

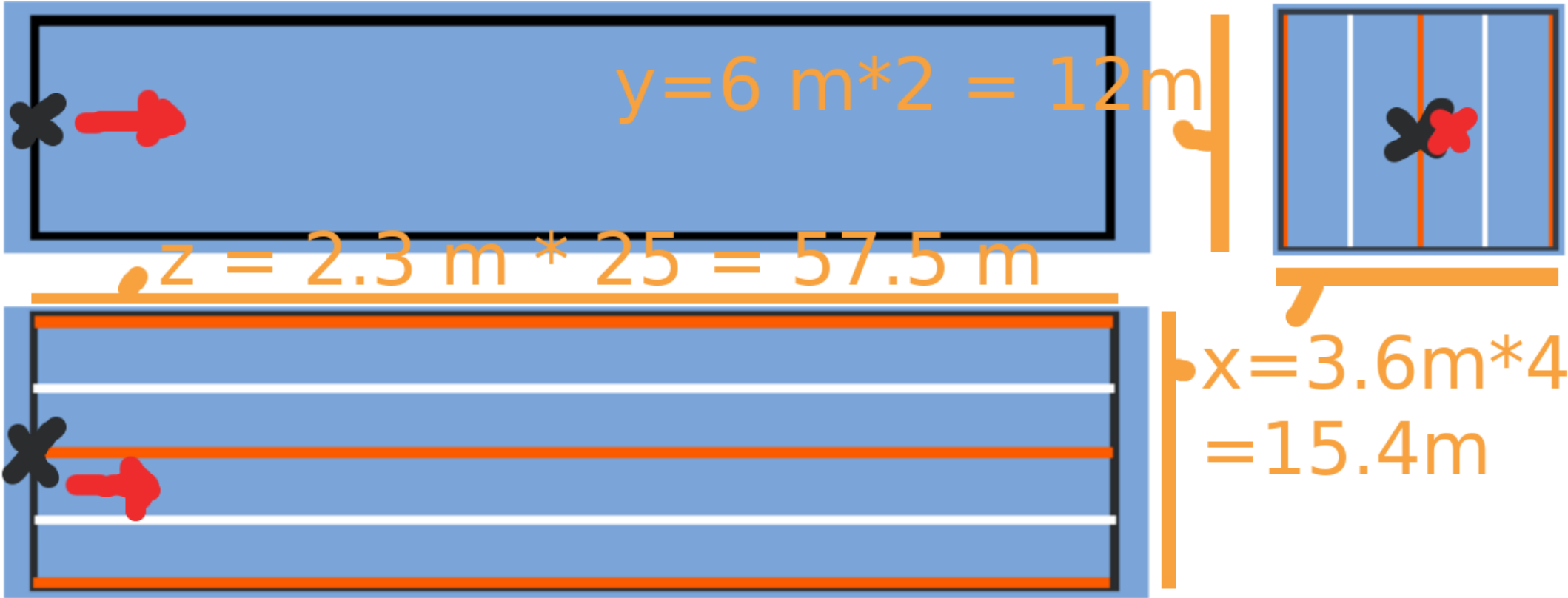
Neutron Transport Update

June 11

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Update

- Used dune10kt_v4 parameters to generate the full far detector
- Neutron transport simulation working in this geometry as well as in protodune_v5.gdml
- Neutrons can be produced with a realistic energy spectrum
- Still need to add angular spectrum to neutrons entering the argon.
- Still need to incorporate FR4 cathode components into the full geometry...

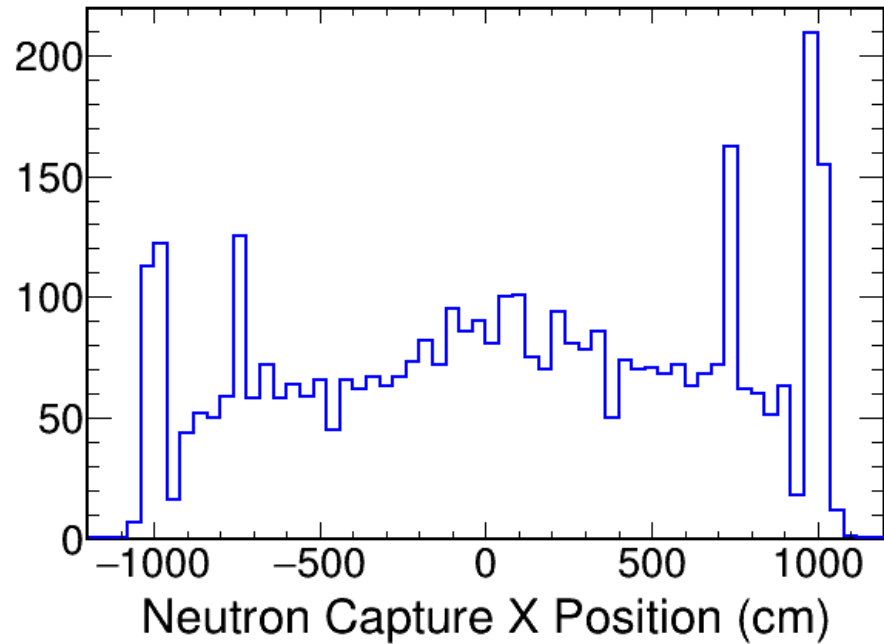


- Active volume: black rectangles
- Origin: Black X
- APAs: Orange lines
- CPAs: White lines
- 57keV neutrons at (1m,0,1m) with momenta in +z

