Simulations for the campaign of AGATA at GSI (brief summary on geometry aspects)

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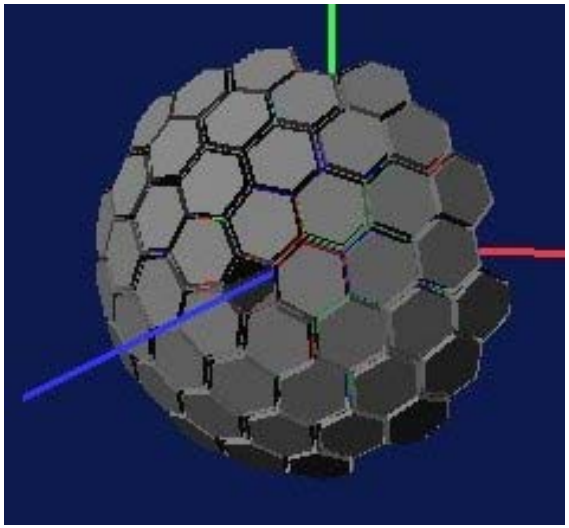
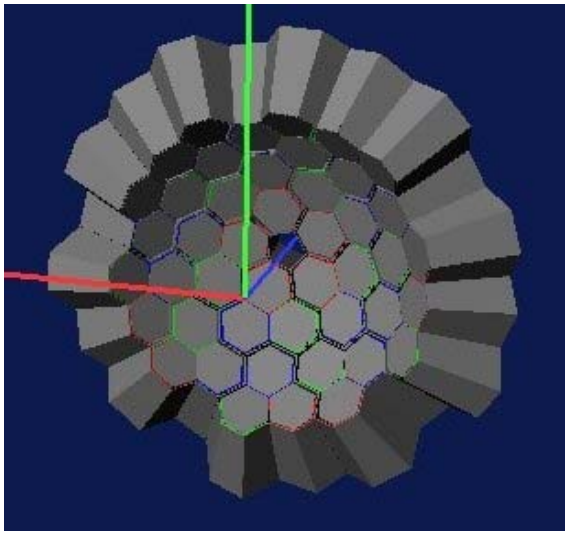
Outline

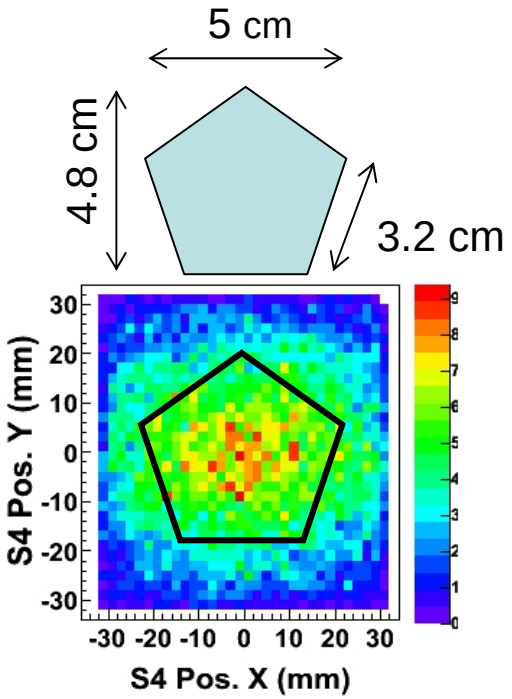
- Main constraints
- Possible geometries
- Optimal geometry

Particular constraints for the setup at GSI

- Ideal geometry (first approach, first step)







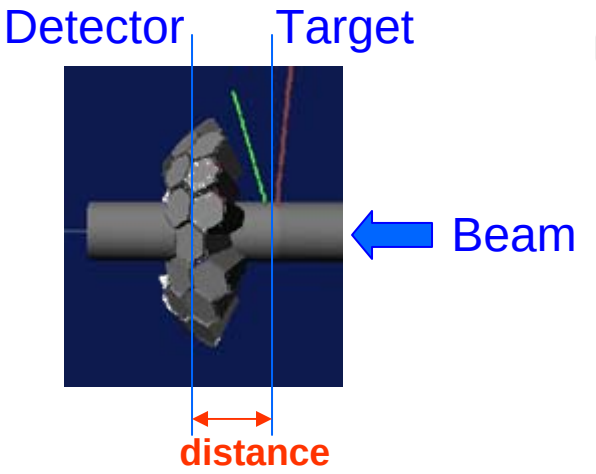
- two main constraints:
  1. 15 cluster detectors will not be available yet in 2011/2012 (10-12 instead)
  2. The beam hole (pentagon) is too small for the GSI beam size

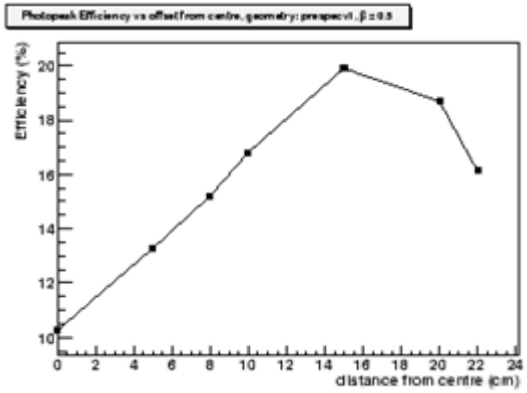
- General geometry constraint: triple clusters (not single)

Performance comparison: general aspects

- Systematic study of efficiency and resolution vs. distance for all geometries

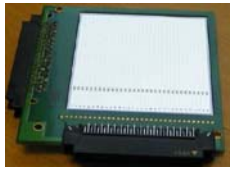
- "Reference physics case": (GEANT4 AGATA code from E.Farnea et al.)
  - ➡ $E_{\gamma,o}$ = 1 MeV, recoil nucleus at β = 0.43 (E = 100 MeV/u), Mγ = 1
  - ➡ Systematic study several distances sec. target – detector

