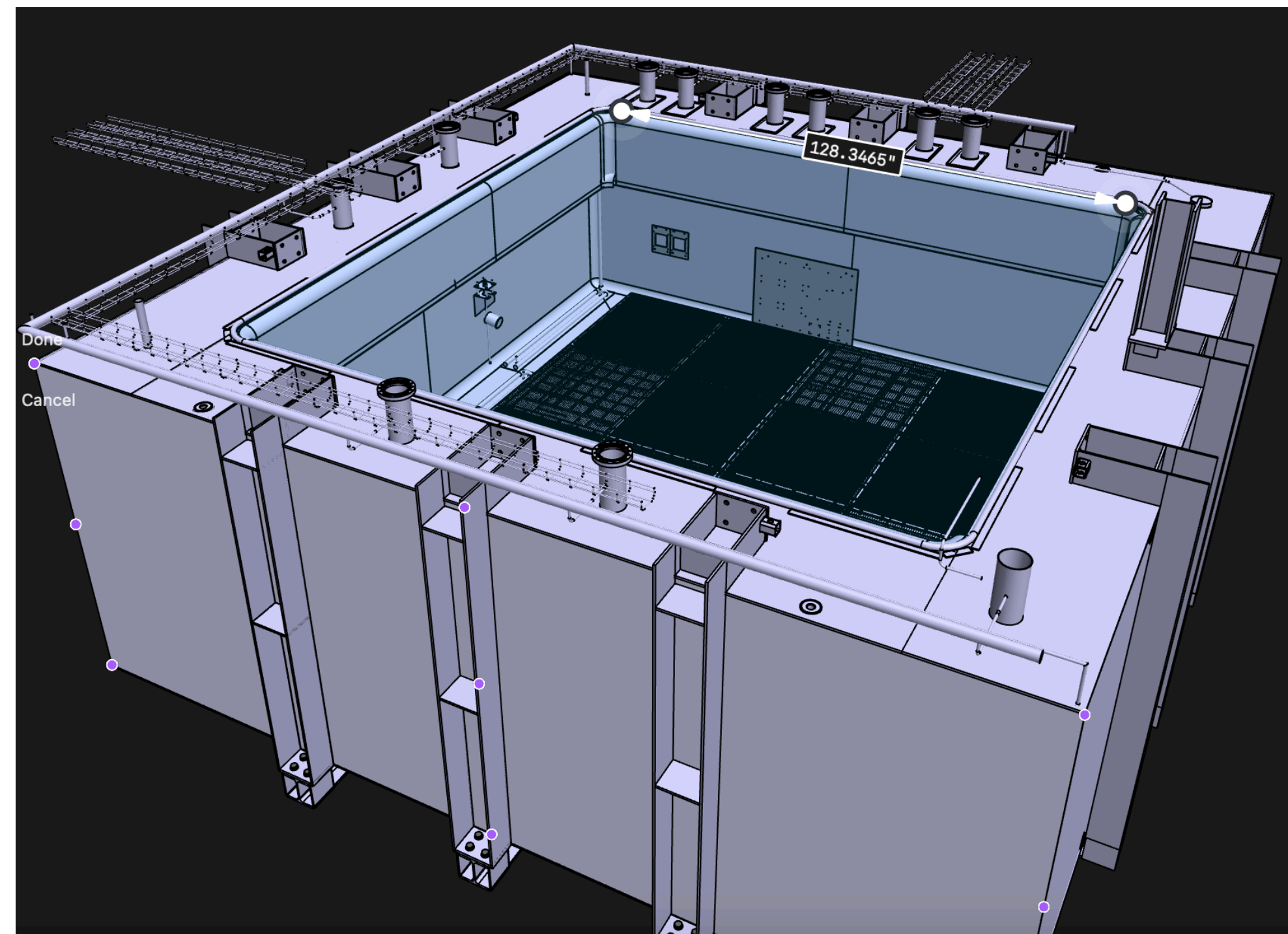


Membrane XAs Light Simulation Update

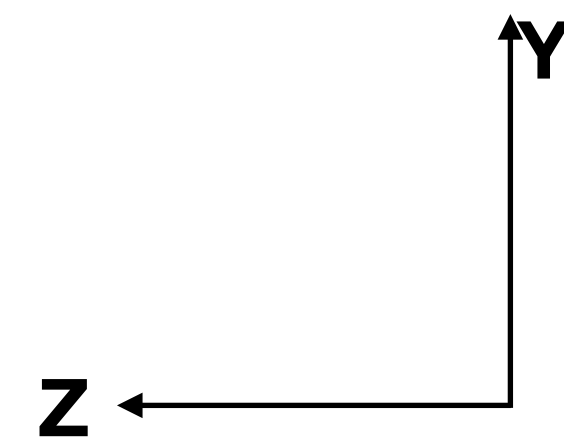
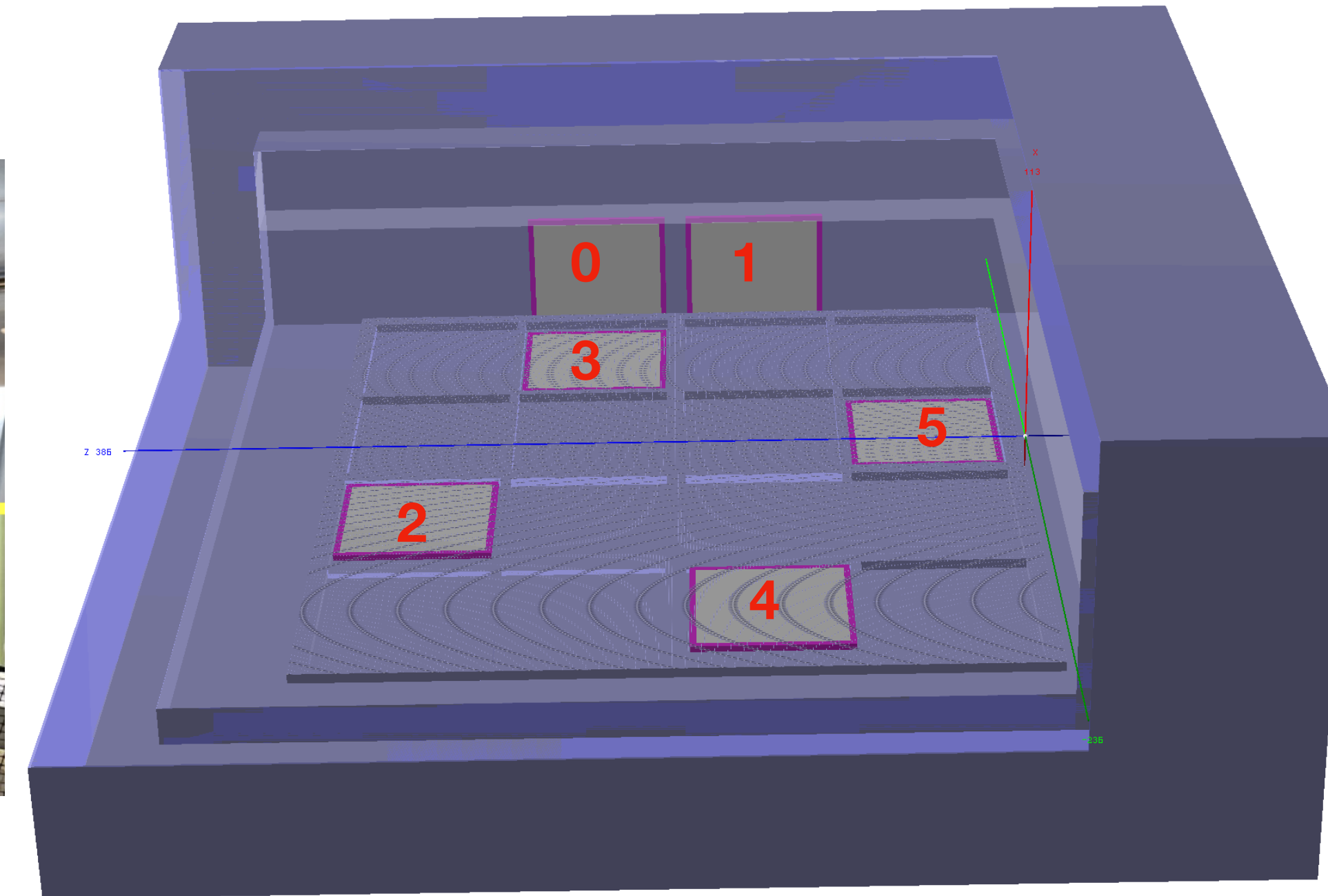
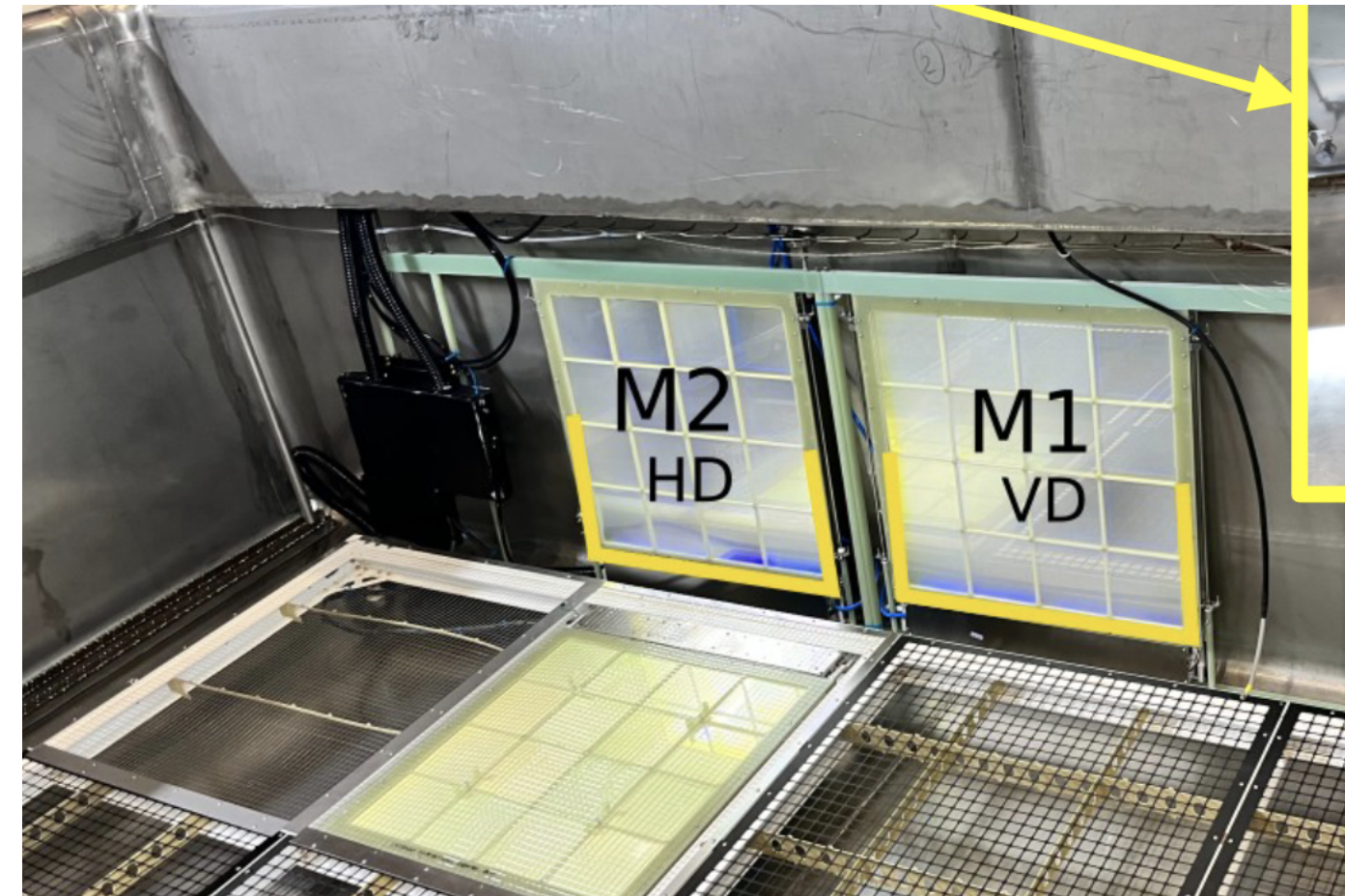
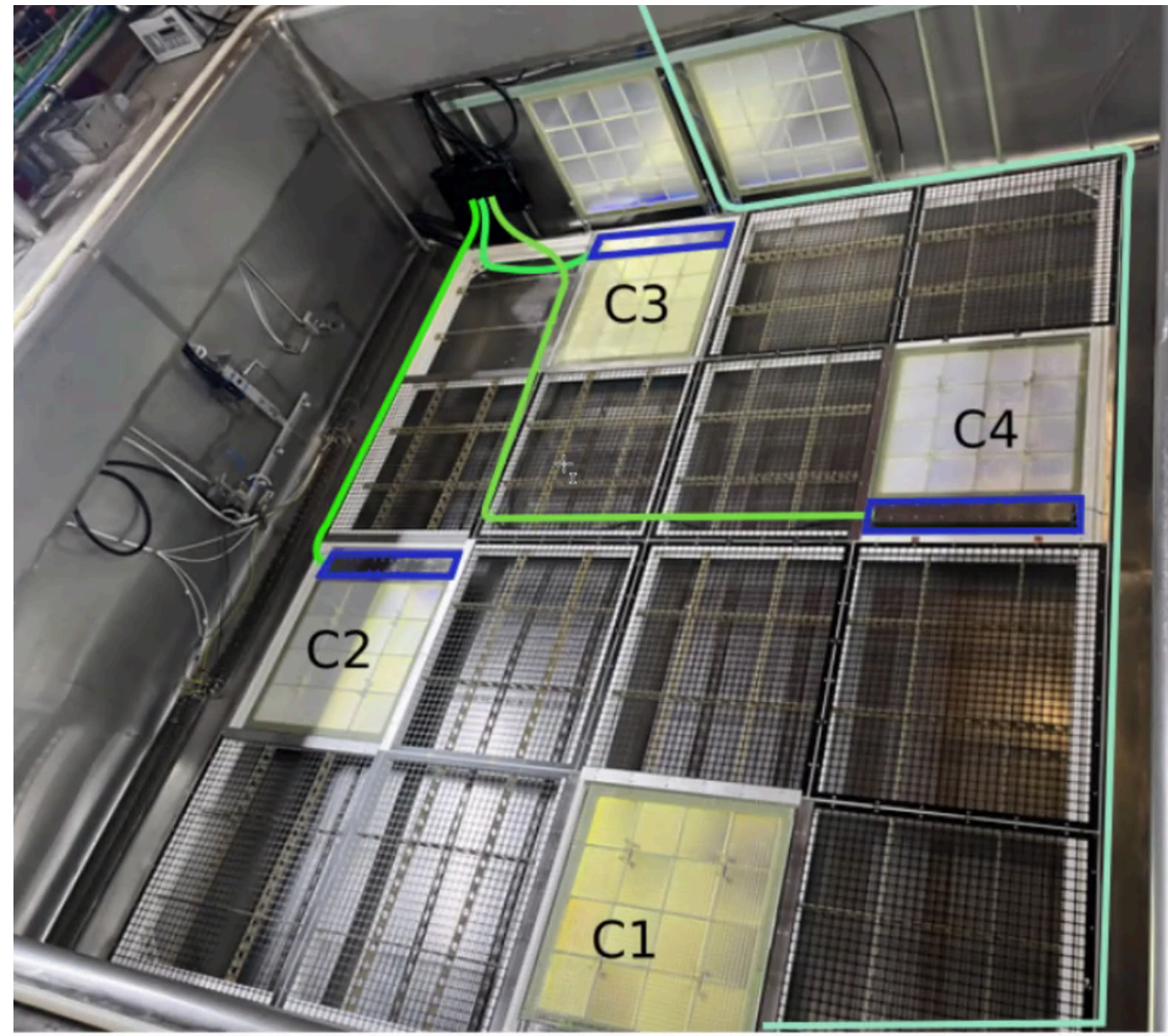
Apr 17, 2024