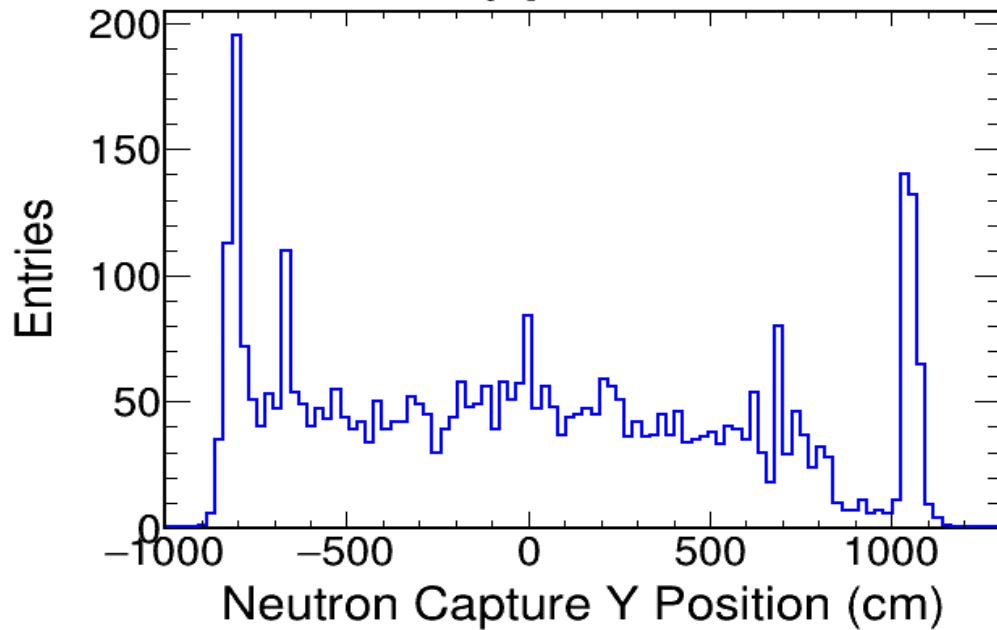
Full FD Geometry

Neutron Ending Positions

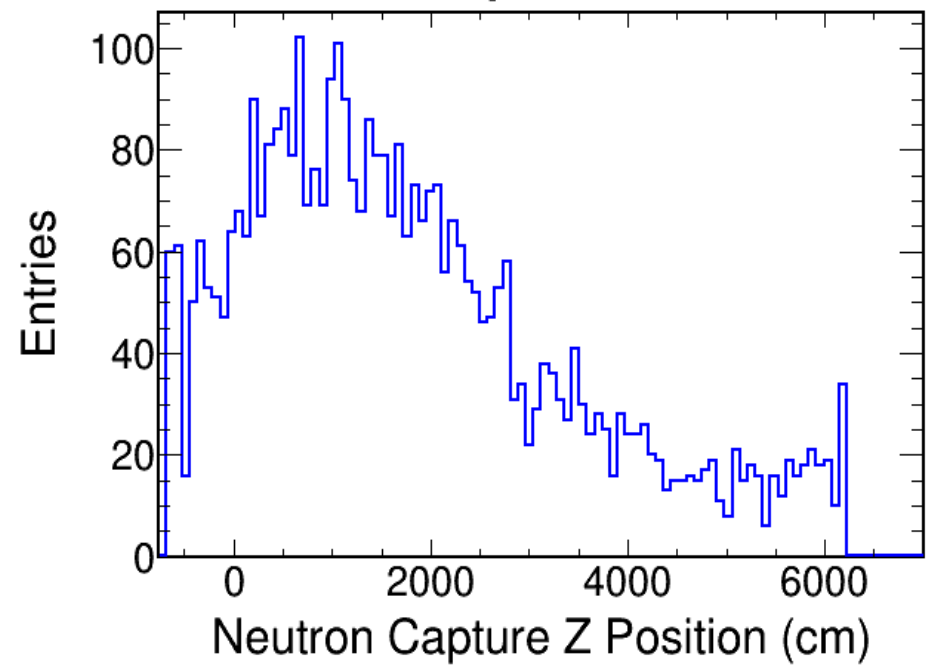
end x position



end y position

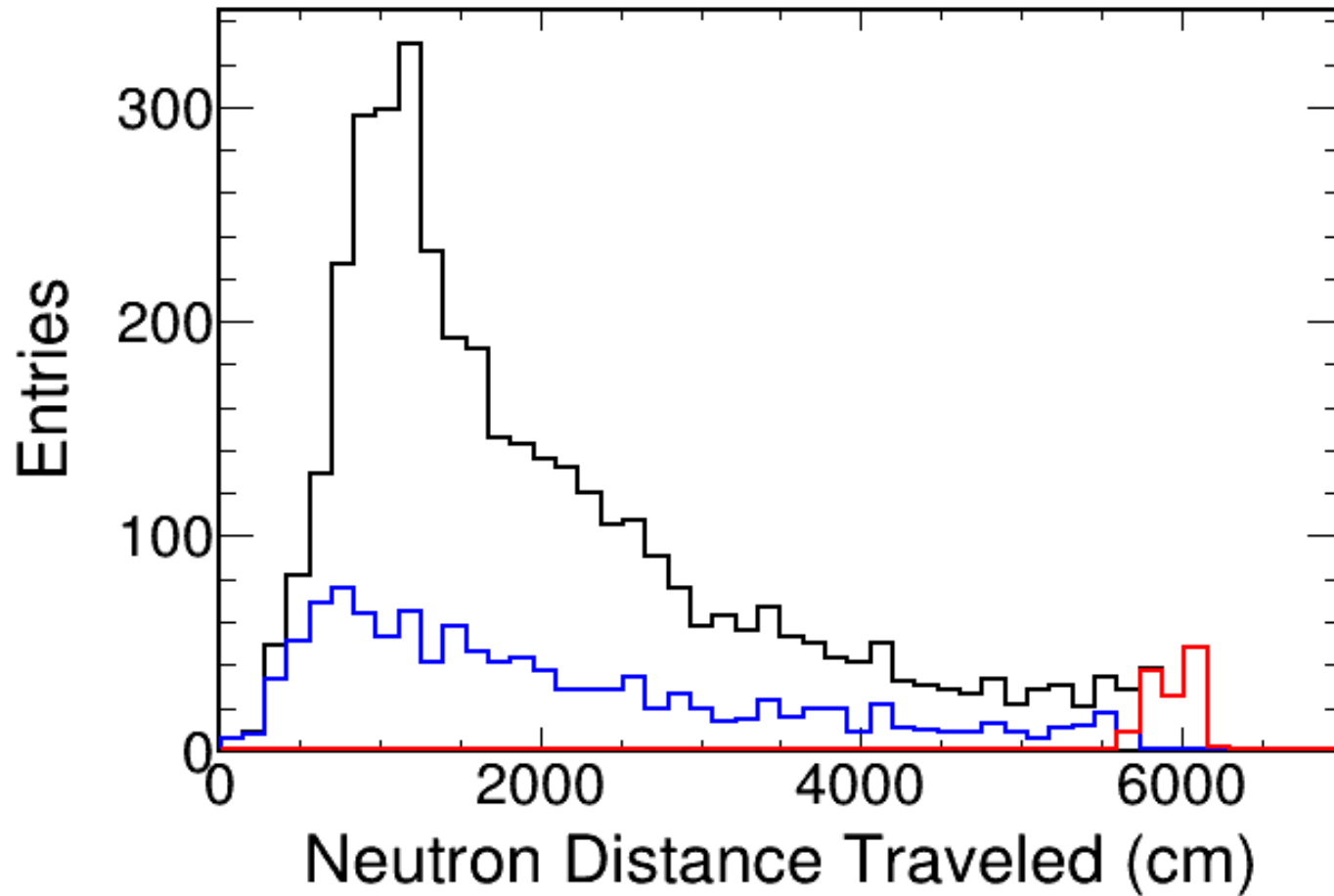


end z position

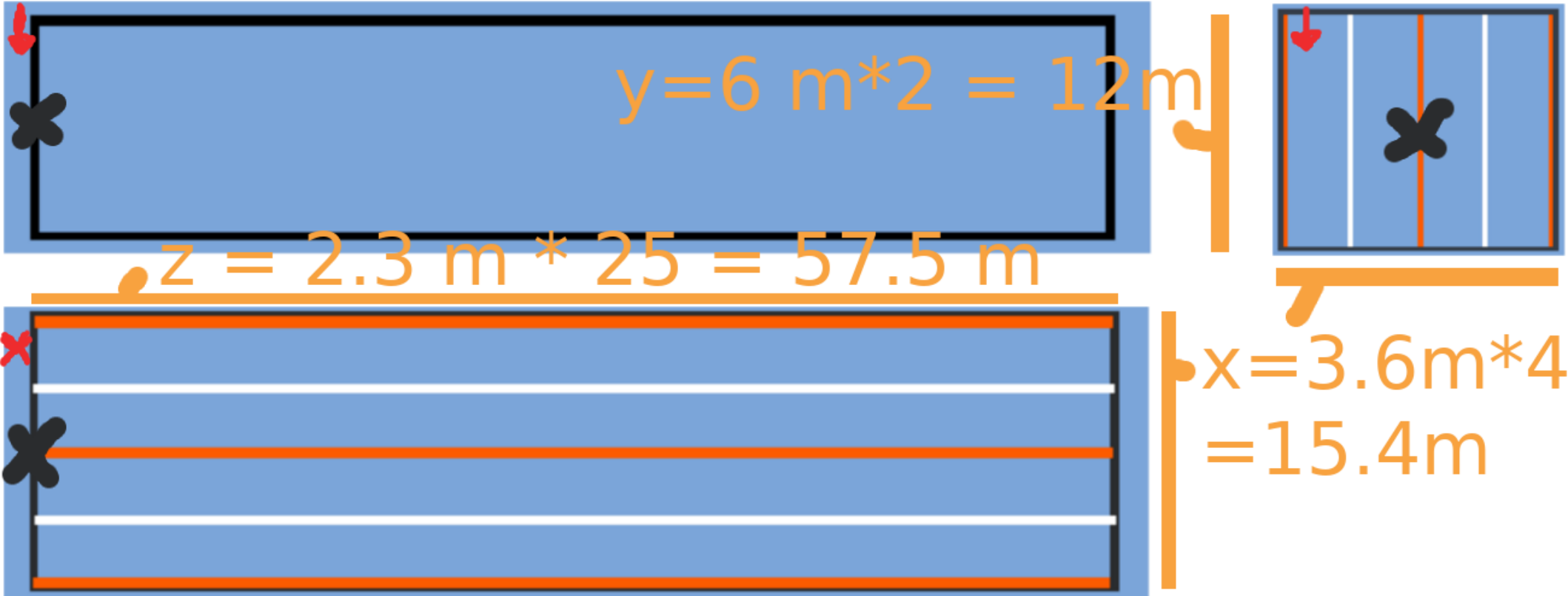


Travel Distances

Neutron Travel Distance