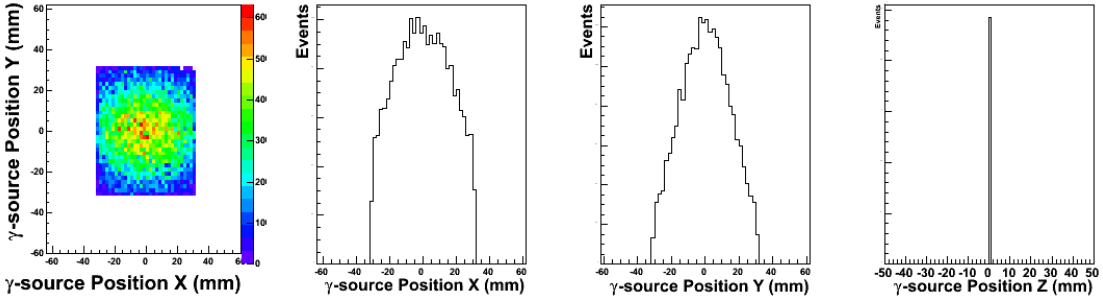




  - ➡ GSI FRS Spatial Beam Profile FWHM_x = 6 cm FWHM_y = 4 cm

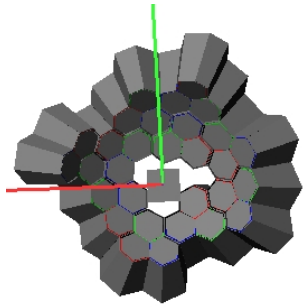
Active target
DSSSD



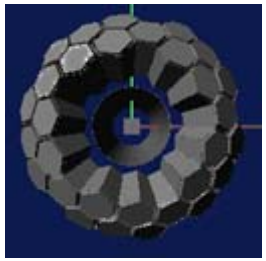


First approach in geometry optimisation: S and C geometries

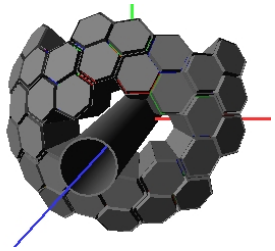
S1



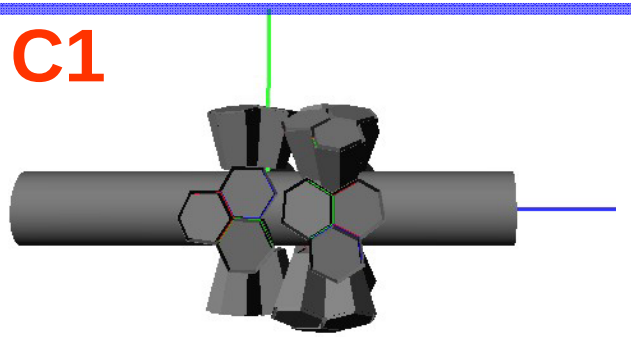
S2



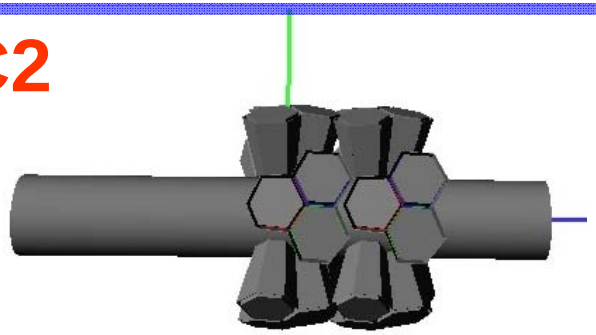
S3



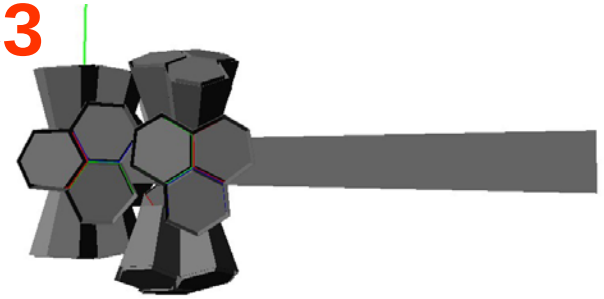
C1



C2



C3

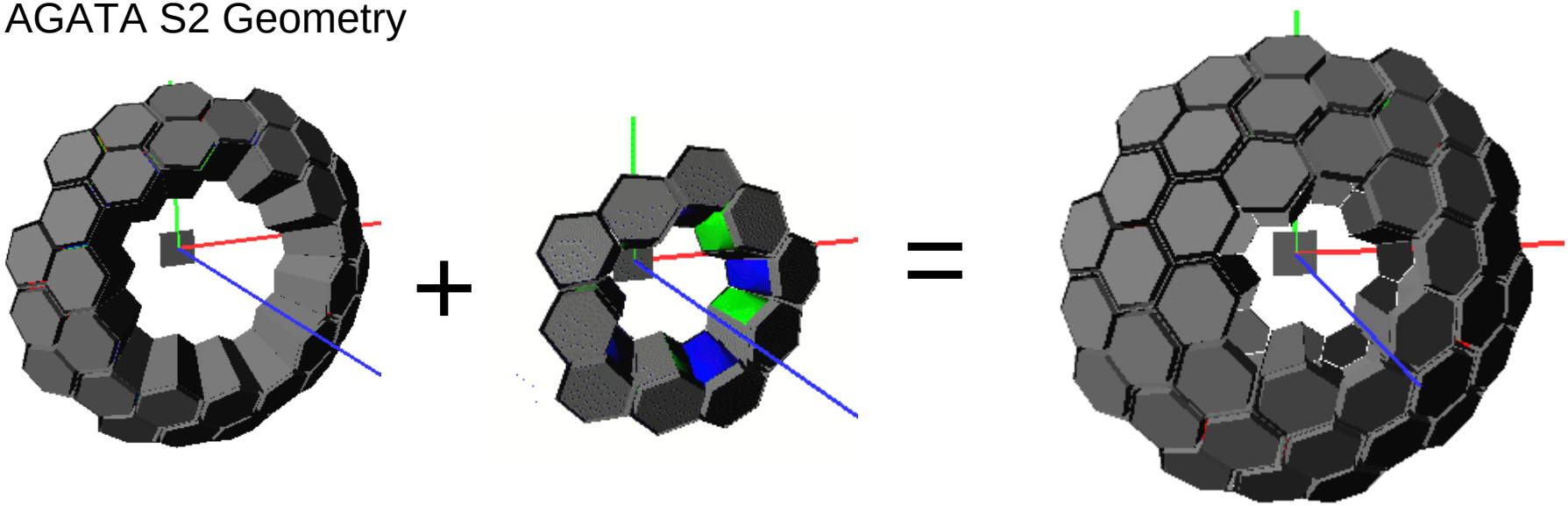


New approach considering AGATA double cluster detectors

Geometry cases

- Task 1: S2 + 5 Double Cluster detectors closing part of the central hole (15-16cm?). Remains shell with 5 crystals hole + pentagon hole

