Internal shielding for BULLKID-DM at LNGS

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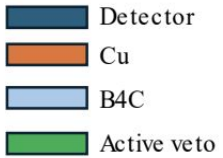
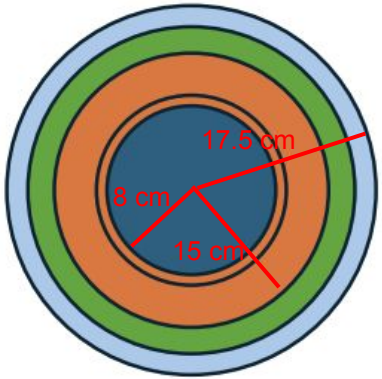
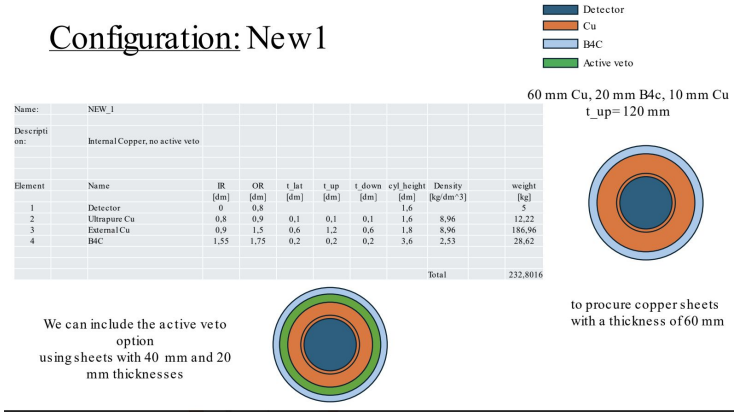
Digest, 12/11/2025

Internal shielding

- Original proposal exceeded the mass limit inside the cryostat
- NEW1 was proposed (sent by Angelo)
  - 1 cm of ultrapure copper
  - 6 cm of external copper for sides and bottom of the detector
  - 12 cm of external copper on top of the detector
  - 2 cm of B_4C
- Total mass of 232.8 kg