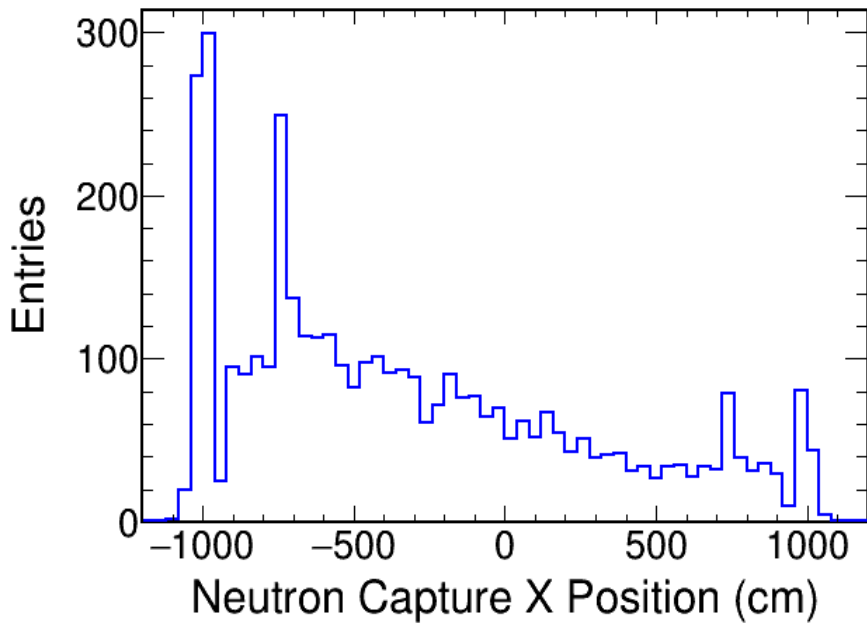
- All neutrons
- Neutrons captured in active volume
- Neutrons exiting the active volume downstream



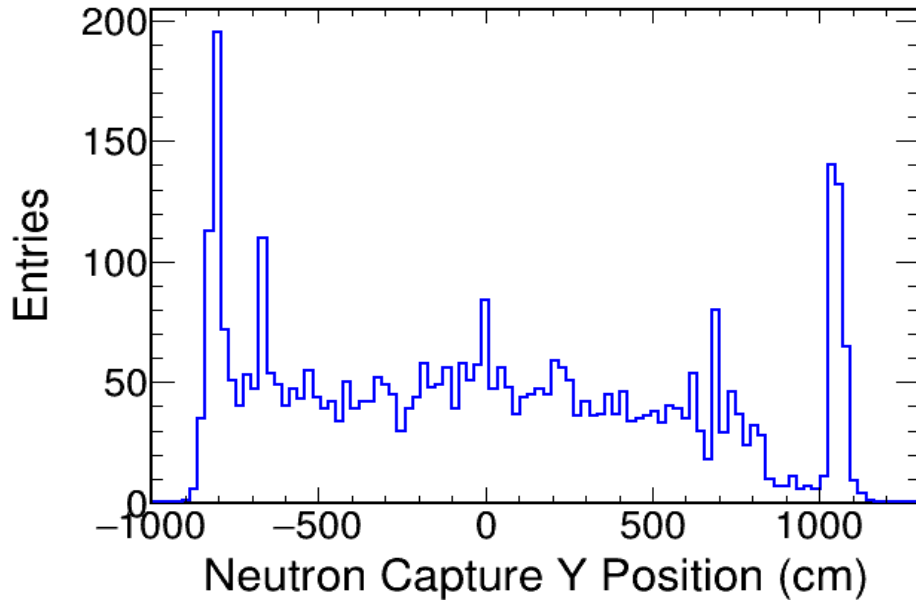
- Active volume: black rectangles
 - Origin: Black X
 - APAs: Orange lines
 - CPAs: White lines
 - 57keV neutrons at (-5.76m, 6.10m, -.7m). Upstream of active volume. Just above field cage.
- The production location was chosen as my best guess from looking at the diagram on pg 433 of the tdr draft on dunedocdb:
https://docs.dunescience.org/cgi-bin/private/RetrieveFile?docid=11650&filename=vol-sp_22Apr2019.pdf&version=7#glo%3Adss

