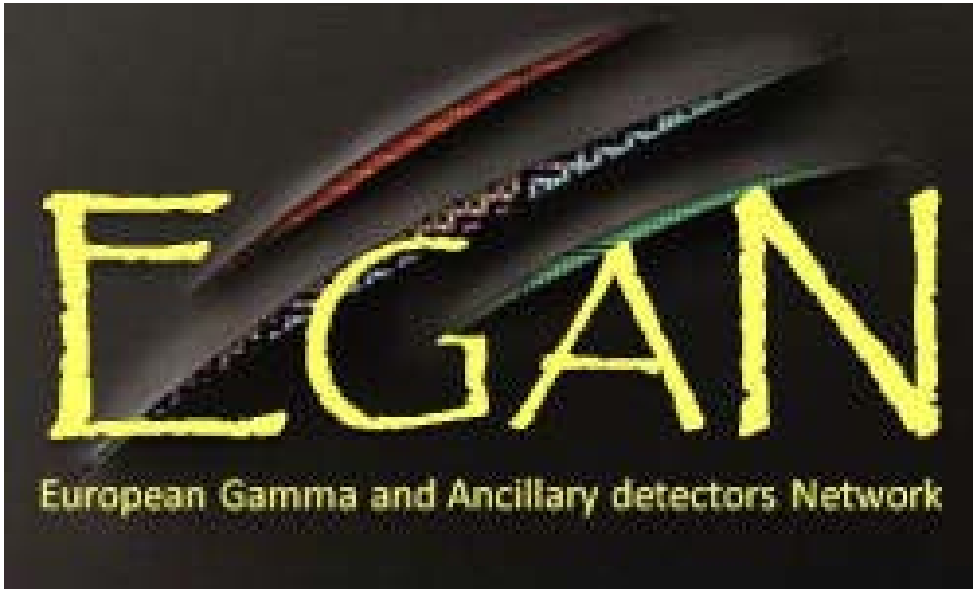
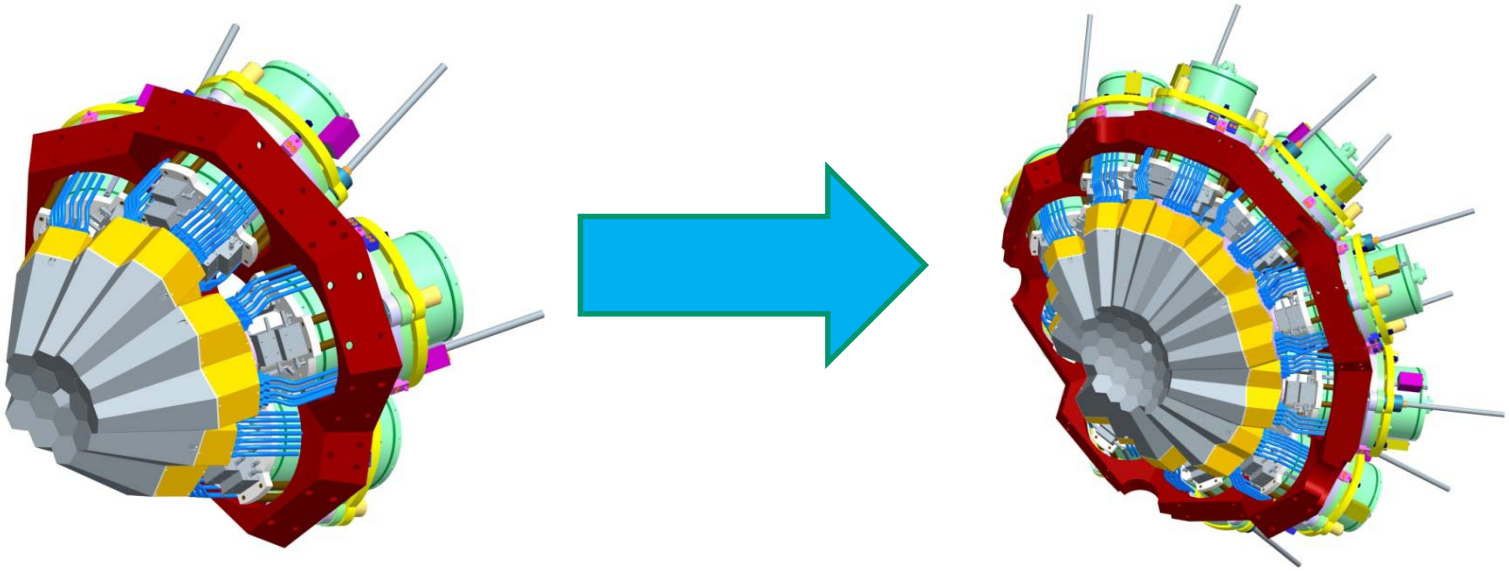
The AGATA-PreSpec campaign at GSI



Wolfram KORTEN
CEA Saclay

The AGATA-PreSpec campaign at GSI

From the AGATA demonstrator to 1/3 phase



Demonstrator operational at LNL
Deliverable of the R & D phase

First exploitation phase
Operation and construction

New memorandum of Understanding has been signed by (almost) all parties
Defines planning, funding, construction and operation of AGATA to 4π
First construction phase 15-20 triple cluster within "~4 years"
http://npg.dl.ac.uk/AGATA/AGATA_MoU_web.pdf

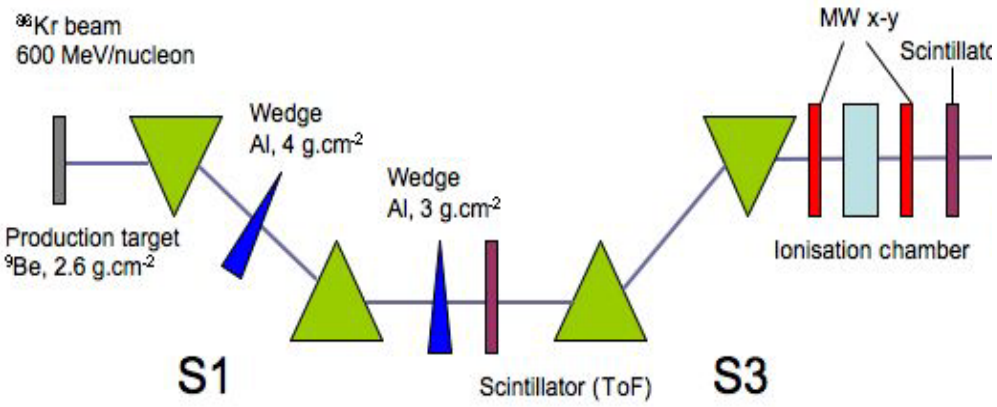
Goal is to use "as many detectors as possible" for AGATA@GSI

AGATA at the GSI Fragmentseparator (2012/13)

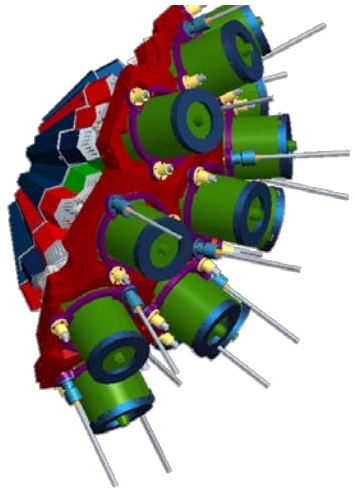
“In-flight spectroscopy of exotic nuclei”

Campaign coordinators: M. Bentley & W. Korten

Higher SIS intensities (x10)

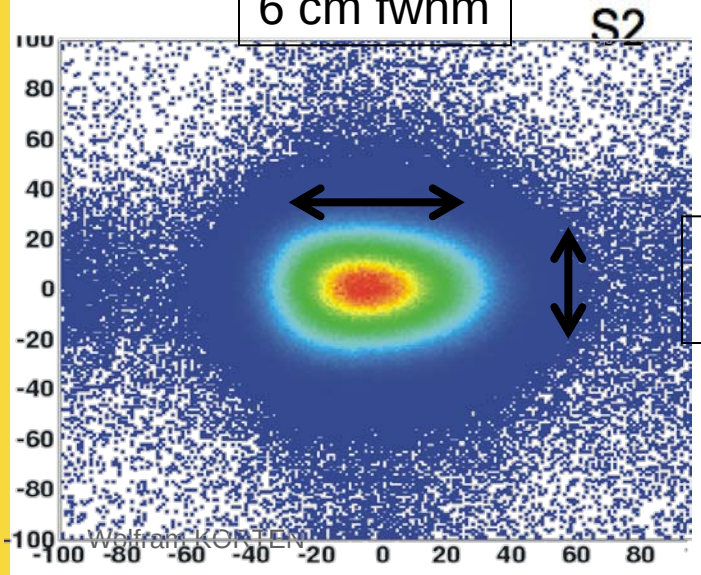


AGATA sub array (x10-100)

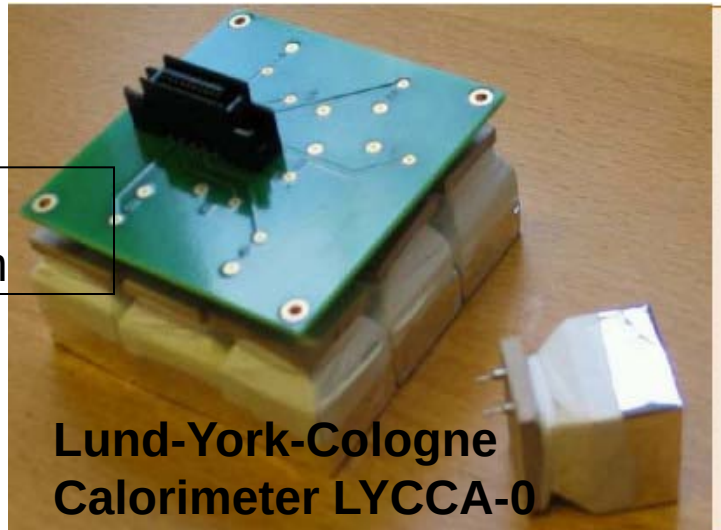


Particle ID
ΔE,E, ToF
➔ΔA/A~1%

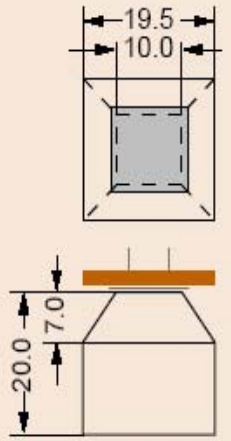
6 cm fwhm



4 cm fwhm

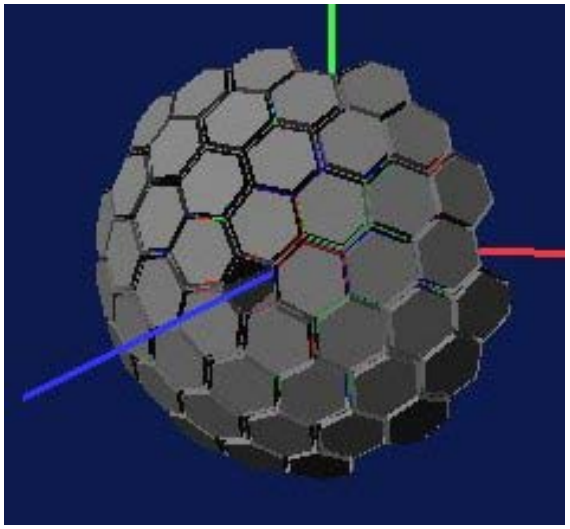


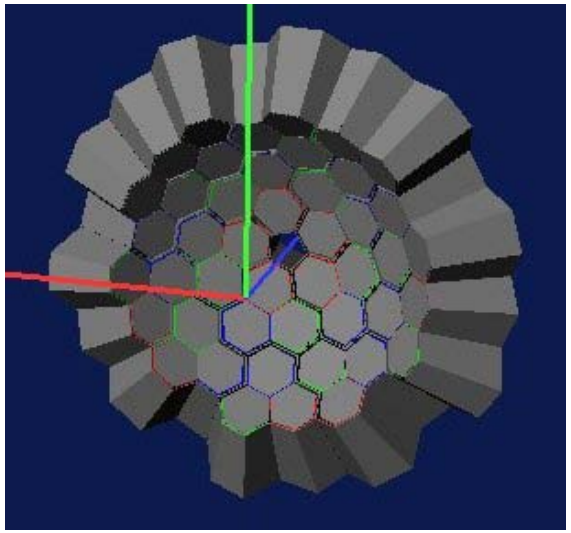
Lund-York-Cologne Calorimeter LYCCA-0

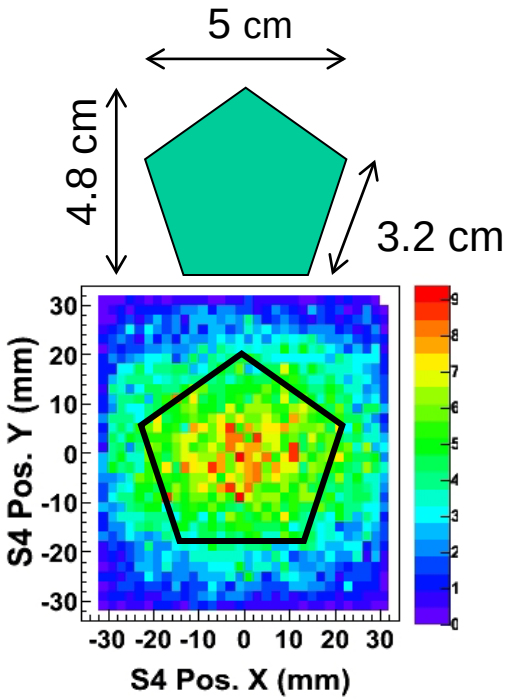


Constraints for the AGATA set up at the FRS

- Ideal geometry (first approach, first step)







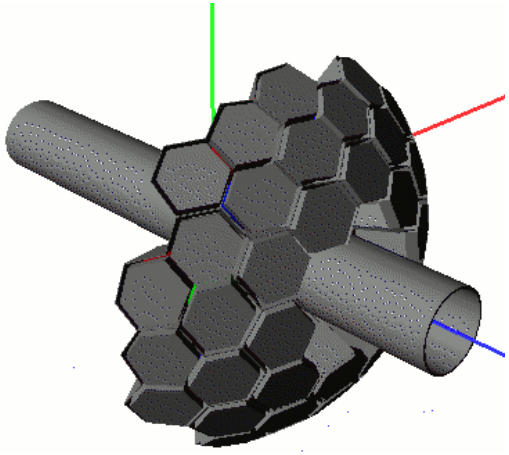
- two main constraints:

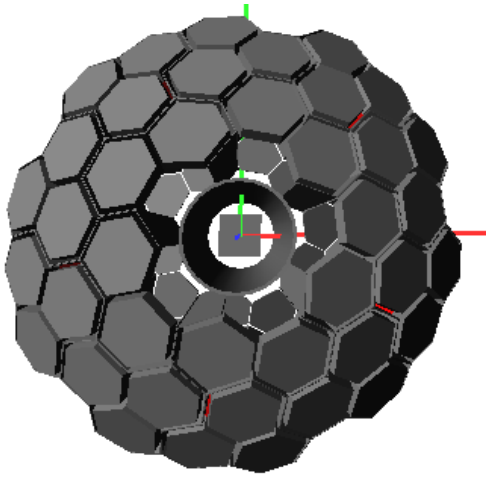
1. The beam exit (through pentagon) is too small for the GSI beam size
2. 15 cluster detectors will not be available yet in 2012 (25-30 detectors max.)

