Update in the BULLKID-DM Shielding (neutron contribution)

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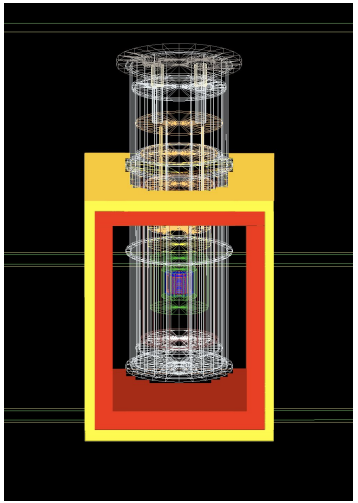
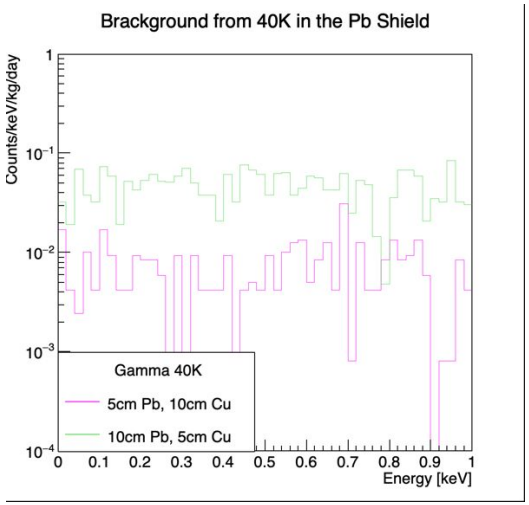
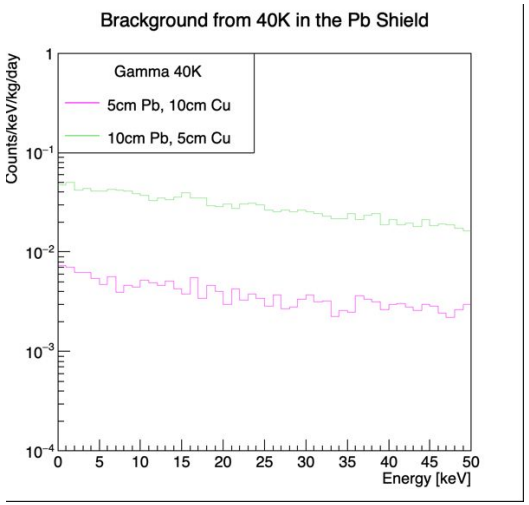
External Shielding

- Developed a design with a hat shield to reduce contribution from gammas
  - yellow: Lead
  - red: Copper
- Considered 5 cm thick of Pb plus 10 cm thick of Cu and a second case with 10 cm thick of Pb and 5 cm thick of Cu
  - second case reduced the mass of Cu by 2.1 T, but the limits in radiopurity of Pb (OPERA) have to be around 1 order of magnitude lower



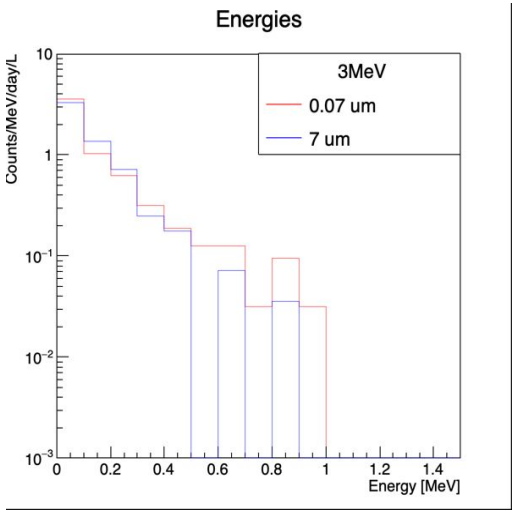


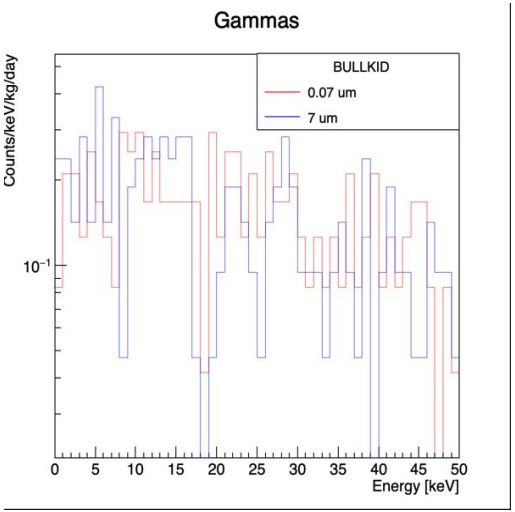


External Shielding

- The minimum radiopurity for the external Cu was estimated
- Modifying the cut value of energy for e^-, e^+ and γ when simulating gammas from the hall, does not show a considerable difference
  - it might be important for cosmogenic

Isotope	Minimum purity [mBq/kg]
^{40}K	0.57
^{60}Co	0.04
^{226}Ra	85.39
^{232}Th	1811.21*
^{234}Th	7.57

