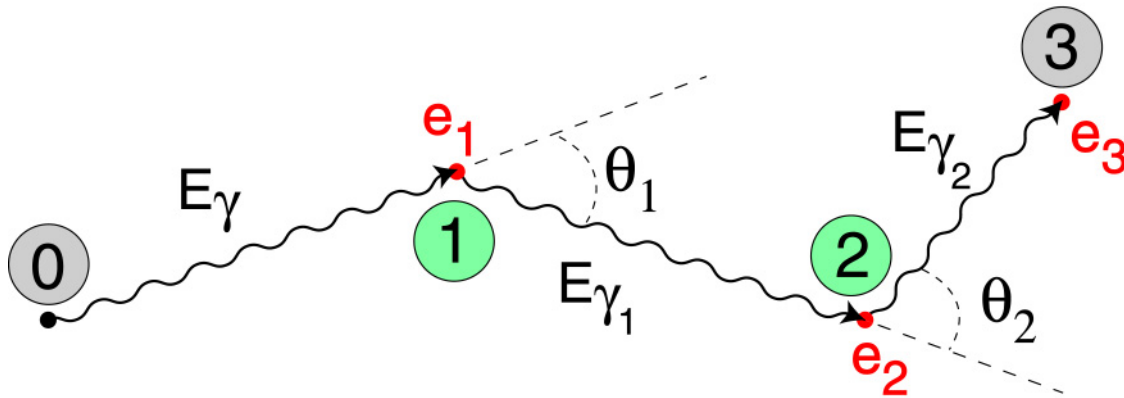


Impact of ancillary detectors on AGATA

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γ -ray Tracking



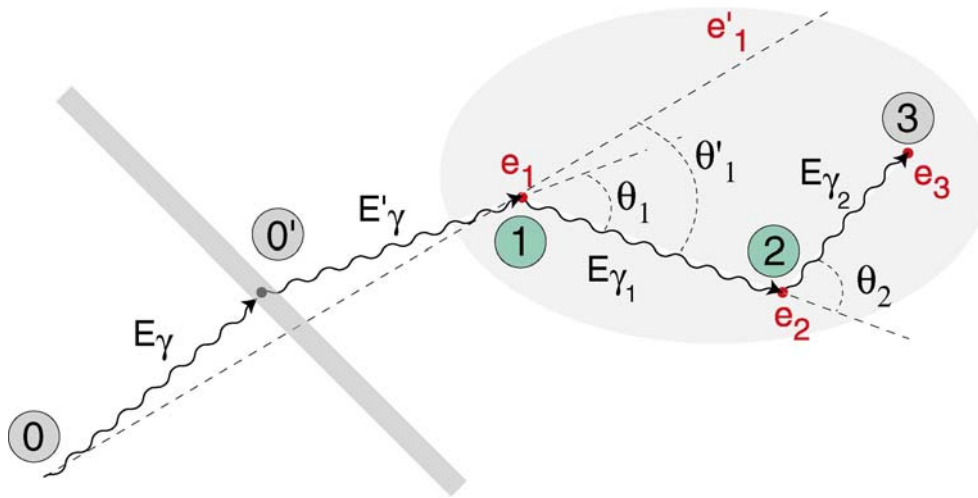
Identifying the interaction points, the energy releases and assuming an origin for the photon, one can check whether the combination of points/energies is compatible with the Compton formula

Ancillary detectors and conventional detectors

Ancillary detectors positioned inside the array induce:

- Absorption of low-energy photons
- Scattering of the photons (reduction of the intensity and/or uncertainties performing Doppler correction)

Ancillary detectors and tracking detectors



Direction of the γ :