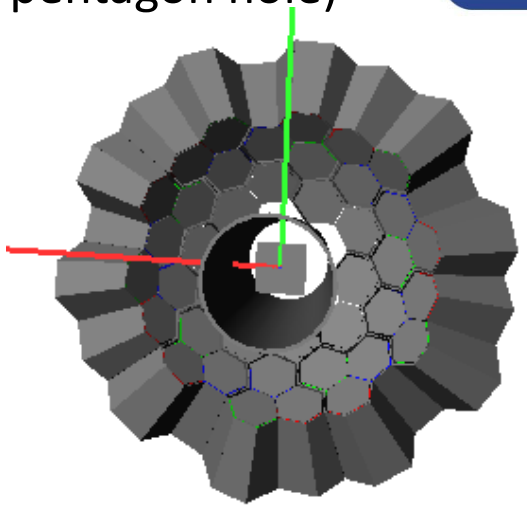
AGATA 1π array for GSI with double clusters

- 10 Triple Clusters + 5 Double Cluster detectors

  ➔ beam pipe diameter ≈9-12cm (5 hexagons + pentagon hole)







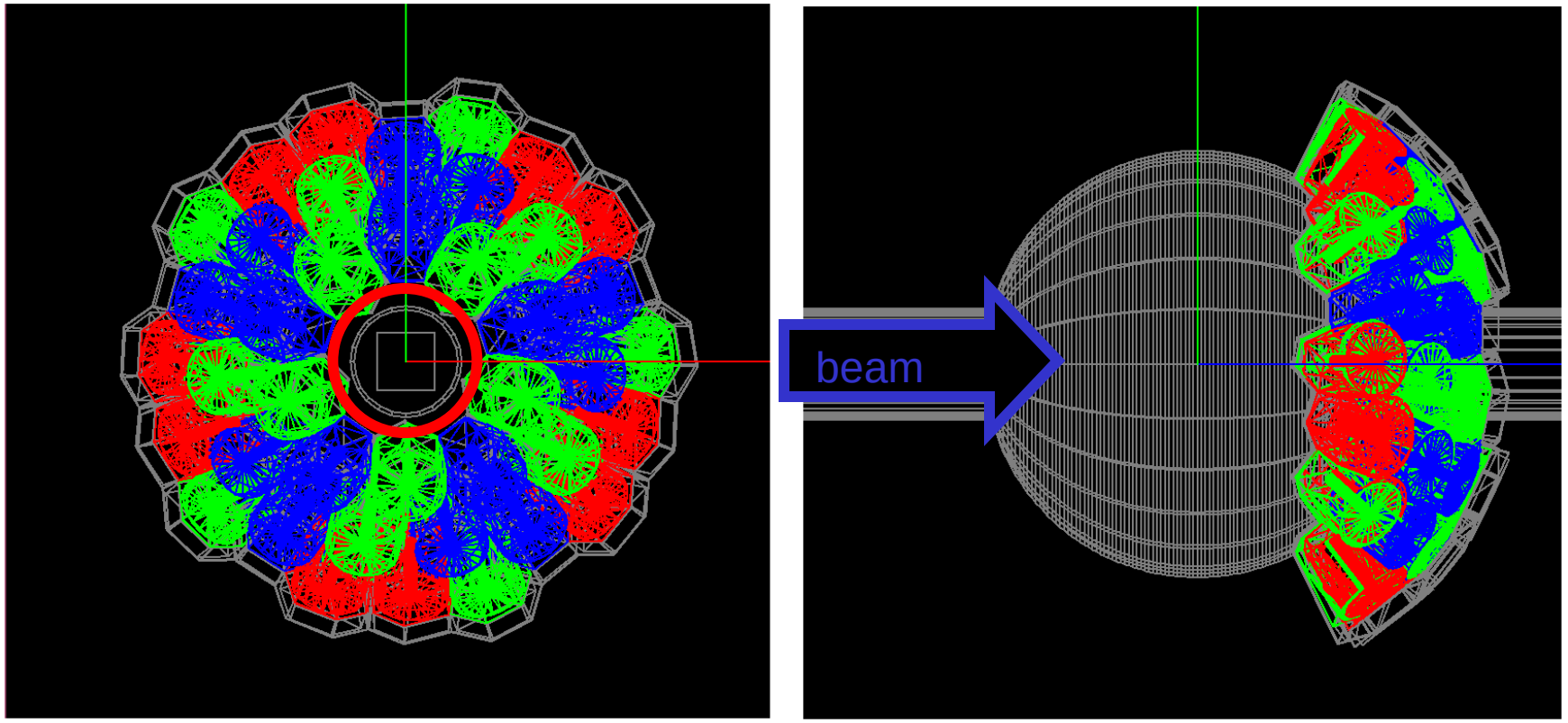
10 triple Cluster + 5 double Cluster = 40 Ge detectors

Courtesy of
C. Domingo-Pardez

AGATA 1π geometry : 10 triple + 5 double cluster detectors

Closest Ge crystals are at ~ 17 cm

Room for a chamber 46cm diameter

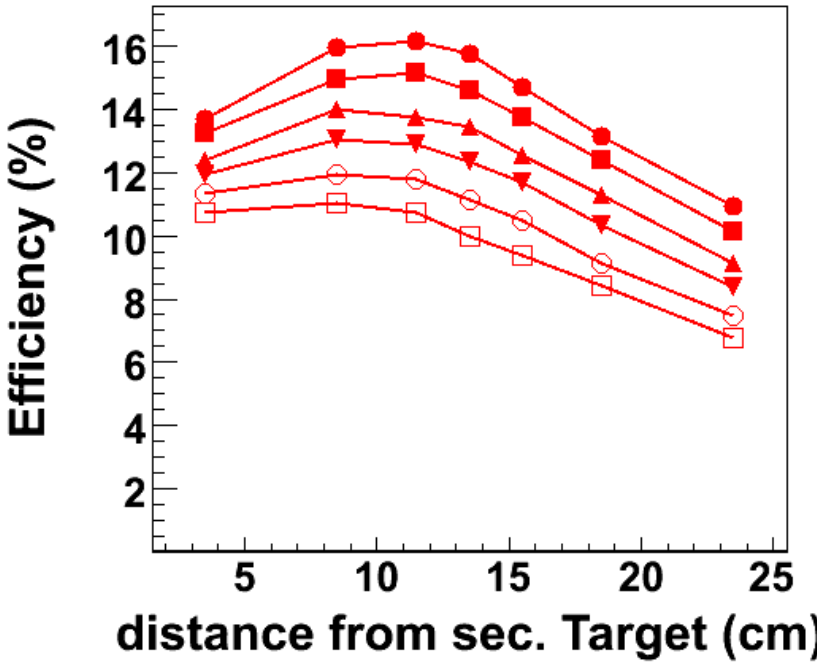


Detector distance will be varied by moving the target “downstream”

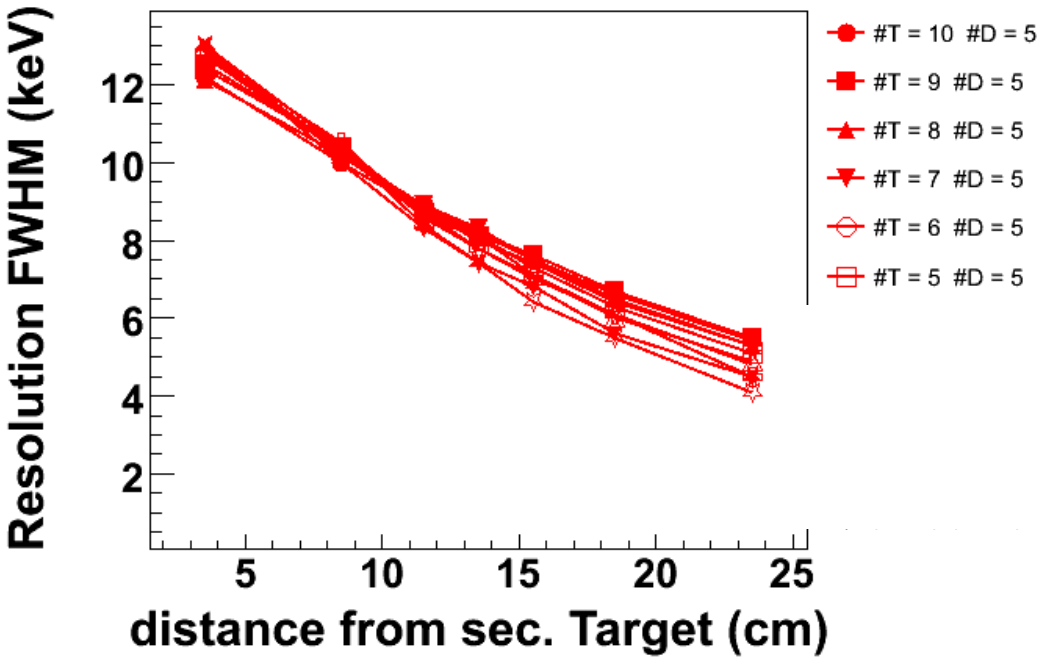
Courtesy of
C. Domingo-Pardez

AGATA 1π geometry: efficiency vs. # of triple clusters

EFFICIENCY



RESOLUTION



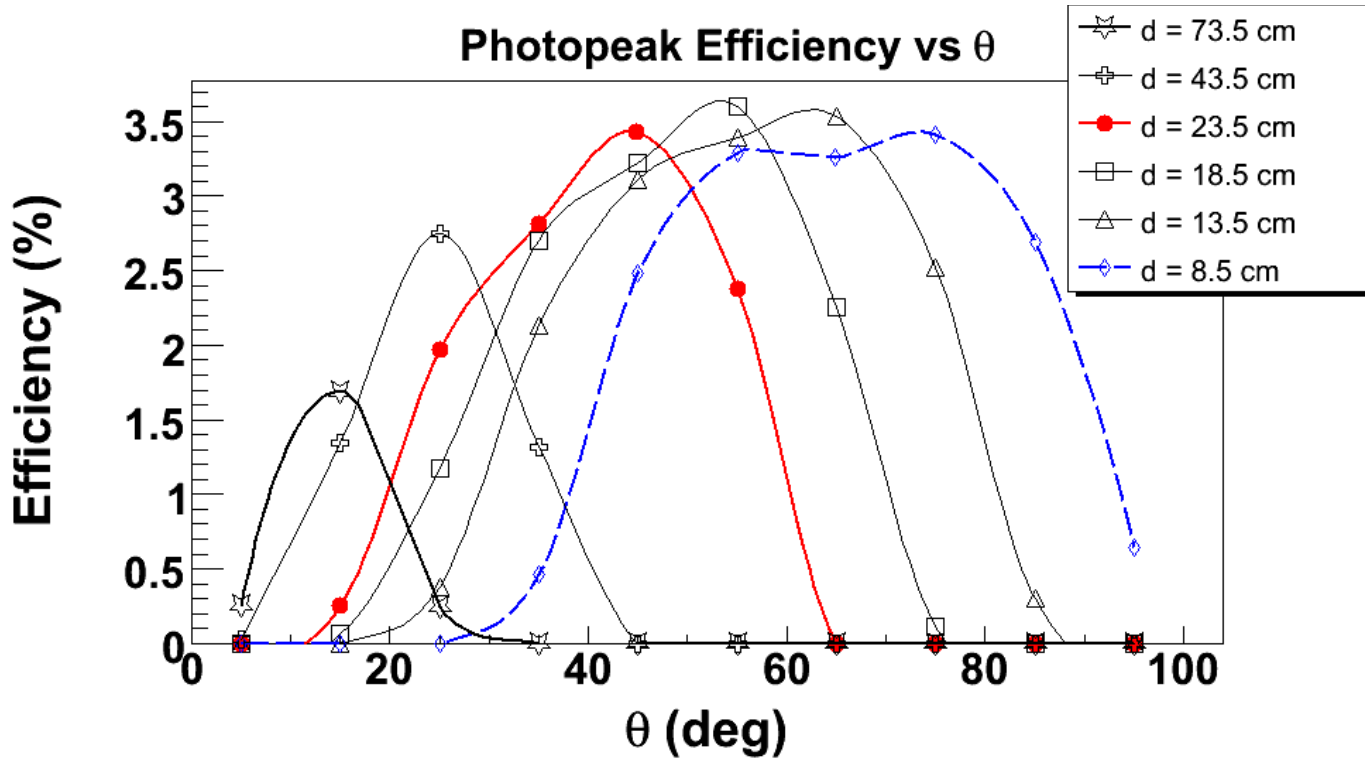
• "Reference physics case": $E_{\gamma,o}$ = 1 MeV, recoil nucleus at β = 0.43 (E = 100 MeV/u), Mγ = 1

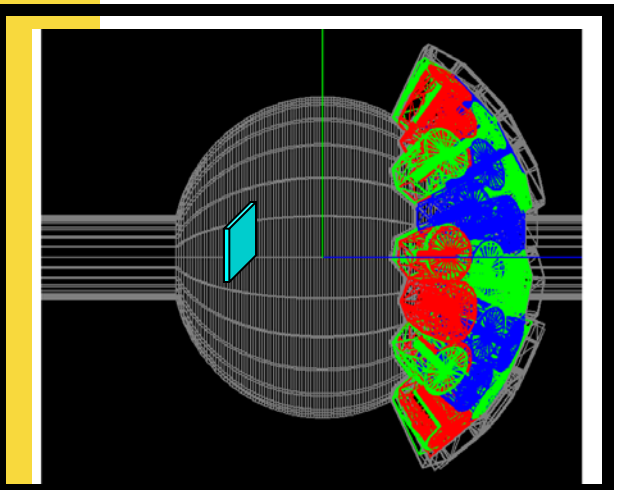
(GEANT4 AGATA code from NIMA 621 (2010) 331-343, E.Farnea et al.)

