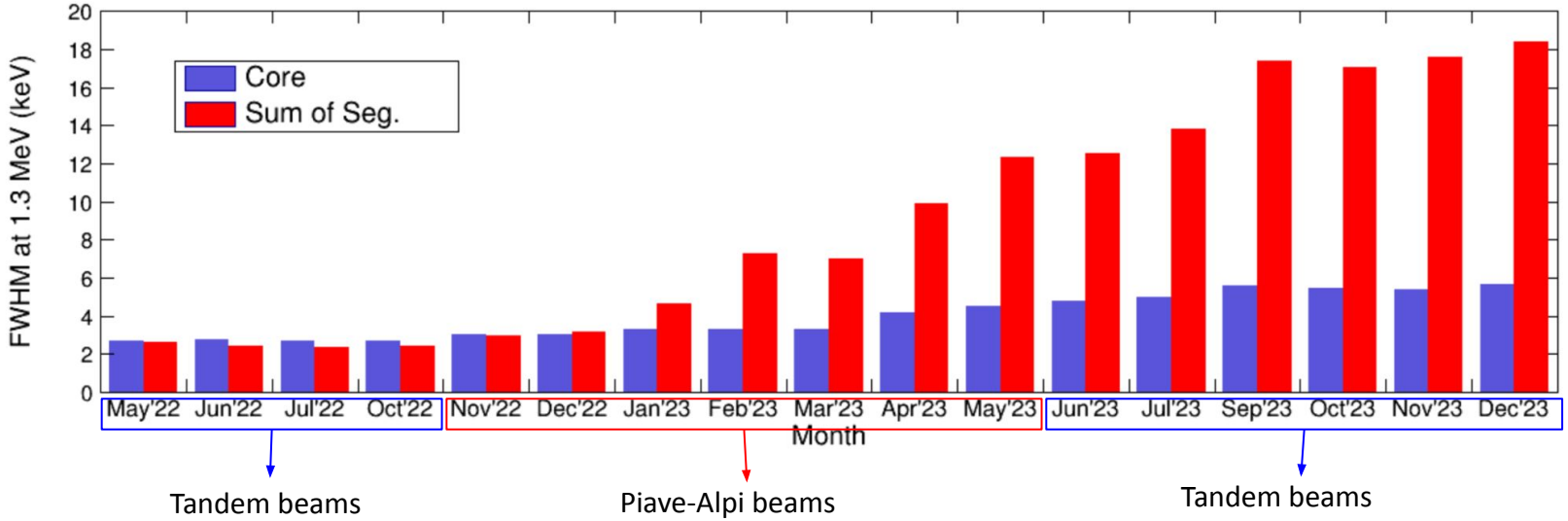
Before vs after irradiation



2.5 µs of trapezoidal-filter risetime
data taken 17/07/2024
data taken 31/07/2024

Resolution

FWHM over time for detector 00C (ATC12-C018)



FWHM resolution at 1.3 MeV for the encapsulated detector 00C since the beginning of the AGATA phase II campaign at LNL. The core energy resolution worsened from 2.7 keV to 5.7 kev, while the sum of segments deteriorated from 2.7 keV to 17.9 keV. Note: the measurements were performed by using 6 μs of trapezoidal-filter risetime (May-Oct 2022 and Feb 2023 and Nov 2023) and 2.5 μs of trapezoidal-filter risetime (Nov 2022-Dec 2023).

