# VD-XA Photon Flux Simulation

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August 1st 2023

Simulation Summary

- Non-discriminatory photon counter, where the filters act as sensitive.
- Inherited from a previous work done by Vinicius Andreossi, modified to fit the Napoli setup:
  - Geometry of the top grid 🟢
  - 16 individual filters (acting as individual counters) 🟢
  - Cryostat inner walls lined with light-absorbent material 🟢
 - Alpha source support brace 🟠

OLD ➡ NEW
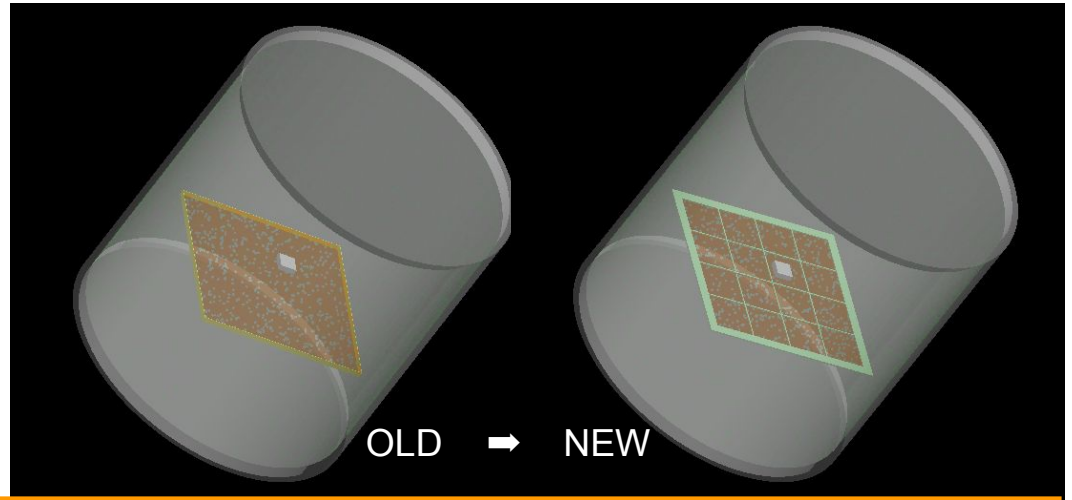
Alpha source

- Americium disc, $\varnothing$ 1.0cm, 140μm thick
- Monochromatic alphas @ 5.49 MeV, uniformly generated 1.4nm beneath the disc surface.