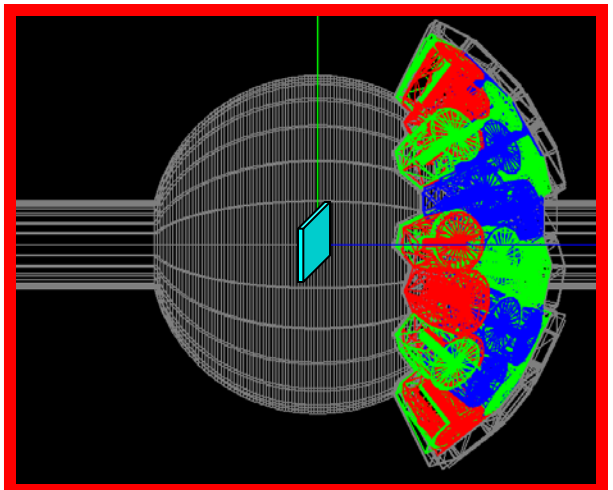
➔ **highest priority are double clusters**

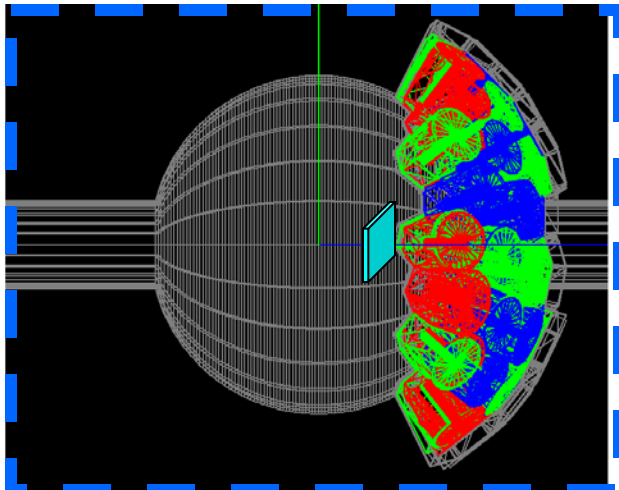
Courtesy of
C. Domingo-Pardez

AGATA 1π geometry: angular dependence of efficiency

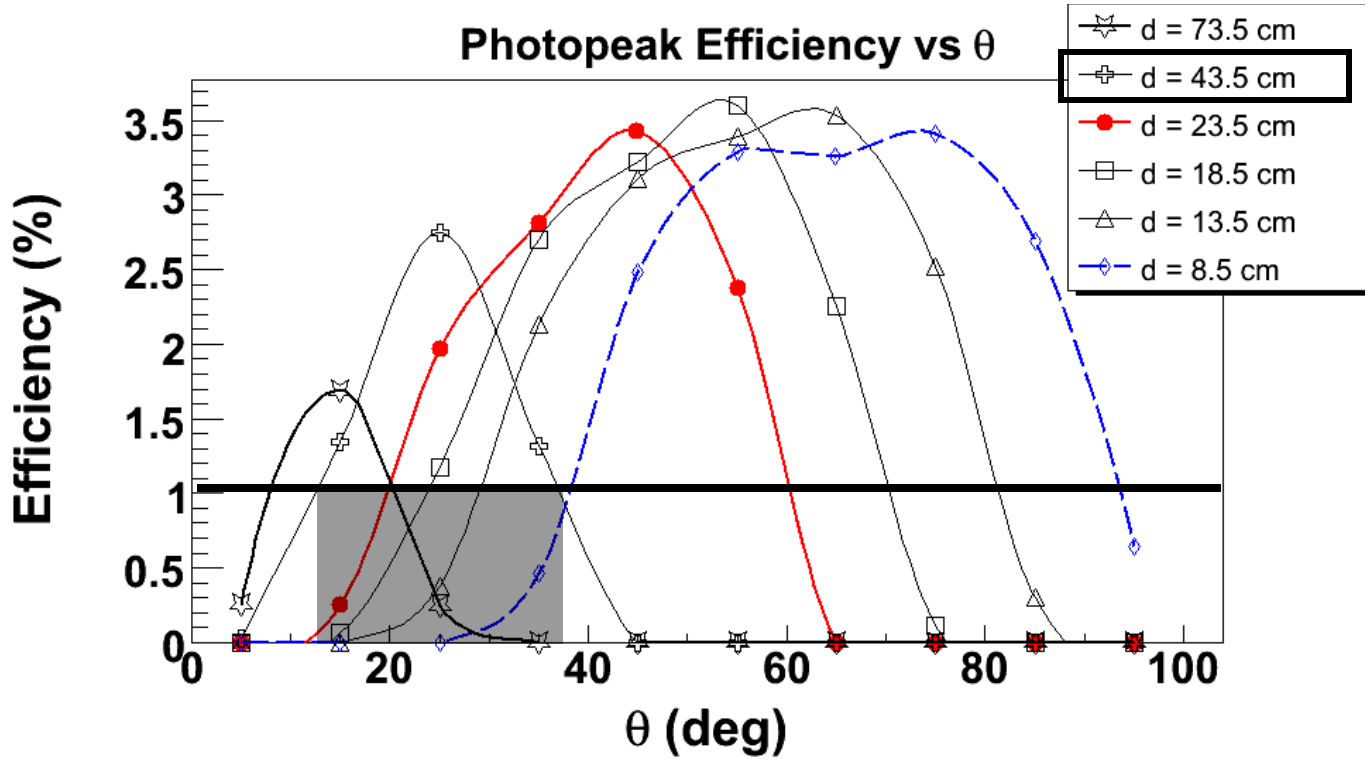


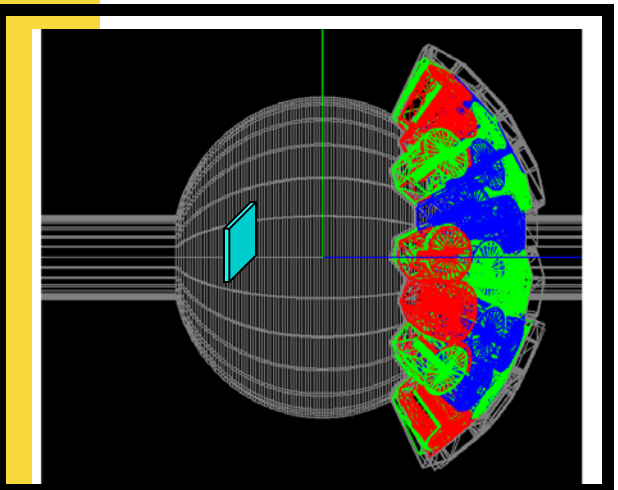


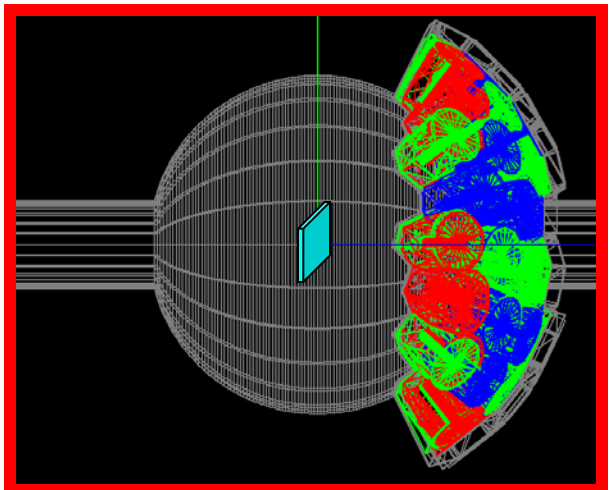


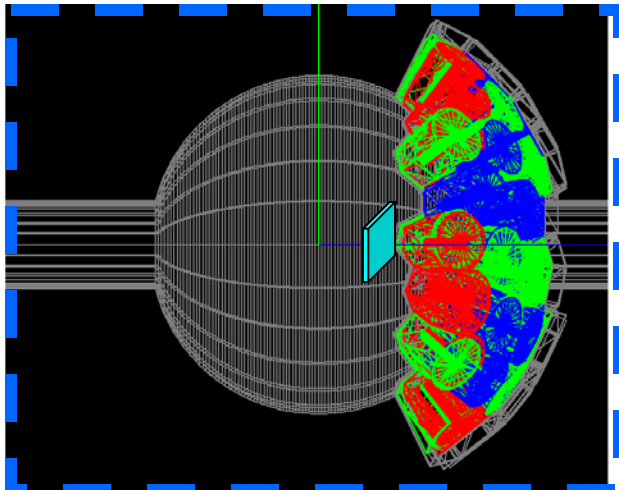


AGATA 1π geometry: angular dependence of efficiency

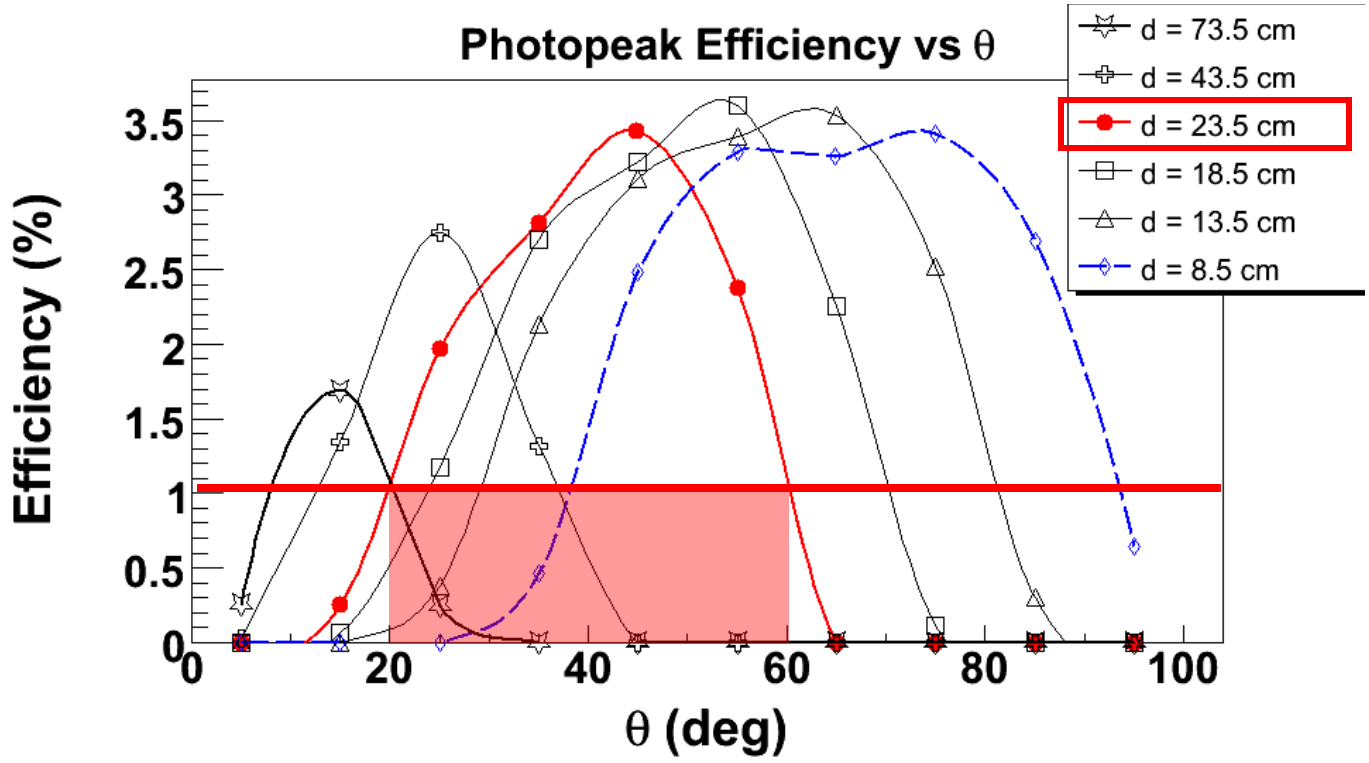


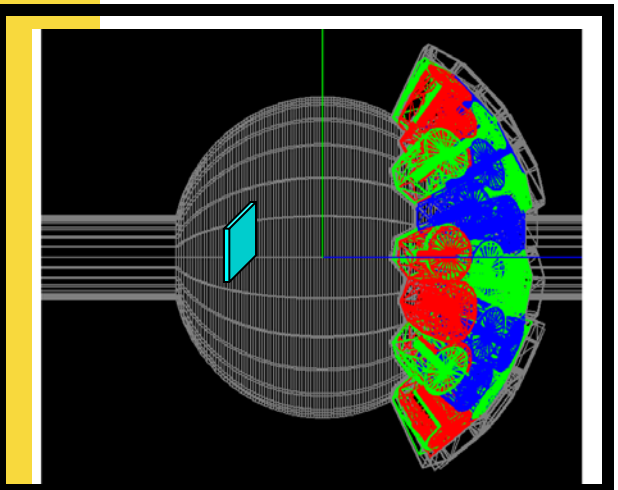


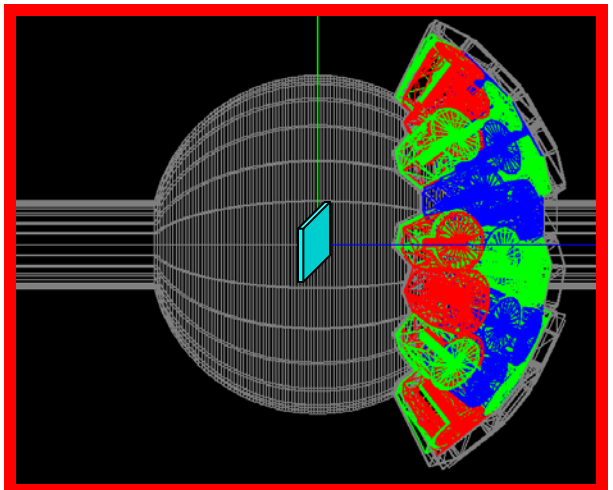


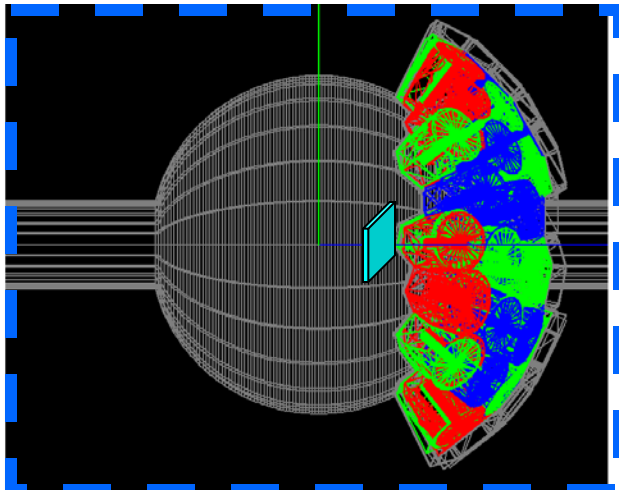


AGATA 1π geometry: angular dependence of efficiency

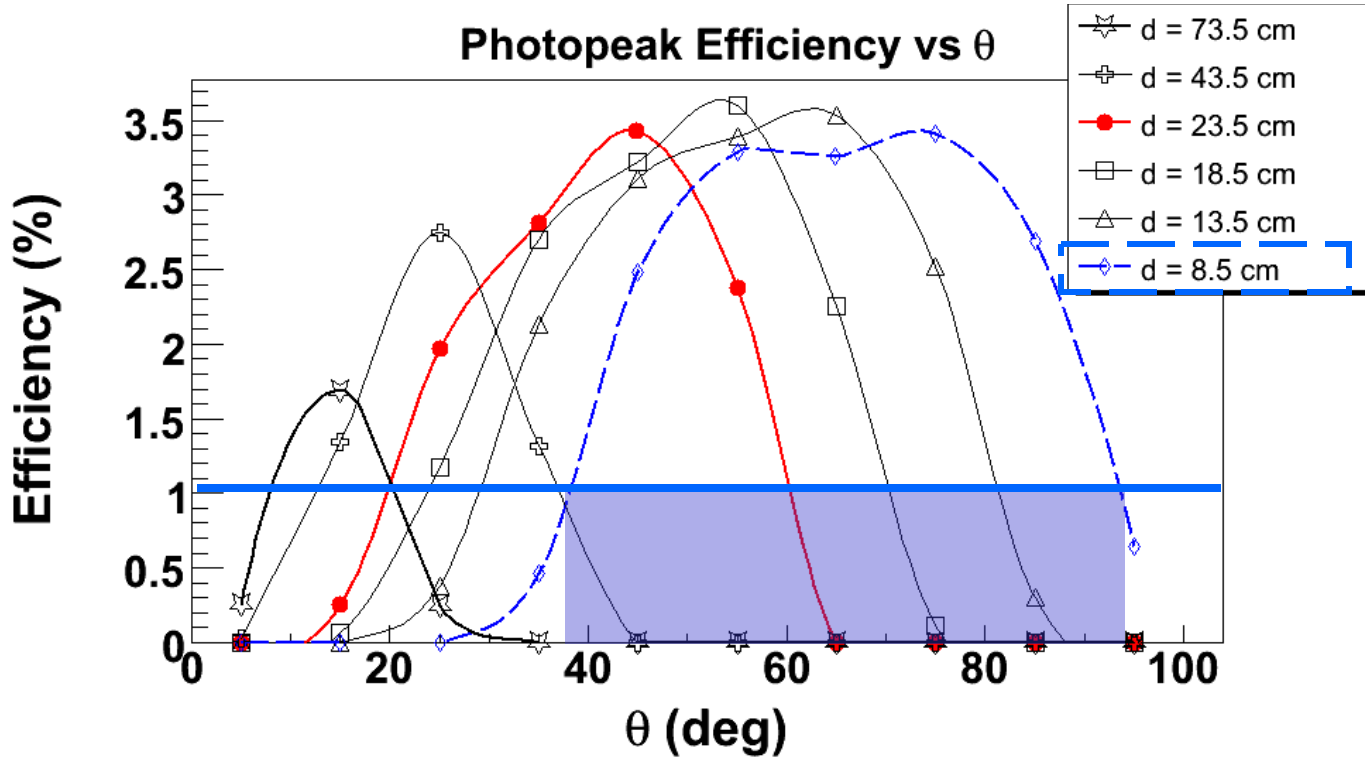