AGATA S2 Geometry

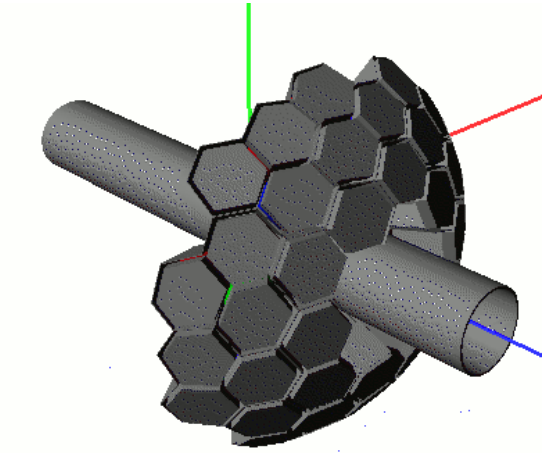


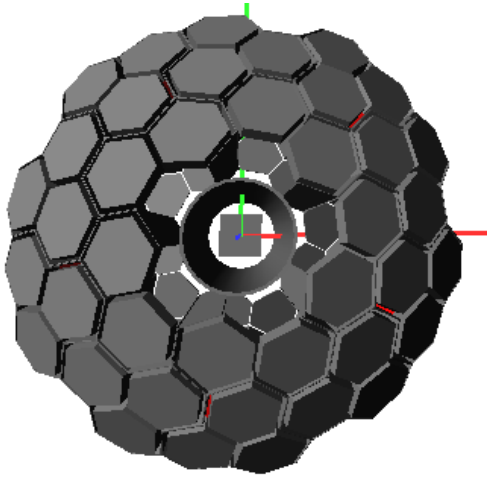
10 triple Cluster + **5 double** Cluster

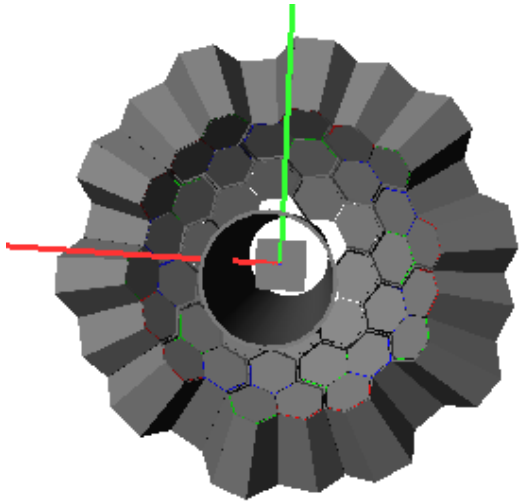
New approach considering AGATA double cluster detectors

Geometry cases

- Task 1: S2 + 5 Double Cluster detectors closing part of the central hole (15-16cm?). Remains shell with 5 crystals hole + pentagon hole





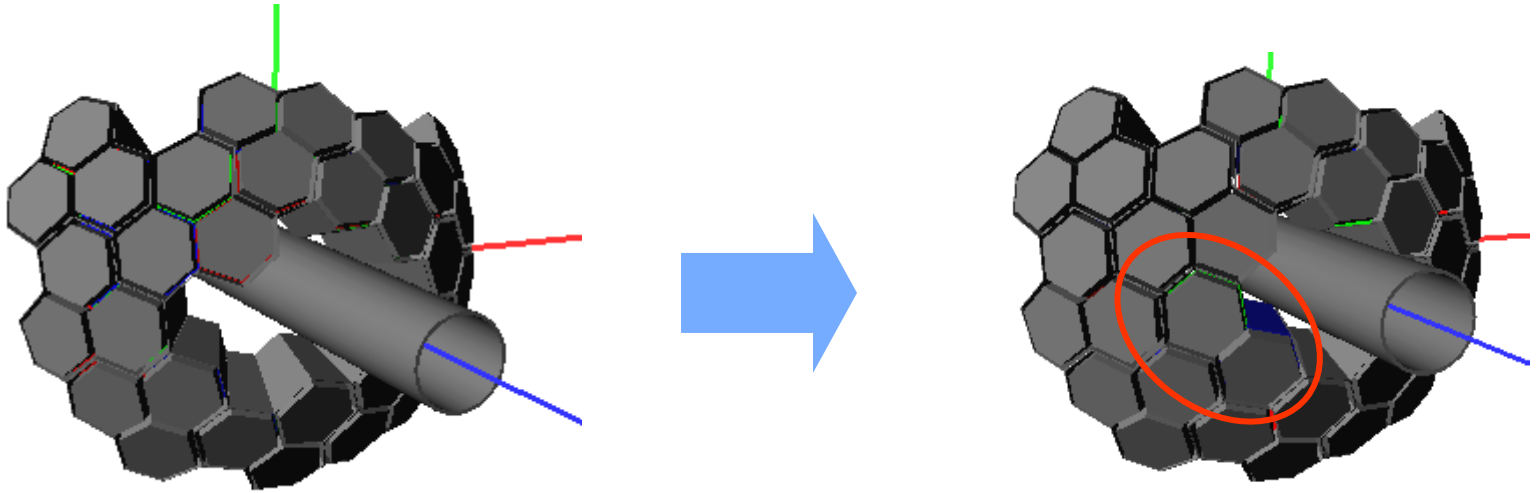


Beam pipe diameter = 13 cm

New approach considering AGATA double cluster detectors

Geometry cases

- Task 1: S2 + 5 Double Cluster detectors closing part of the central hole (15-16cm?). Remains shell with 5 crystals hole + pentagon hole
- Task 2: S3 + 1 Double Cluster detector closing part of the central hole (10-11 cm?). Remains shell with 4 crystals hole + pentagon hole.

