Simulation meeting BULLKID-DM

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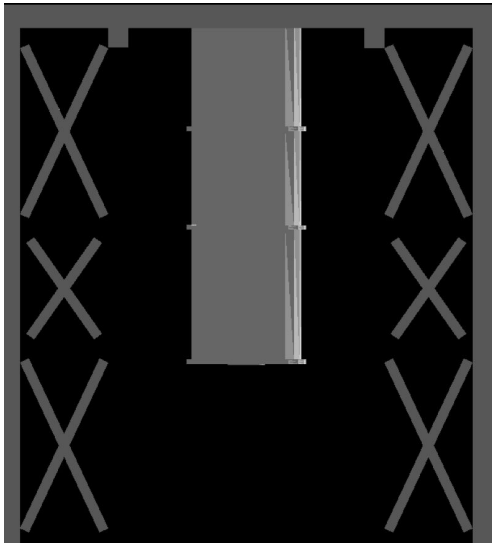
Geometry for BULLKID-DM at LNGS

- The cryostat has been updated with the modifications that Matteo developed
- A difference of 2 mm in the external and internal radius for the ultra-pure copper shield between the Monte Carlo and the design from Daniele (Grenoble meeting) was found
- The geometry is ready to run current simulations for the TDR



Sizes

Lid: ΦE: 300mm, h: 110mm, 70kg

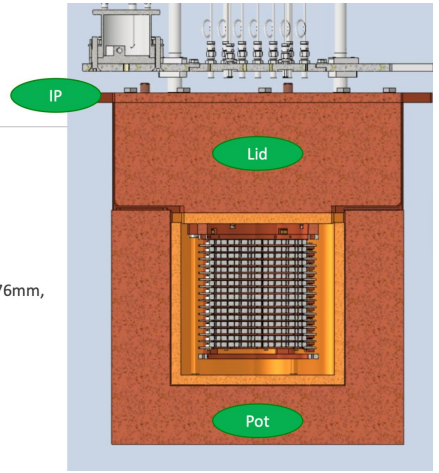
Pot: ΦE: 300mm, ΦI: 180mm, h: 240mm, 110kg

Interface Flange: ΦE: 350mm, h: 10mm, 8kg

Detector: ΦE: 134mm, h: 128mm, 5kg

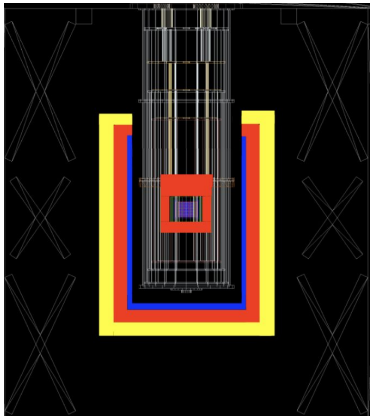
Ultra-Pure copper shield: ΦE: 178mm, ΦI: 158mm, h: 176mm, 12kg

Tot: 205kg
Missing: B4C Shield, Fasteners, Veto, Source calibration
Max available 250kg



Simulation to study the background

- External background
  - gammas
  - neutrons (radiogenic and cosmogenic)
    - study if more PE will have an impact
  - muons
  - contribution from the external shielding
    - lead, copper and polyethylene