Wei



Membrane XAs

Optical Channels positions: 6			
0	-5.42	187.2	186.701
1	-5.42	187.2	111.701
2	-15.387	-38	257.901
3	-15.387	118	186.701
4	-15.387	-118	111.701
5	-15.387	37.2	40.9009



Membrane XAs

Captures 10cm on top of XA3 (69.2cm from XA0):

Signal on XA3 (left blue dashed) larger than XA0 (left blue solid)

Closest distance from cathode (CRP signal available) to XA0 plane is 27cm

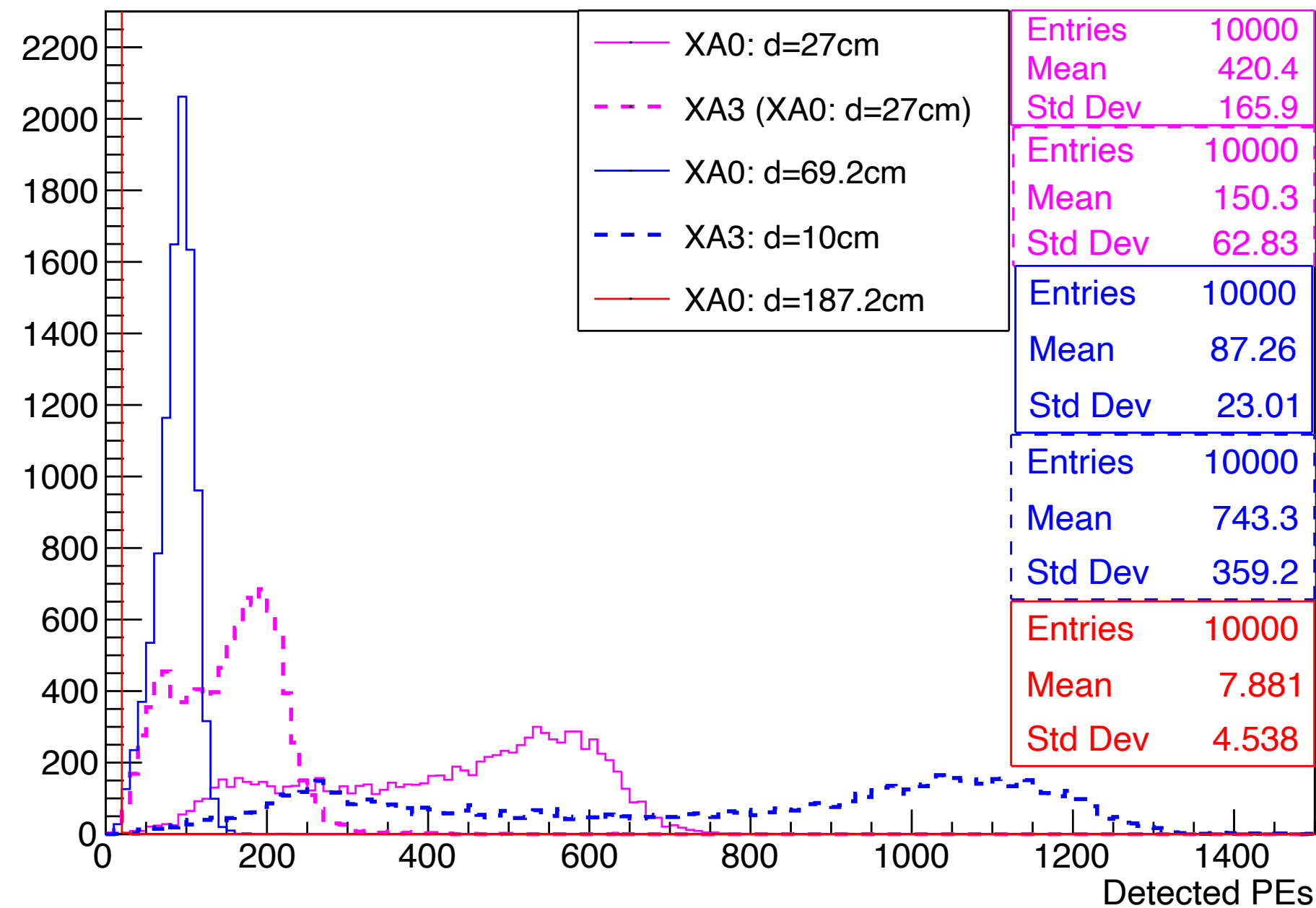
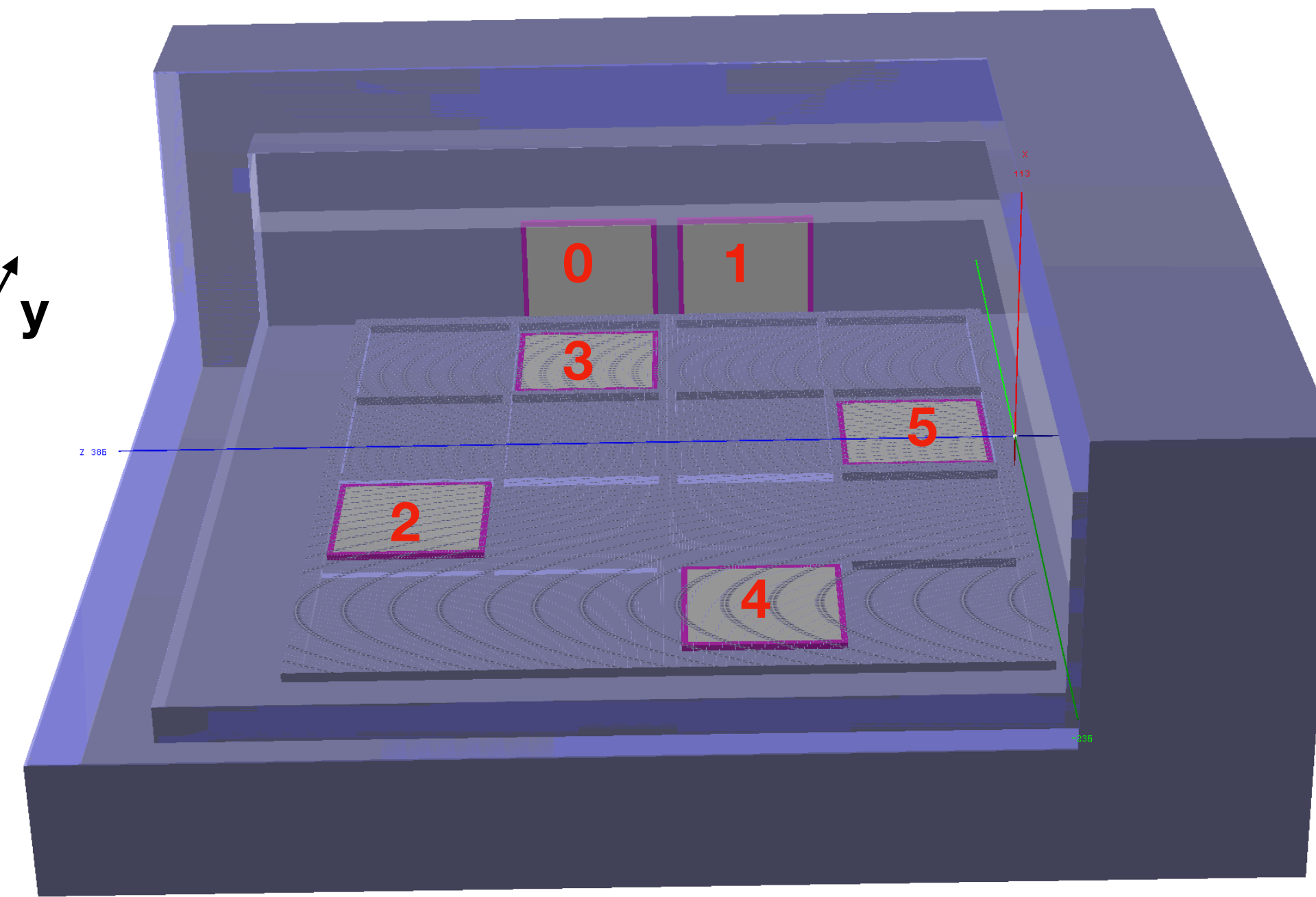
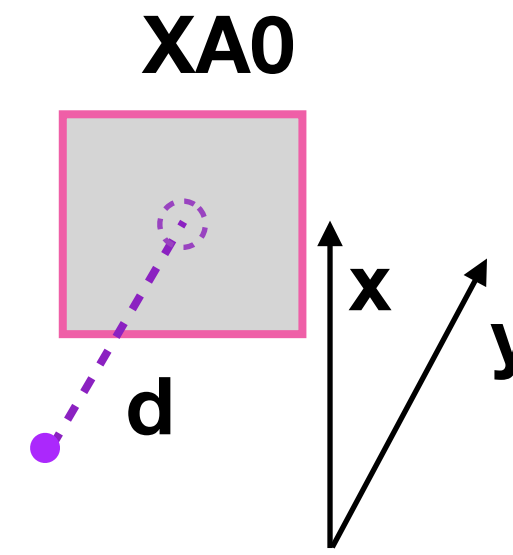
27cm already larger than the max drift distance for cathode XAs