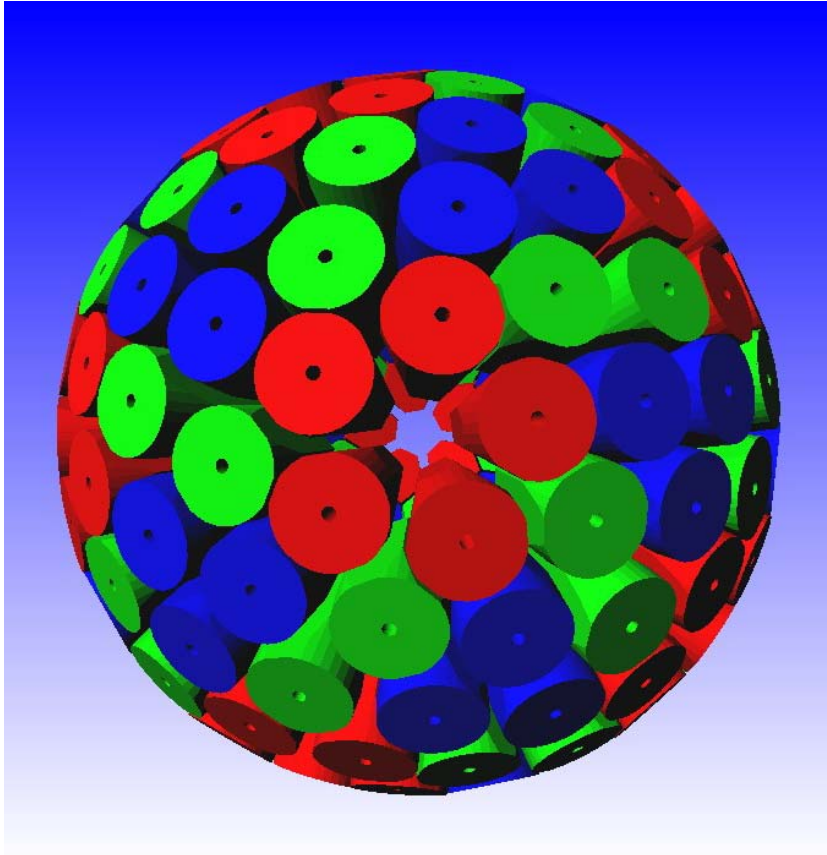
e_1 (angle θ_1)

Direction considered by the tracking algorithm:

e'_1 (angle θ'_1)

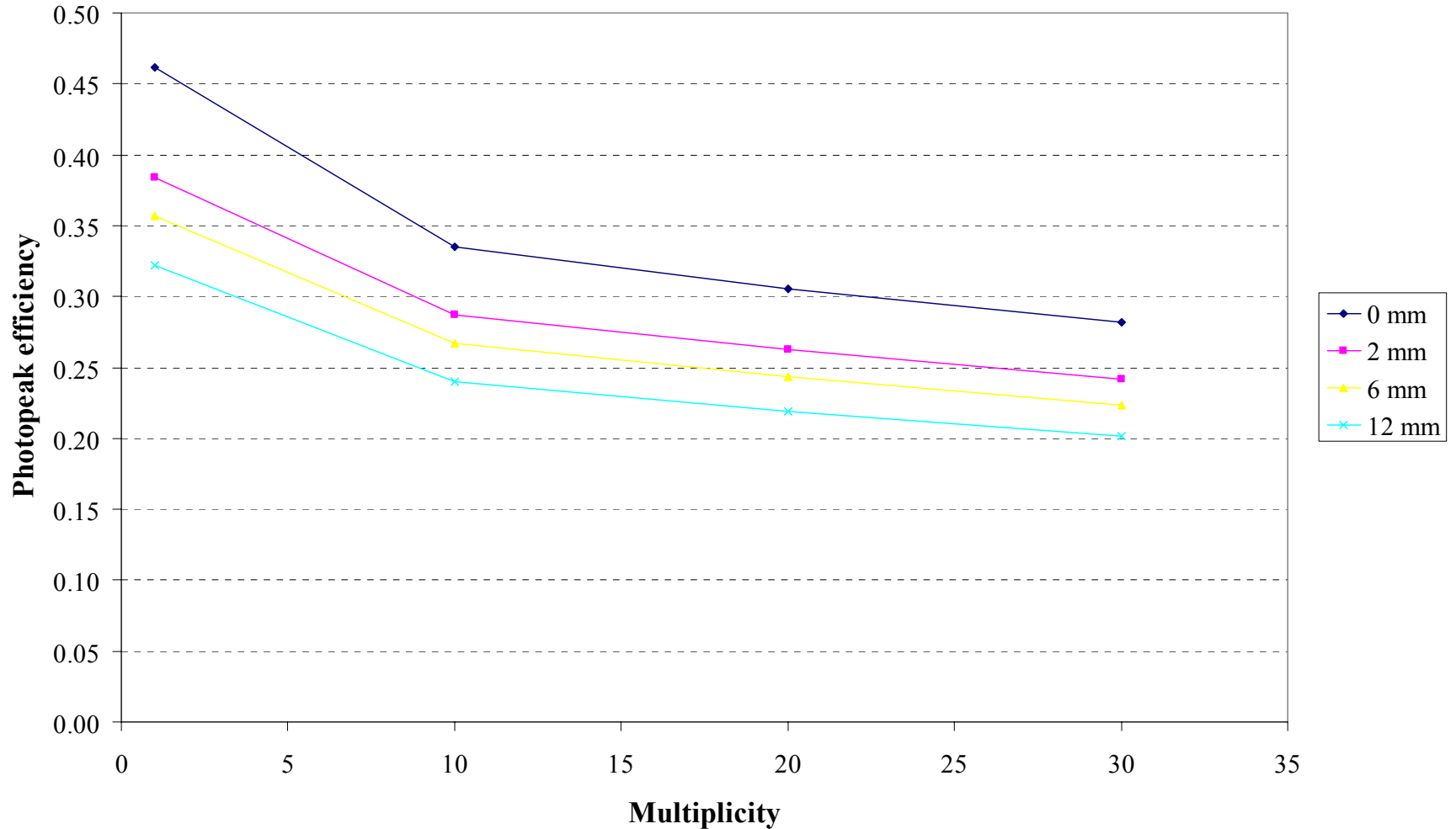
The tracking algorithm fails (completely or partially), ie absorption and background are produced!