Neutron Ending Positions

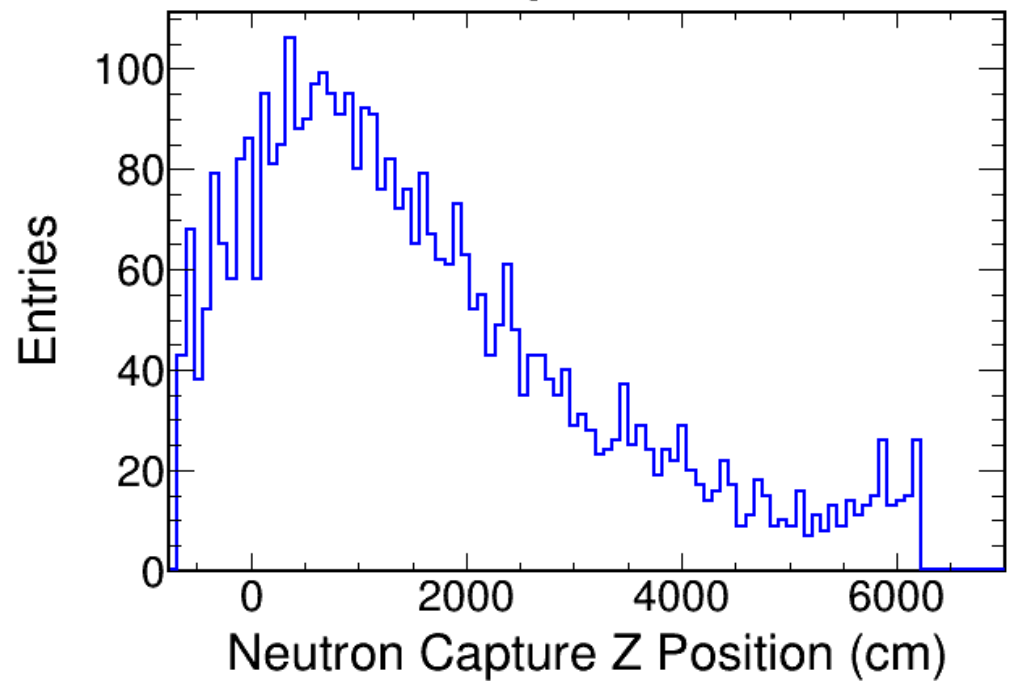
end x position



end y position

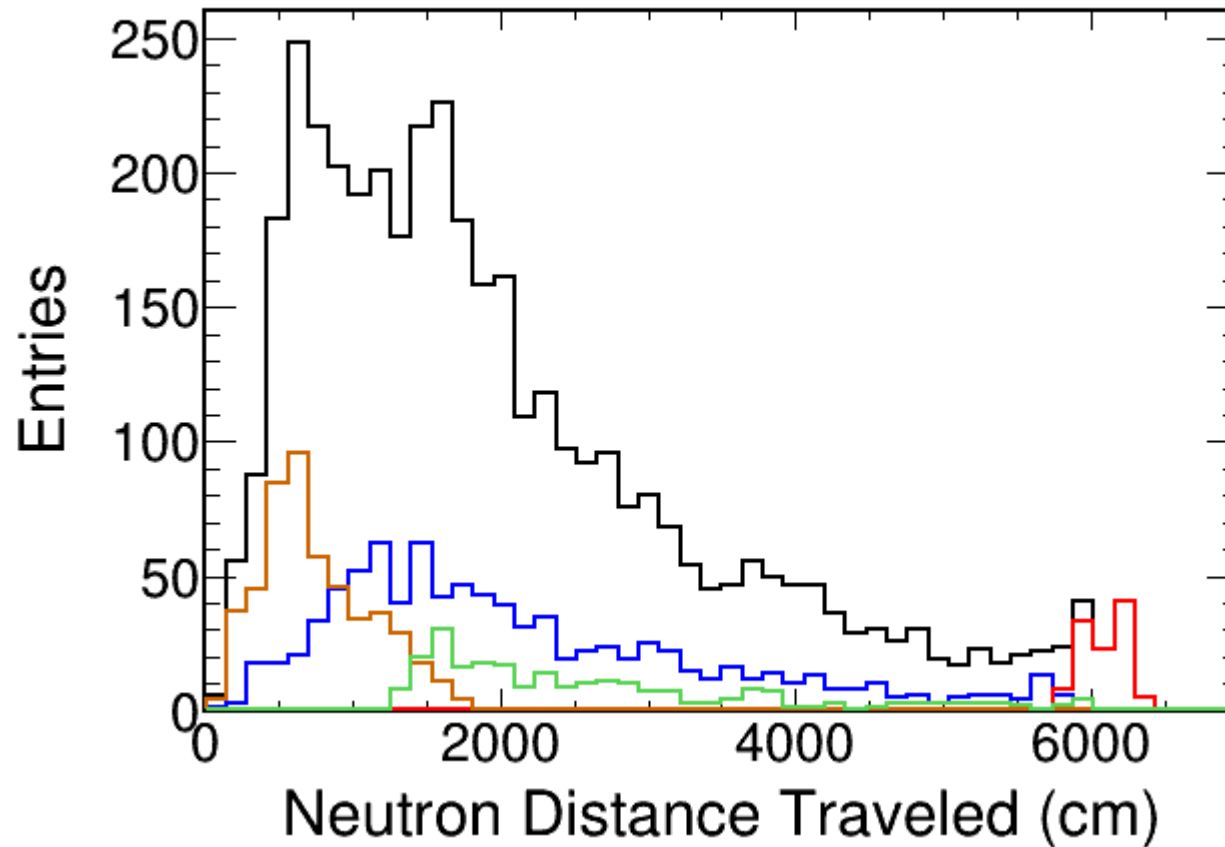


end z position

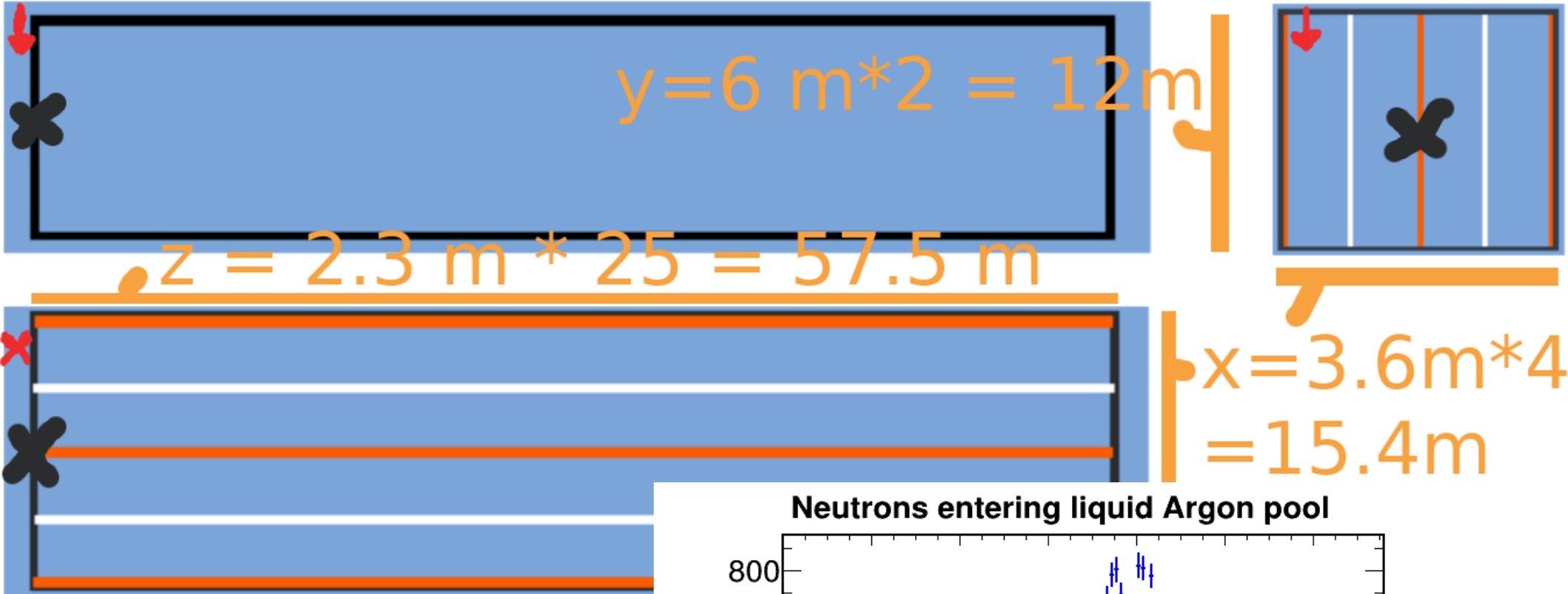


Travel Distances