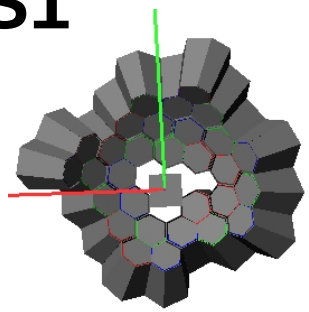


10 triple Cluster (Asym) + **1 double** Cluster

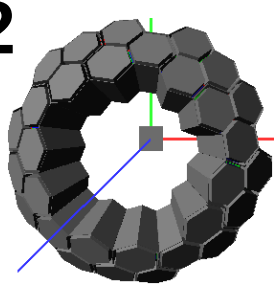
Beam pipe diameter = 11 cm

S-Geometries Performance comparison: Efficiency

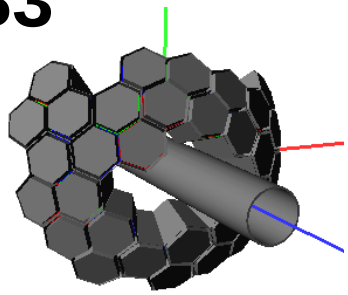
S1

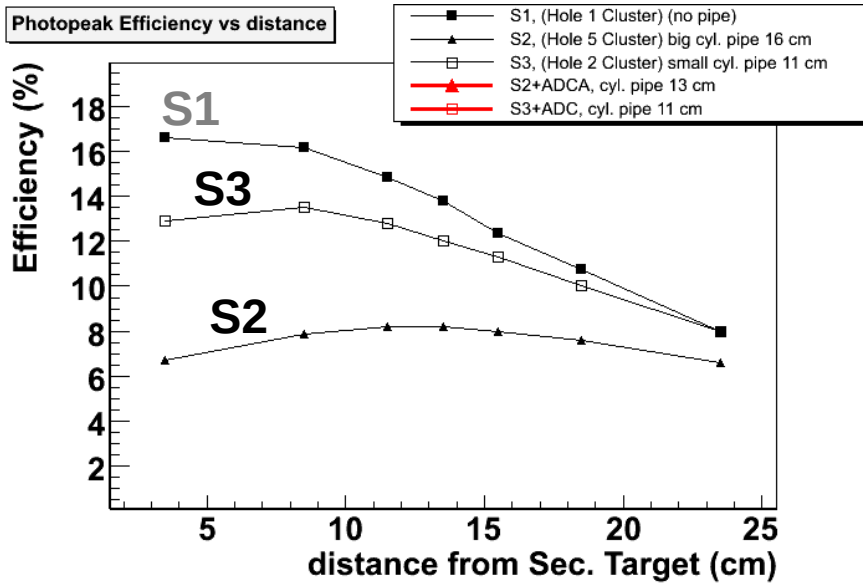


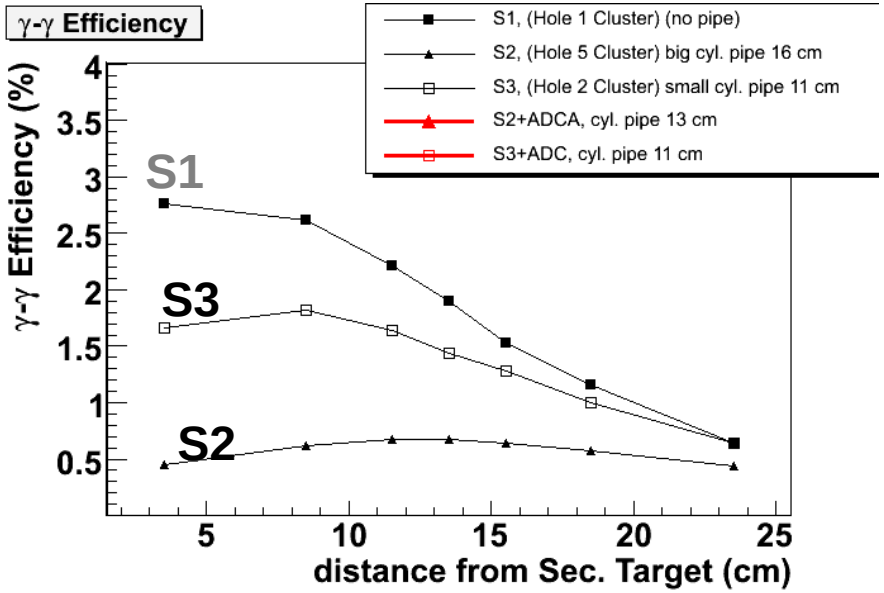
S2



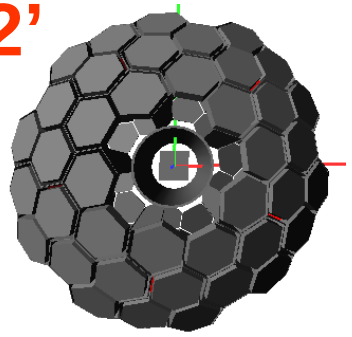
S3



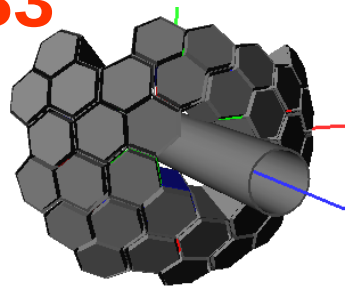




S2’

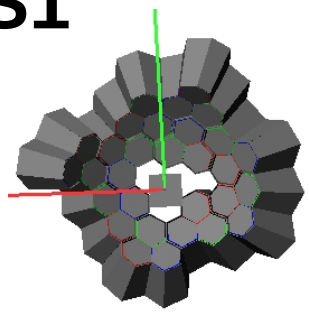


S3’