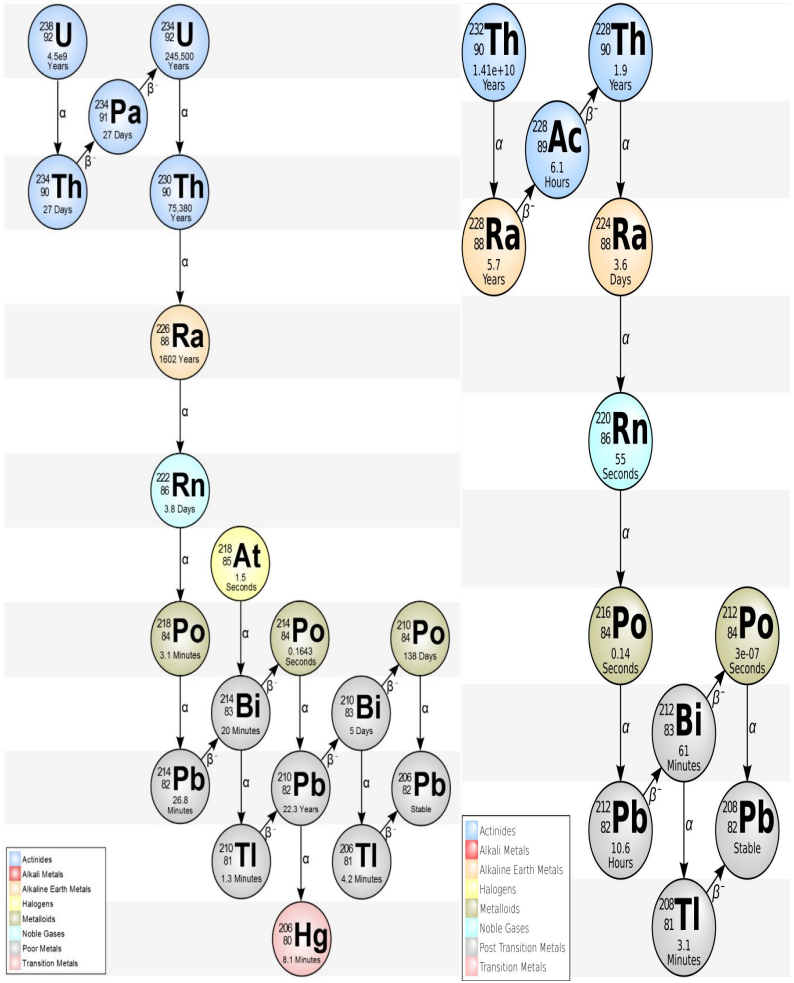


Th-232:	
Ra-228:	< 0.18 mBq/kg
Th-228:	< 0.46 mBq/kg
U-238:	
Ra-226	< 0.12 mBq/kg
Th-234	< 2.5 mBq/kg
Pa-234m	< 8.0 mBq/kg
U-235:	
U-235:	< 6.7 mBq/kg
K-40:	< 1.8 mBq/kg
Cs-137:	< 0.26 mBq/kg
Co-60:	< 10 microBq/kg
Pb-210:	(58 +- 9) Bq/kg

Isotope	Energy [keV]	Intensity $[cm^{-2}s^{-1}]\times10^{-3}$
^{208}Tl	2614	9.03
^{214}Bi	2204	3.59
^{214}Bi	1764	9.49
^{40}K	1460	33.56
^{214}Bi	1238	3.24
^{214}Bi	1120	7.29
^{228}Ac	968	3.59

Simulation to study the background

- Internal background
  - contamination present in materials used
    - cryostat
    - supports
    - cables
  - internal shield
    - copper
    - B_4C
    - veto/GAGG