Resolution

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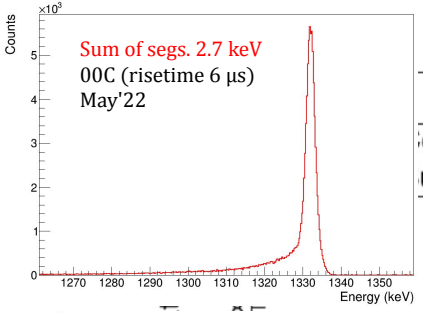

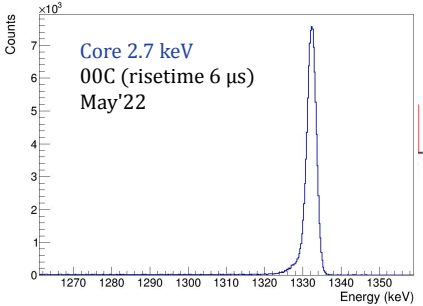

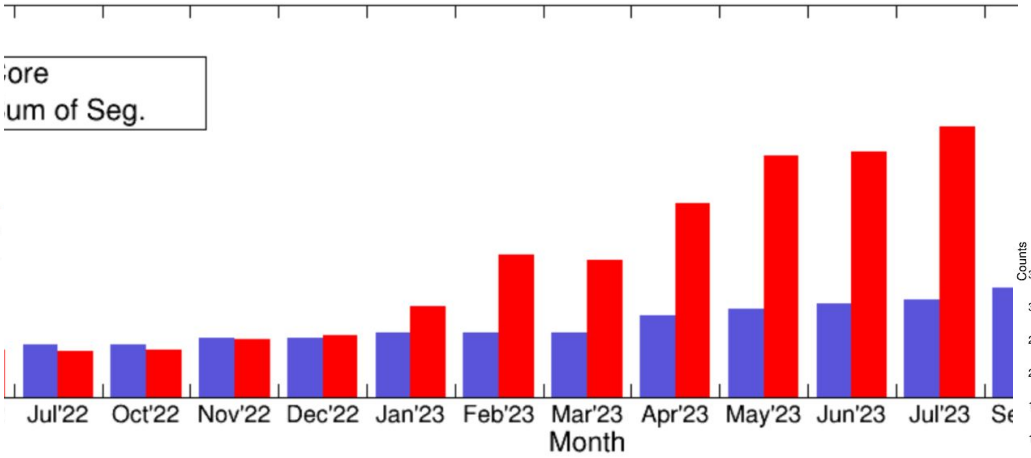

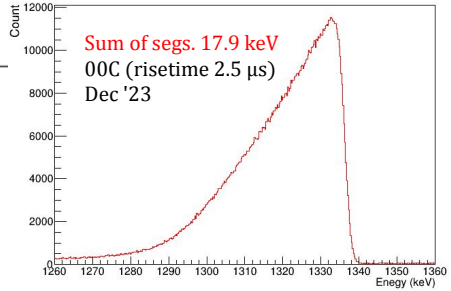

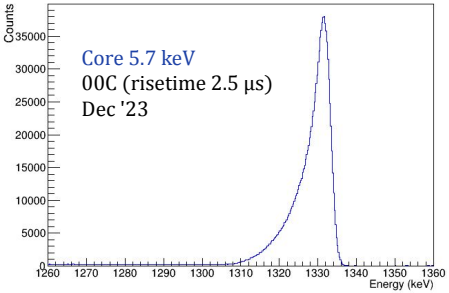

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Resolution

Average FWHM at 1.3MeV

February 2024

- Core: ~4,3 keV ➡ ~3,0 keV
- Sum Seg.: ~9,2keV ➡ ~ 3,9 keV