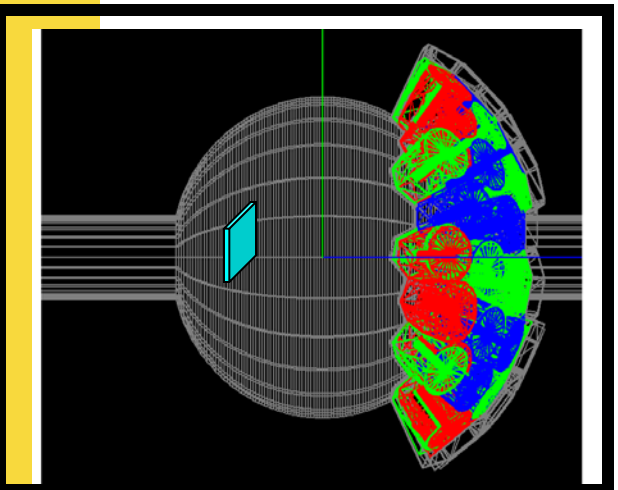


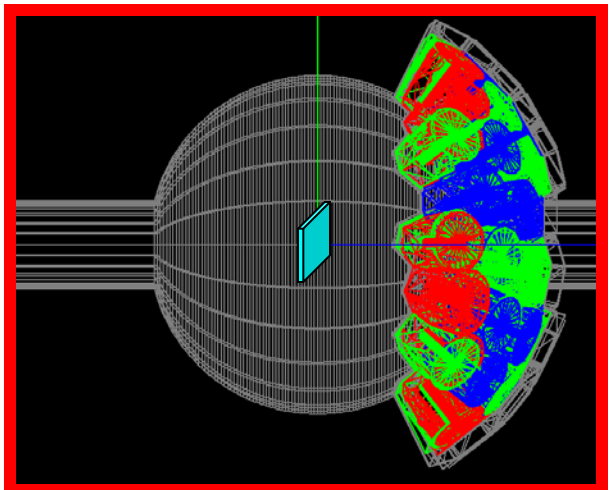


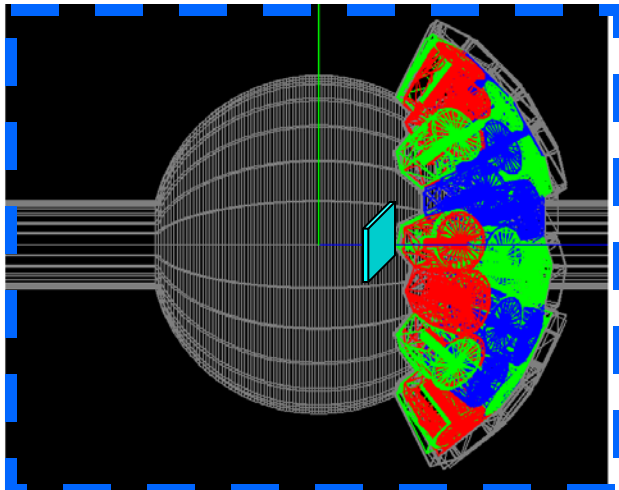


AGATA 1π geometry: angular dependence of efficiency

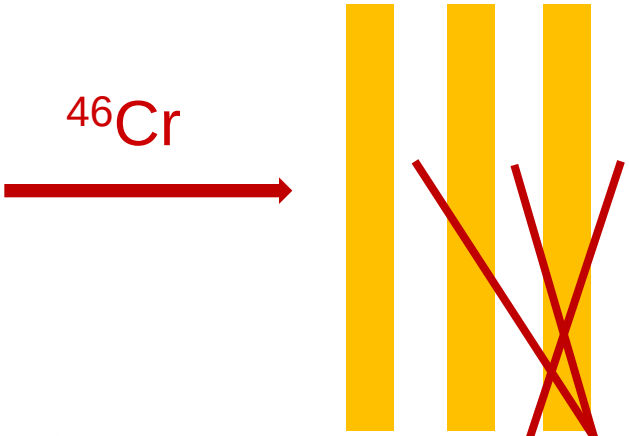




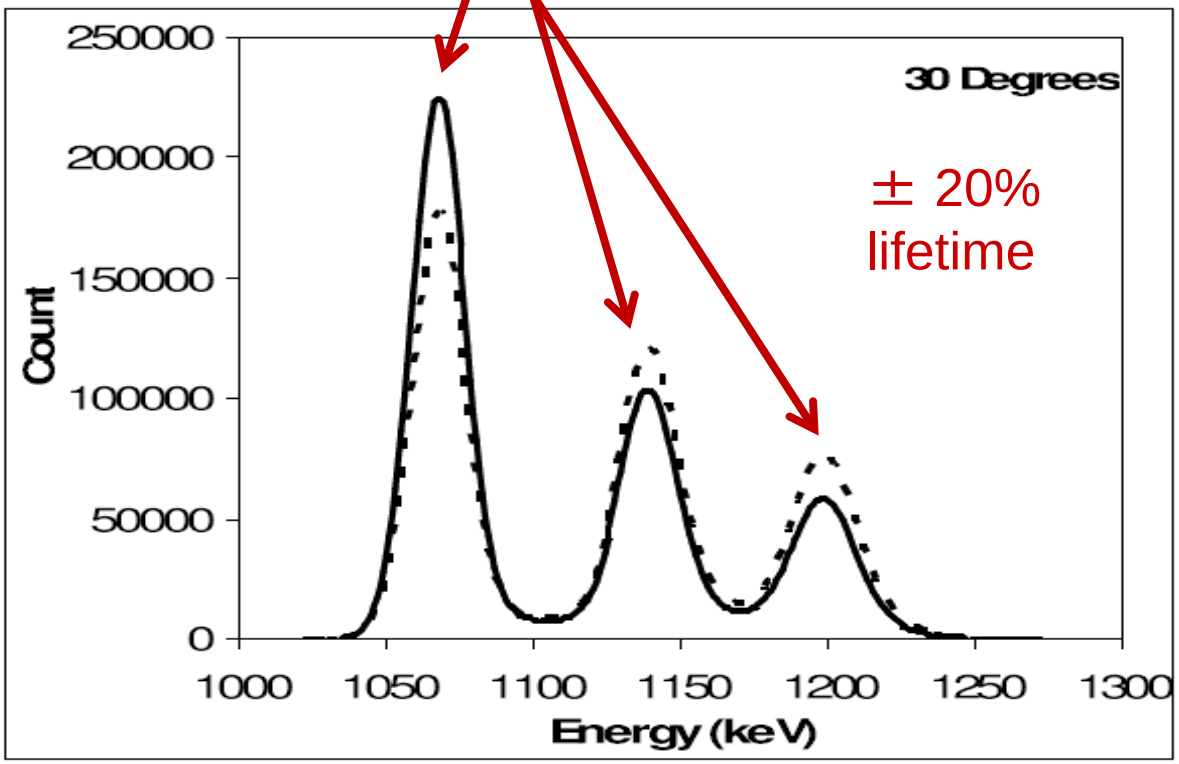




Applications of AGATA: Plunger lifetime method



Stack of 3 gold foils (~2x750, 1x500 mg/cm^2) separated by 1mm
(Sort of) differential plunger
Designed for specific case/lifetime



Key points:

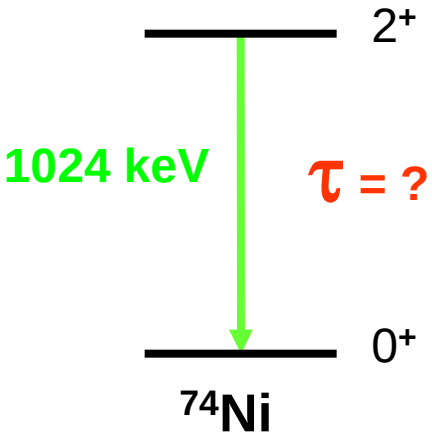
2^+ states all populated directly by Coulex
Lifetime determined from lineshape/plunger distributions alone

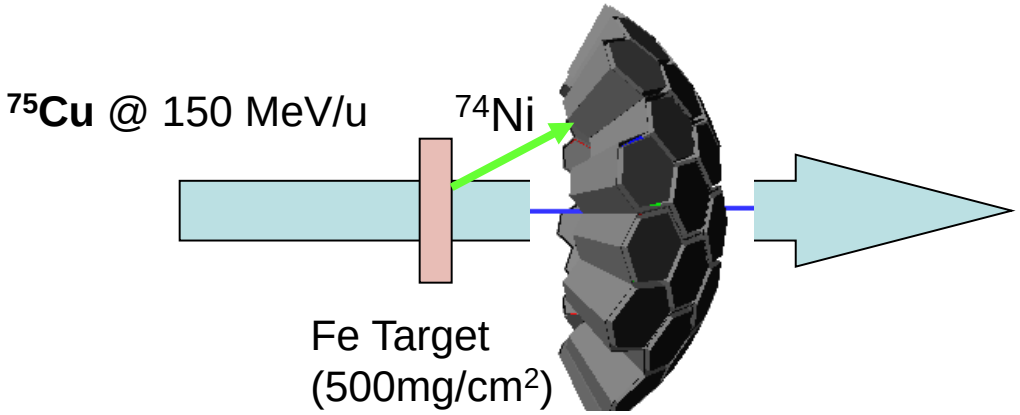
- Lineshape effects only
- No straggling, no background, mono-energetic beam