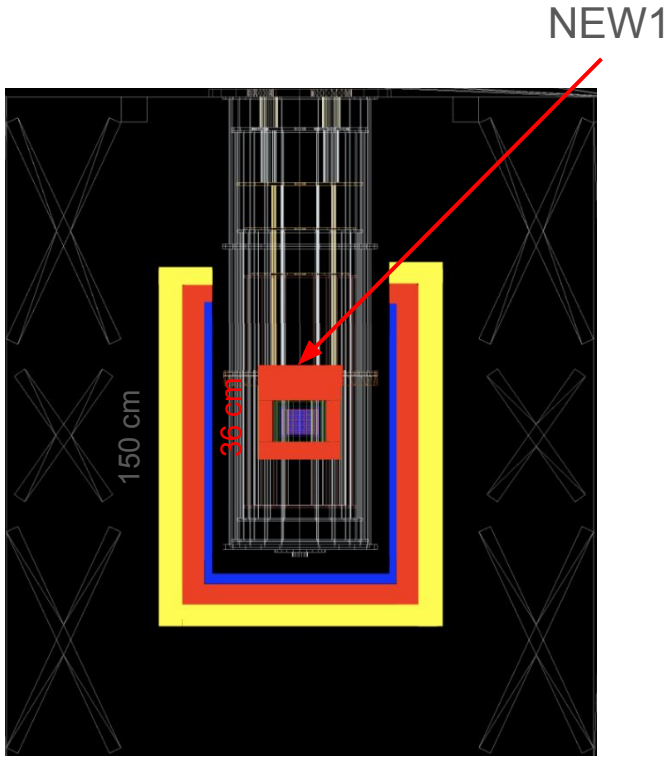




Internal shielding

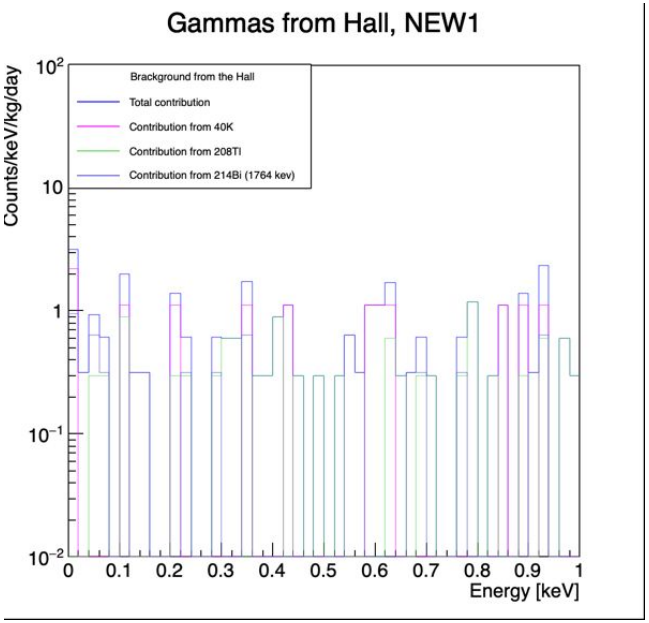
- Considering external shielding plus internal copper shielding (no B4C)
- Main gamma contributions simulated

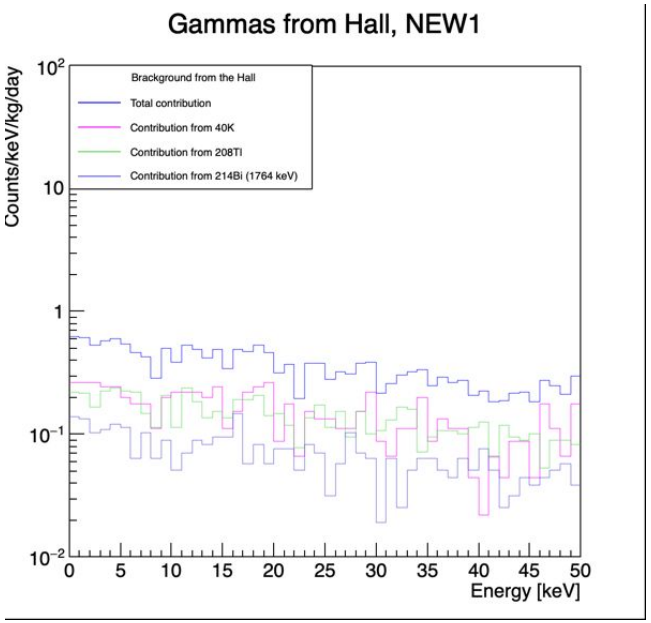
Isotope	Energy [keV]	Intensity [$cm^{-2}s^{-1}$] x 10^{-3}
^{208}Tl	2614	9.03
^{214}Bi	1764	9.49
^{40}K	1460	33.56



Internal shielding: background contribution with NEW1

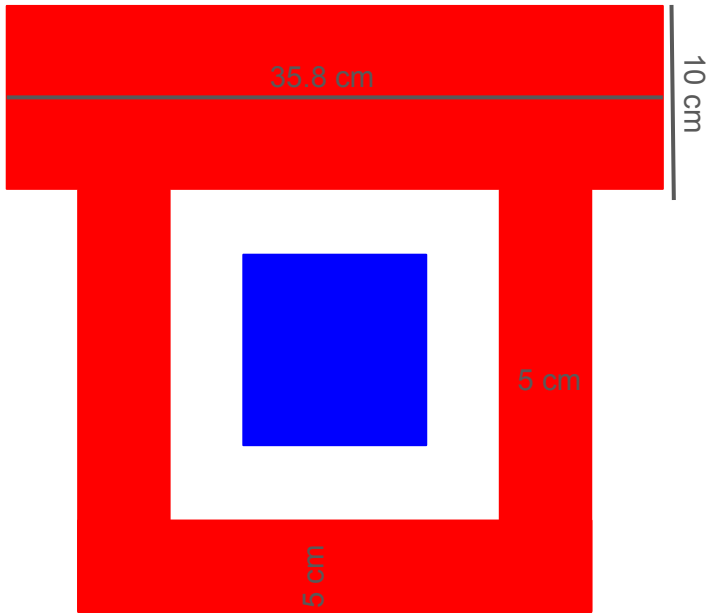
- We are close to 1 dru!
  - the rest of the gamma lines contribution will increase a little bit the background