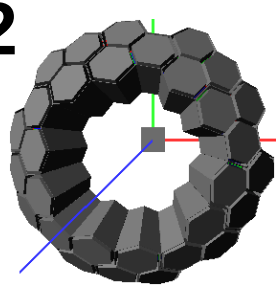


S-Geometries Performance comparison: Efficiency

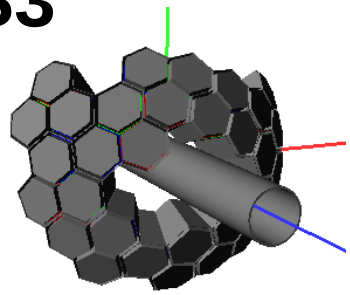
S1

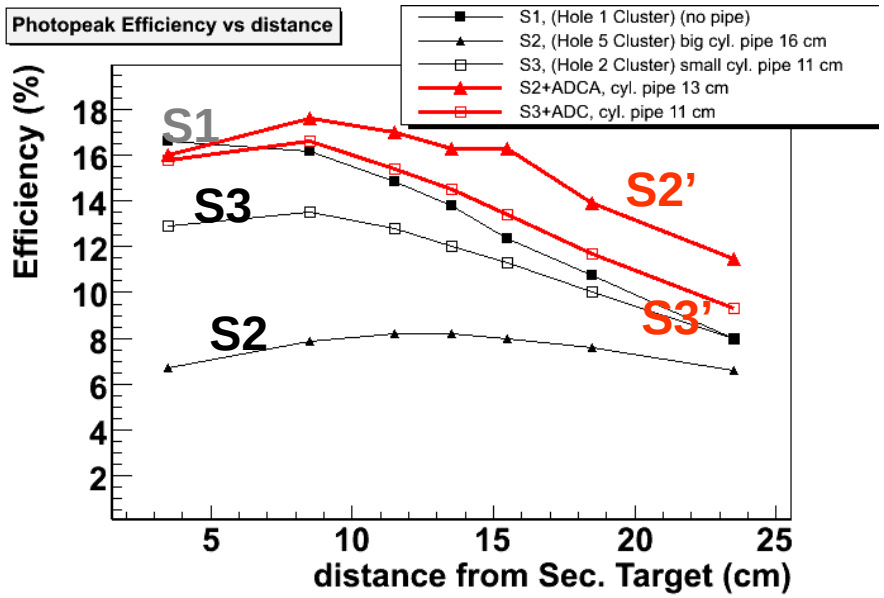


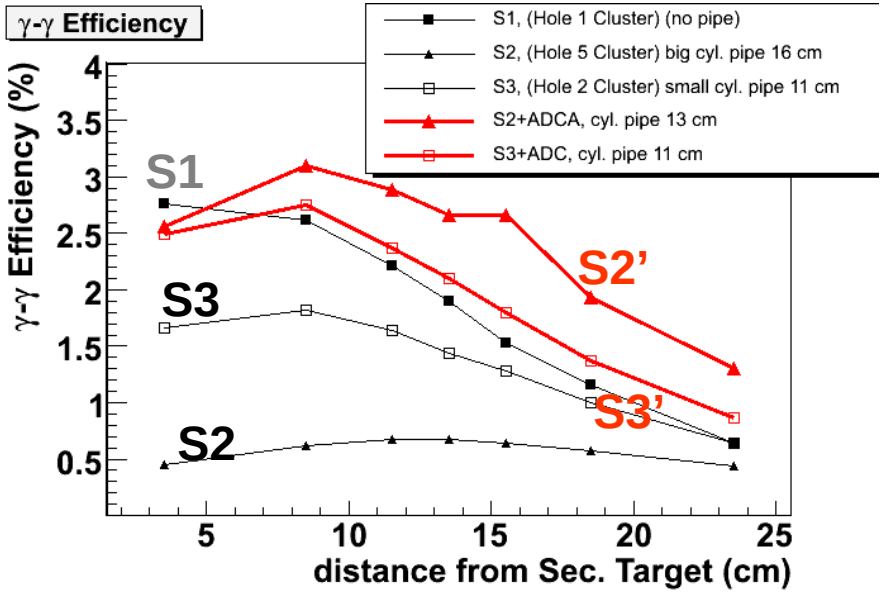
S2



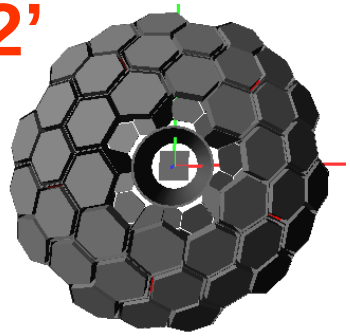
S3



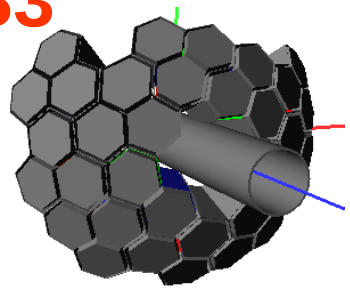




S2'

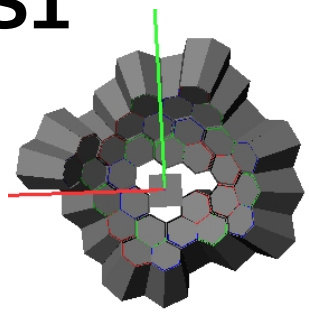


S3'

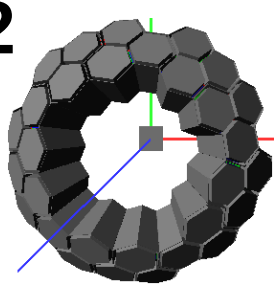


S-Geometries Performance comparison: Resolution

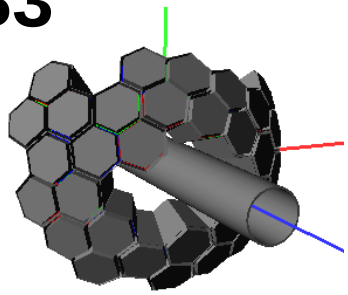
S1

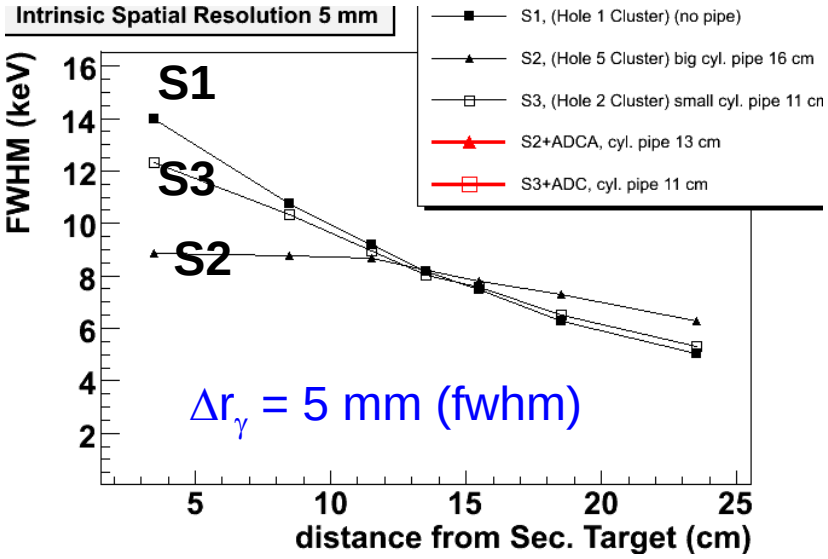


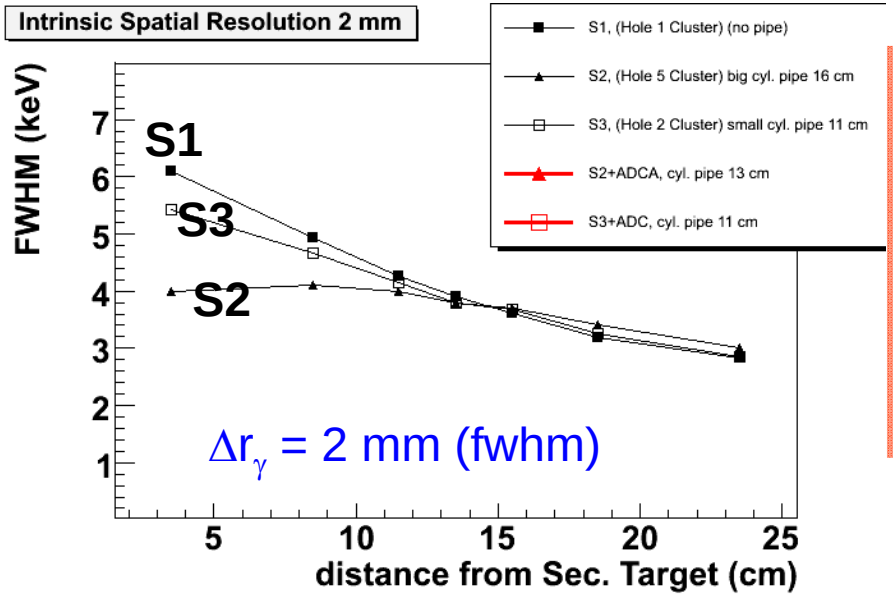
S2



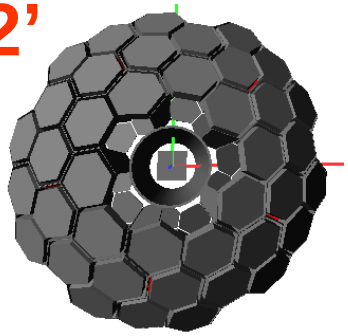
S3



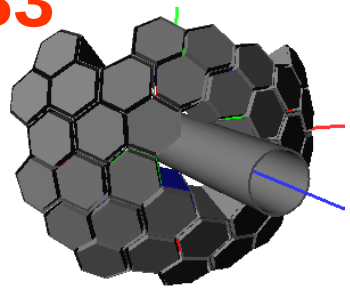




S2’