Courtesy of M. Bentley

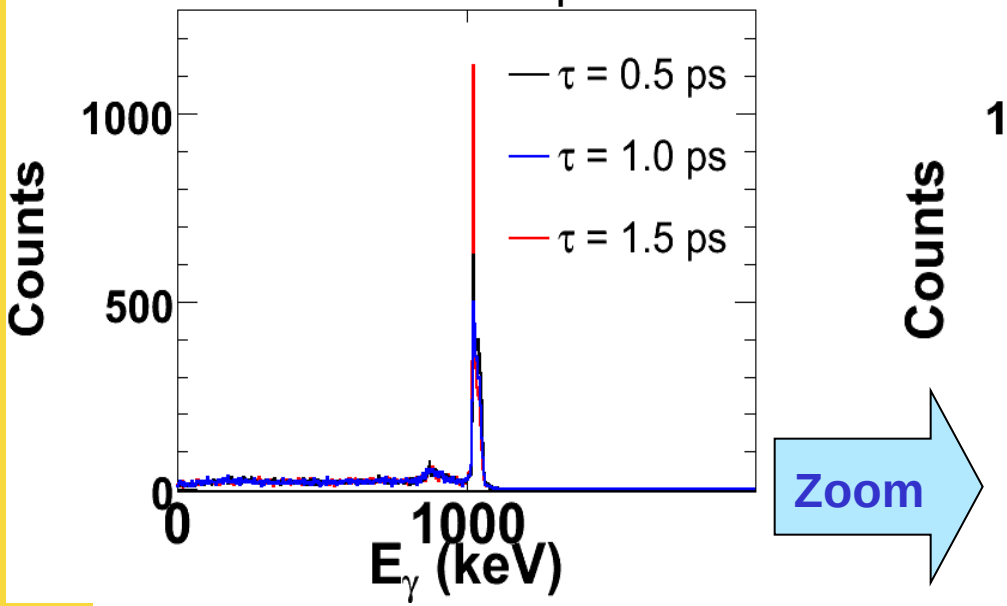
Example for a full AGATA Geant-4 simulation: Line shape effects of the 2^+ state in ^{74}Ni

Realistic Monte Carlo Simulation of a **fragmentation** experiment: DSAM Analysis