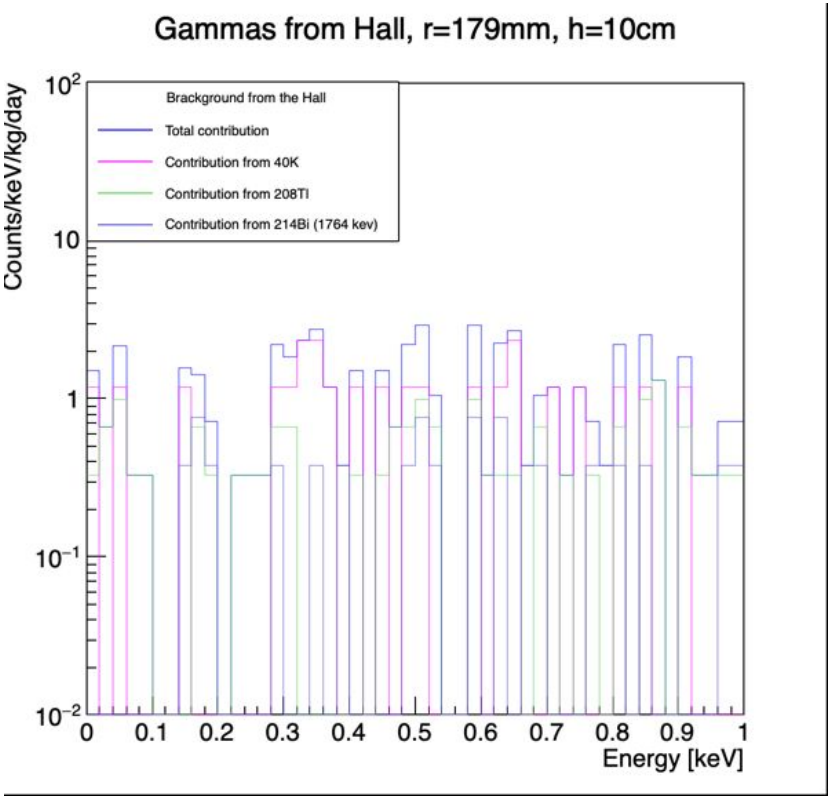


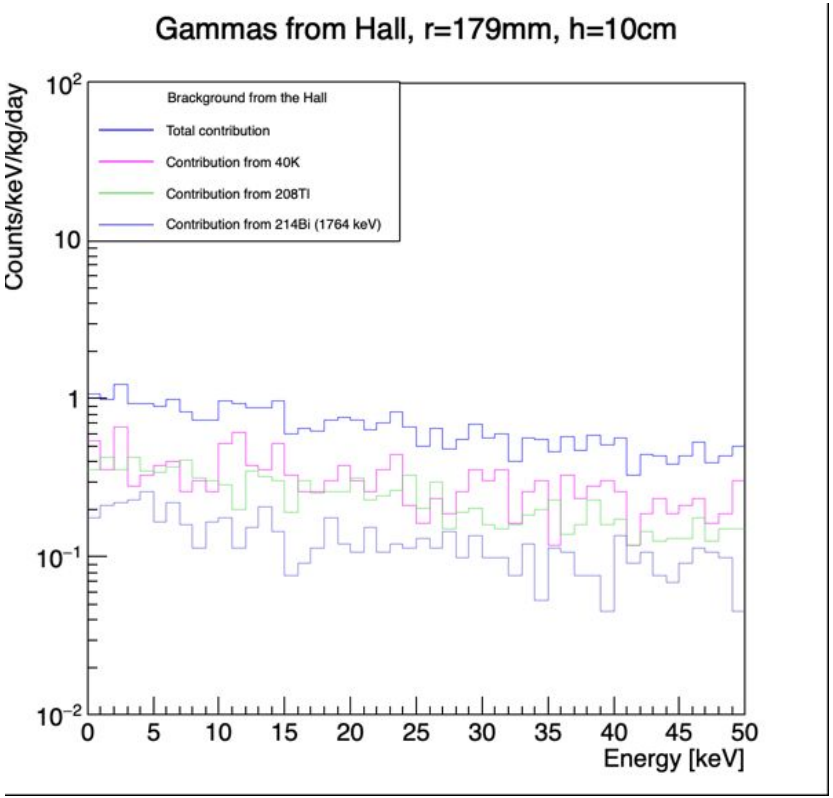
Internal shielding: tuning the internal shielding

- Increasing the radius maintaining the copper mass, radius from 15 cm to 17.9 cm
  - 10 cm on top, 5 cm + 1 cm on sides and bottom
  - 8 cm on top, 6 cm + 1 cm on sides and bottom