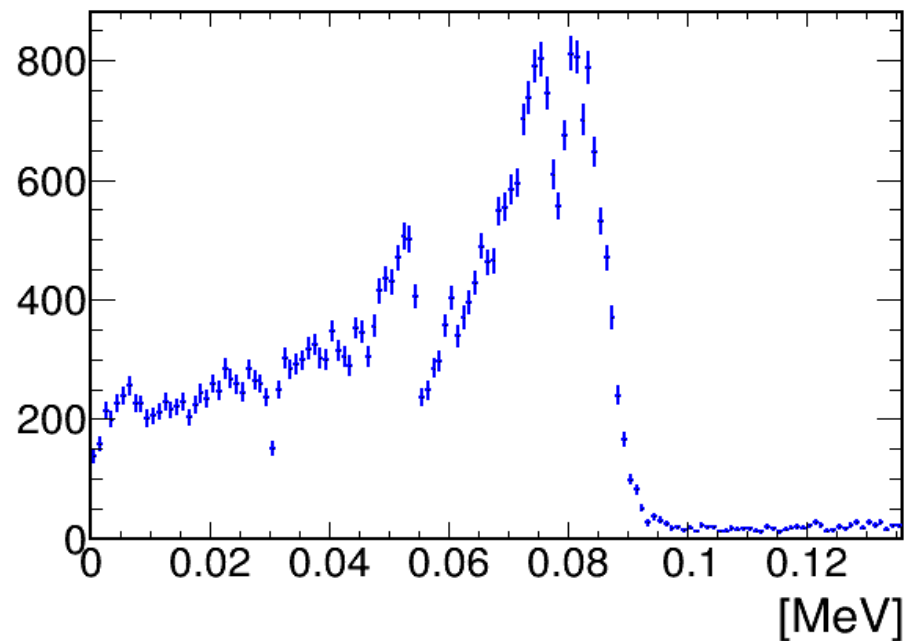
Neutron Travel Distance



- Neutrons captured in active volume
- Neutrons ending upstream of active volume
- Neutrons ending below active volume
- Neutrons ending downstream of active volume