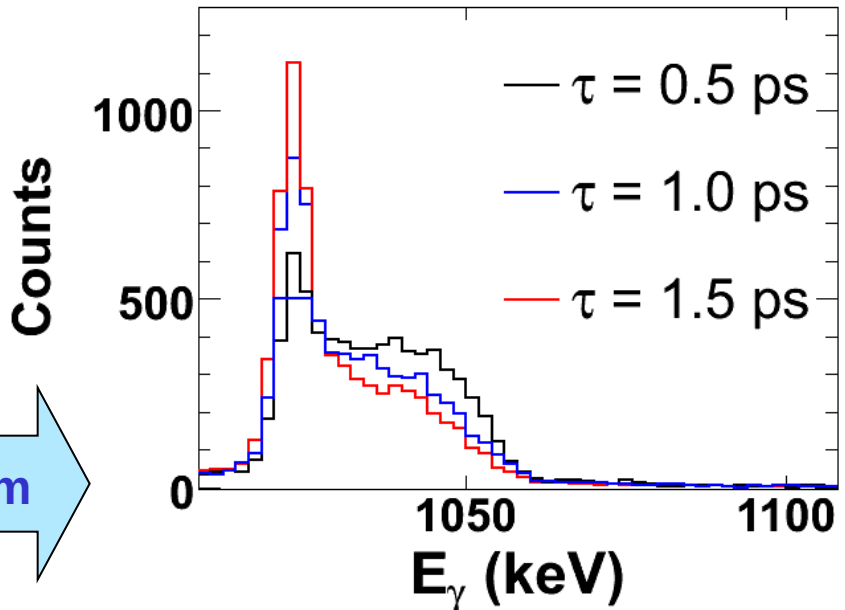




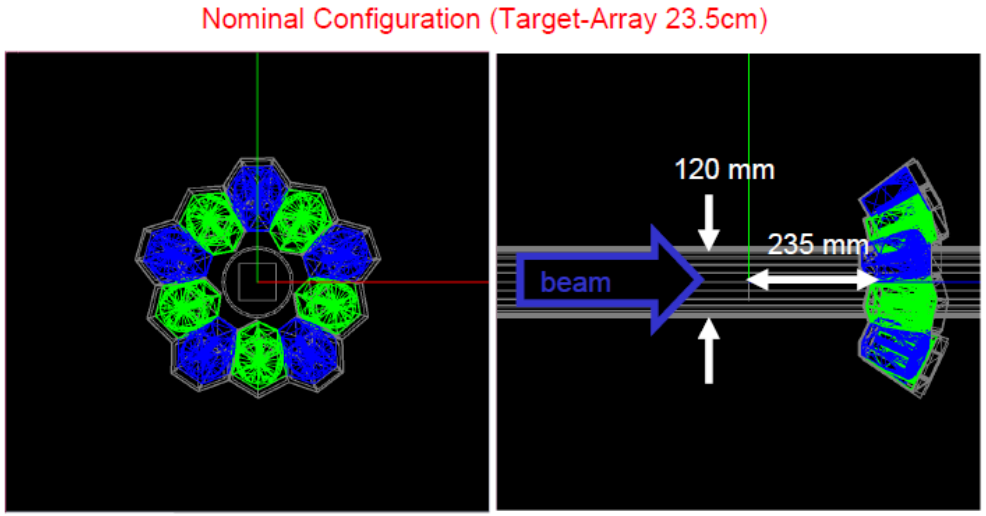
τ = 0.5 to 1.5 ps

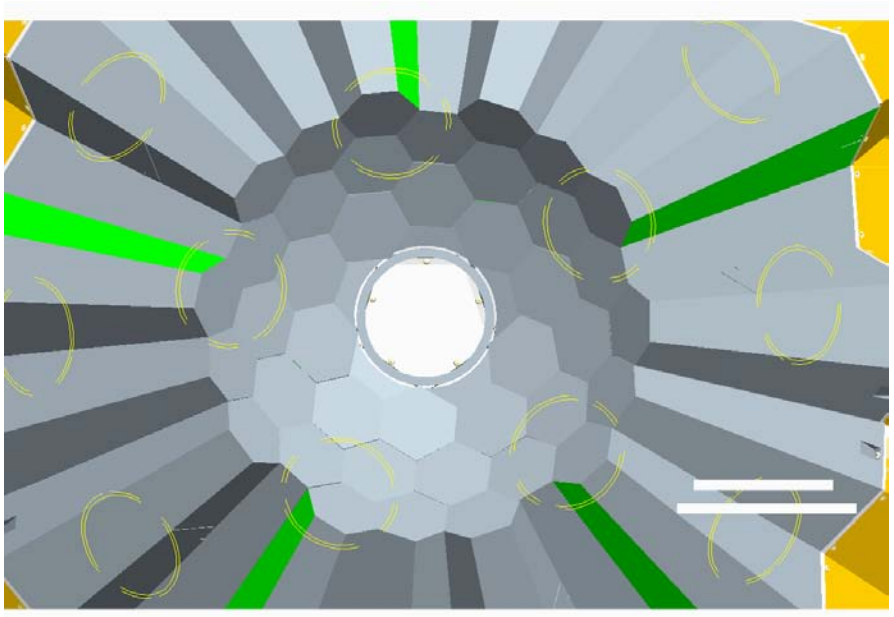


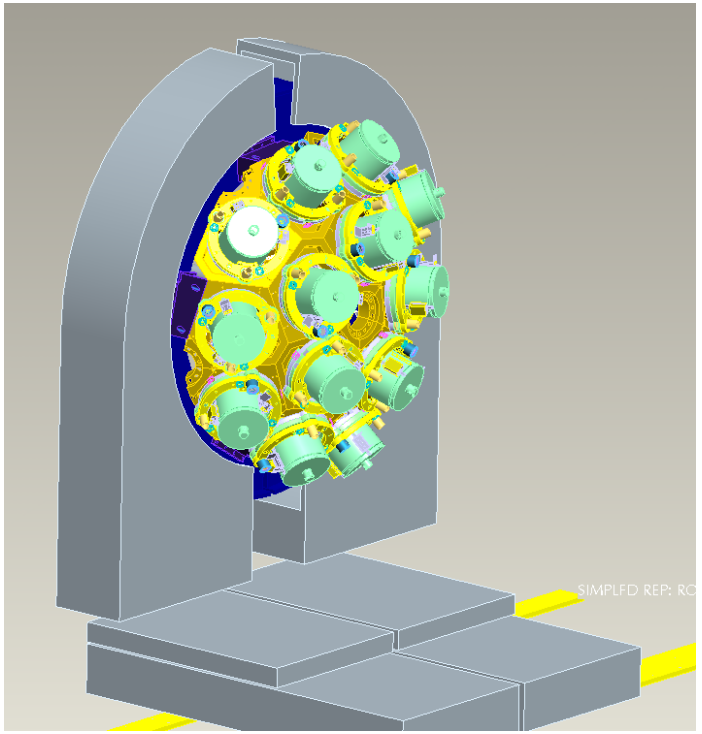
Zoom



Mechanical design of the AGATA@GSI geometry



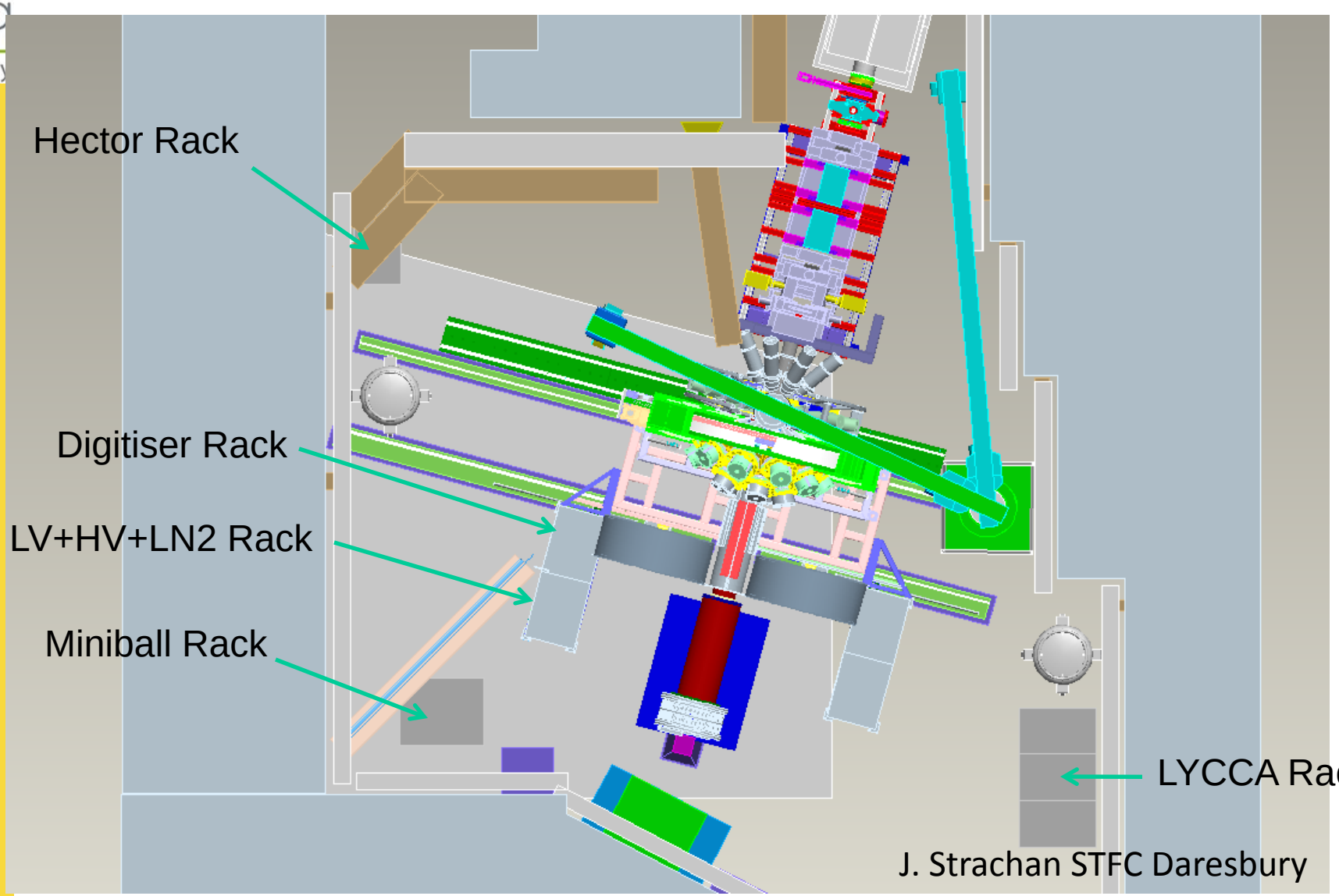




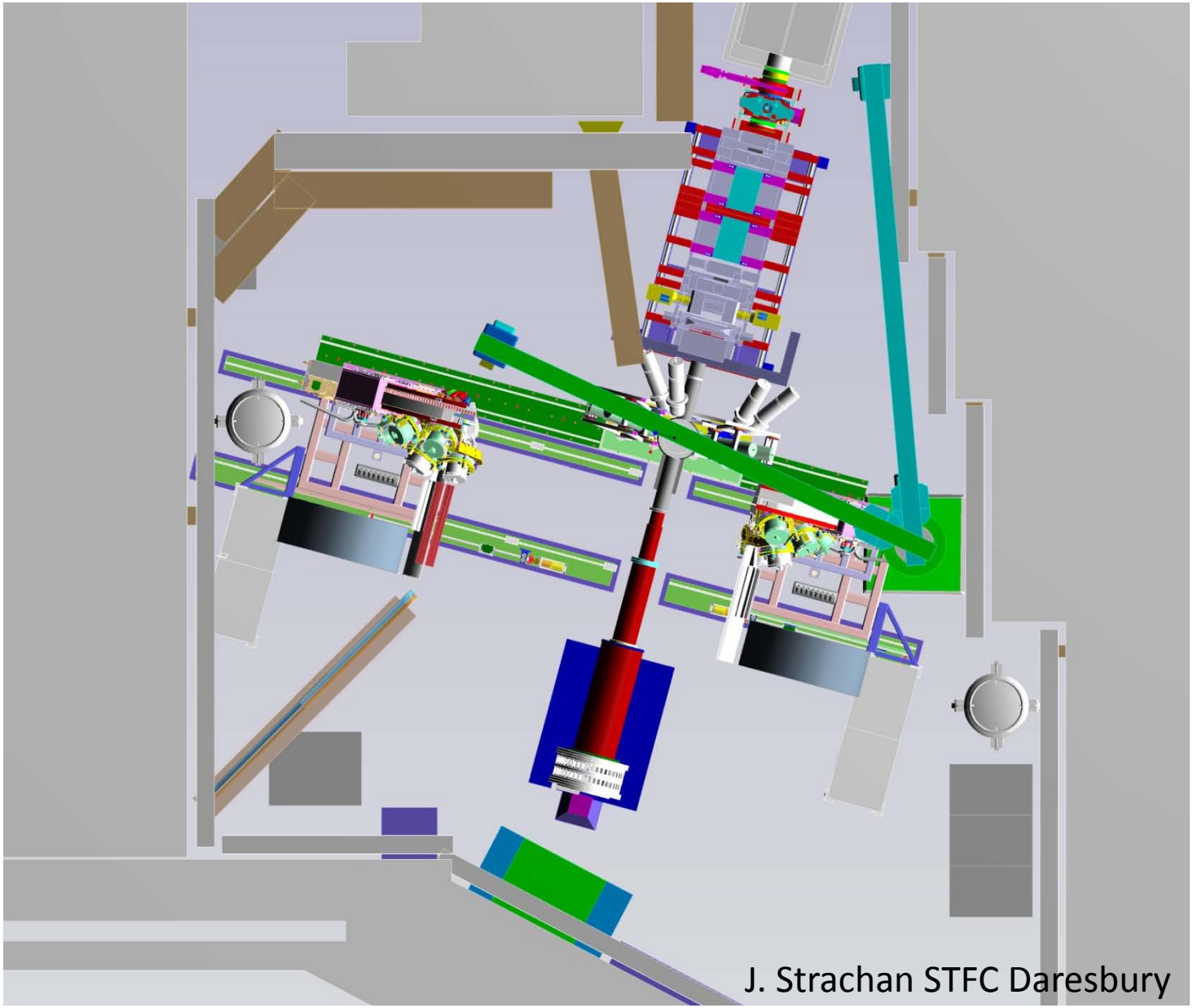
Beamline view (showing 125mm OD beamtube)

Courtesy
J. Strachan STFC Daresbury

Overall Layout in S4 – array closed



Overall Layout in S4 – array open



Preparation of AGATA-PreSpec campaign

- **February 2010** – Call for letters of intent (from MAB and WK)
- **May 2010** – Workshop as part of AGATA week – Istanbul

RESULTS

(A) 35 Letters of Intent (current number)
(B) Decision on two G-PAC submissions (2011 and 2012)
(C) Programme divided into six themes
(D) Theme co-ordinators appointed

- **July 2010** – Technical evaluation led by GSI team
- **Sept-Nov 2010** – working groups meet to discuss, focus, prioritise, combine proposals etc.
- **January 2011** –first meeting of conveners, campaign spokespersons and GSI team to formulate first PAC submission in 2011.
  CRITERIA: Physics quality and priorities, availability of specialist apparatus, readiness, level of complexity etc.
- **July 2011** – final meeting of conveners, campaign spokespersons and GSI team to finalise first PAC submission in 2011.
- **September 2011 (?): First PAC submission**

Preparation of AGATA-PreSpec campaign

Theme	Convenor	No of LOI	Props in PAC 1	Days PAC 1
Nuclear Structure near N=Z: n-p degree of freedom and rp process	Giacomo DeAngelis	7	4	~19
Shell Evolution in light n-rich nuclei	Alejandro Algora	7	1	~7
Nuclear Structure towards 78Ni and the N=50 shell gap	Gilbert Duchene	4	1	~4
Shape Evolution and Collectivity in nuclei far from stability	Zsolt Podolyak	7	4	~23
100Sn region and the heaviest self-conjugate nuclei	Bo Cederwall	4	1	~7
Astrophysically important region near 132Sn	Magda Gorska	6	2	~15
TOTAL		**35**	**13**	**~75**

13 proposals being prepared for PAC in fall 2011 (~11 weeks + setup)
about 40% of the campaign? (~18 proposals remaining plus new ideas ?)

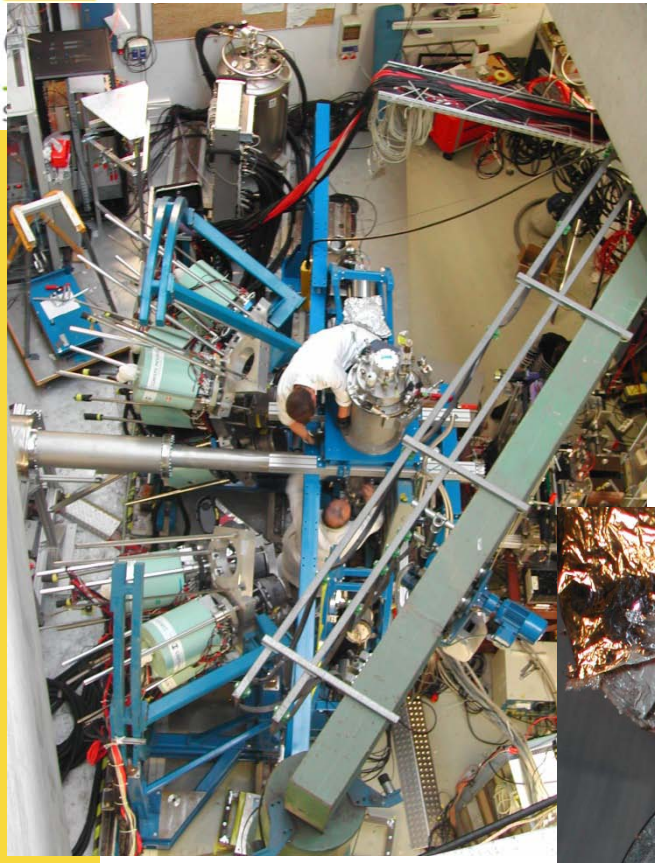
- **G-PAC is expected to allocate about 50% of the "agreed" beam time (6 weeks)**

Preparation of the AGATA-PreSpec campaign

- Commissioning of new FRS detectors
  - Finger detector : S2 rate up to 10^6 pss (per strip)
  - Digital readout of MUSIC : S4 rate >10^5 pps
- Rate and background test of AGATA detector
  - Max. rate <10^4 Hz (with 10^5 pps, plunger target, ~12 cm)
- Commissioning of new Cologne plunger device
- Commissioning of new Saclay LH2 target
- Performance of Lund York Cologne CAlorimeter

In-beam test of the Saclay LH2 target (S378, May 2011)

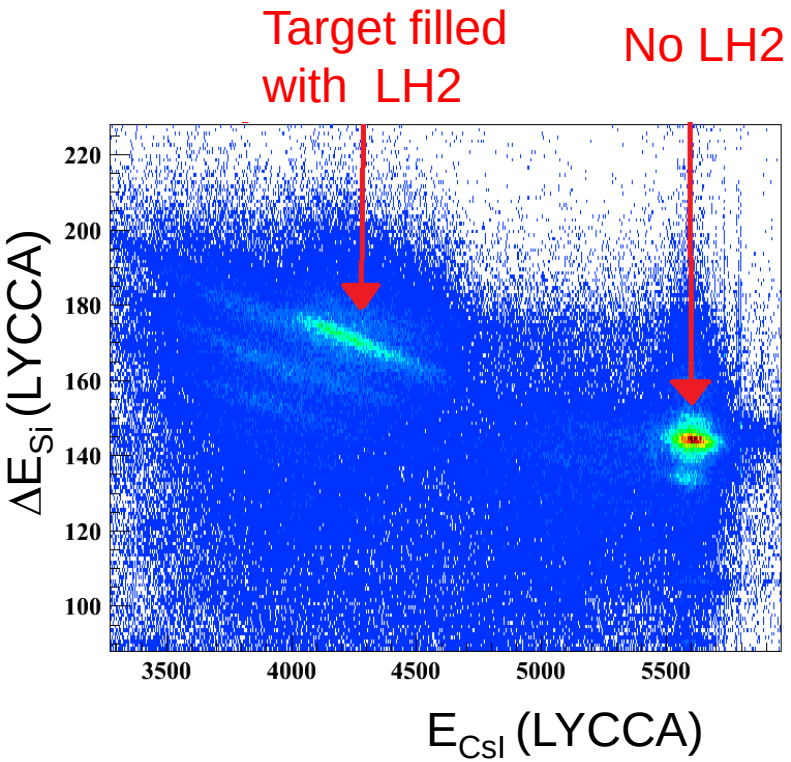
Irfu



^{54}Cr(p,p') and ^{54}Cr(p,pn) and (p,2p) at 125 MeV/nucleon

- ✓ Target mounted
- ✓ Target filling successfull
- ✓ Data taking: 7 hours of beam time (analysis ongoing)

LH2 target cell
60 mm diameter
20 mm thickness
300 μm Mylar wind.

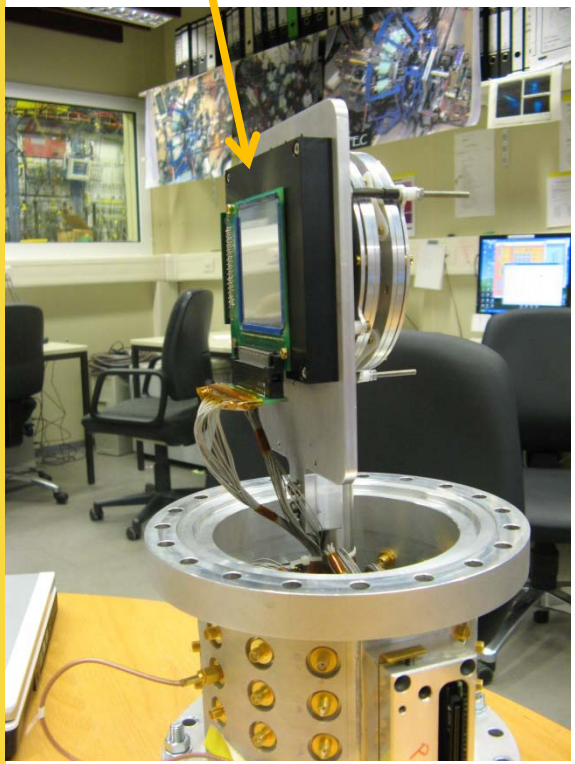


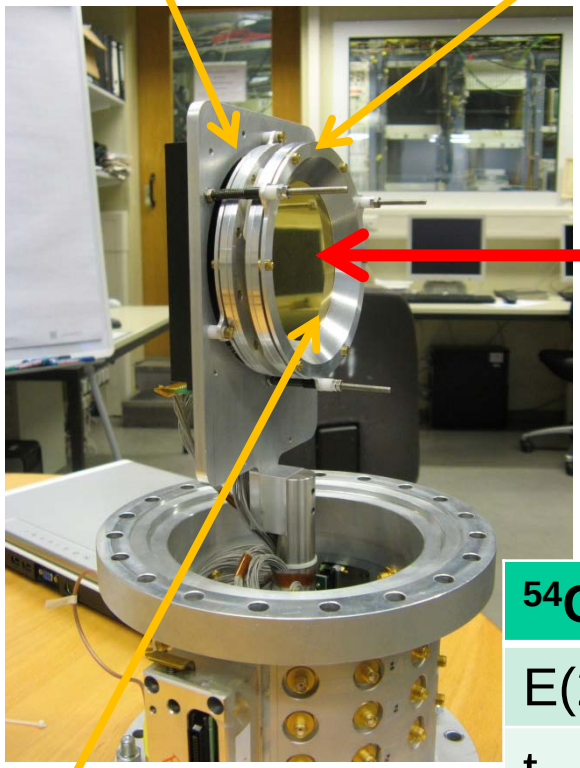
In-beam test of the Cologne Plunger for GSI (May 2011)

Target - DSSD

Ir Degrader (0.5 mm)

Au Target (1 mm)





Beam

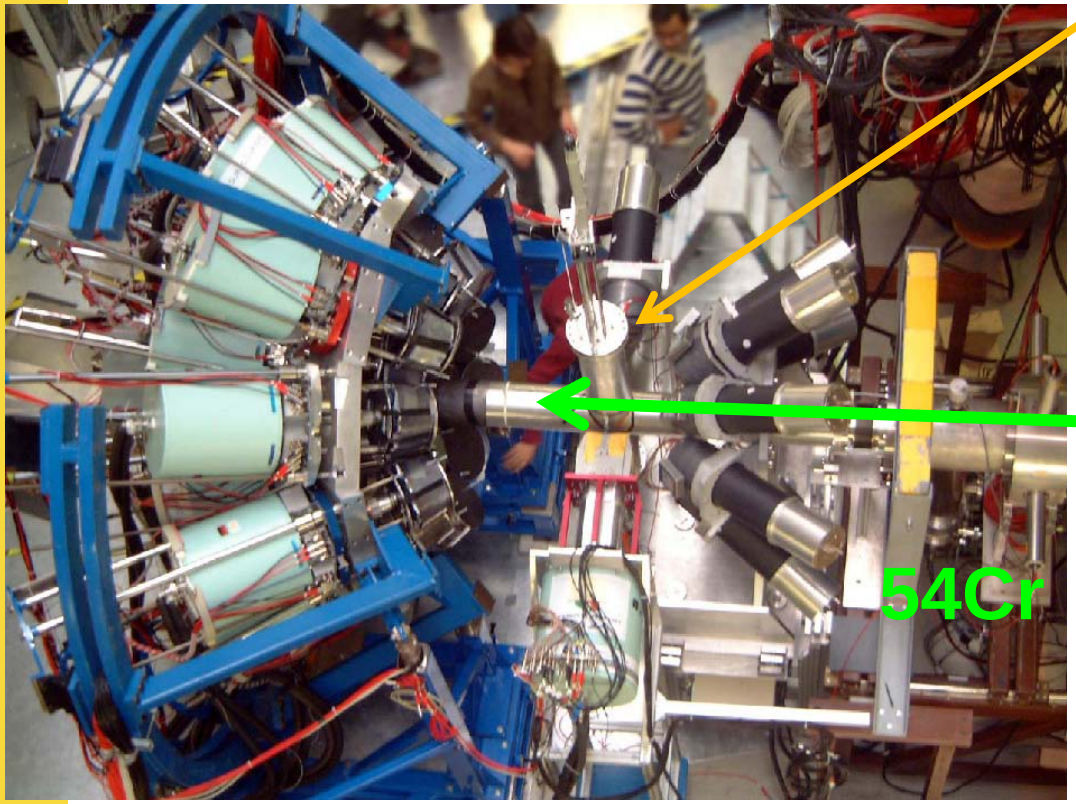
^{54}Cr

(not actually in this room)