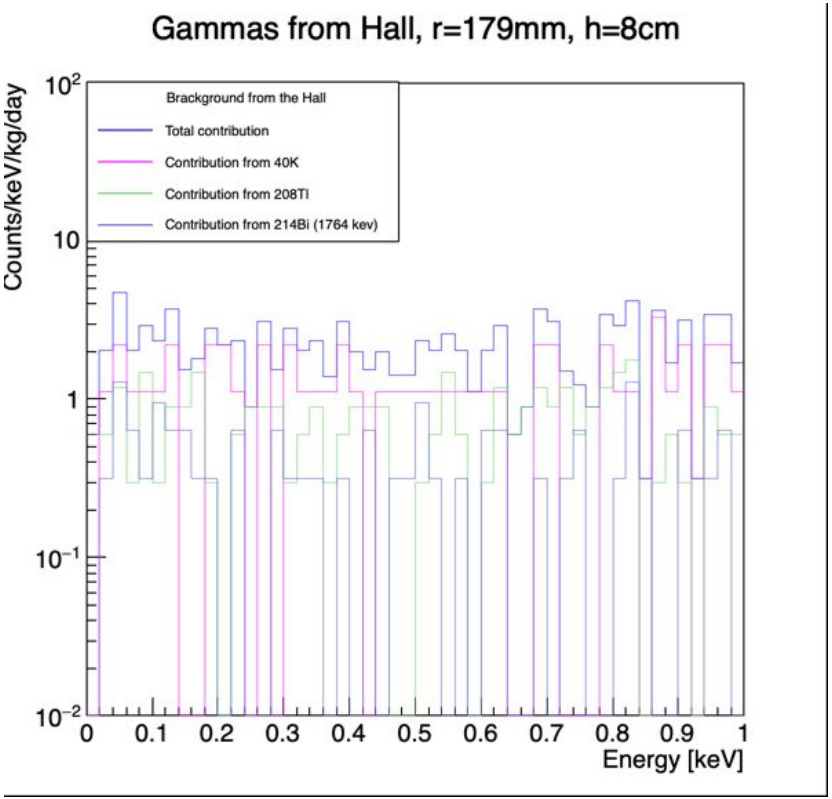


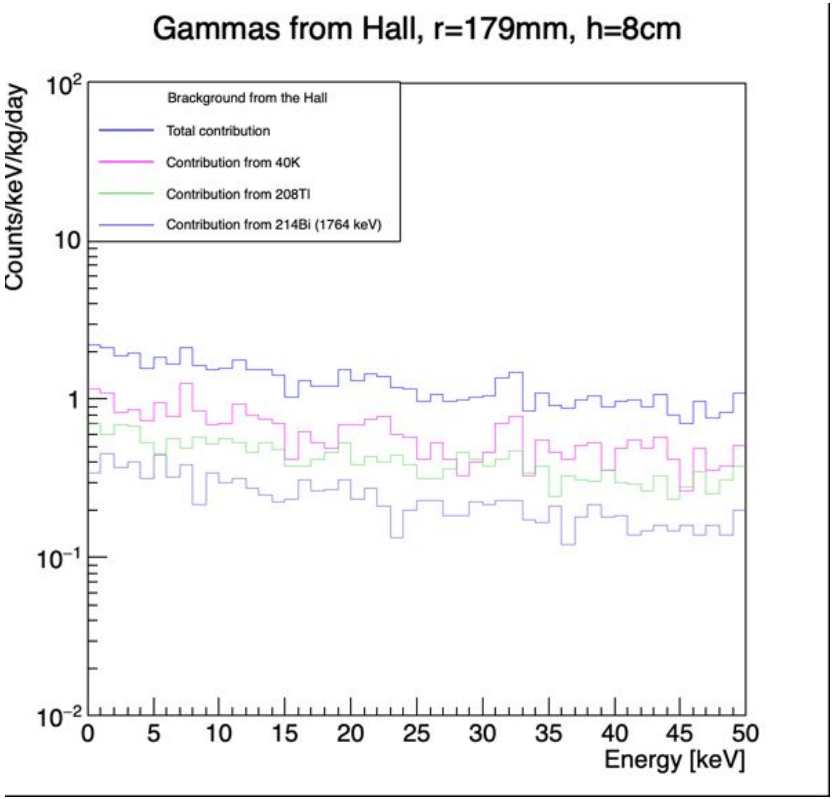
- Radius = 17.9 cm, 10 cm on top, 5 cm sides and bottom