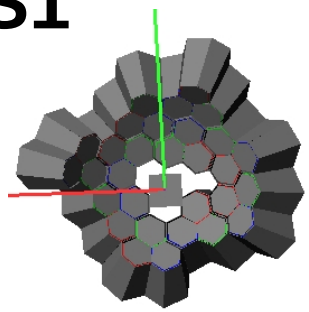


S3’

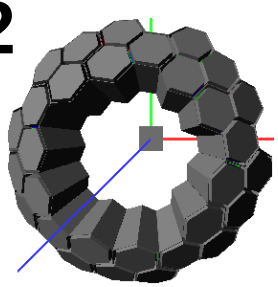


S-Geometries Performance comparison: Resolution

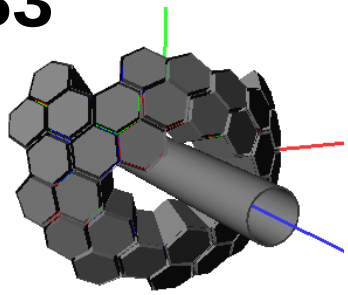
S1

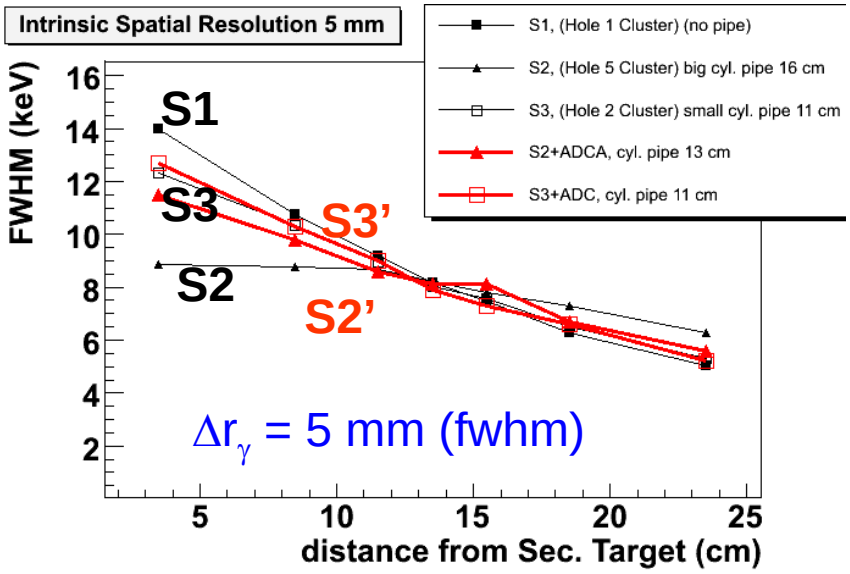


S2

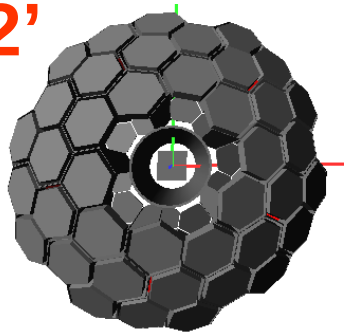


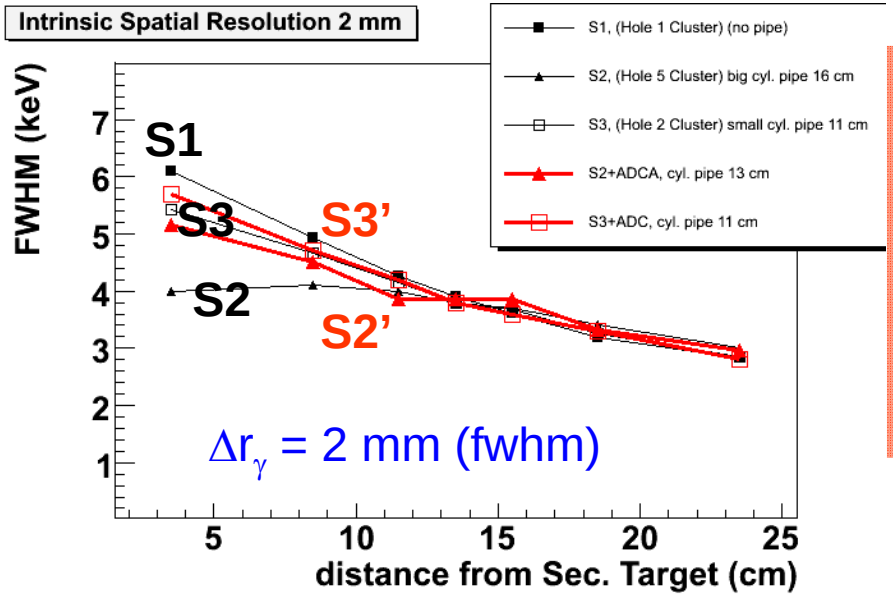
S3



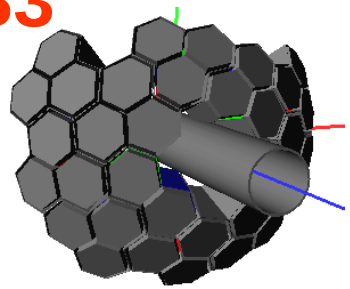


S2'



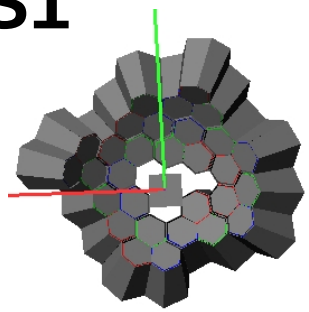


S3'