Separation 700 um

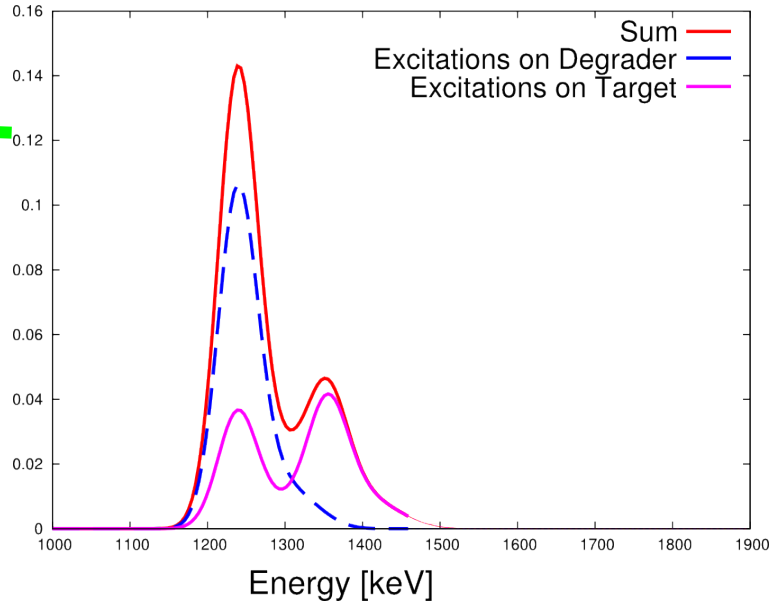
^{54}Cr	
E(2^+)	835 keV
$t_{1/2}$	7.9 ps
B =v/c	0.55

In-beam test of the Cologne Plunger for GSI (May 2011)



Target Position
(different Target chamber)

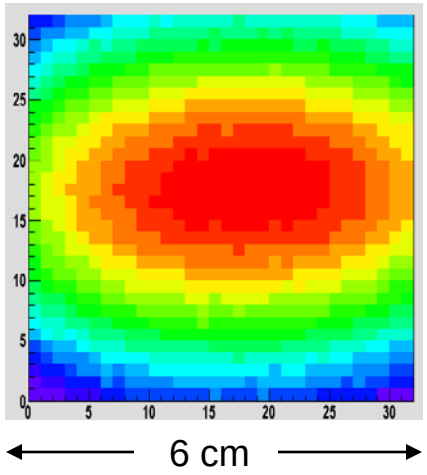
Expected Lineshape



About 10 h Beamtime
700 counts in 2^+ of ^{54}Cr expected
(for inner Ge – Ring only)

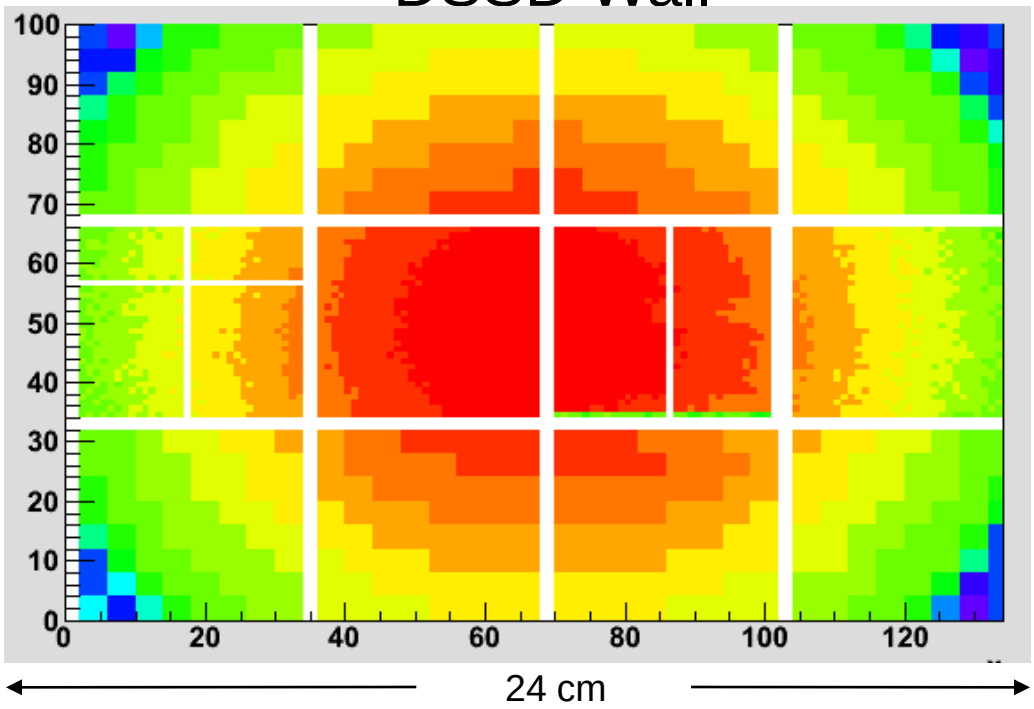
Analysis in progress…

Status of LYCCA-0 (commissioning Oct/Nov 2010)