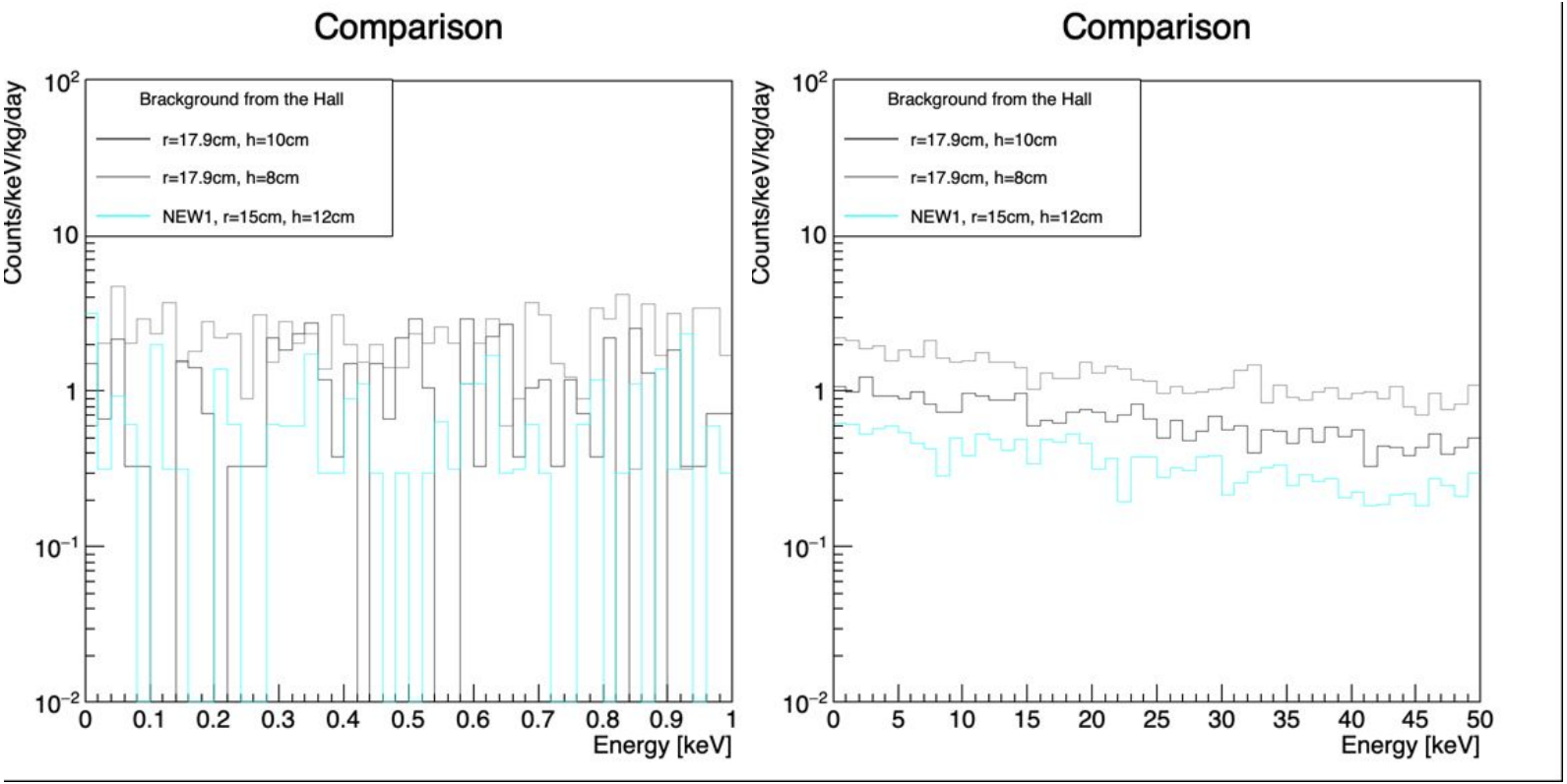


- Radius 17.9 cm, 8 cm on top, 6 cm sides and bottom





- The amount of copper on top has a major impact on reducing the background than the increase of the radius