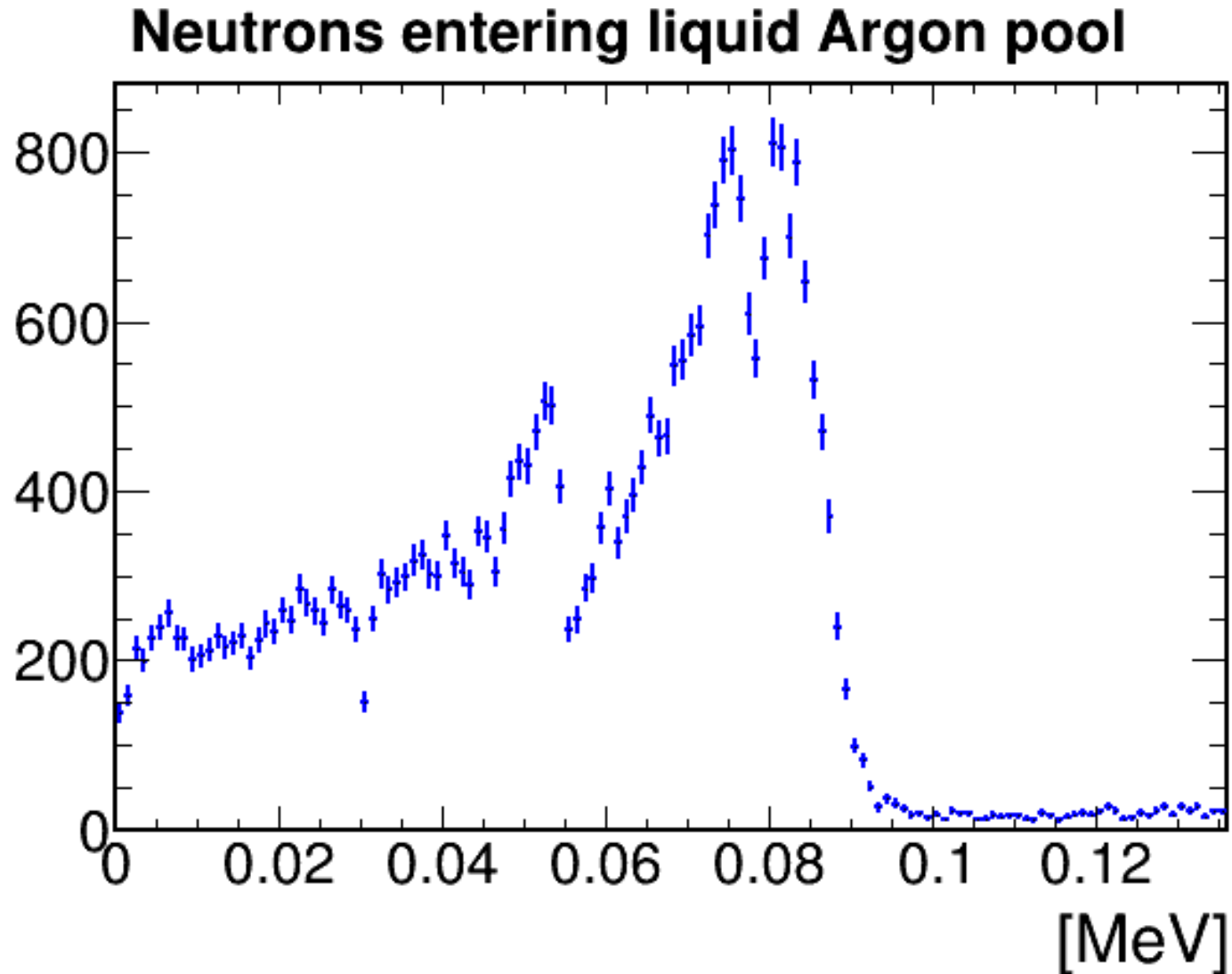


Neutrons entering liquid Argon pool



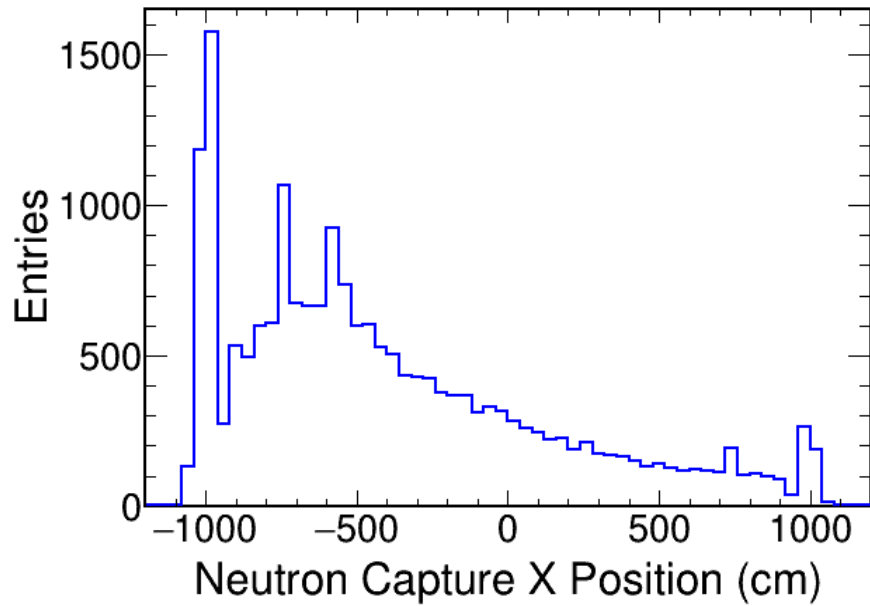
- Active volume: black
- Origin: Black X
- APAs: Orange lines
- CPAs: White lines
- Realistic energy spectrum of neutrons at (-5.76m, 6.10m, -.7m).
- Momenta are in the -y direction (will add angular spectrum soon)