➡

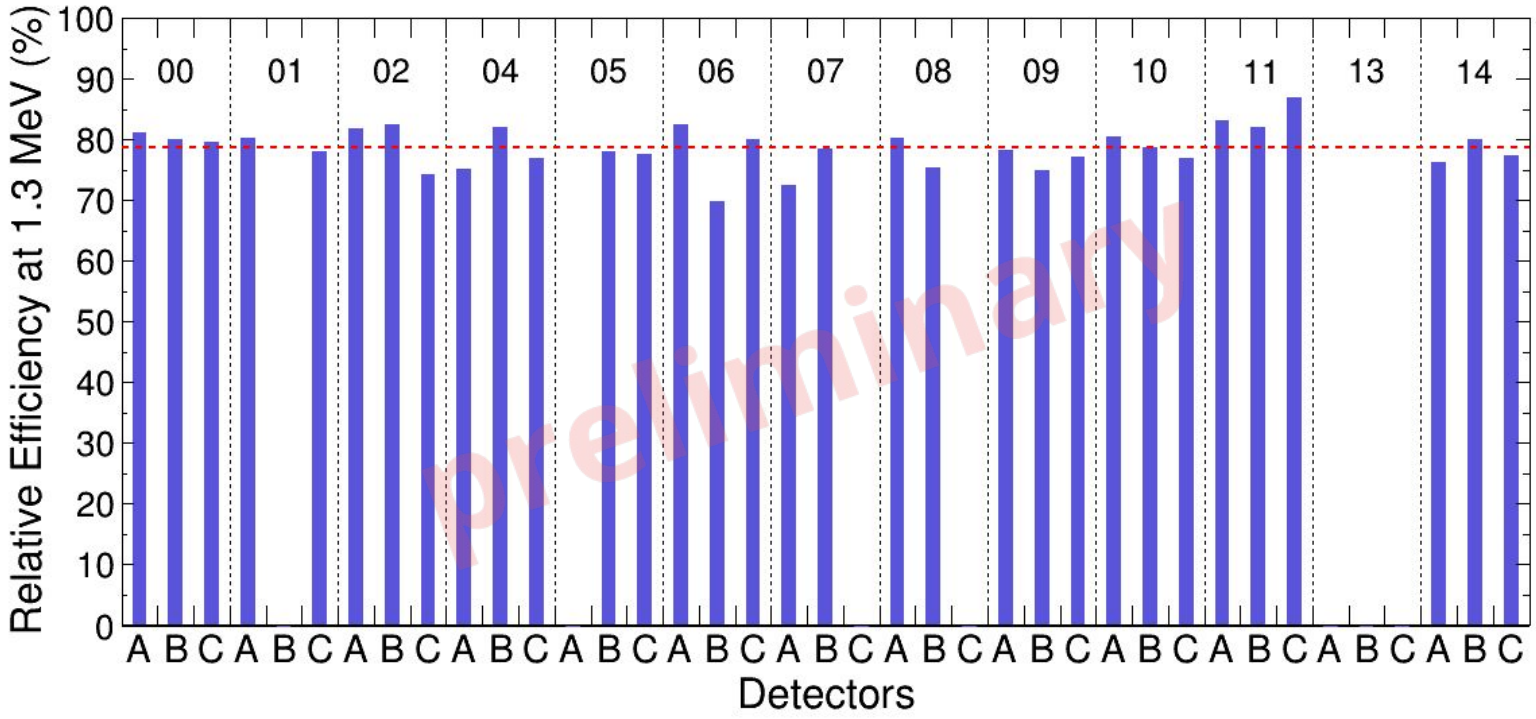
July 2024

- Core: ~5,8 keV ➡ ~3,6 keV
- Sum Seg.: ~17,6keV ➡ ~ 4,9 keV

Efficiency

AGATA crystals

Relative efficiency to the reference value of a 3'x3' NaI at 25 cm= 0.0012



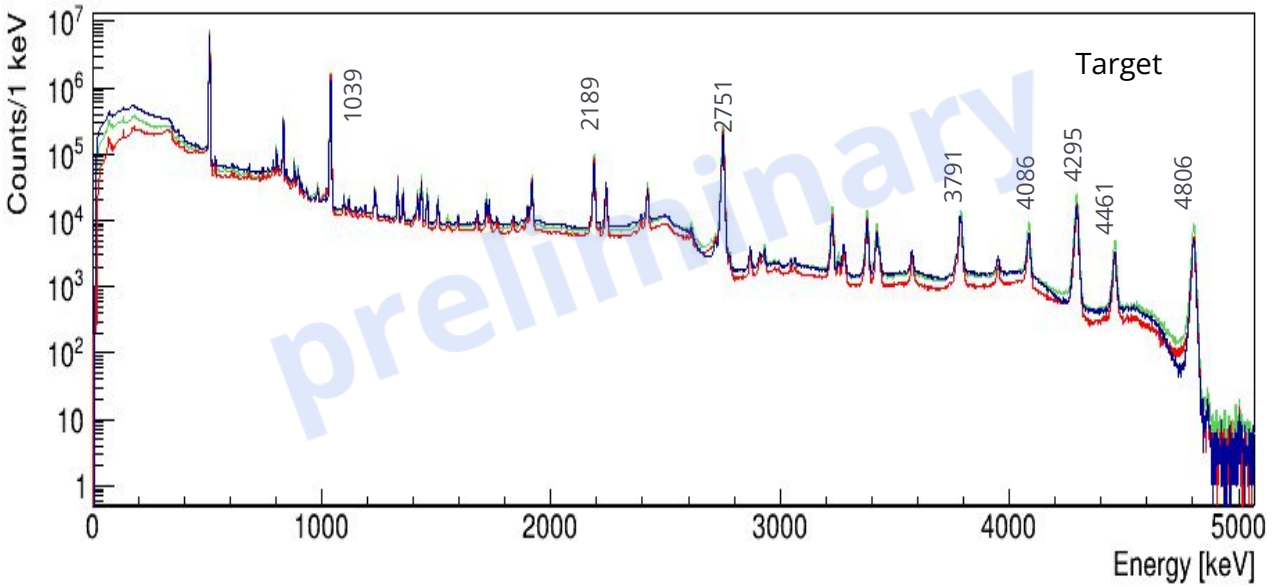
Efficiency

AGATA array

$^{66}Zn(p,n)^{66}Ga$ reaction:

Energy [keV]	Intensity [%]	Rel. uncertainty [%]
833.53	5.90	5.08
1039.22	37.00	5.41
1333.11	1.17	5.13
1918.33	1.99	5.53
2189.62	5.30	5.66
2422.53	1.88	5.32
2751.84	22.70	5.29
3228.80	1.61	5.30
3380.85	1.47	5.44
3422.04	0.86	5.81
3791.00	1.09	5.50
4085.85	1.27	5.51
4295.19	3.81	5.51
4461.20	0.84	5.95
4806.01	1.86	5.38

Core	sum of the core histograms over all crystals
Tracked	energy of the reconstructed tracks after OFT algorithm
Addback	sum all the neighbouring crystal cores position is given by the highest energy