- After the main production, it was brought to my attention that there was a missing brace, 6mm thick.
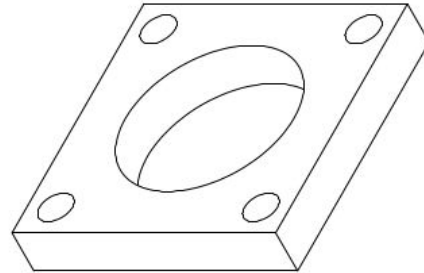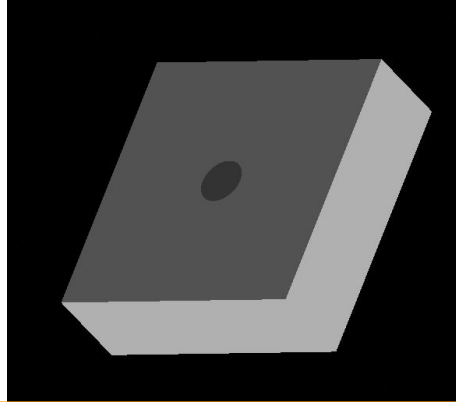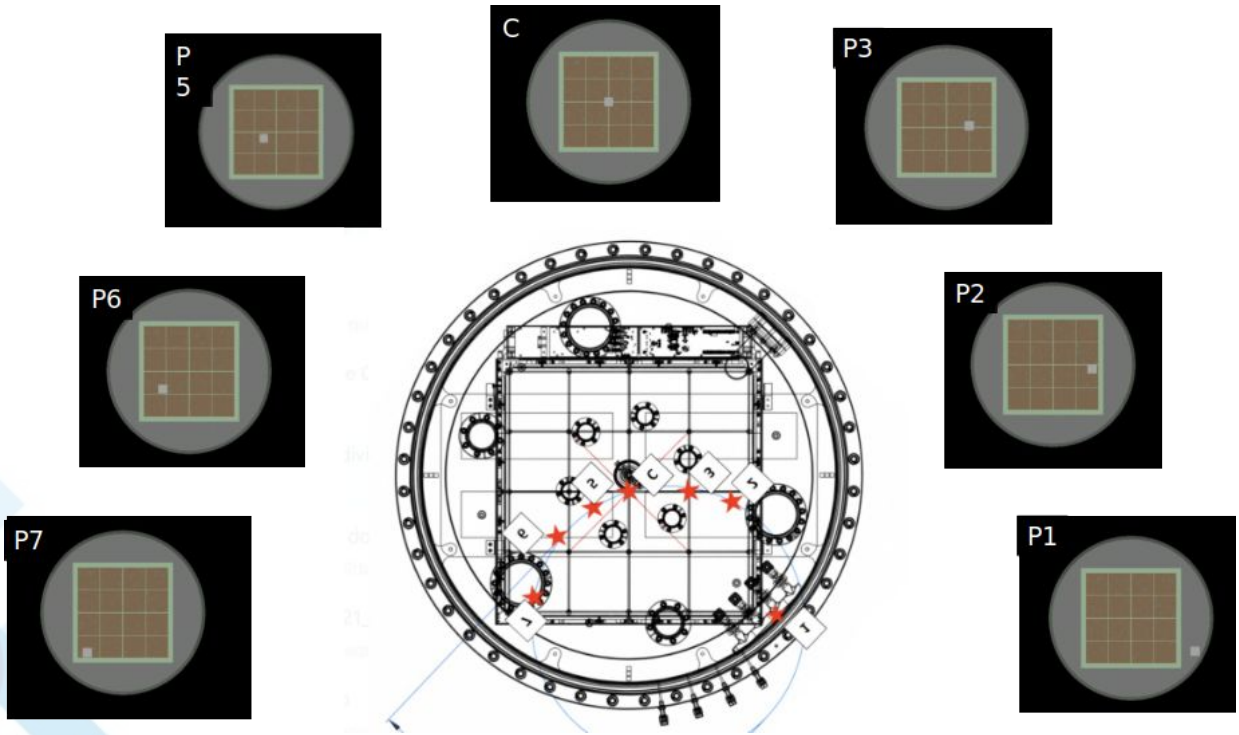
Alpha source

- Source positions were taken from the experiment's planning document.
- The 7 positions were calculated by selecting points over the blue circle (source mechanical trajectory).
- All the points are selected to be as close to the red starts as possible.
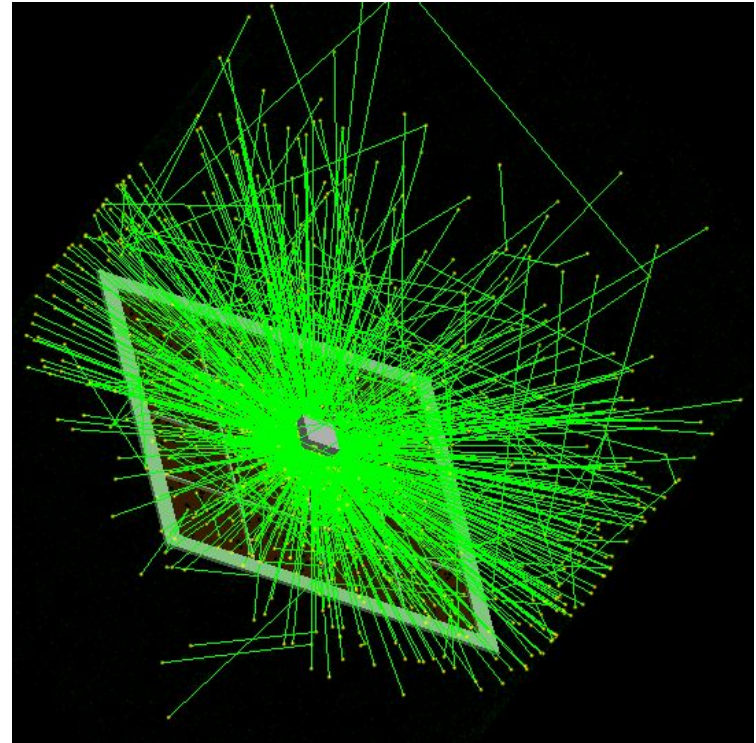- Note that P1 is off the blue line (not in the simulation though).
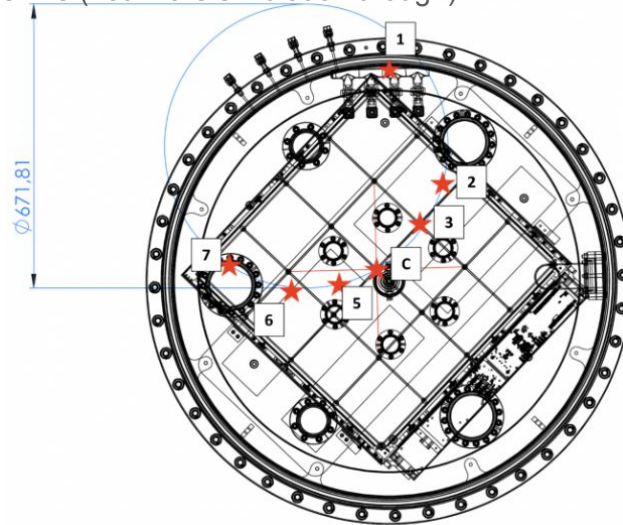
Implemented the different