Only in this edge case the XA0 signal (solid pink) is larger than XA3 (dashed pink)

Captures at the center of cathode (187cm away from XA0):

Small signal (<30PE) on membrane XA0

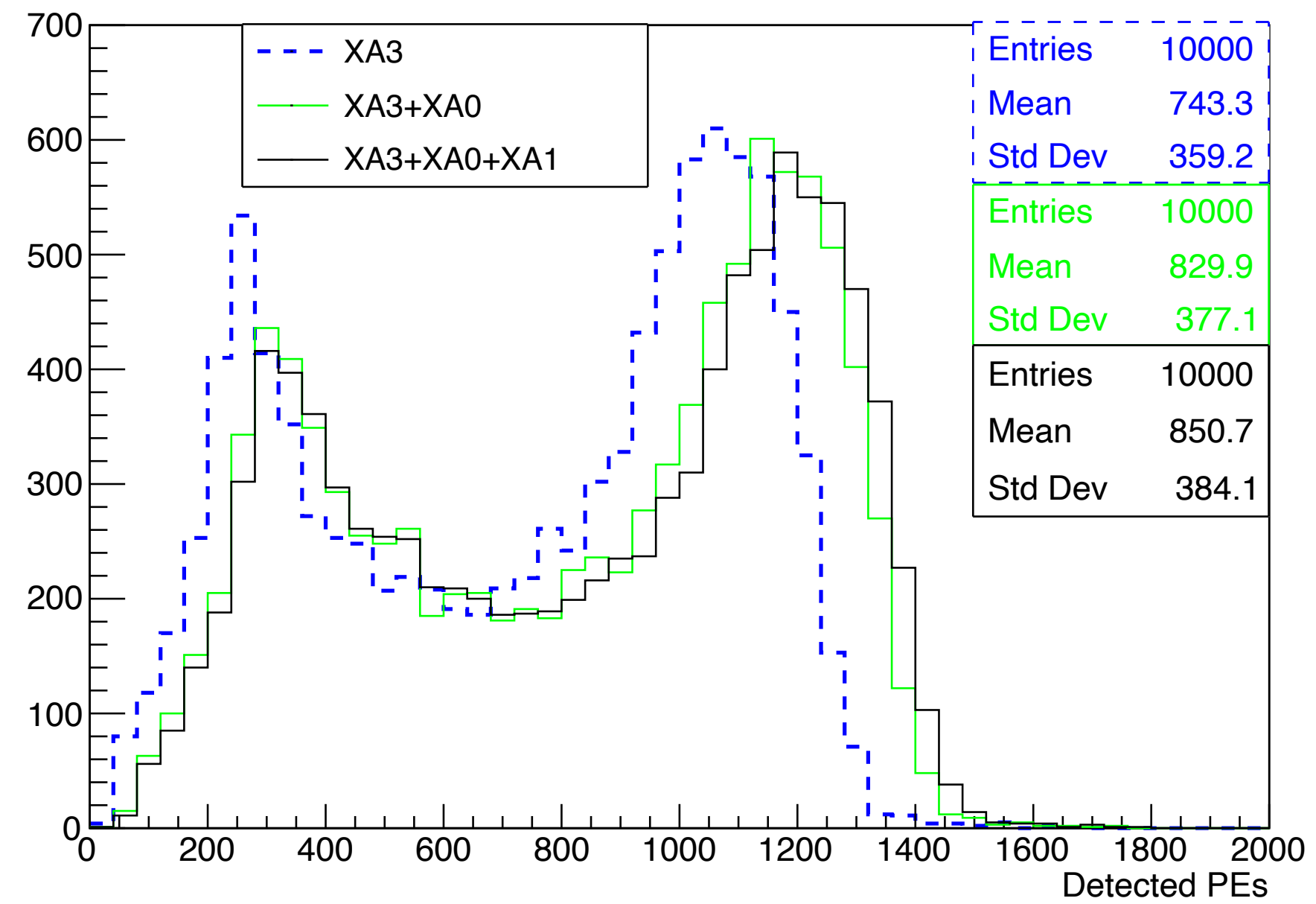
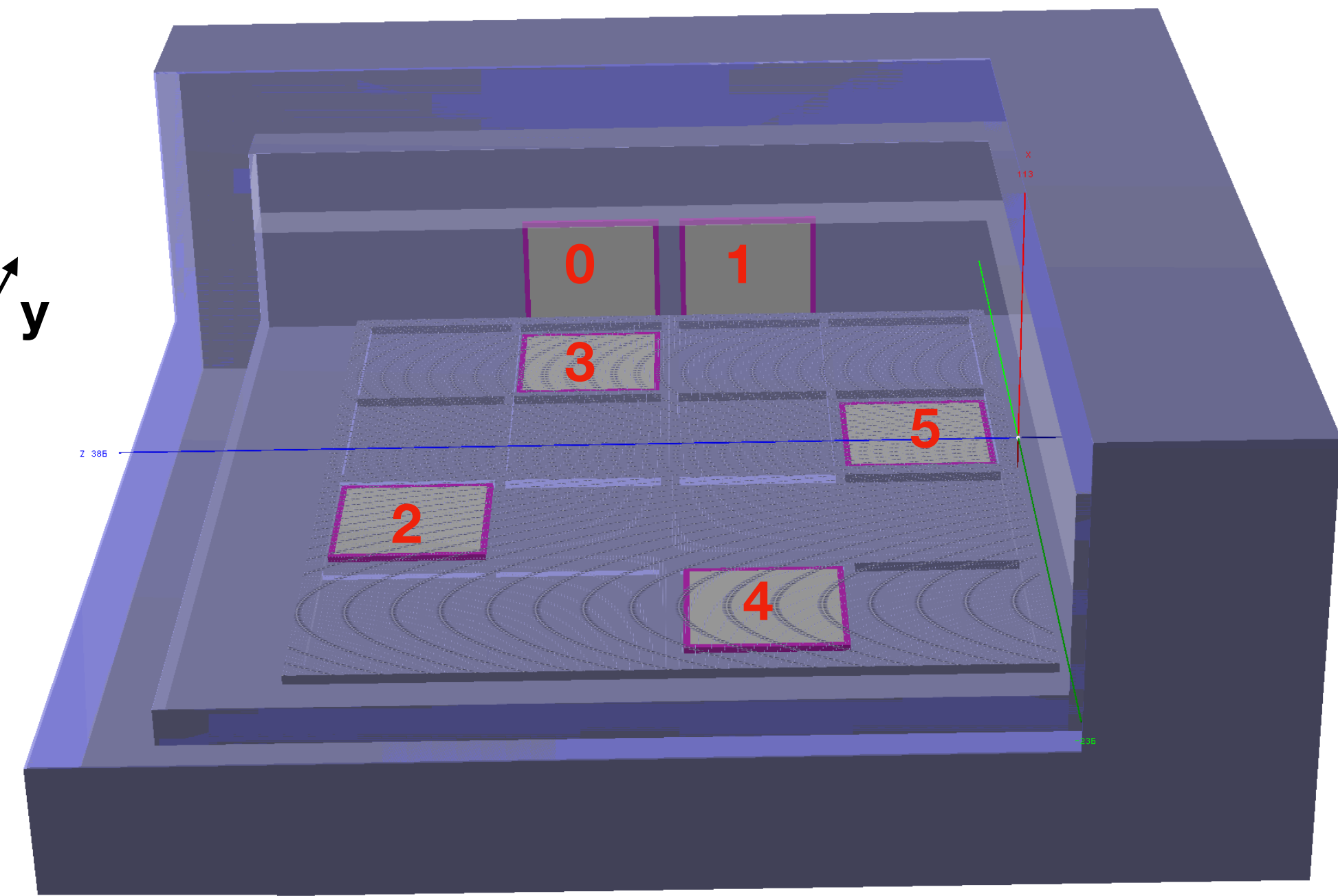
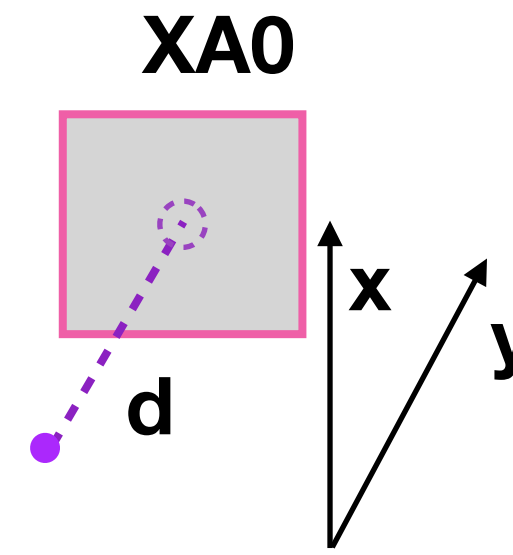
No better than cathode XA



Membrane XAs

Captures 10cm on top of XA3 (69.2cm from XA0):

Interest to see combine XA3 with one or both membrane XAs



Membrane XAs

Captures 10cm on top of XA3 (69.2cm from XA0):

