Preliminary Fluka simulations

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Geometry

- Inner membrane : Fe7Cr2Ni steel thickness 0.12cm $\rho = 7.93 g/cm^3$
- Insulation: polyurethane foam, $C_{17}H_{16}N_2O_4$, 40cm in each dimension
  - $\rho = 0.035 g/cm^3$.
  - Checked with $\rho = 0.085 g/cm^3$.
- Steel support: Fe7Cr2Ni 1 cm
- 4 PD modules, 60x60 cm, 1.5cm thickness, assumed plastic
- PDS frame G10, 2.5 cm lateral 1.5 cm thick
- Drift distance 21.5 cm
- inner membrane dimension 100 x 389 x 391.3
- active LAr 337 x 299.3
- Ar gas starts 60 cm from bottom
- Three anode planes, G10, 0.32 cm each

More Geometry

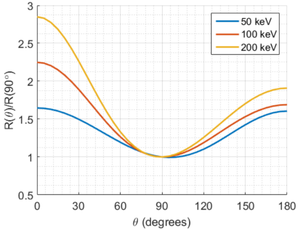
- Axis: x is vertical, z is Salève-Jura
- DD generator shielding:
  - 12 cm square internal hole
  - 15 cm Borated (5%) poly on all sides
  - 2.5 cm lead on all sides
  - $\approx$ 10 cm Al support below
- placement
  - on top of the cryo, at z=y=0
  - on the side, x at middle of the drift

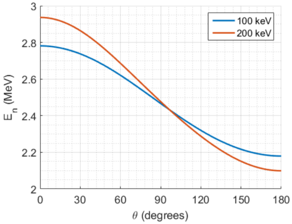
Neutrons

Source location at 1 cm above the bottom poly level. To be changed?: from ORNL/TM-2017/57 (2017): *ThermoFisher Scientific MP 320... point of neutron generation ≈14.4 cm from the end of the tube*.

Energy / angle

- 2.5 MeV monoenergetic isotropically emitted
- Non-isotropic, non monochromatic, according to parameters in C.S.Walz PhD thesis, Univ. of California, Berkeley, 2016, assuming tube operation at 95 keV





Photon detectors

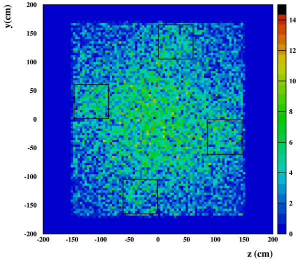
- 60 x 60 cm, four of them, at 10 cm above bottom membrane
- material: plastic
- thickness:
  - 1.5 cm (wrong initial guess)
  - 0.5 cm reasonable

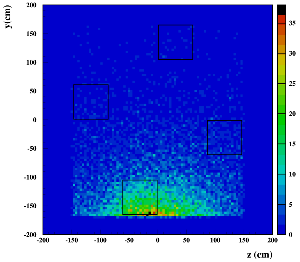
PD influence neutron capture, through thermalization

Figures: Distribution of capture locations, view from top.

Top: D-D on the top: accumulation above PD

Bottom: D-D on the side: asymmetric z-distribution





More geometry questions

- Anode: material. thickness, transparency
- Anode support: steel? dimensions?
- Photon detectors: thickness and material

Geometry sections

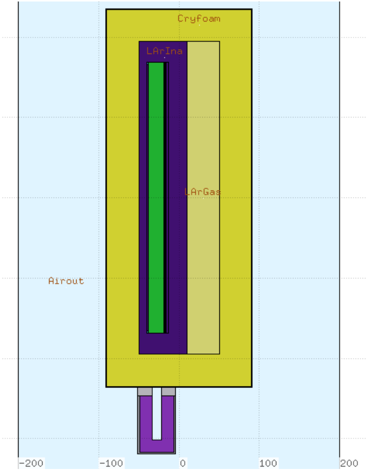
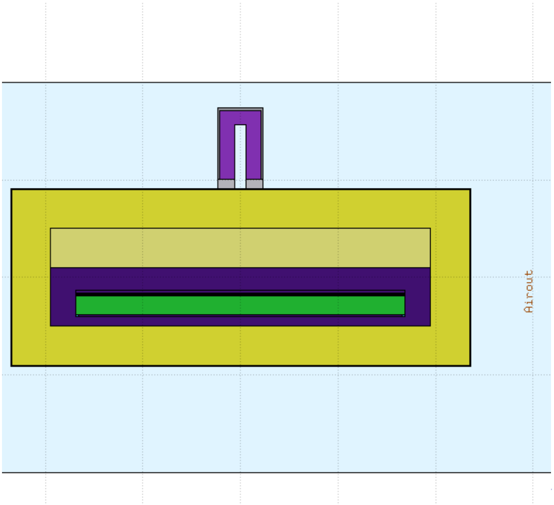


Figure: Top view with DD gun on the side

Figure: Side view with DD gun on the top

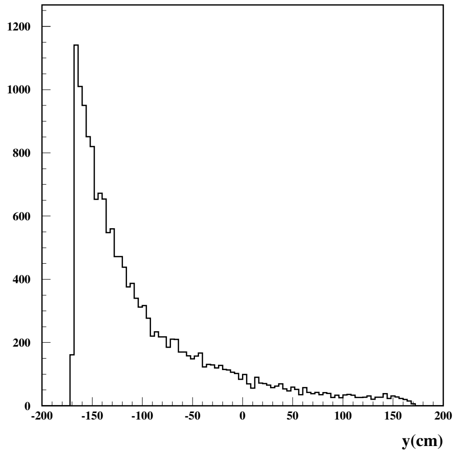


Capture rates

	D-D on top	D-D on side
PD 0.5 cm Foam 0.035 Mono E	$8.2\ 10^{-4}$	$6.7\ 10^{-4}$
PD 0.5 cm Foam 0.085 Mono E	$1.5\ 10^{-3}$	$1.2\ 10^{-3}$
PD 1.5 cm Foam 0.035 Mono E	$9.7\ 10^{-4}$	$7.8\ 10^{-4}$
PD 1.5 cm Foam 0.085 Mono E	$1.7\ 10^{-3}$	$1.3\ 10^{-3}$
PD 0.5 cm Foam 0.035 Distr. E	$9.1\ 10^{-4}$	$7.4\ 10^{-4}$

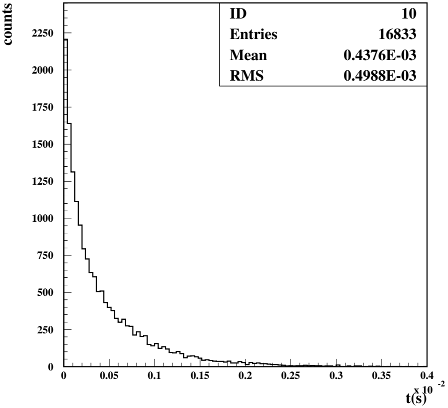
- Capture rates in the 0.1 % range
- Higher foam density $\rightarrow$ more captures
- More Photon Detector material $\rightarrow$ more captures
- Non uniform energy/angle neutron distribution $\rightarrow$ more captures

Capture depth



Depth distribution of capture positions. For a DD gun on the side In the last 20 cm 4.8^{-6} captures/neutron Over the farthest tile 5.0^{-6} captures/neutron

Capture time



Time distribution(seconds) of neutron captures in the active LAr volume. For a DD gun on the side

Average: 0.4 milliseconds

ToDo

- Understand differences wrt G4
- Finalize the geometry
- Dump more detailed description of the events
- maybe look also at ^{36}Ar? small percentage but high energy photons