Positions (P1, P2, P3, C, P5, P7).

and

Height (5cm, 10cm, 20 cm and 30cm)

Alpha source

Example event

- Source @ C, 5cm
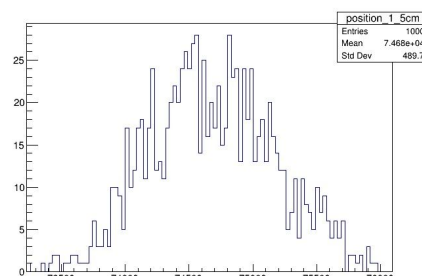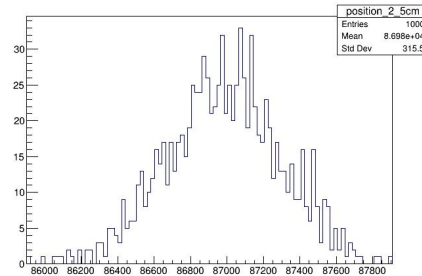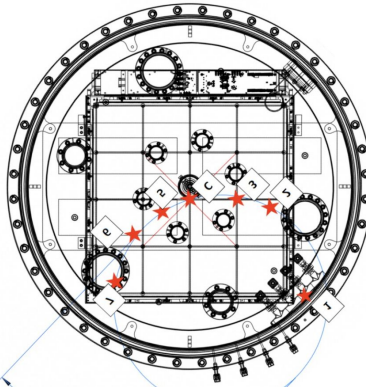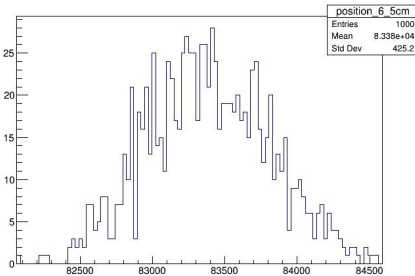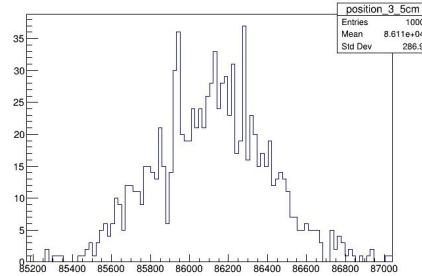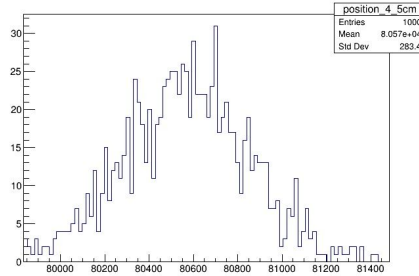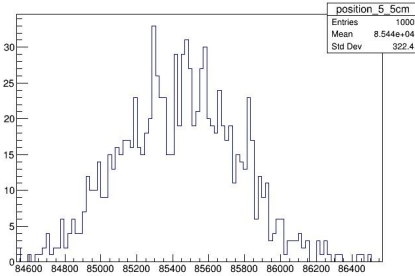- Using 1% LAr scintillation yield just for visualization