XA3: blue dashed, $\sigma_{PE}/\overline{PE} = 13.5\%$

XA0: blue solid, $\sigma_{PE}/\overline{PE} = 17\%$

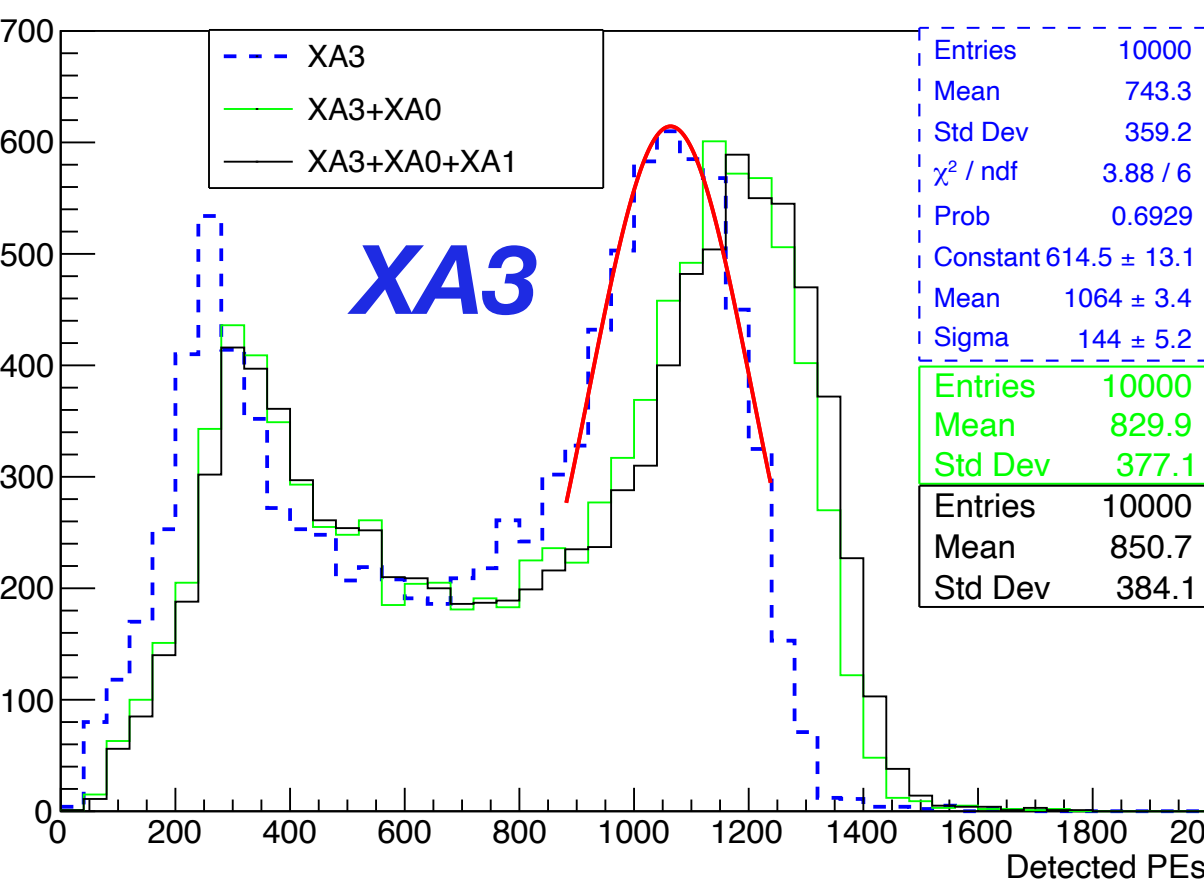
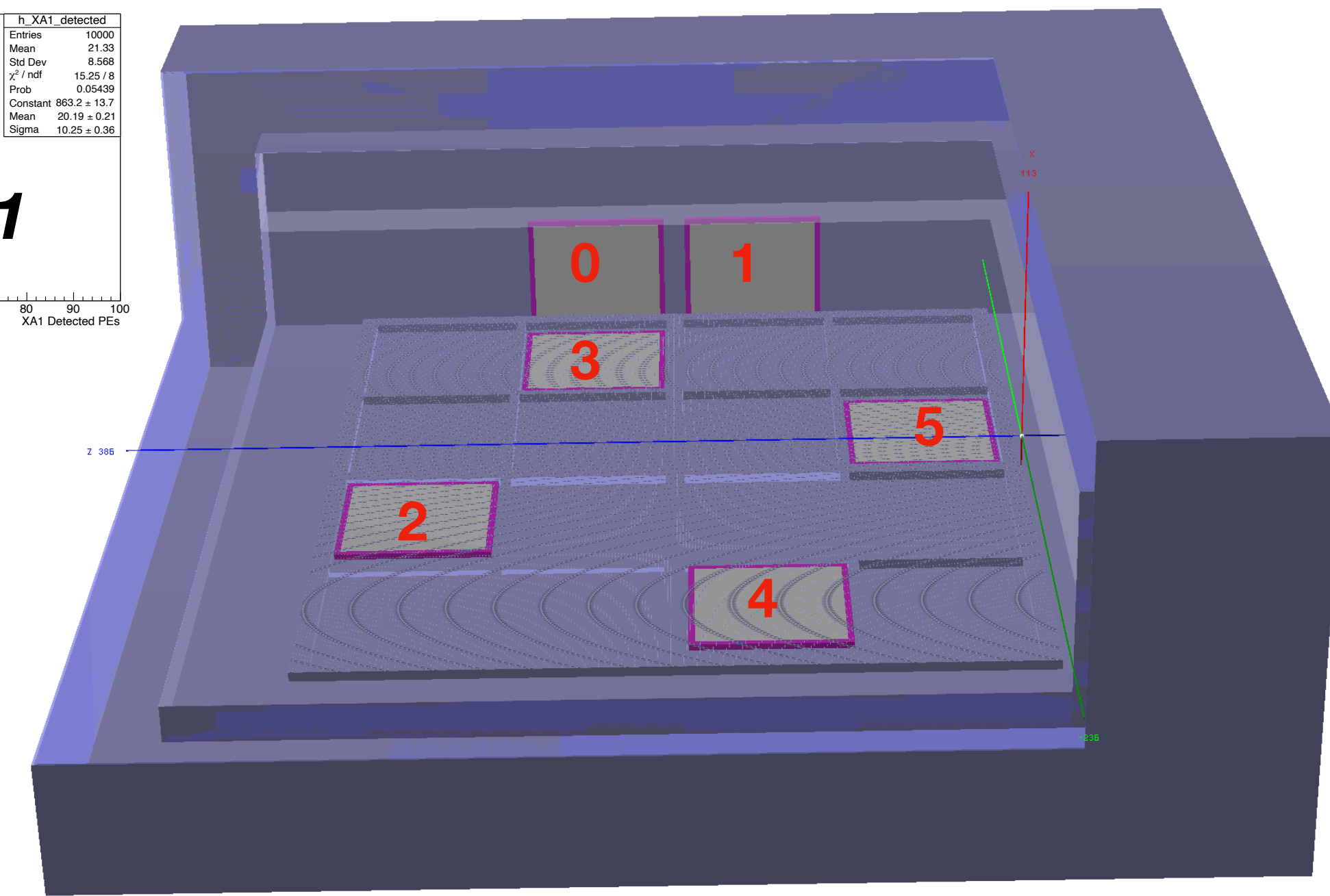
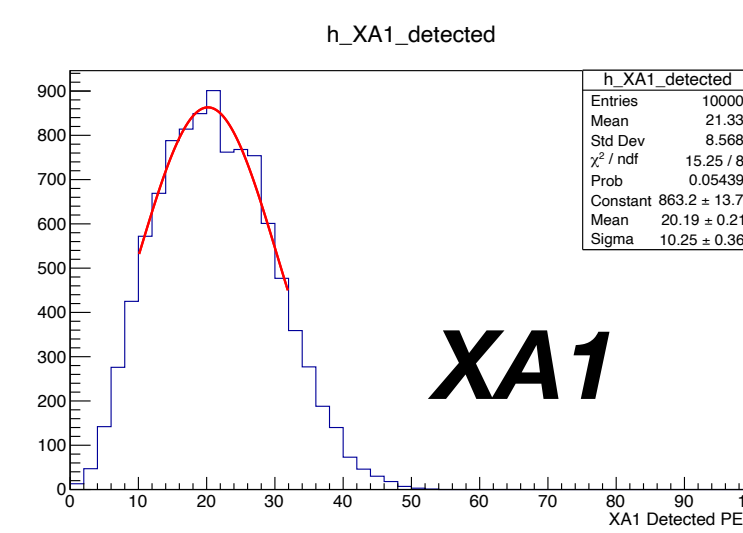
Interest to study combine XA3 with one or both membrane XAs

XA3+XA0 combined: $\sigma_{PE}/\overline{PE} = 12.4\%$

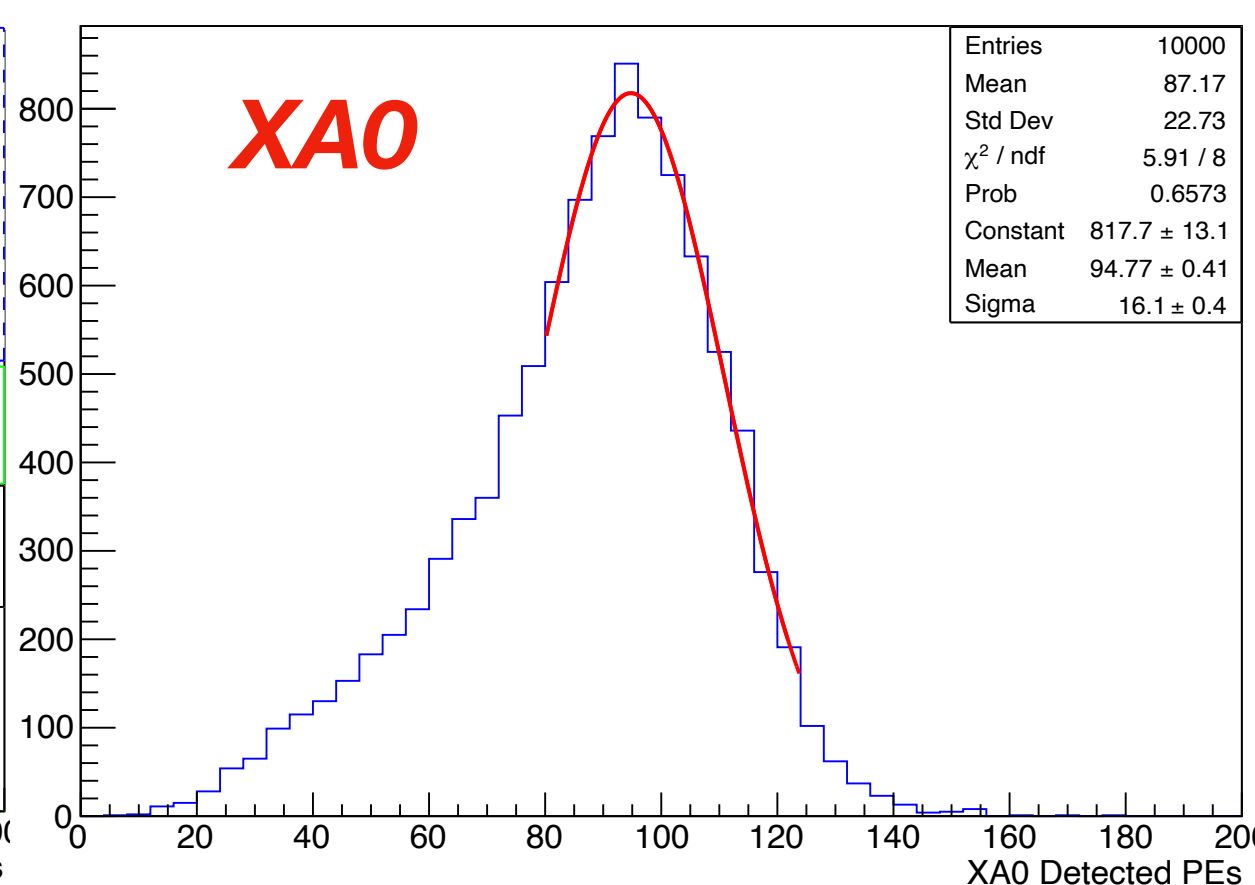
XA0 peak correlates well with XA3 peak \rightarrow Slight improvement