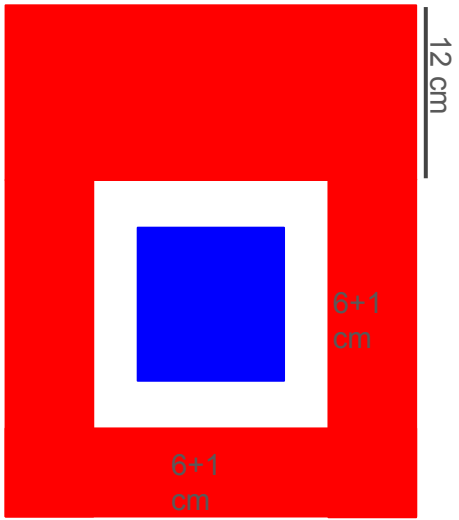
Top: 8 cm
side: 6 + 1 cm
r = 17,9 cm

Top: 10 cm
side: 5 + 1 cm
r = 17.9 cm

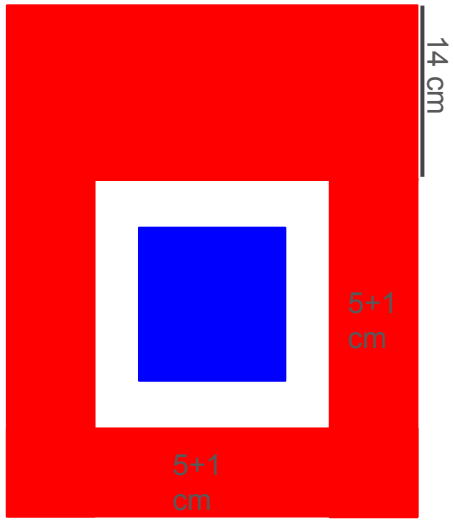
Top: 12 cm
side: 6 + 1 cm
r = 15 cm

Next model

- Keep NEW1
- Sides and bottom to be reduced, increase the top
  - sides and bottom 5 + 1 cm
  - top □ 14 cm
- It will start run soon
- These simulations must be performed with the full shield