Exploratory runs

- Fast simulations used to plan a larger run.
- Adding up the counts from all filters.
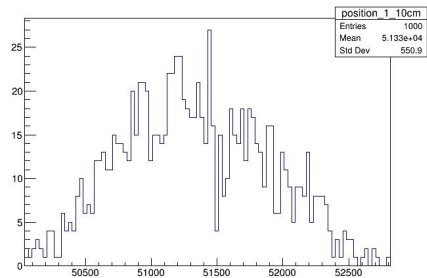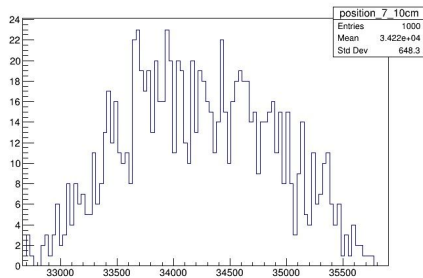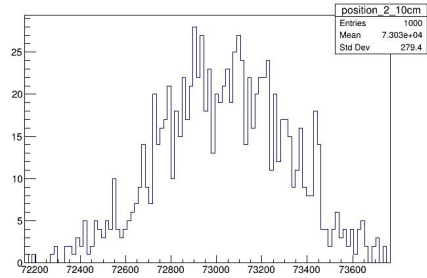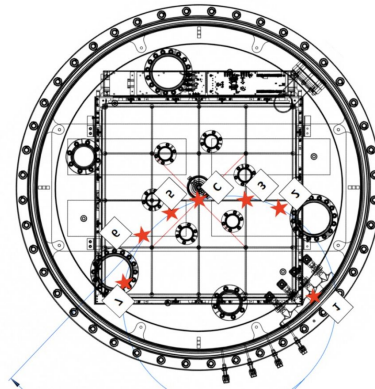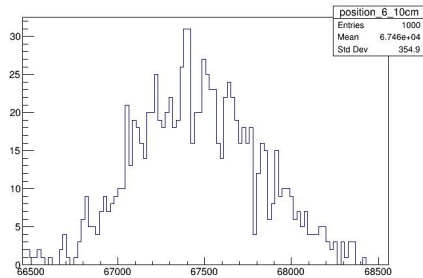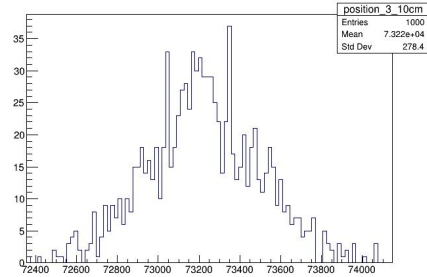- Simulating 1k alphas @ 10% scintillation yield