XA3+XA0+XA1 combined: $\sigma_{PE}/\overline{PE} = 13.3\%$

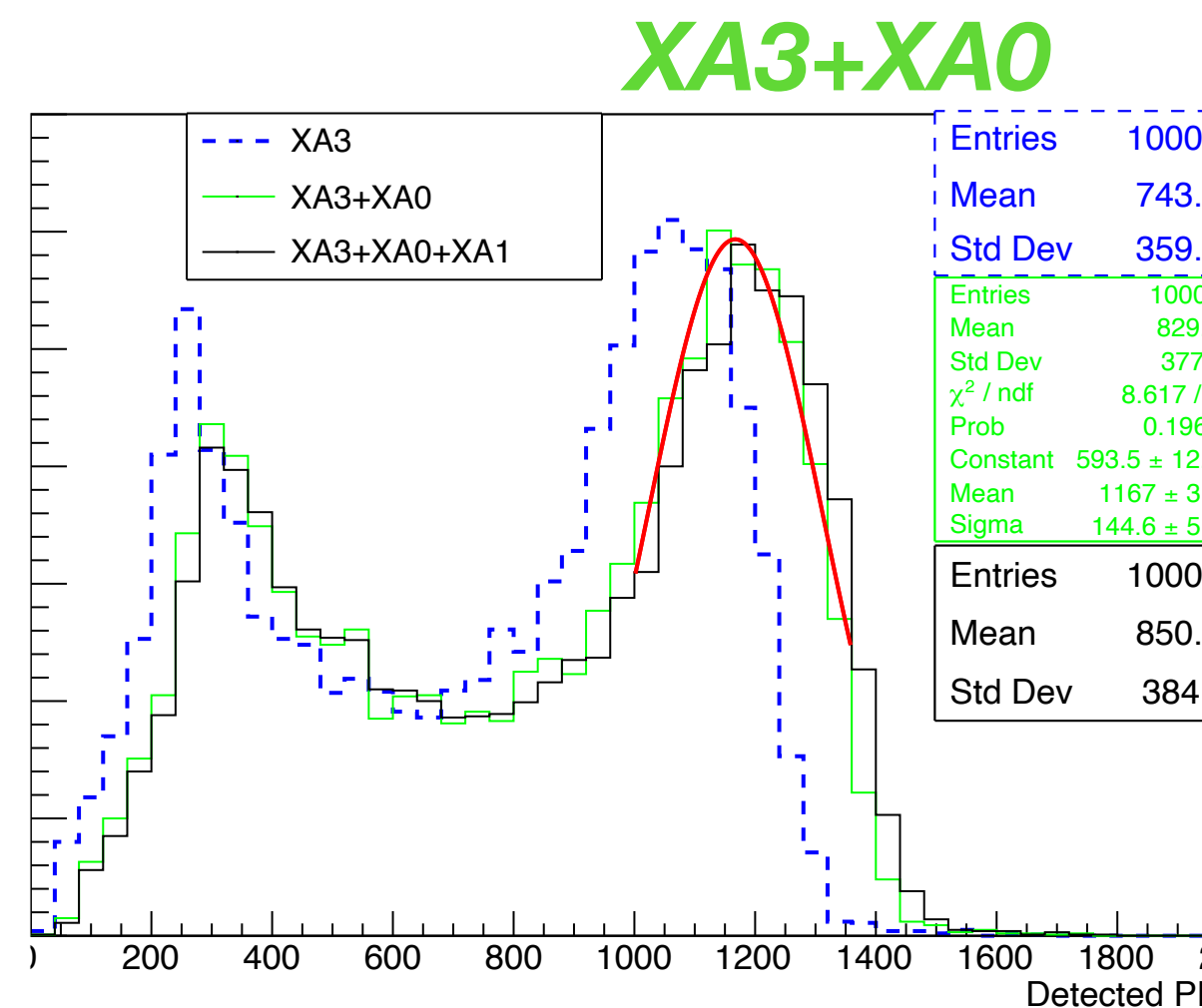
XA1 peak less well correlated \rightarrow negligible



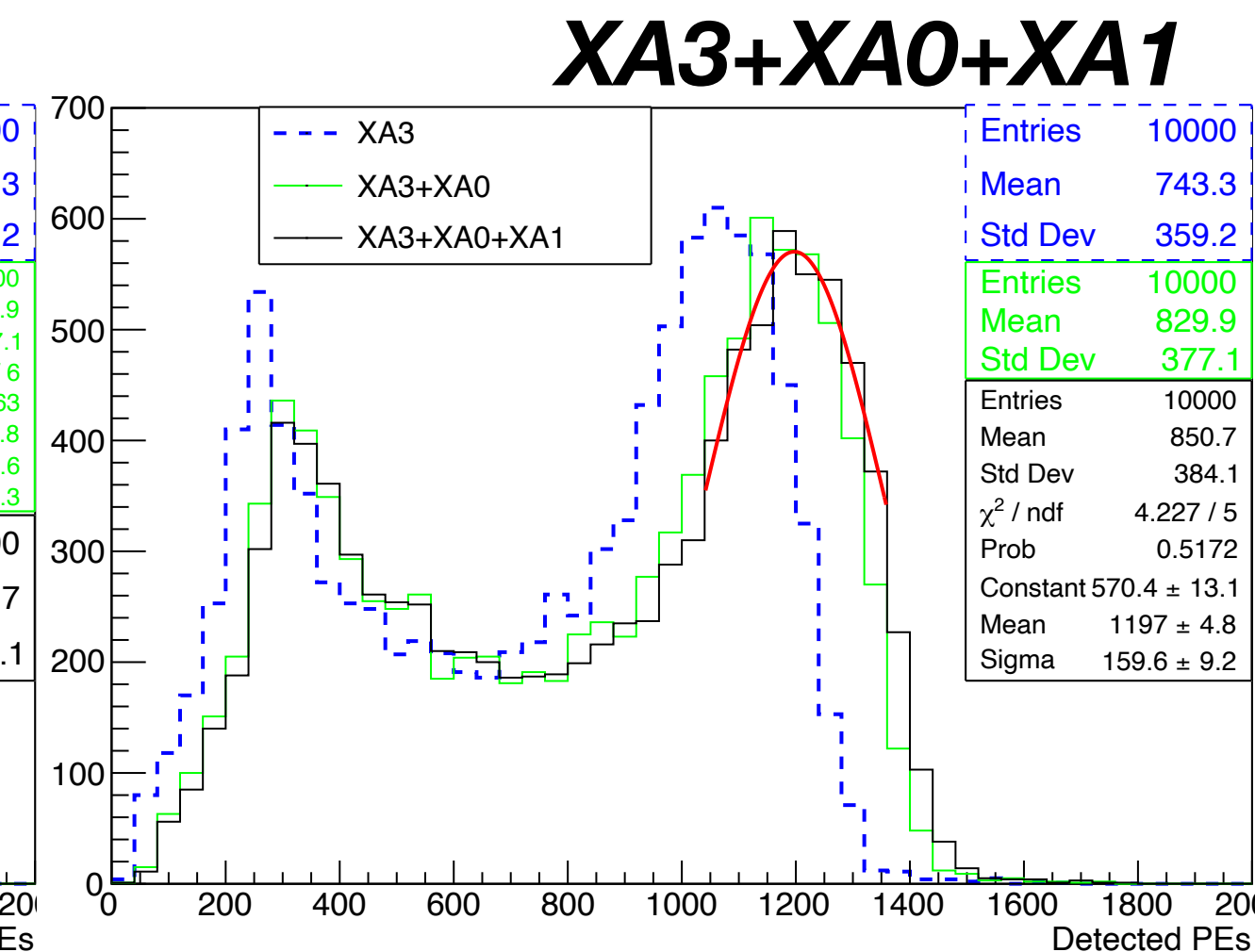
$\sigma_{PE}/\overline{PE} = 13.5\% @10\text{cm}$
 (~10% @15cm)



$\sigma_{PE}/\overline{PE} \sim 17\%$

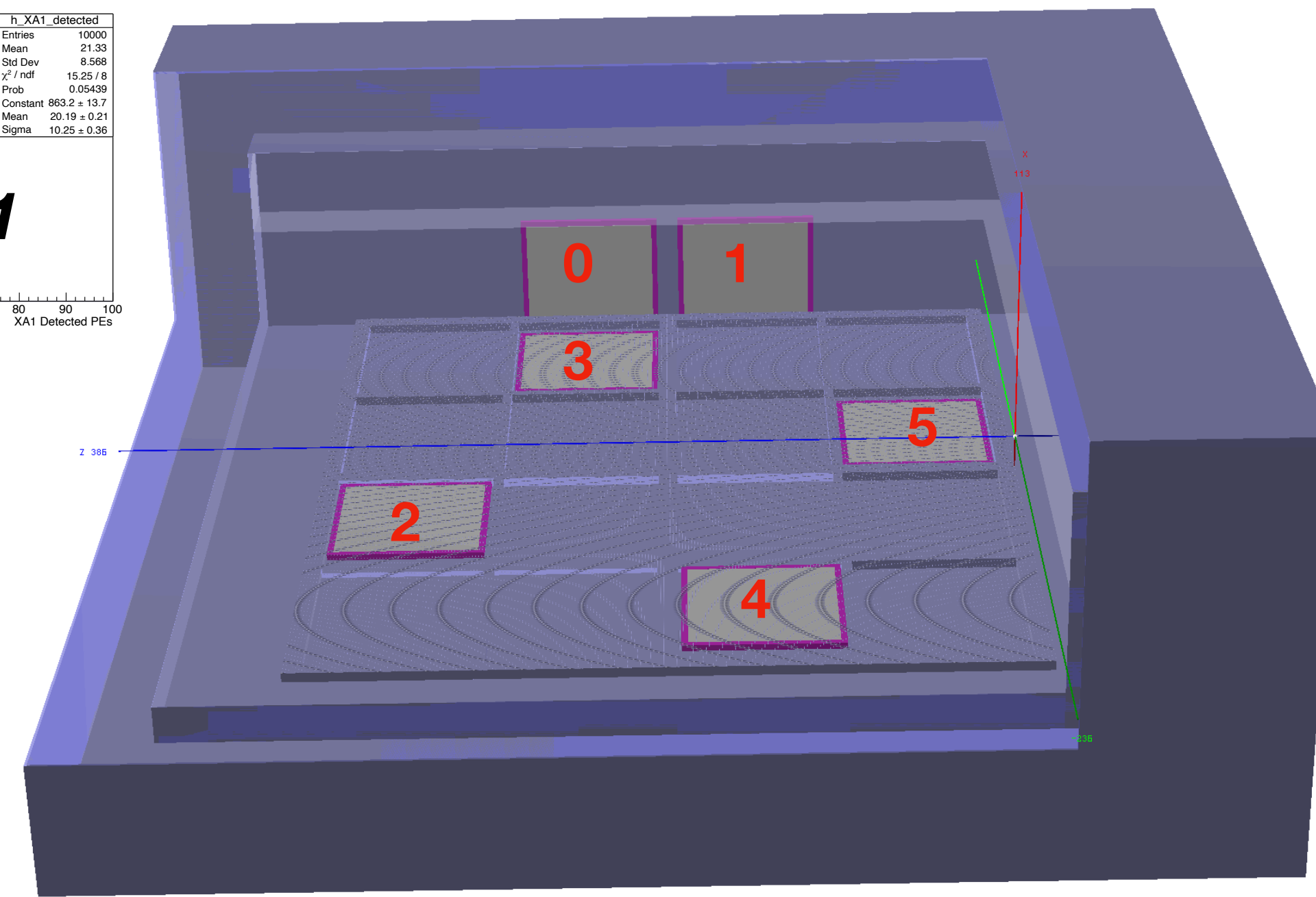
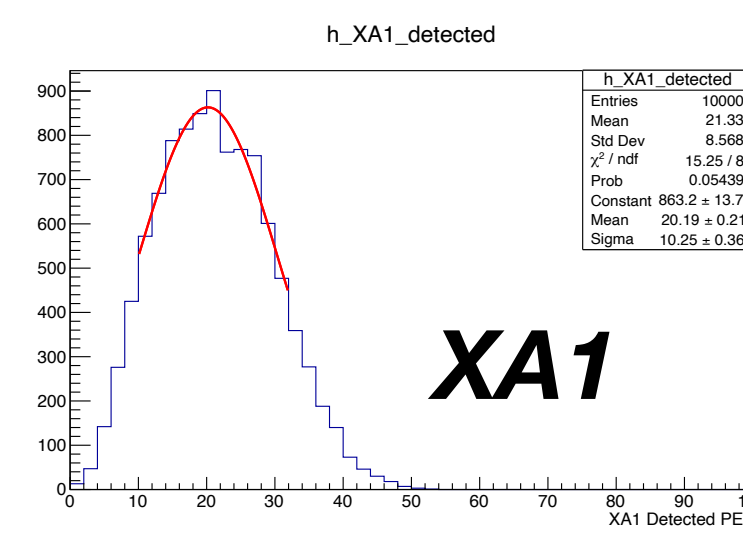