Some calculations

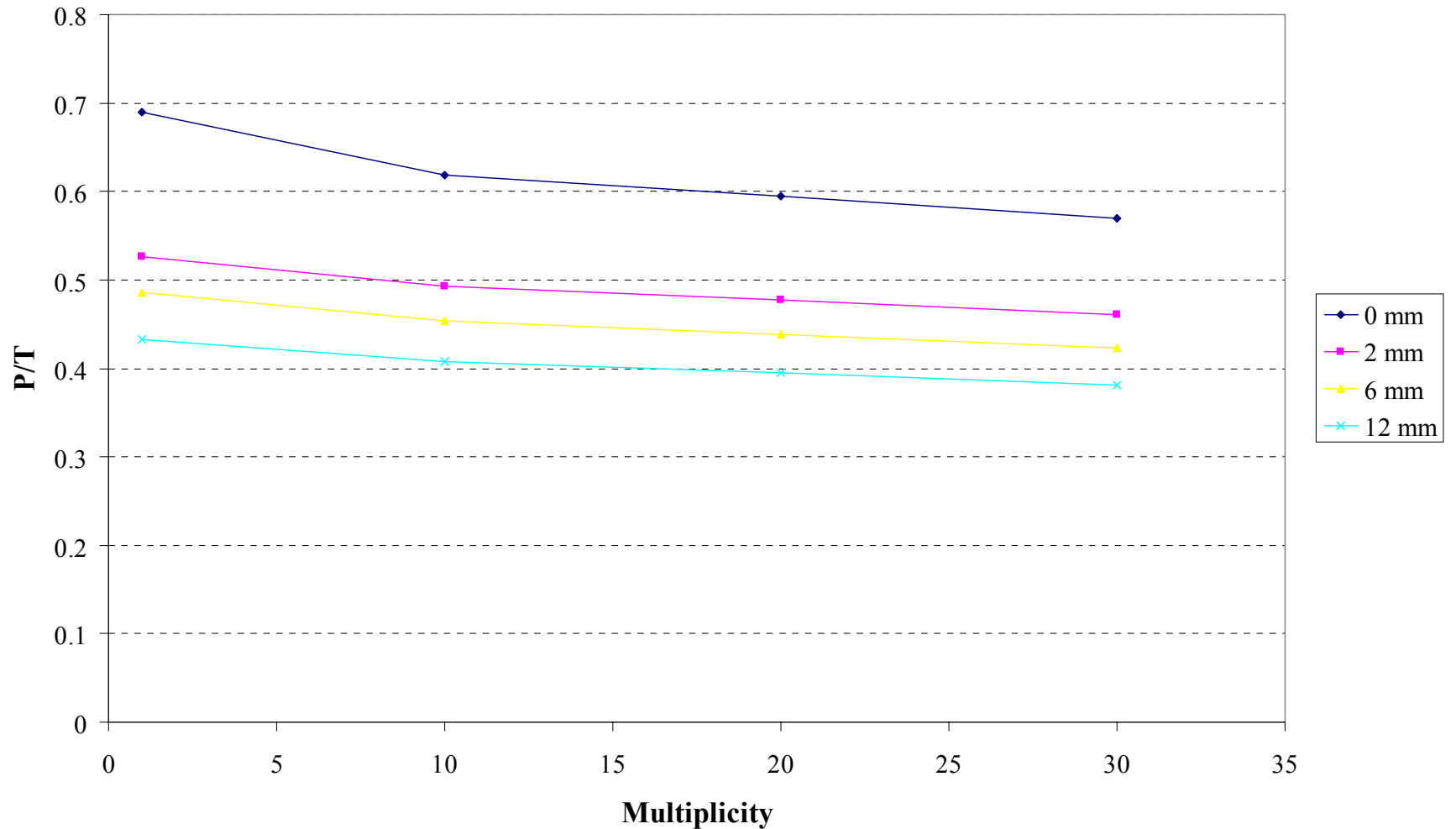


The effect of an ancillary detector has been estimated considering (for the geometry with 180 crystals) a spherical chamber of aluminium with radius $r=10\text{cm}$ and wall thickness variable from 2mm to 12mm. The results have been obtained with the tracking algorithm by D.Bazzacco