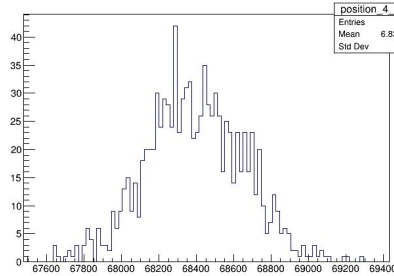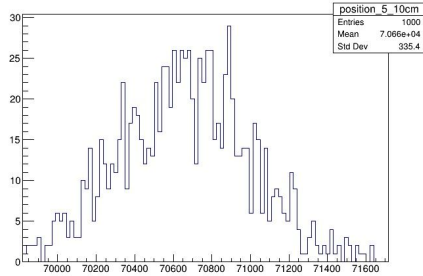 - Example (position 4 = C)
  - Entries multiplied by 10 (yield correction)
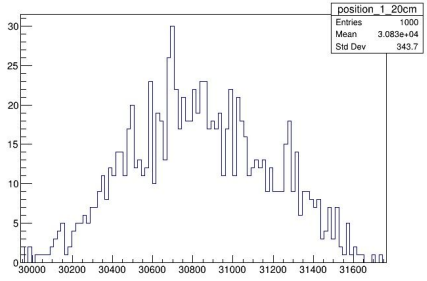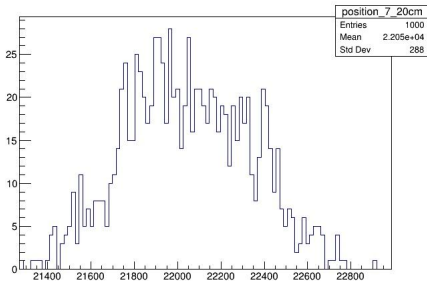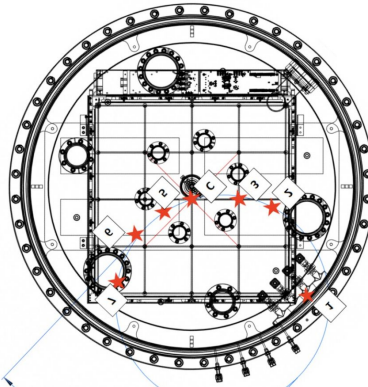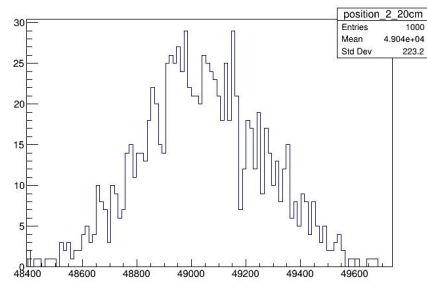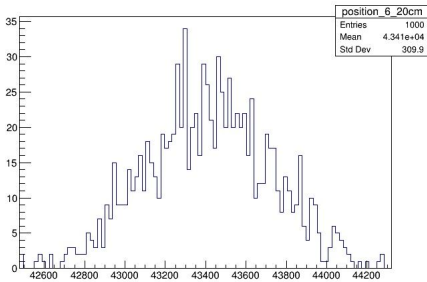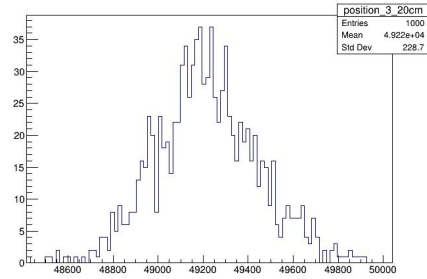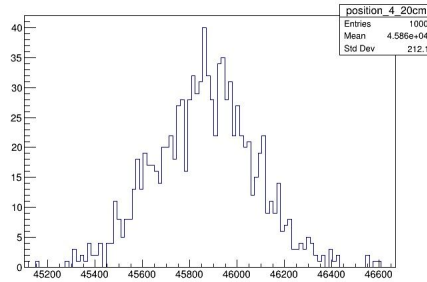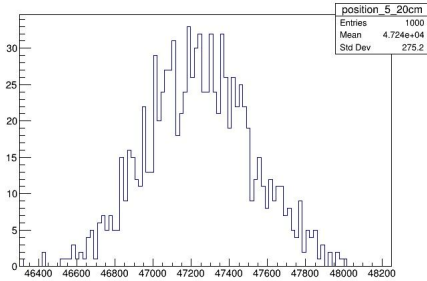 - The mean is accurate to $3{:}10^4$ ($N^{-1/2}$)
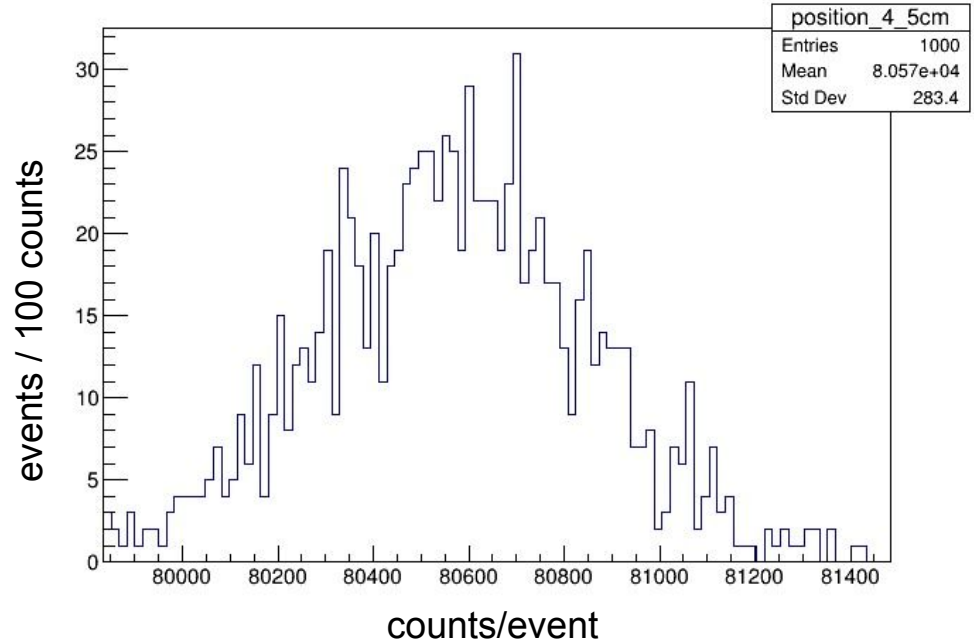
Distance of 5 cm
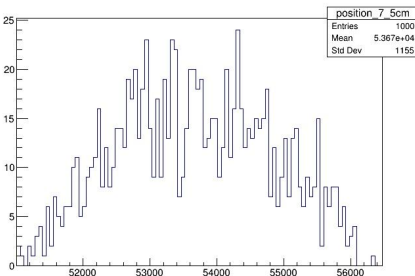
Distance of 10 cm