$\sigma_{PE}/\overline{PE} = 12.4\%$



$\sigma_{PE}/\overline{PE} = 13.3\%$

Summary: Membrane XAs



Membrane XAs could help calibration in two scenarios:

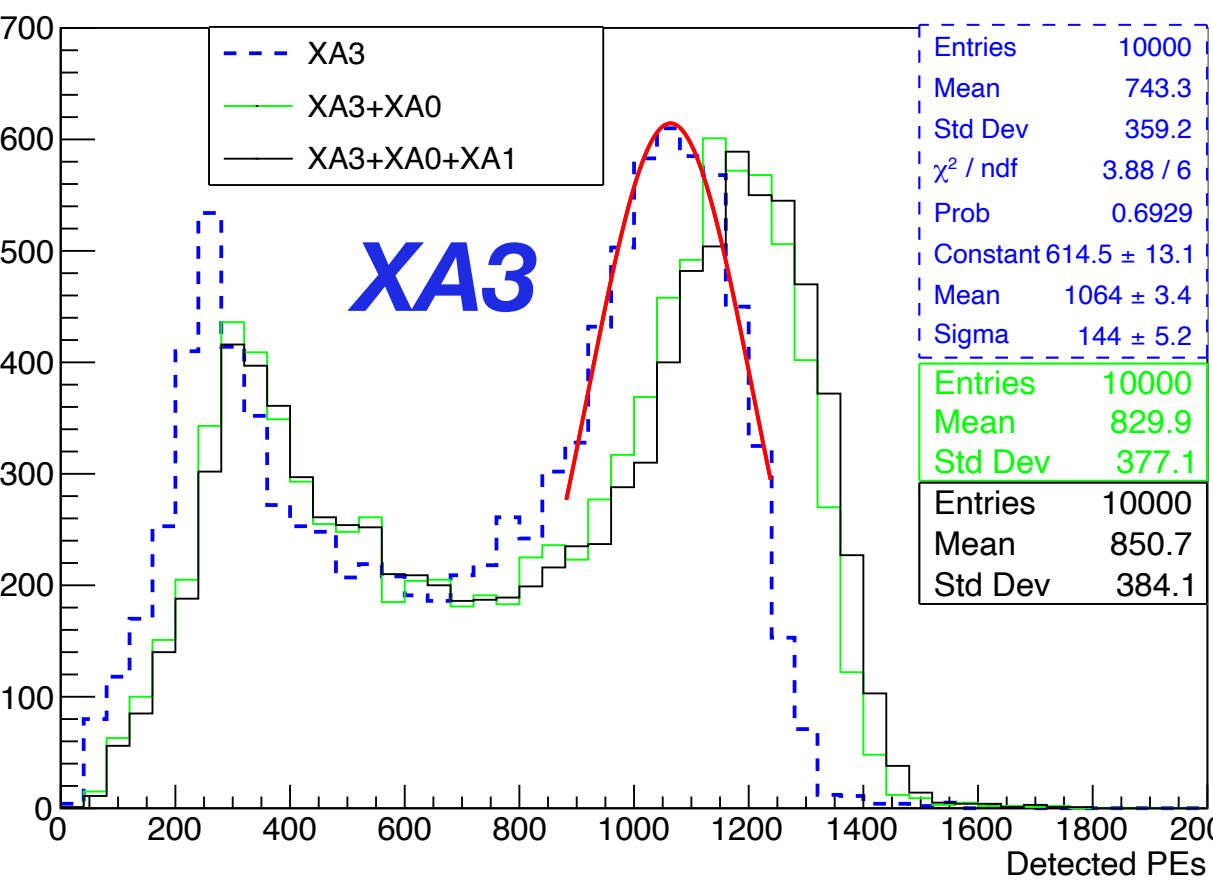
- 1) captures very close to membrane (no cathode XA around)
- 2) captures on top of cathode XA, combine membrane XA + cathode XA (mostly XA3+XA0, not helping in XA2/4/5)

$$LY(i, j, k) = \overline{PE}/6.1\text{MeV}, \sigma_{LY} = \sigma_{PE}/6.1, \sigma_{LY}/LY = \sigma_{PE}/\overline{PE}$$

$$E_{reco} = \text{Det_PE}/LY(i, j, k)$$

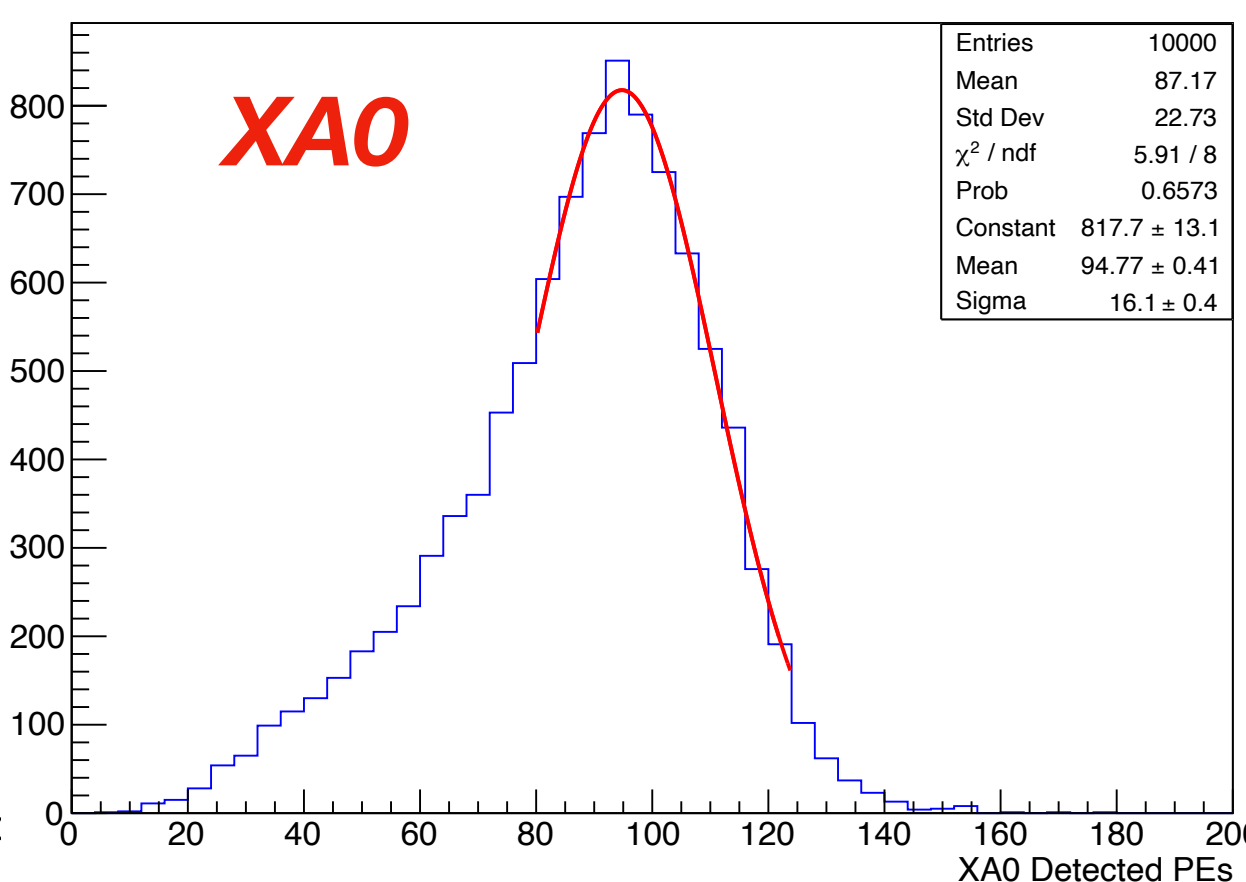
$$\sigma_{E_{reco, calibration}} = E_{reco} * (\sigma_{LY}/LY) = E_{reco} * \sigma_{PE}/\overline{PE}$$