Photopeak efficiency at 1 MeV



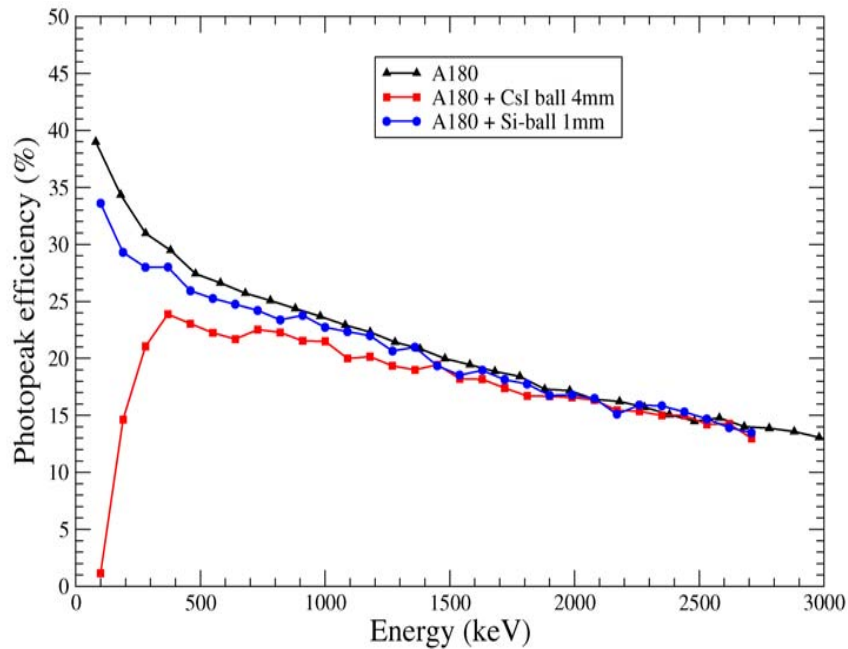
Peak-to-total ratio at 1MeV



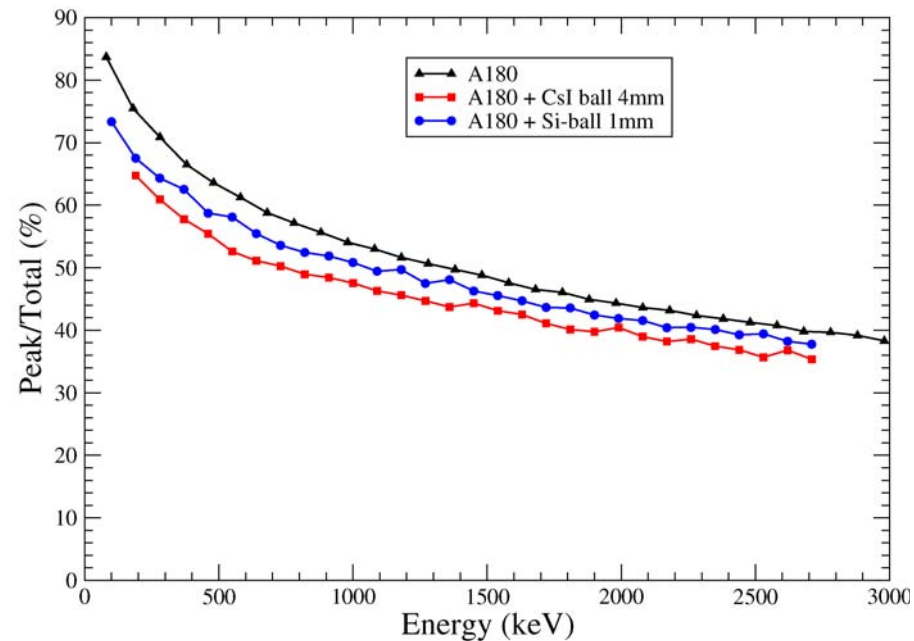
Effect of ancillary devices

In addition to cryostats, capsules and scattering chamber, an “ancillary” sphere is considered in the simulation.
Only the results for A180 are shown.