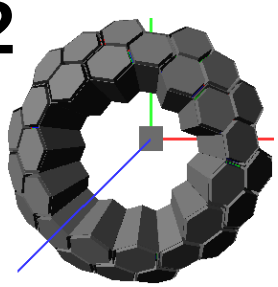


Shell Geometries performance comparison: Summary

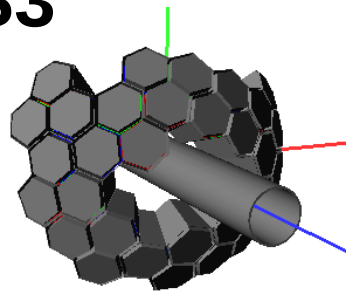
S1

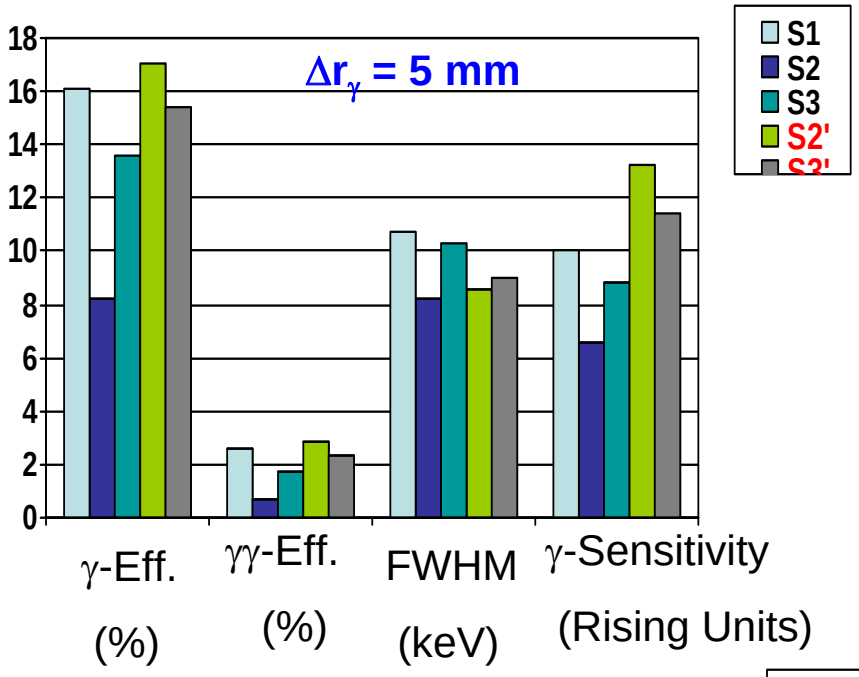


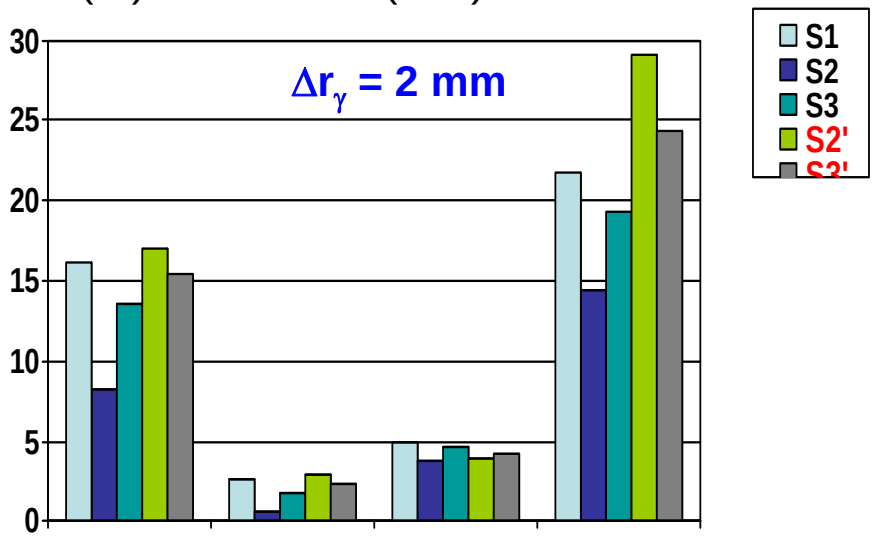
S2



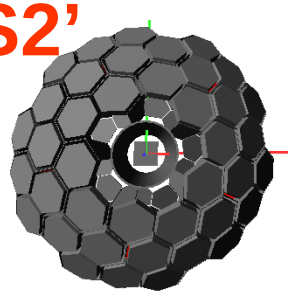
S3



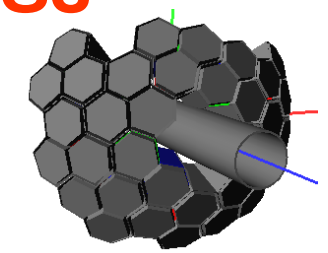




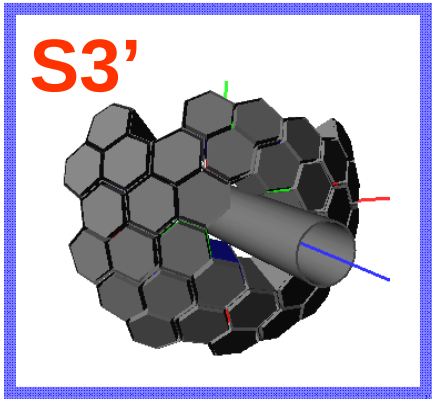
S2’

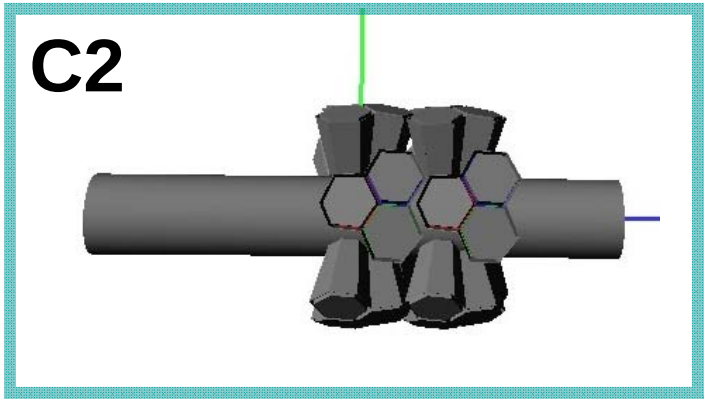


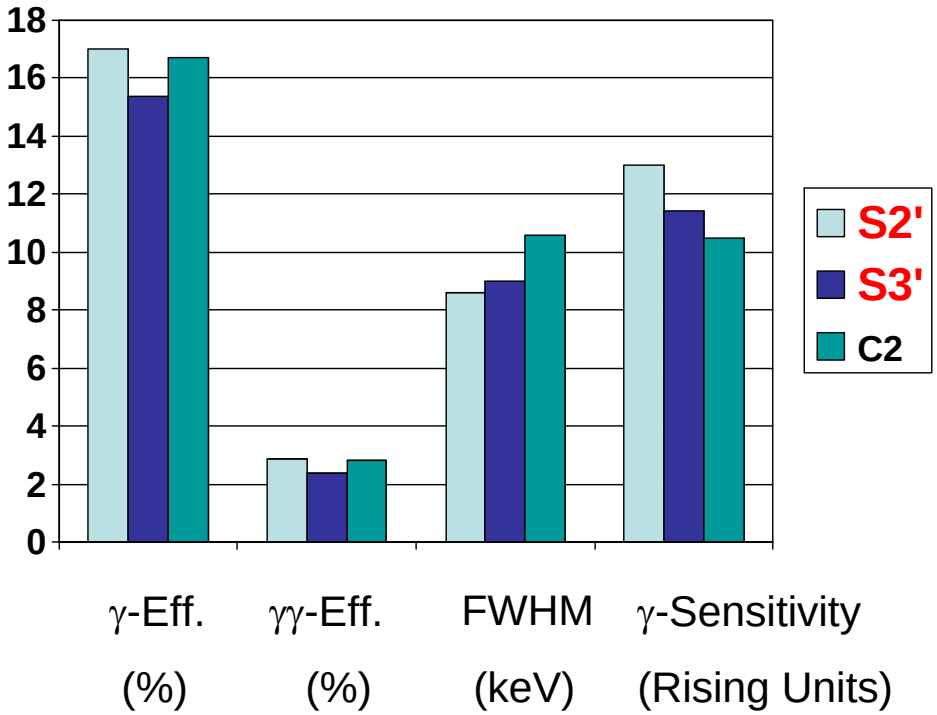
S3’