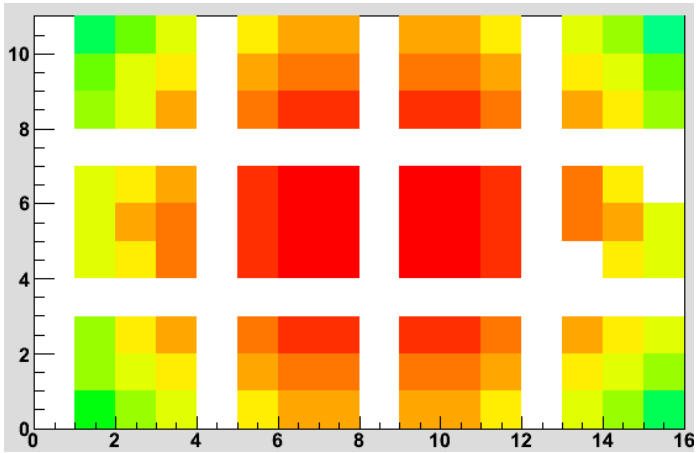


LYCCA-0 Hitpattern

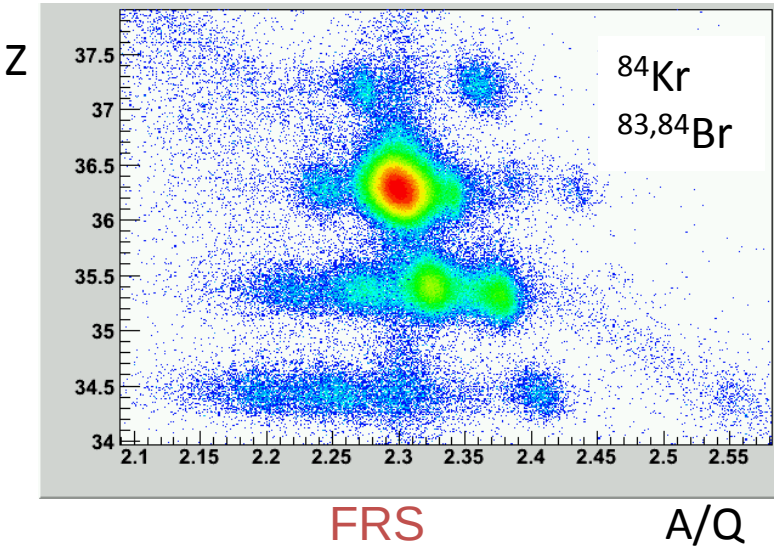
DSSD Wall

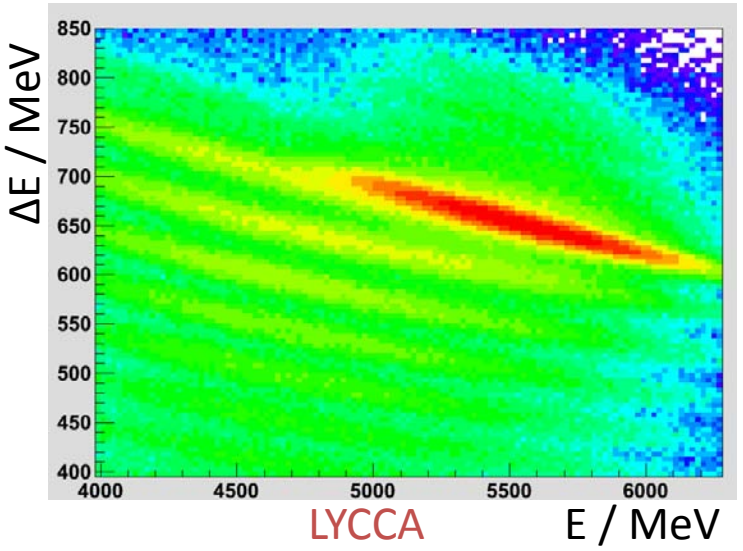


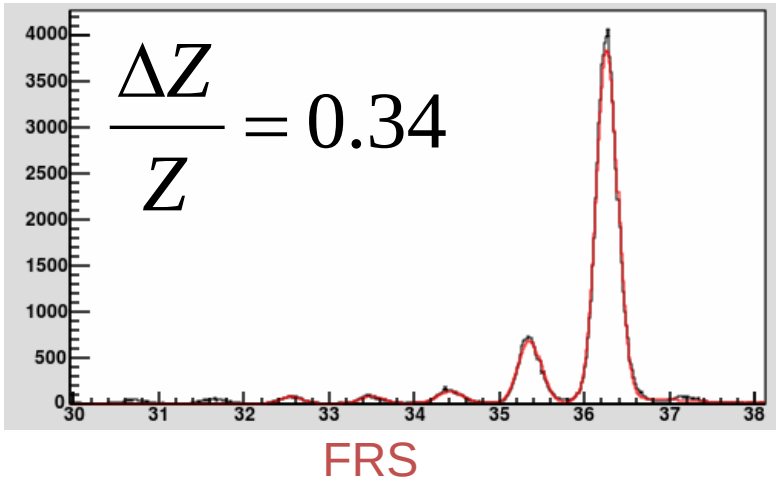
CsI Wall

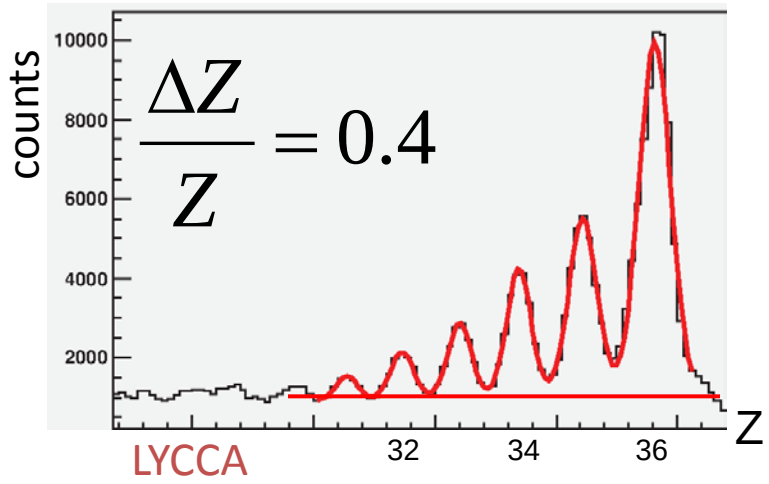


Identification in Kr, Br region

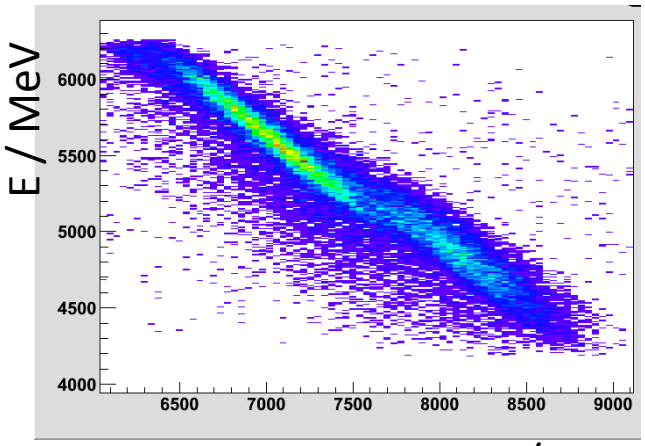


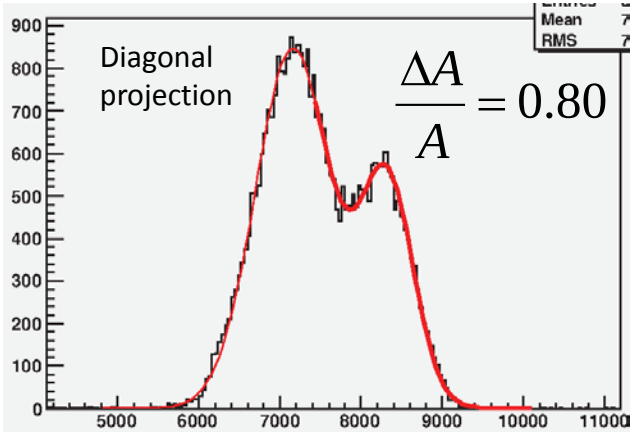


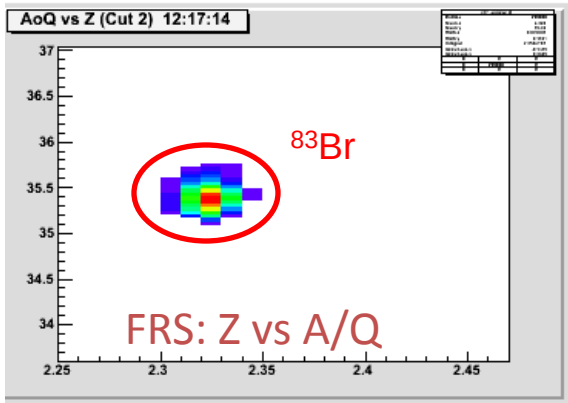


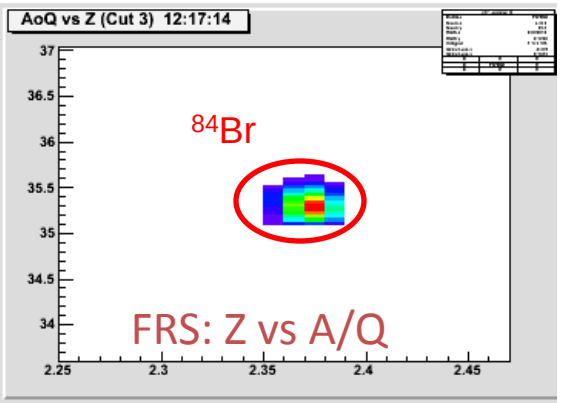


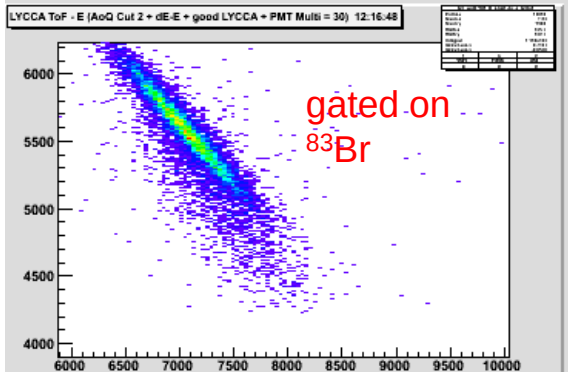
Identification in Kr, Br region

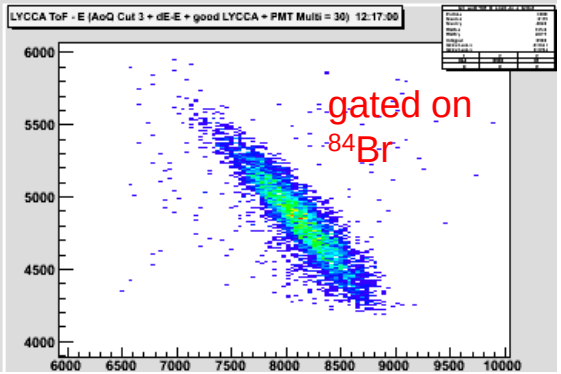






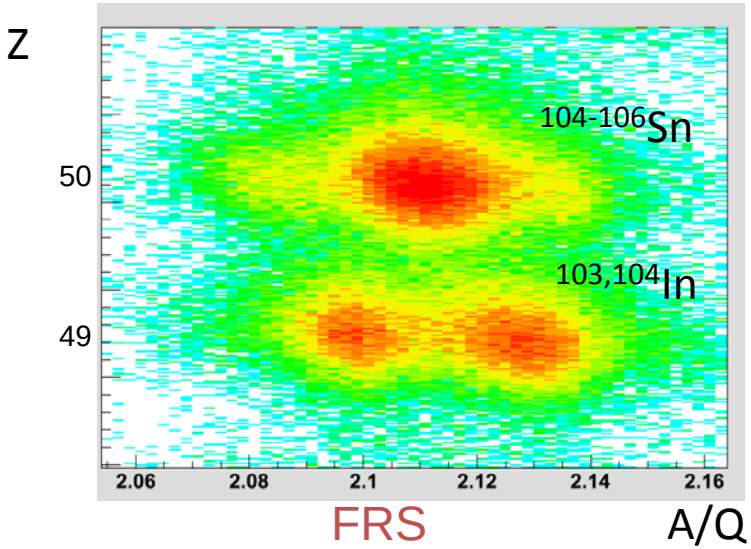


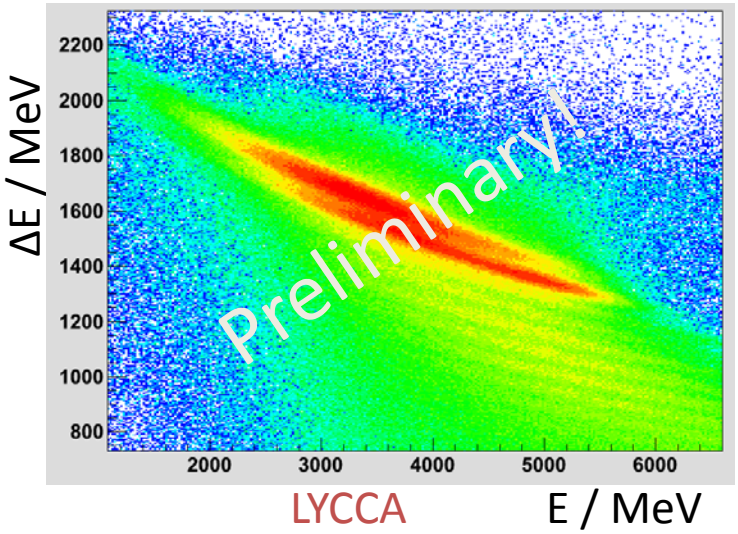


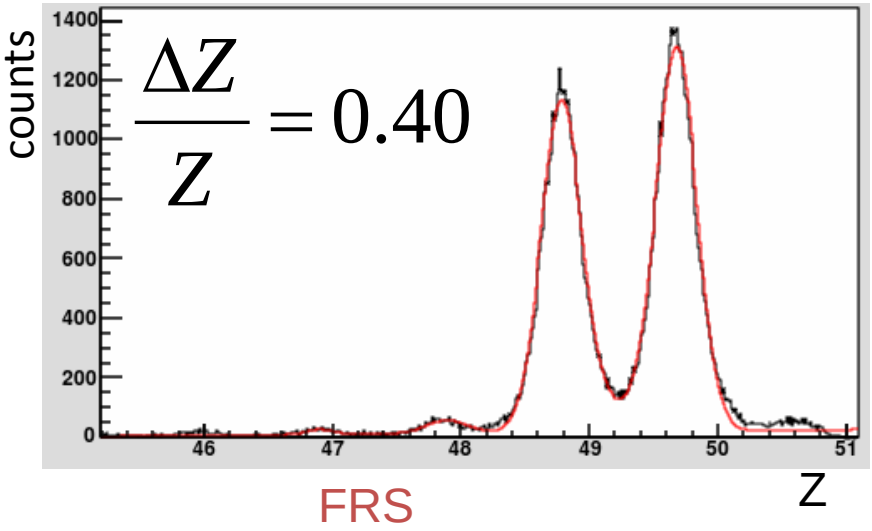


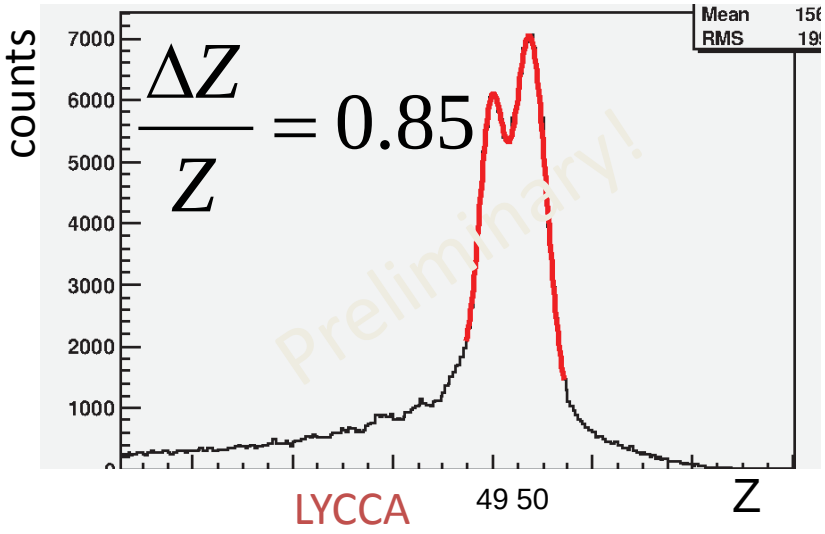
2d-Mass separation for A ~ 80
In-beam for fission products achieved.

Identification in Sn, In region

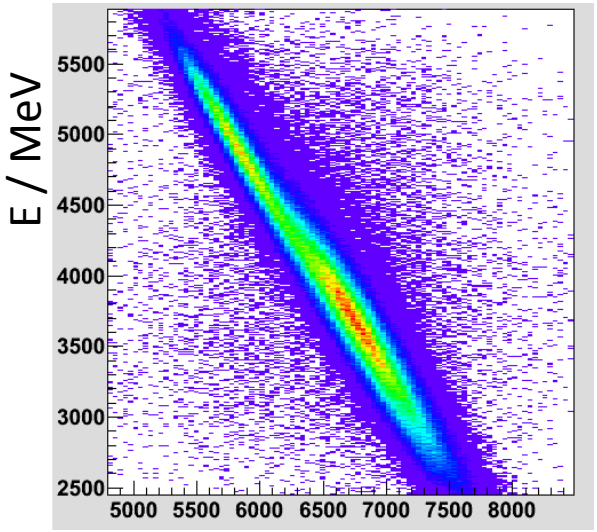




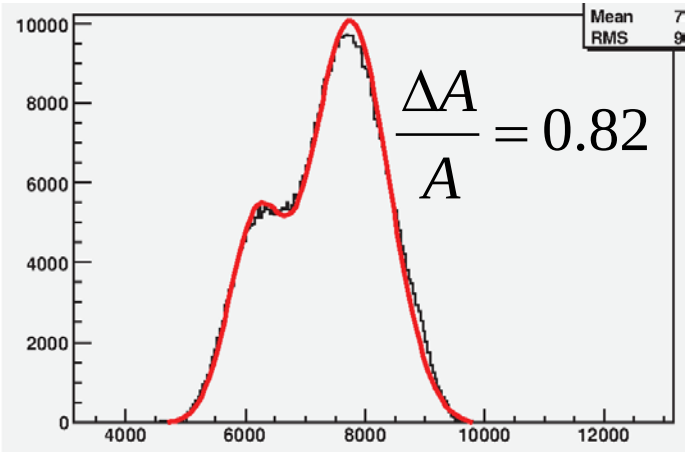


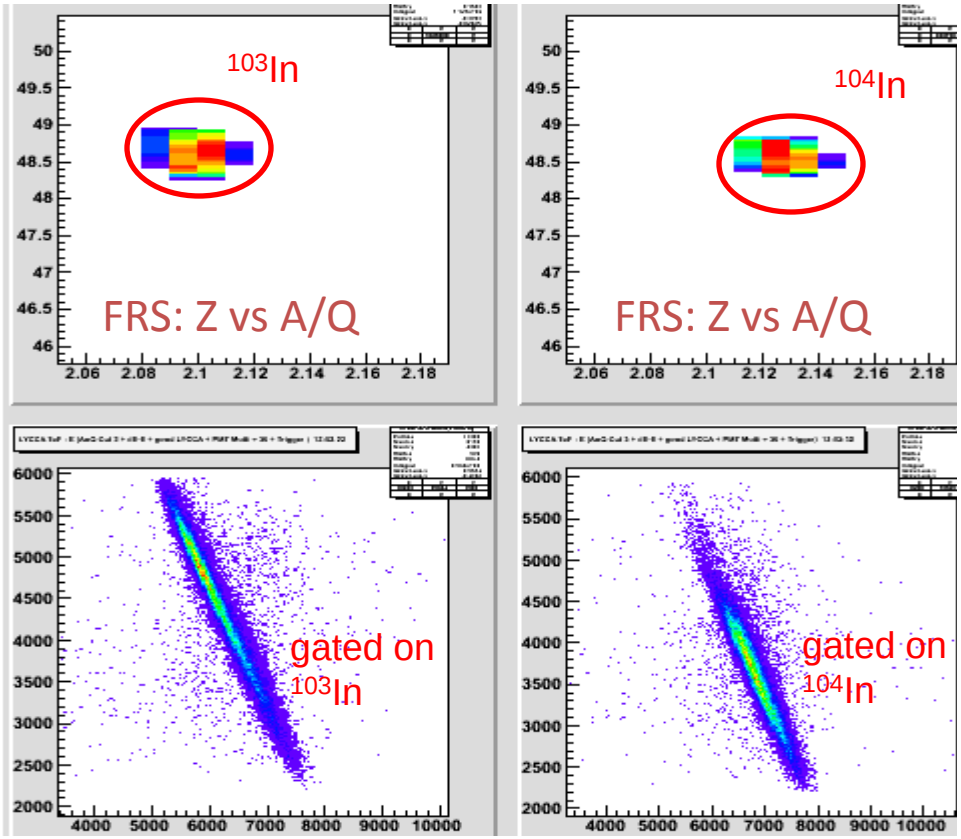


Identification in Sn, In region



LYCCA TOF / a.u.





LYCCA: E / vs TOF LYCCA: E / vs TOF

2d-Mass separation for A ~ 100
In-beam for fragments achieved.

Summary

Commissioning and first in-flight experiments successfully performed

➔ PreSpec is ready for AGATA

➔ Additional equipment (plunger, LH2 target) partially commissioned

AGATA demonstrator successfully running at LNL

➔ AGATA double clusters of highest importance for PreSpec campaign

➔ Construction of electronics, DAQ, infrastructure must follow

Preparation of proposals is well underway

➔ Experiments must make best use of the uniqueness of a set-up combining AGATA (sensitivity) and the FRS (yields and selectivity)