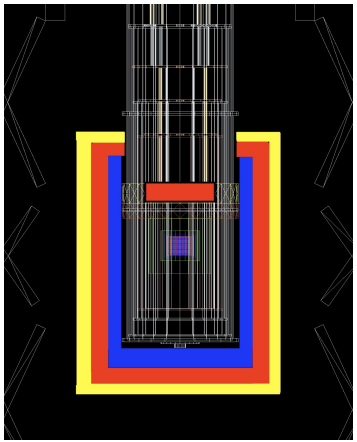




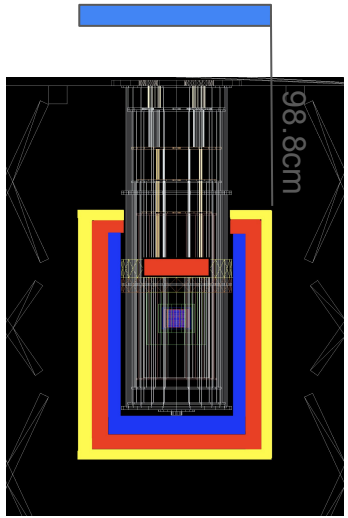
Estimating neutron contribution (radiogenic)

- Radiogenic neutron flux $(7.5 \pm 0.1) \times 10^{-7}\ cm^{-2}\ s^{-1}$ P. Belli et al Nuov Cim A 101 959-966 (1989)
- Analize different cases

Yellow: Lead
Red: Copper
Blue: PE

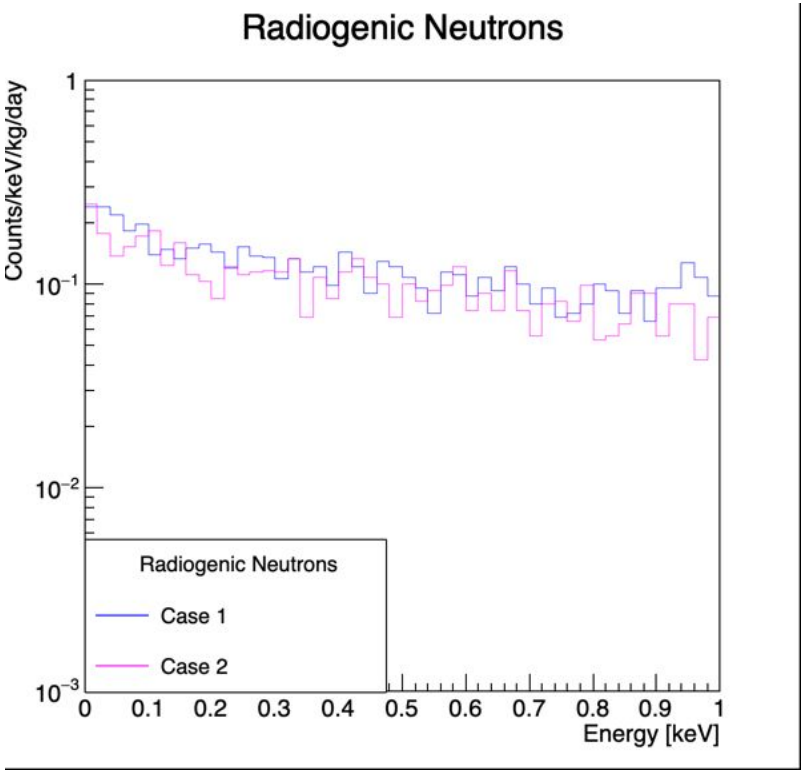


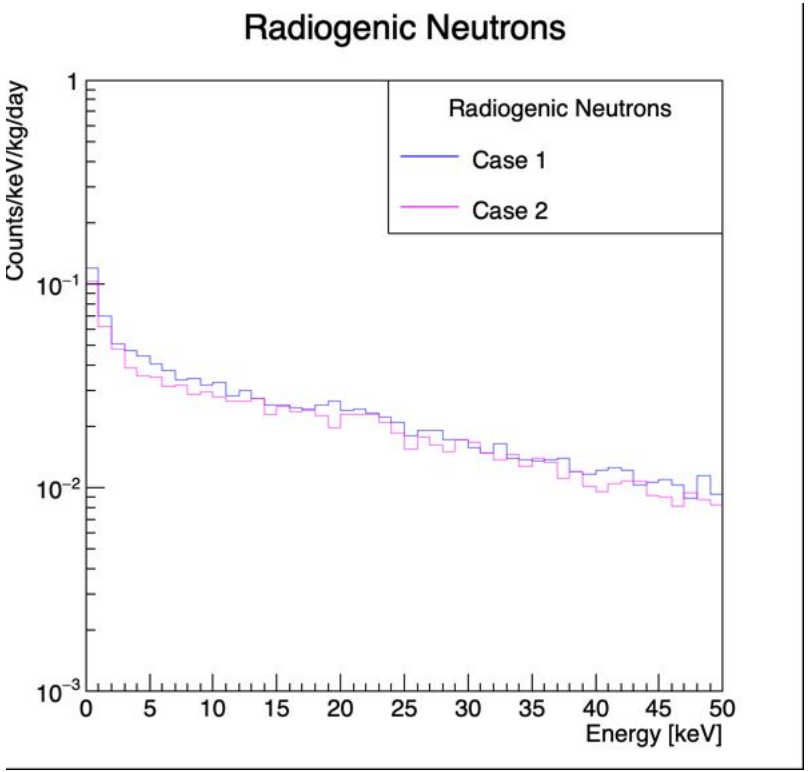
Case 1



Case 2

Radiogenic Neutrons





Summary

- We have design for the external shielding with 5 cm thick of Pb and 10 cm thick of Cu
  - option to reduce amount of Cu it depends on limits for radiopurity of Pb (OPERA)
- There is an estimated purity for the external Cu shielding
- As expected, for radiogenic neutrons there is not considerable difference between the two cases analyzed
- We need neutron shielding outside the Pb and Cu shielding
- Estimation for cosmogenic neutrons is still in progress