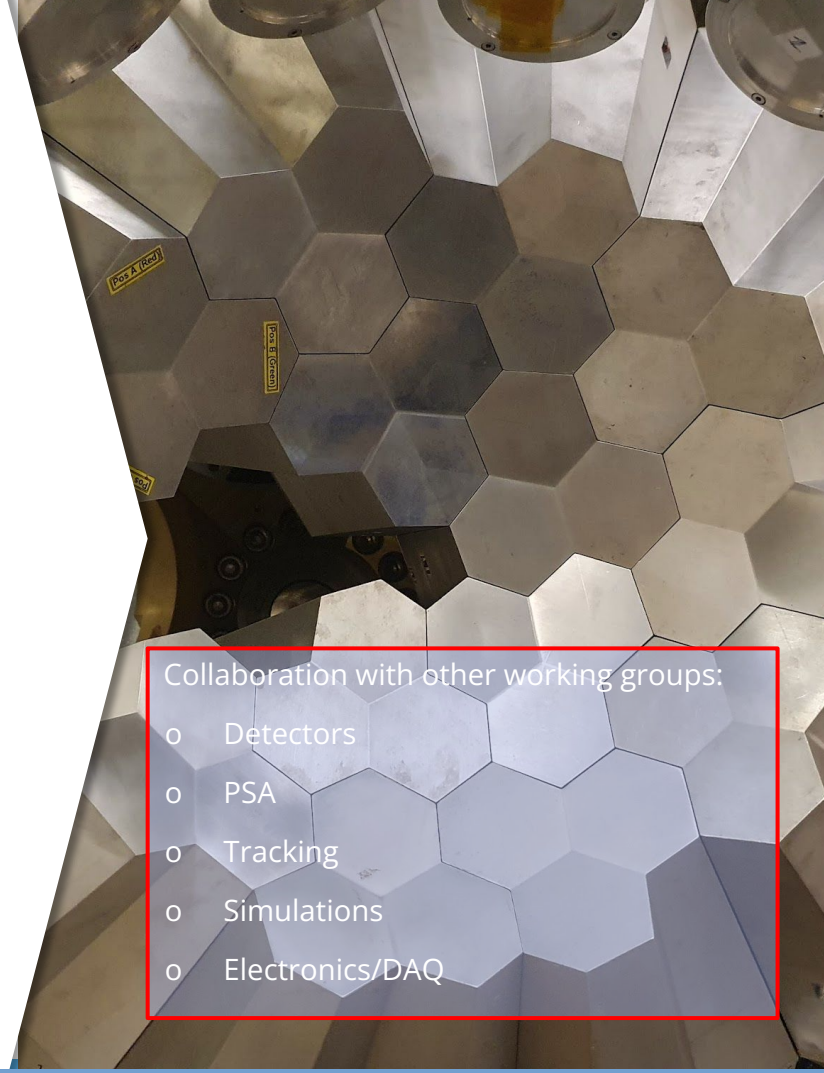


Summary

- Experiments looking for gamma rays in the region between 2-5 MeV where the performances in terms of calibration, efficiency and tracking are not well known.
- **Measurement to investigate those performances up to 5 MeV realized at the end of July**
- Next steps:
  - PSA
  - PostPSA
  - Dead time evaluation
  - Core and Addback analysis
  - Optimization of the tracking algorithms
  - Validation of GEANT4 simulations

- **Average FWHM resolution at 1.3MeV (before/after correction):**
  - Core: ~5,8 keV ➡ ~3,6 keV
  - Sum Seg.: ~17,6keV ➡ ~ 4,9 keV
  - Detectors in positions 10 and 9 will be exchanged by new detectors

- Future perspectives: towards high multiplicity events



Collaboration with other working groups:

- Detectors
- PSA
- Tracking
- Simulations
- Electronics/DAQ

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for the AGATA collaboration

This work was partially supported by MCIN/AEI/10.13039/501100011033, Spain with grant PID2020-118265GB-C42, by Generalitat Valenciana, Spain with grant CIAPOS/2021/114 and by the EU FEDER funds.

24rd AGATA Week | 12th September 2024

AGATA Crystal lookup table

Position	ATC	Crystal			Installation date
		A	B	C	
00	12	006	005	001	01/04/2022-15/01/2024
	18*	017	018	018	15/01/2024
01	10	011	006	012	01/02/2022- 03/04/2024
	13	003	016	015	03/04/2024
02	**17**	016	017	013	01/02/2022
04	11	004	004	010	01/09/2022-04/04/2024
	7*	007	014	003	04/04/2024
05	**09**	001	001	004 006	? 01/05/2022
06	06	008	009	002 014	? 01/09/2022-14/12/2023
	19	018	012	019	13/02/2024
07	14	014	010	016	01/03/2022-18/09/2023
	2	019	019	020	18/09/2023
08	**3**	002	007	007	01/03/2022
09	18	017	018	018	01/03/2022-19/10/2023
	14*	014	010	016	19/10/2023
10	15	013	015	011	01/03/2022
11	**1**	010	011	009	01/04/2022
13	**19**	018	012	019	01/09/2022
14	7	015 007	014	008 003	? 01/09/2022-01/01/2023
	20	009	020	005	01/01/2023

*2nd time in the array