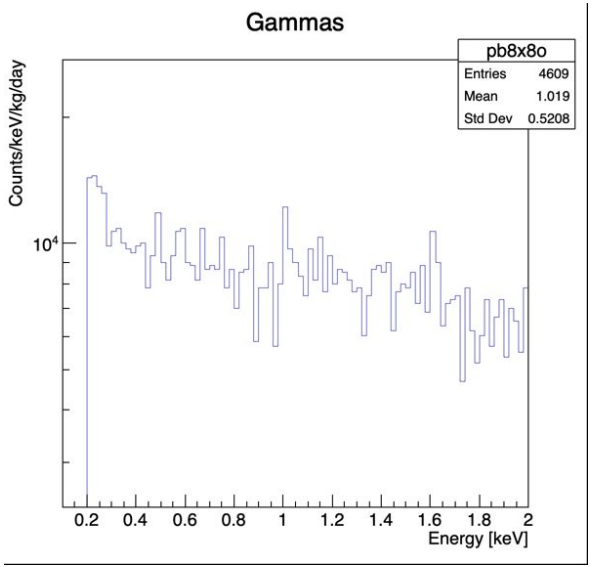


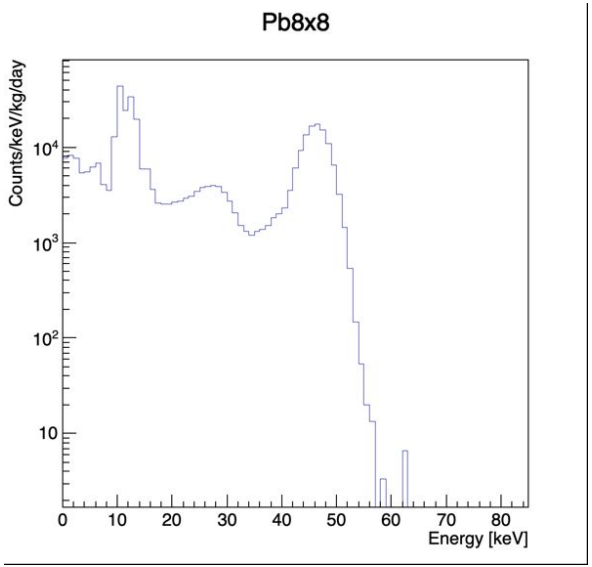
Simulation to study the background

- Other background
  - (γ, n) reaction
    - nucleus absorbs a high energy gamma emitting a neutron
  - radon exposure
    - radon diffusion
      - radon diffuse into materials over time
      - for each decay of ^{222}Rn there is one atom of ^{210}Pb
    - radon daughter deposition
      - deposition of ^{210}Po on surfaces due to exposure to radon in air

Simulation of lead for BULLKID-DM at Sapienza

- We observe the 46.6 keV gamma line
- X-ray produced from ^{210}Pb decay? Or is it only fluorescent?
- Cut for production of secondaries from Compton scattering
  - 100 eV



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* G4Track Information:   Particle = Bi210[46.539],   Track ID = 2,   Pa
**************************************************************************

Step#    X(mm)    Y(mm)    Z(mm) KinE(MeV)  dE(MeV) StepLeng TrackLeng
    0 4.88e+03     -436 -1.2e+03  1.64e-08        0        0         0
    1 4.88e+03     -436 -1.2e+03         0 1.64e-08 6.63e-08  6.63e-08
    2 4.88e+03     -436 -1.2e+03         0        0        0  6.63e-08
    :----- List of 2ndaries - #SpawnInStep= 14(Rest=14,Along= 0,Post= 0
    :  4.88e+03      -436  -1.2e+03  8.11e-08              Bi210
    :  4.88e+03      -436  -1.2e+03  0.000367                 e-
    :  4.88e+03      -436  -1.2e+03  0.000101                 e-
    :  4.88e+03      -436  -1.2e+03  3.31e-05                 e-
    :  4.88e+03      -436  -1.2e+03  0.000237                 e-
    :  4.88e+03      -436  -1.2e+03  0.000104                 e-
    :  4.88e+03      -436  -1.2e+03  0.000101                 e-
    :  4.88e+03      -436  -1.2e+03  3.53e-05                 e-
    :  4.88e+03      -436  -1.2e+03  0.000196                 e-
    :  4.88e+03      -436  -1.2e+03   0.00225                 e-
    :  4.88e+03      -436  -1.2e+03  8.61e-05                 e-
    :  4.88e+03      -436  -1.2e+03    0.0108             gamma
    :  4.88e+03      -436  -1.2e+03   0.00203                 e-
    :  4.88e+03      -436  -1.2e+03    0.0302                 e-
    :-------------------------------------------------------------
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Summary

- Geometry up to date for BULLKID-DM at LNGS
  - external and internal shield
  - 16 stack
  - correct cryostat dimensions (from Matteo)
- Simulations running to estimate current background contribution (in preparation for TRD)
  - first results coming soon!
- More statistics for lead to study the Compton-like feature observed