Absolute photopeak efficiency



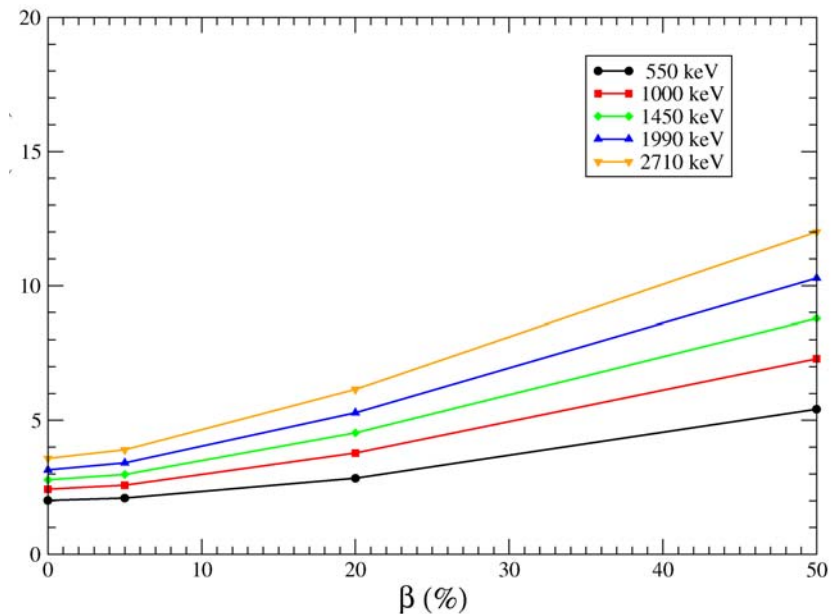
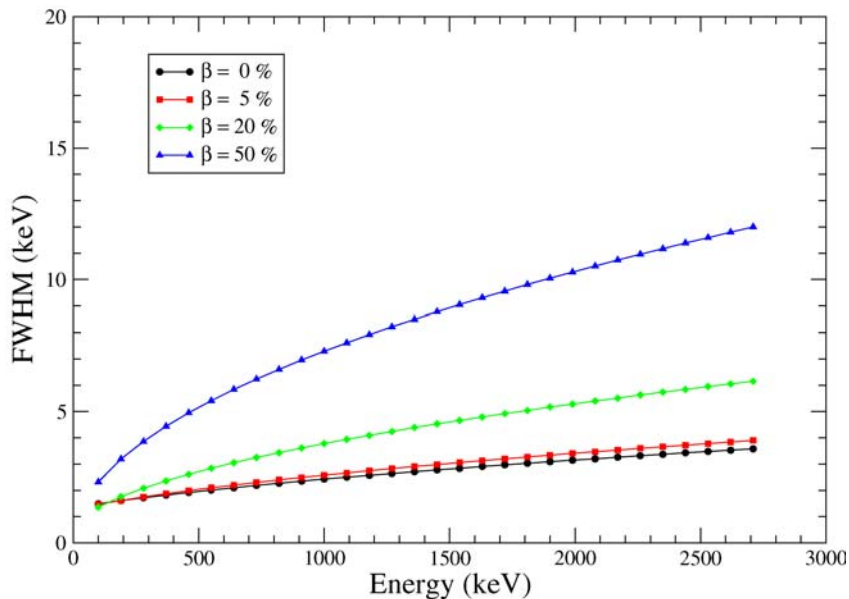
Peak-to-total ratio (response function)