Distance of 20 cm

Exploratory runs

- Mean photon counts for every position

Position	Height of the alpha source		
	5cm	**10cm**	**20cm**
P1	7.468 E+04	5.133 E+04	3.083 E+04
P2	8.698 E+04	7.303 E+04	4.904 E+04
P3	8.611 E+04	7.322 E+04	4.922 E+04
C	8.057 E+04	6.839 E+04	4.586 E+04
P5	8.544 E+04	7.066 E+04	4.724 E+04
P6	8.338 E+04	6.746 E+04	4.341 E+04
P7	5.367 E+04	3.422 E+04	2.205 E+04

Full simulation

- Production of 21k alphas
- Position 5 @ 5cm
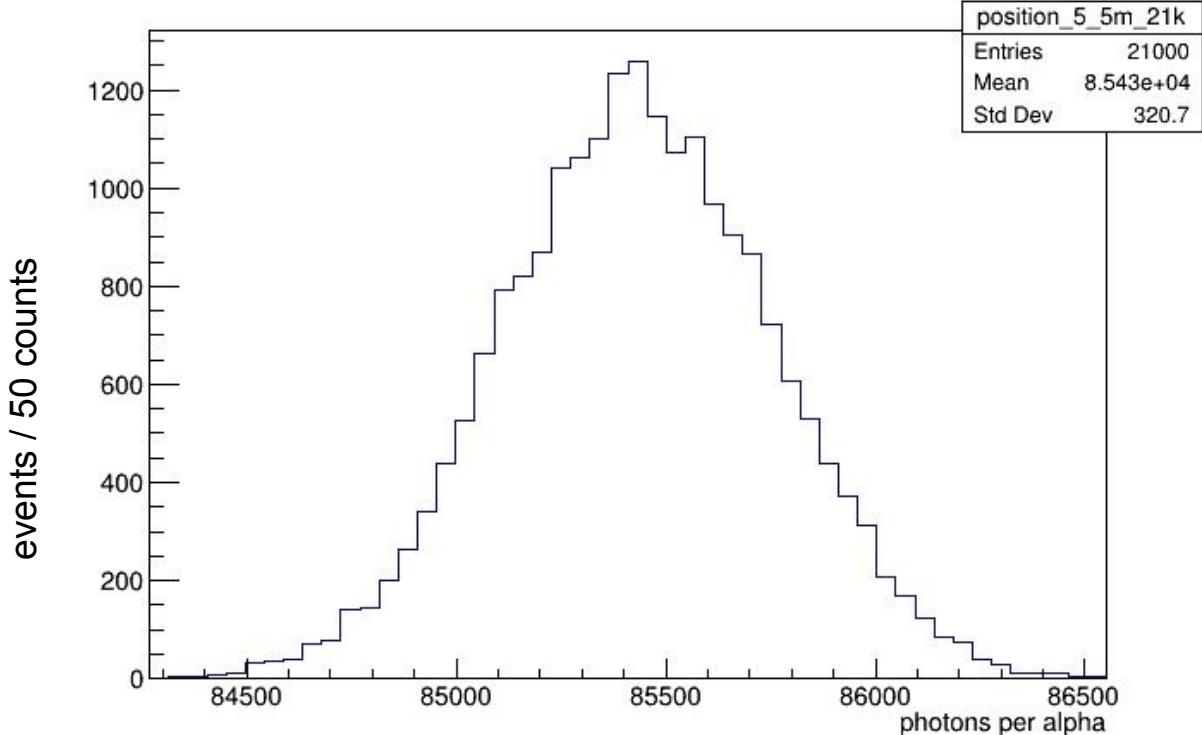- Bins on the order of 100s (fluctuation in the 10s)
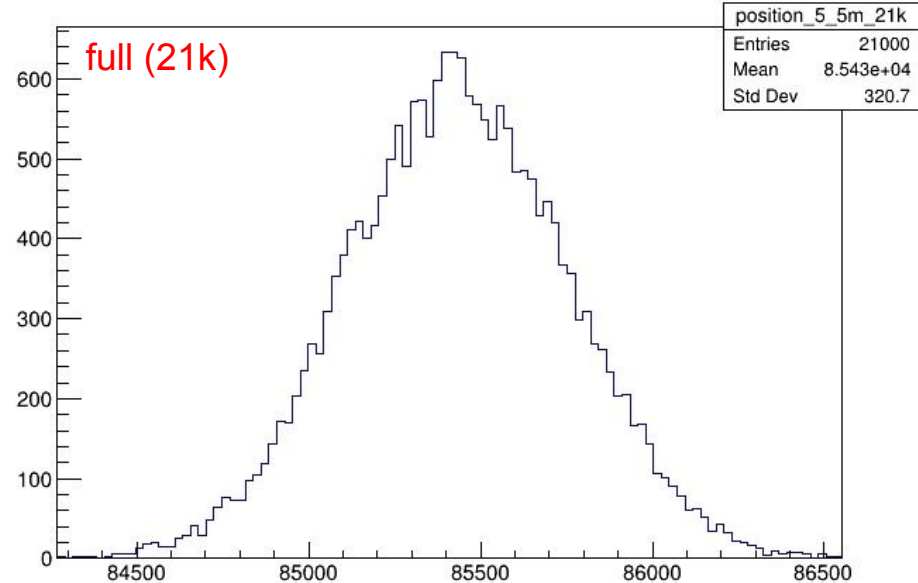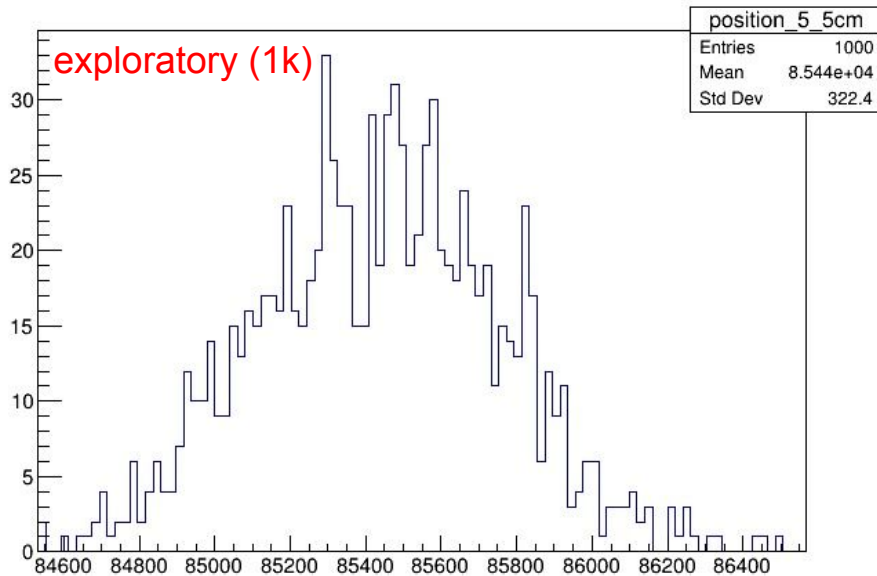
Full simulation

- Binning with 50 MeV

Next steps

- Implement the source brace in the geometry
- Run full simulation for other positions (60 to 80 hours per thread)
- Expect new run in the next day or so.

- Migrate the model to the full physical simulation (ArapucaSim)