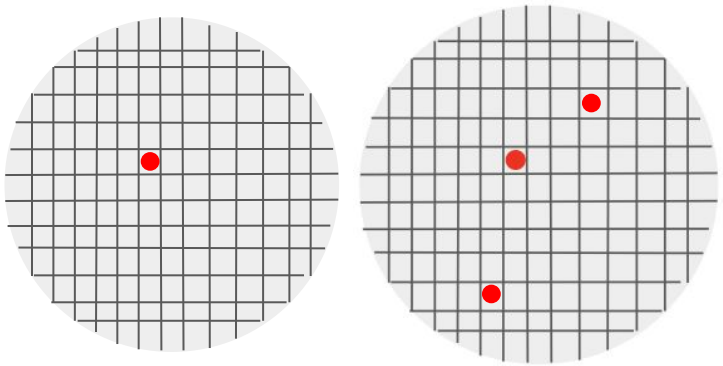
NEW1



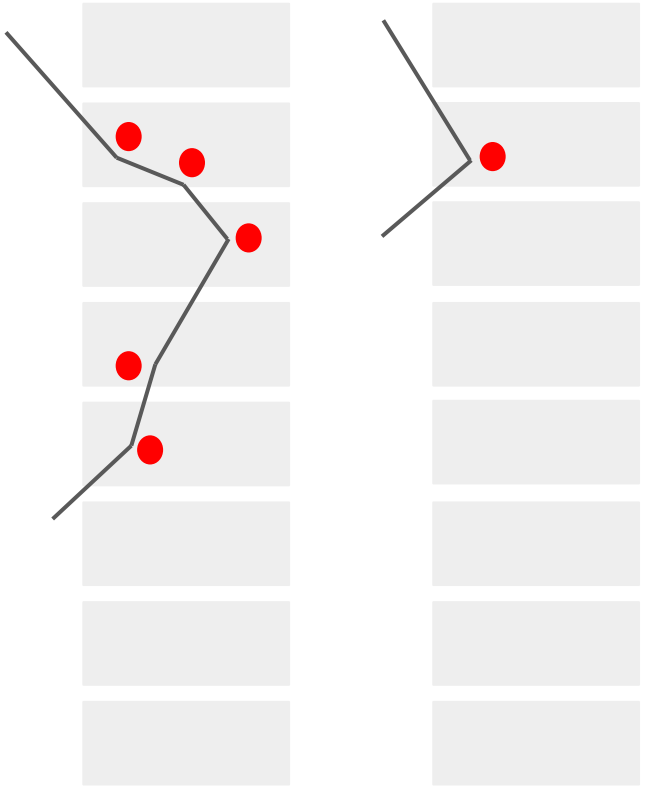
Next model

Cuts to implement

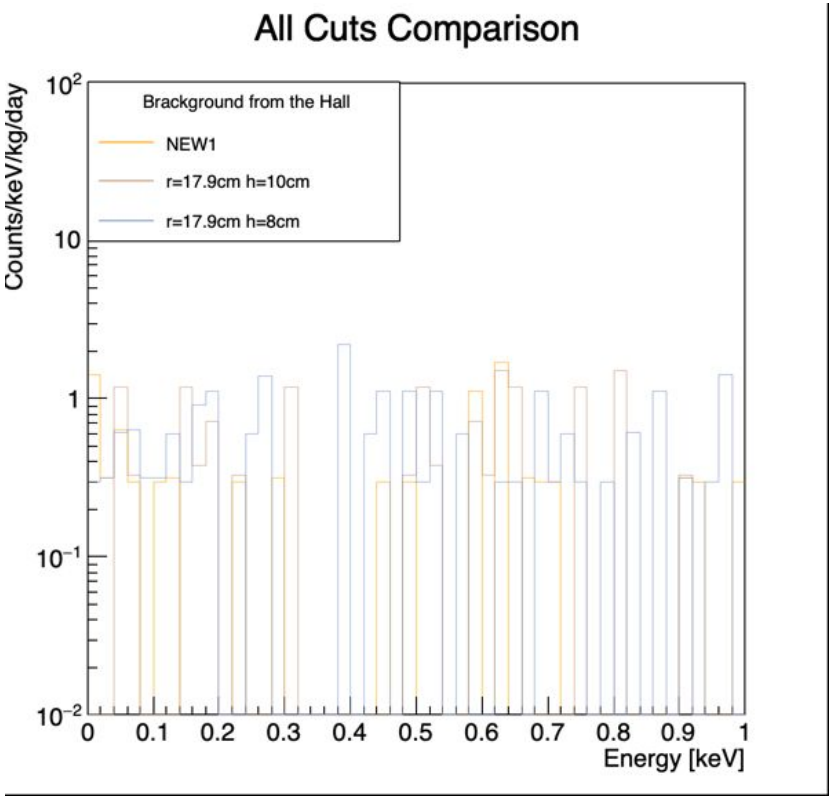
- Results presented so far consider
  - cut of the 8 neighboring dice
- What happens if we include cuts on:
  - single hit per wafer