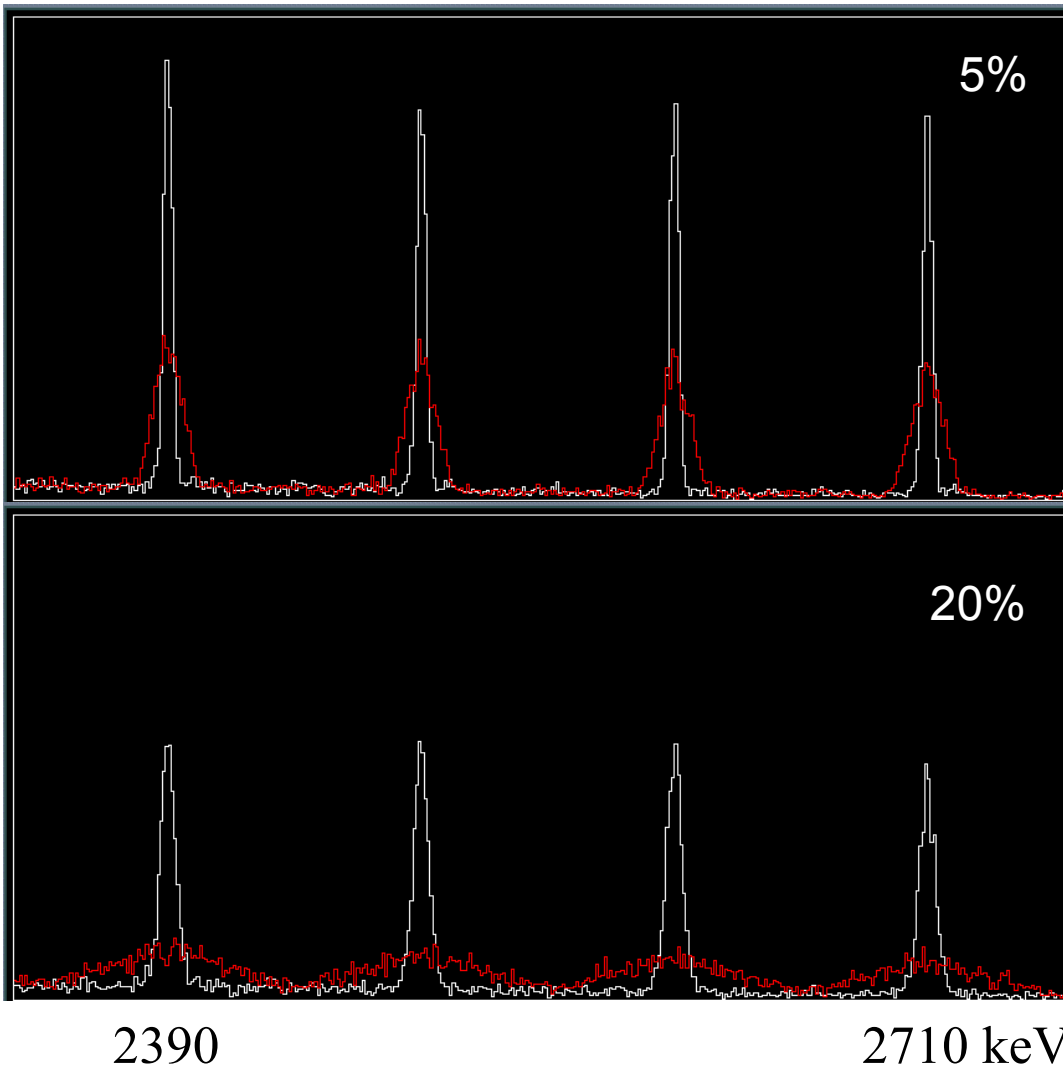
Effect of the recoil velocity - 1

30 photon rotational cascade ($E_\gamma = E_0 + n\Delta E_\gamma$)
A180 configuration (no scattering chamber)
Recoil direction: z axis, β : constant (event by event)
Recoil velocity perfectly known when reconstructing

Reconstructed FWHM



Effect of the recoil velocity - 2



30 photon rotational cascade
($E_\gamma = E_0 + n\Delta E_\gamma$)
A180 configuration (no scattering chamber)
Velocity direction variable event-by-event (recoil opening angle: 5°)

White: recoil direction perfectly known when reconstructing
Red: only average recoil direction known (=z axis)

At $\beta=5\%$:

3.824 keV @ 2710 keV

12.578 keV @ 2710 keV

At $\beta=20\%$:

7.756 keV @ 2710 keV

>80 keV @ 2710 keV!!!

Conclusions

- Any passive material inside the array has an influence and degrades the performances of the array; its effect might be tolerable (as in the case of detectors operated in the standard way) but **should be carefully considered!** The cost might be greater than the benefits.
- In order to maintain the capabilities of AGATA in experiments at high beta, ancillary devices measuring the recoiling nucleus velocity are needed