S- and C-Geometry Performance, Quantitative Comparison







List of Tasks for the **Working Group (17.07.2009)**

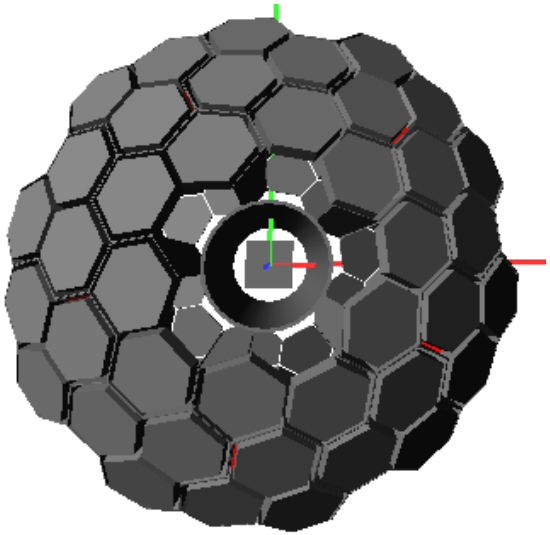
Geometry cases

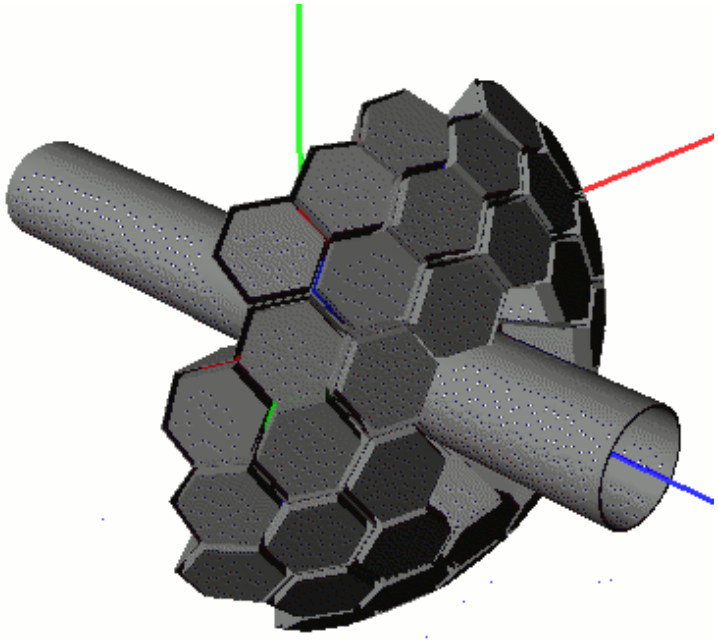
- Task 1: S2 + 5 Double Cluster detectors closing part of the central hole (15-16cm?). Remains shell with 5 crystals hole + pentagon hole
- Task 2: S3 + 1 Double Cluster detector closing part of the central hole (10-11 cm?). Remains shell with 4 crystals hole + pentagon hole.
- Task 3: previous + 4 Triple Clusters enlarging shell (for case one has 15 Clusters available).
- Task 4: C2 geometry, with clusters in 2nd ring pointing to target, and 3rd ring (15 Clusters total)

Conclusion:

- Provided that 10 ATC detectors and 1 “ADC” detector (or more) are available, then a shell geometry (S3’ or S2’) shows a superior performance than any other possible cylindrical geometry (e.g. C2).
- Typical γ-ray efficiencies between 14% and 17% can be achieved, which in combination with resolutions (FWHM) of 8-9 keV will provide a γ-ray sensitivity of more than 10 times the RISING sensitivity.

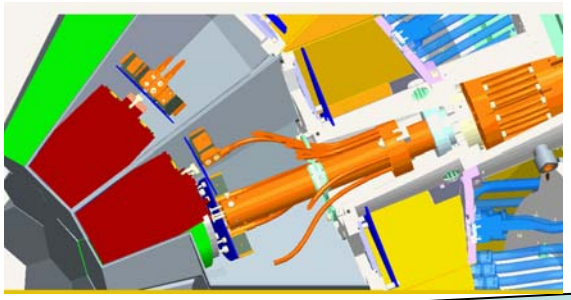
S2´: Best Geometry for experiments at GSI

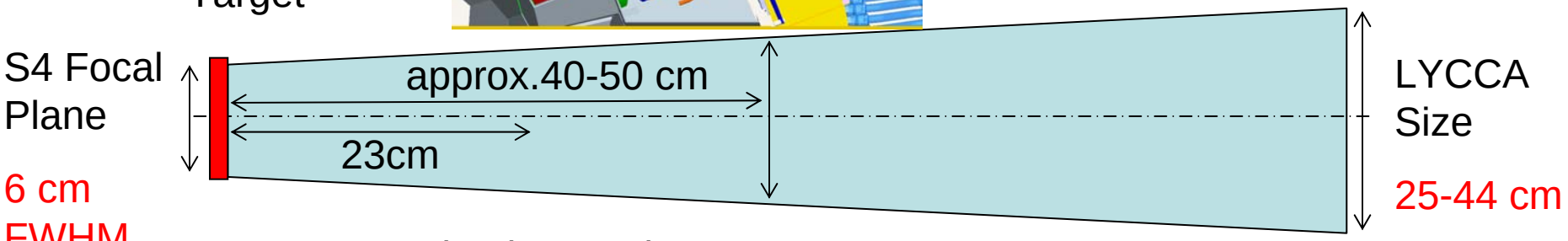




Beam profile at AGATA position... better 120 mm option

Cross Section View from the TOP





Beam angle about 3 deg

$L_{Target-LYCCA}$ = 3.5 m

Beam Size at ADC-Cryostat Flange approx. 10 cm

Example: θ = 3 deg (depends on $L_{Target-LYCCA}$ and on LYCCA size)

Beam Size X at Target Position = 6 cm (FWHM)

Beam Size X at 45 cm downstream = 10.7 cm