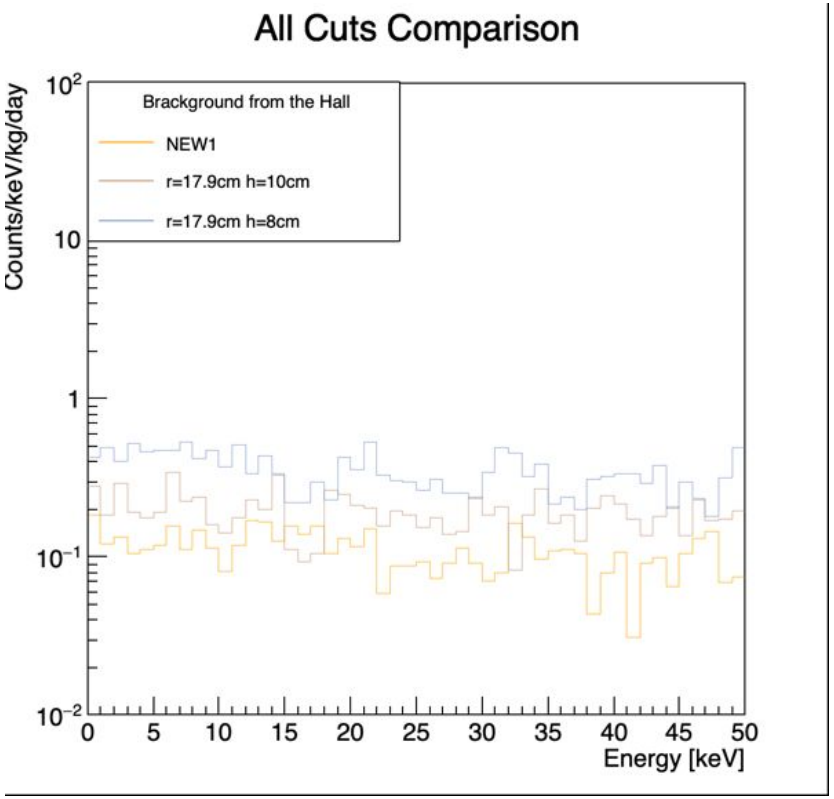


  - single hit in the 16 wafer stack

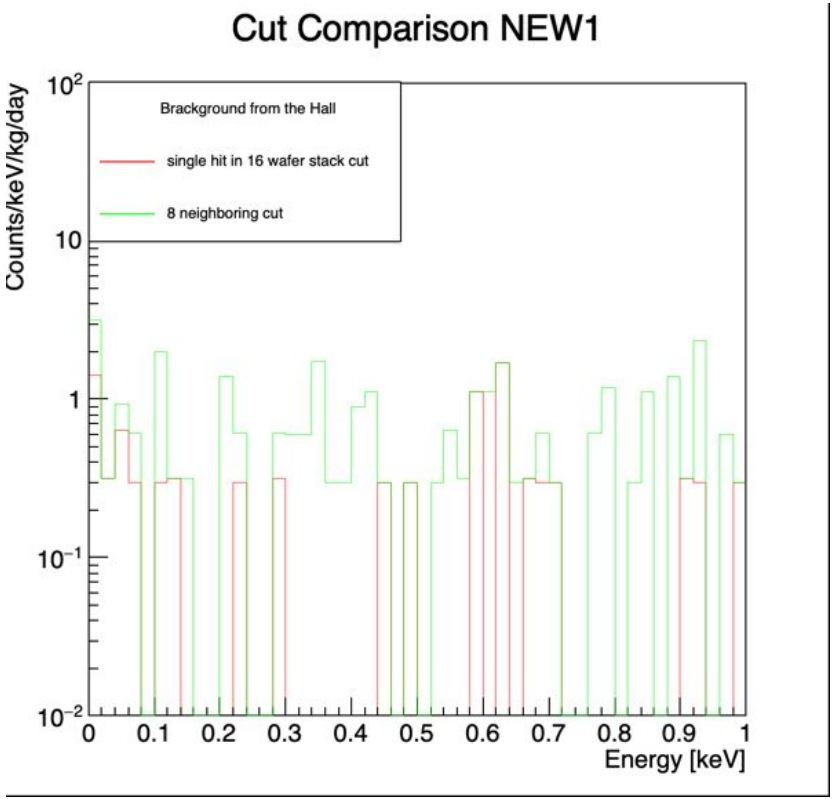


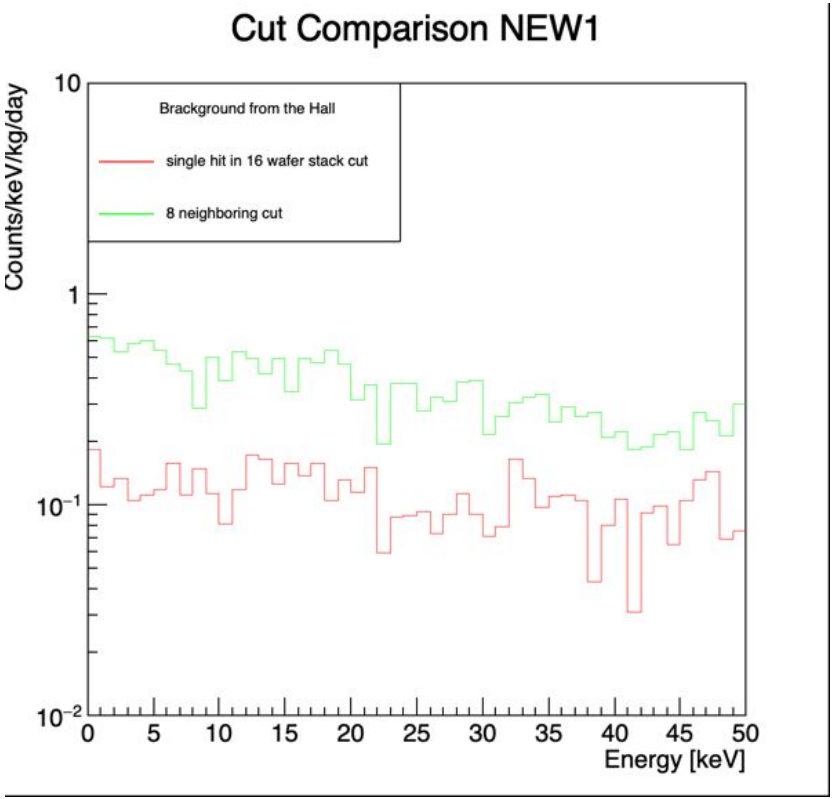
Single hit in 16 wafer stack





Comparison 8 neighboring vs single hit in 16 wafer stack





Summary

- The amount of copper on top has a major impact on reducing the background more than the increase of the radius
- Including all the expected cuts (single hit in the 16 wafer stack), NEW1 is around 10^{-1} dru
- The sides and bottom could be reduce to increase the top shield (lo de la nueva diapositiva sus medidas)
- B_4C not included in the simulations
  - its effect to stop gammas is smaller than copper but will contribute to the reduction of background
- Results ready by the end of the year