$$\sigma_{E_{reco, calibration}} / E_{reco} = \sigma_{PE}/\overline{PE}$$

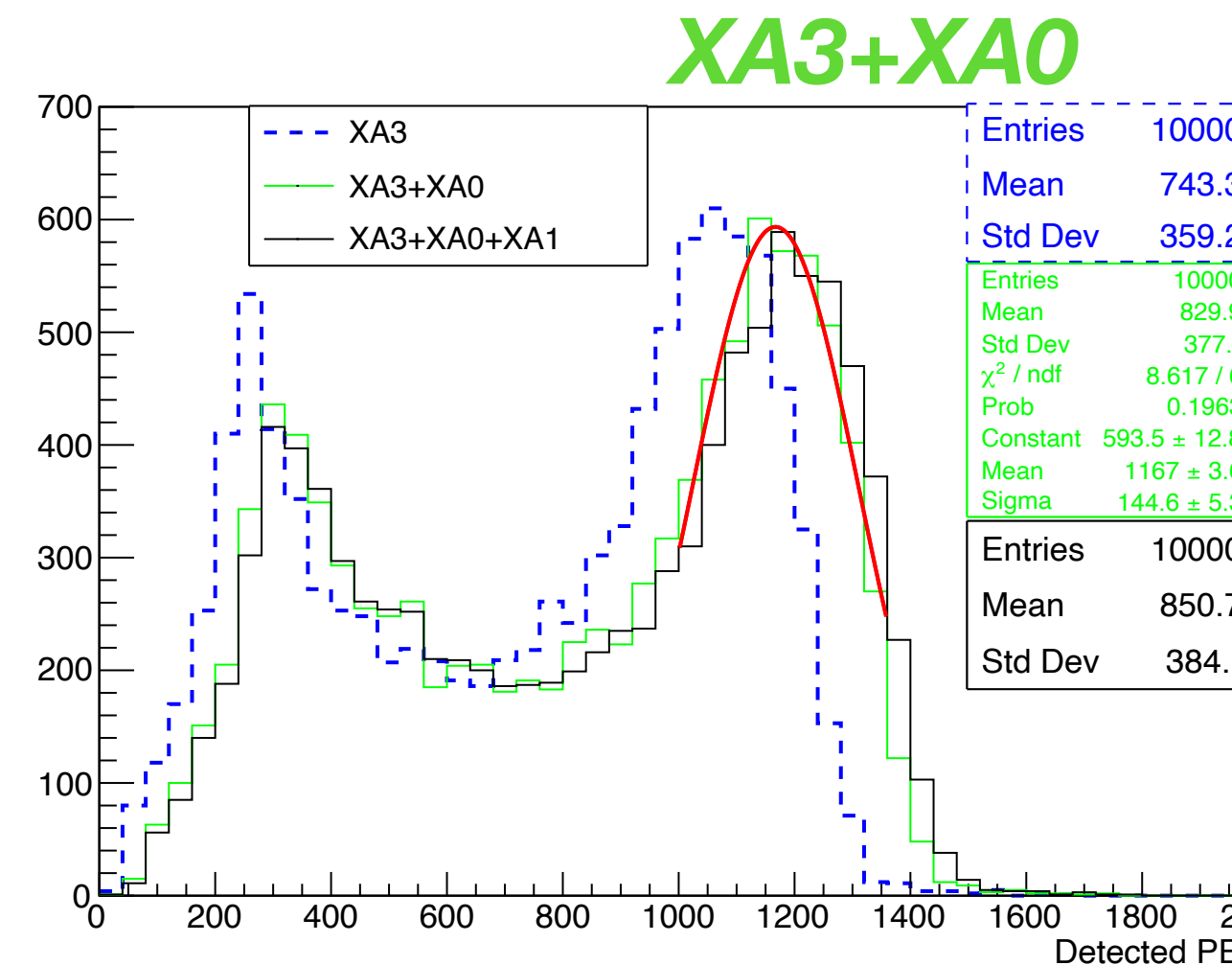


$$\sigma_{PE}/\overline{PE} = 13.5\% \text{ @10cm}$$

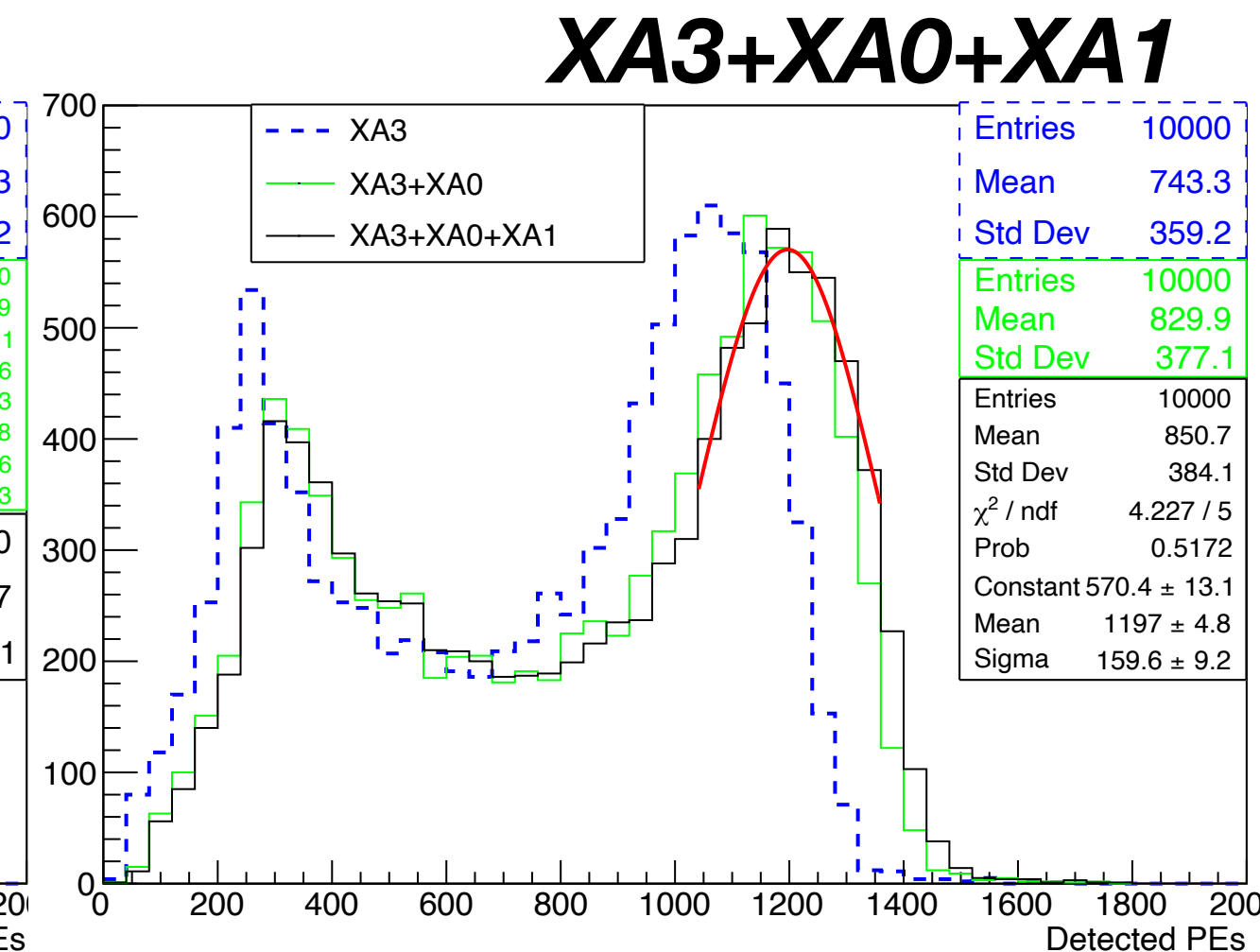
(~10% @15cm)



$$\sigma_{PE}/\overline{PE} \sim 17\%$$



$$\sigma_{PE}/\overline{PE} = 12.4\%$$



$$\sigma_{PE}/\overline{PE} = 13.3\%$$

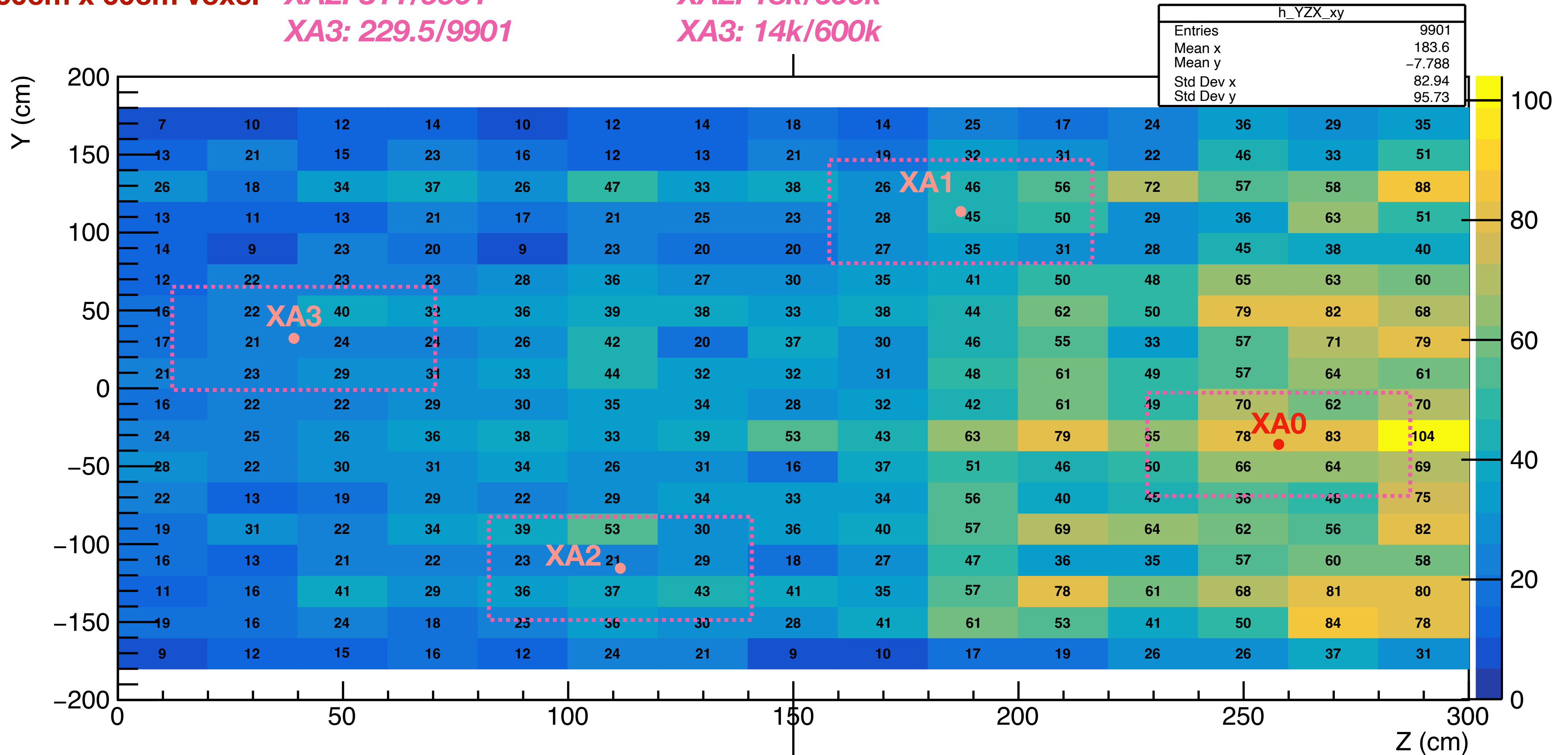
Capture statistics

Full 20cm drift in x:
20cm x 60cm x 60cm voxel

XA0: 708.5/9901
XA1: 344/9901
XA2: 311/9901
XA3: 229.5/9901

XA0: 43k/600k
XA1: 20k/600k
XA2: 18k/600k
XA3: 14k/600k

20cm x 20cm x 20cm voxel: Scale down by 9
10cm x 20cm x 20cm voxel: Scale down by 18
10cm x 10cm x 10cm voxel: Scale down by 72
2cm x 20cm x 20cm voxel: Scale down by 90
1cm x 20cm x 20cm voxel: Scale down by 180
If we want 10x10x10cm³ voxel, would be nice if we can get 6M stats (CRP+PDS)

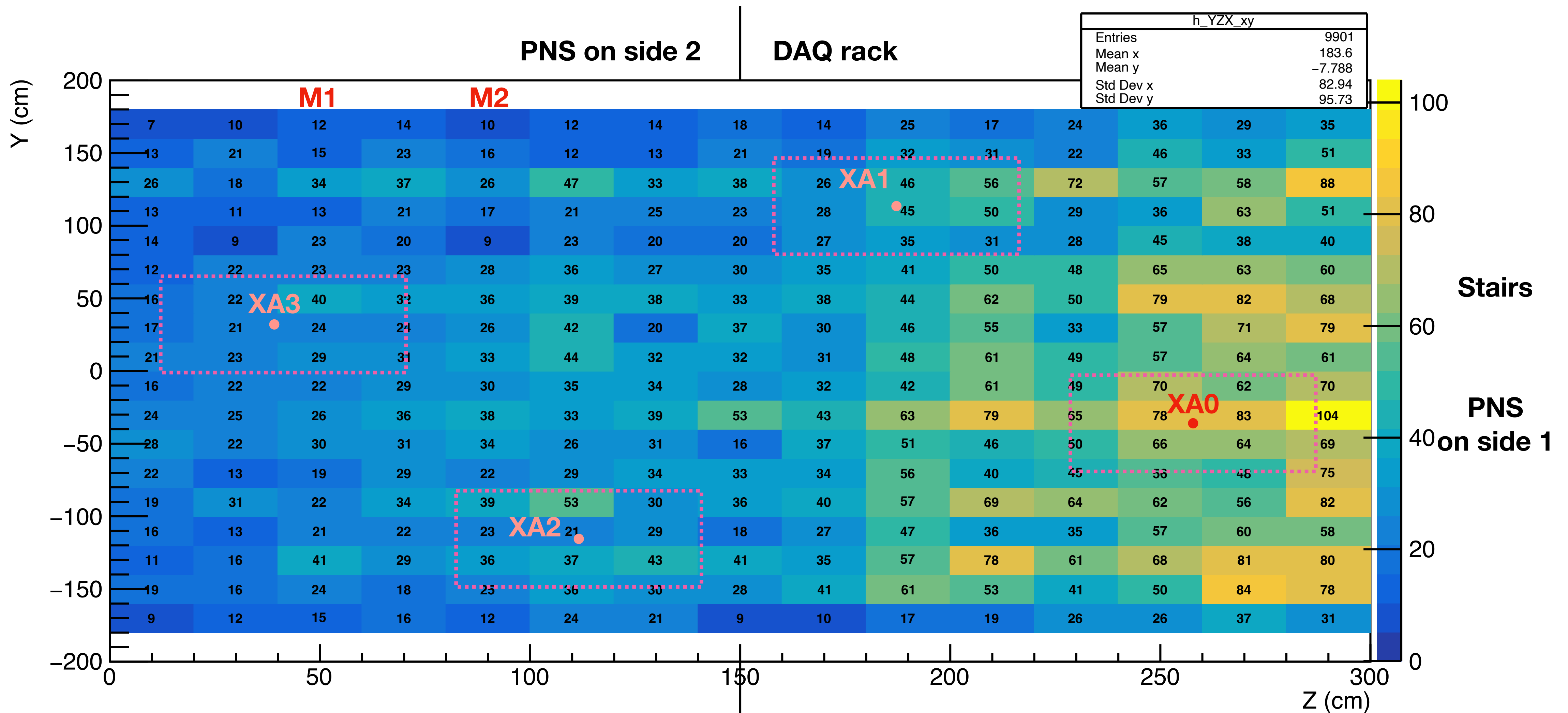


More tips from this plot:

1) PNS if placed on top of CB, most captures will be far from XAs, small signal (prefer PNS side)

2) If want to benefit from wall/membrane XAs (M1&M2), want to place PNS on that side (i.e. behind power supply racks)

3) If want to look at all four XAs with enough stats, may want to place the PNS on each side of CB (sides with DAQ, Monitor racks)



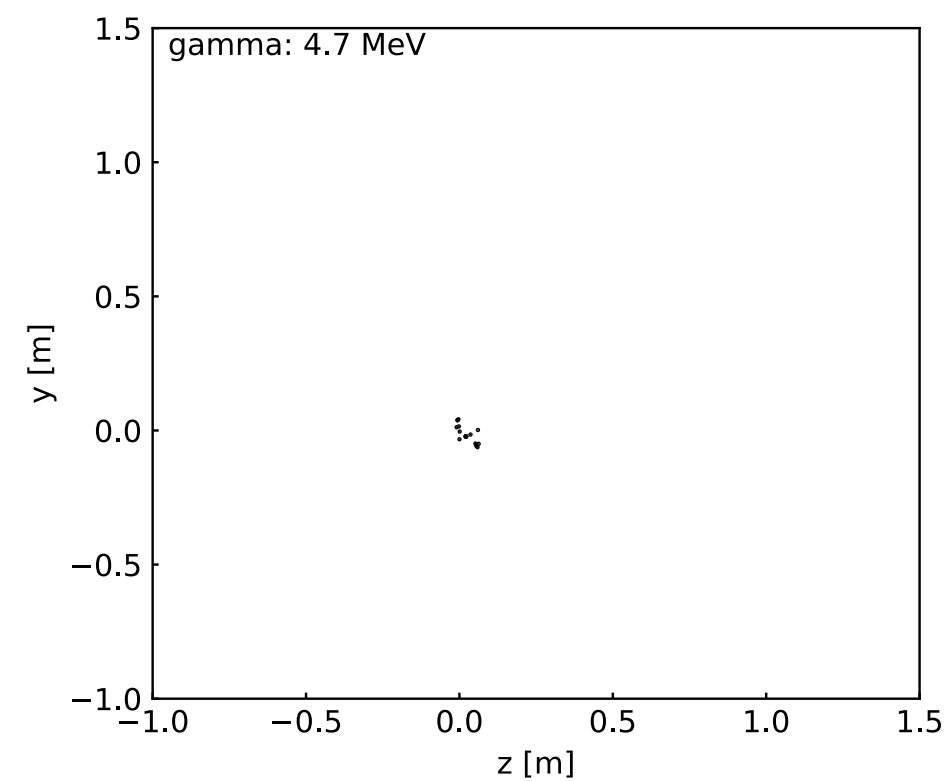
What will n-capture events look like on CRP side?

*Here are 4 event displays from 4.7MeV gamma in infinite LAr (no detector)
(i.e. what you will see from CRP data)*

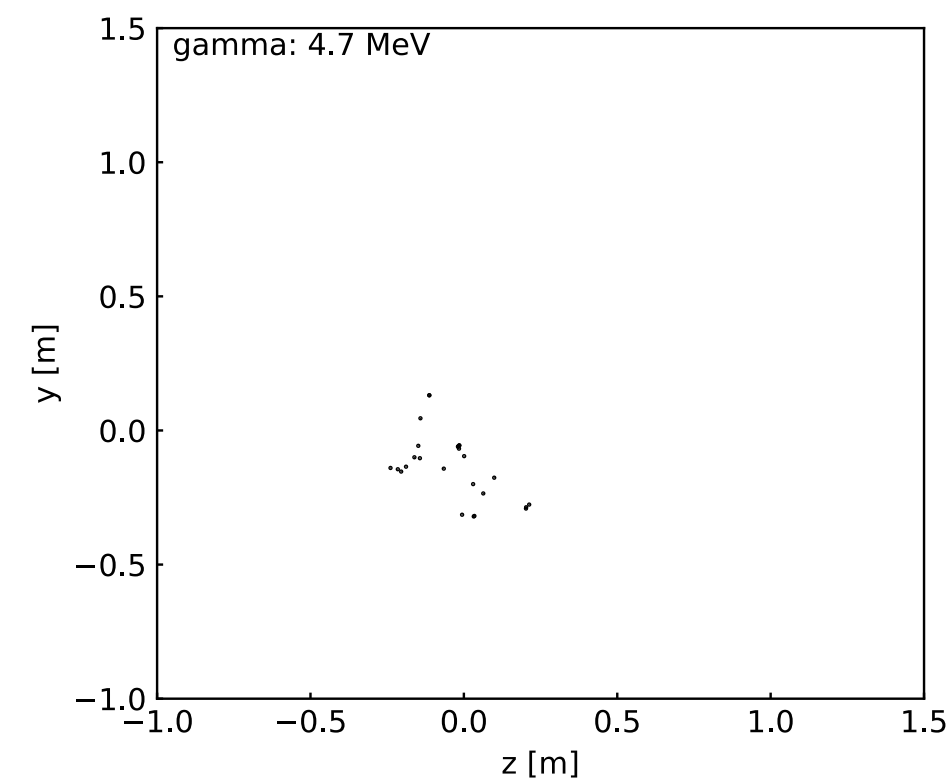
*Where are they released from n-capture? Find highest blip from CRP?
Or choose a voxel to encompass all/most blips
(This ultimately decides voxel size for voxel-based calibration)*

We probably need to select localized events similar to evt 4 or evt 1

Pair prod.

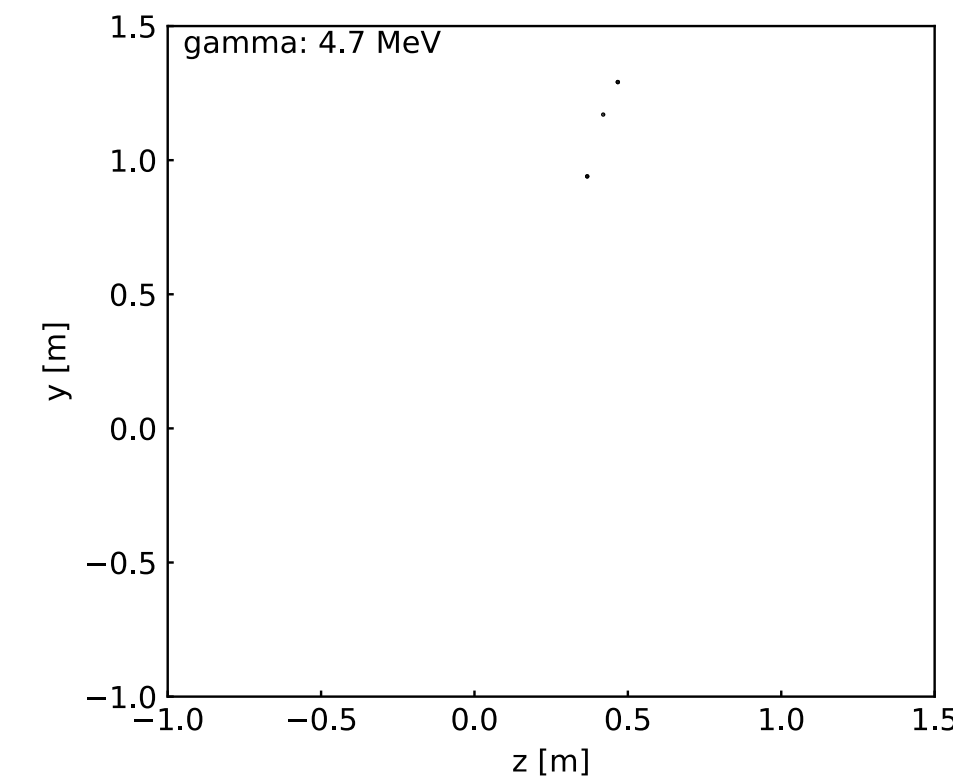


Evt 1

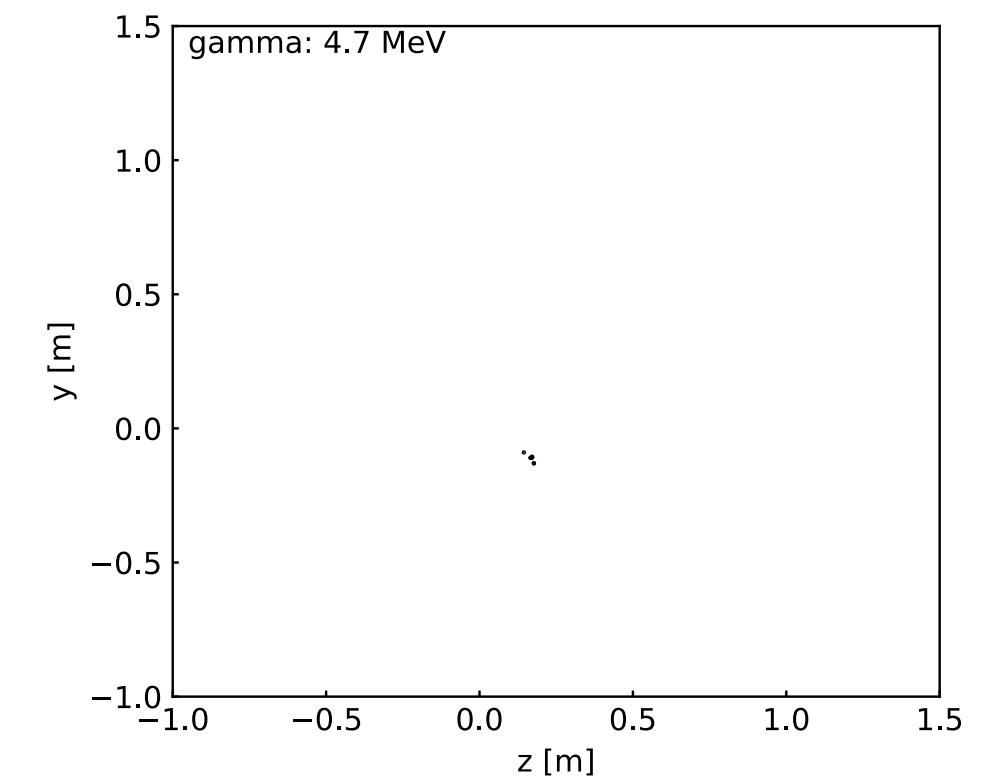


Evt 2

Compton



Evt 3



Evt 4