Initial Neutron Energy spectrum

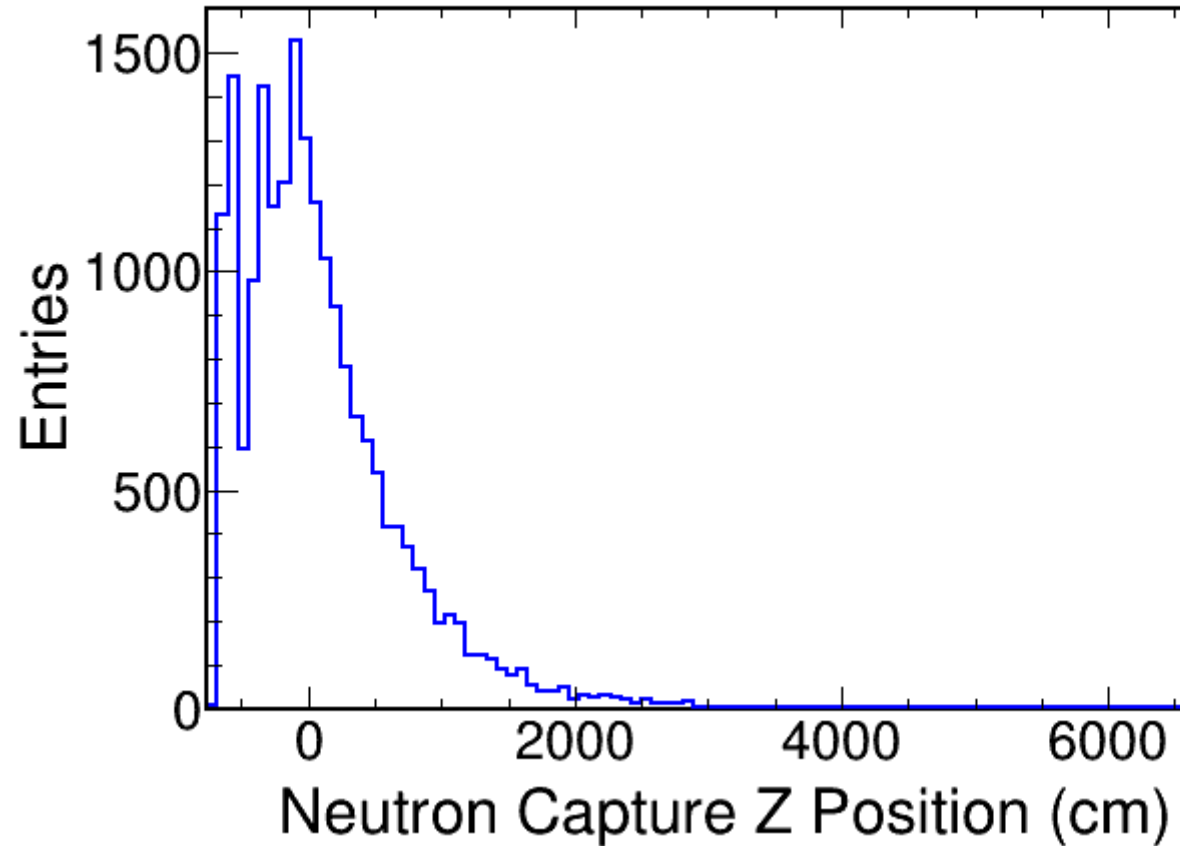


Neutron Ending Positions

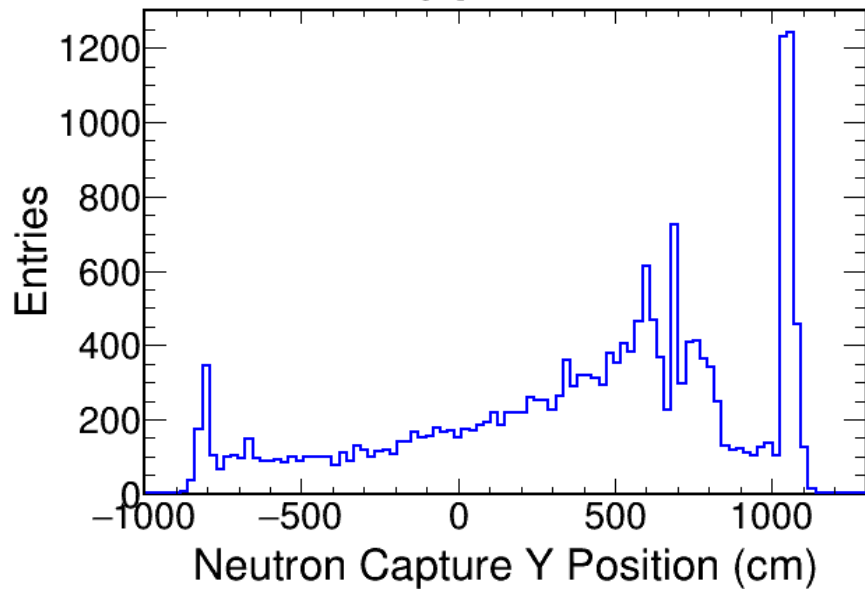
end x position



end z position



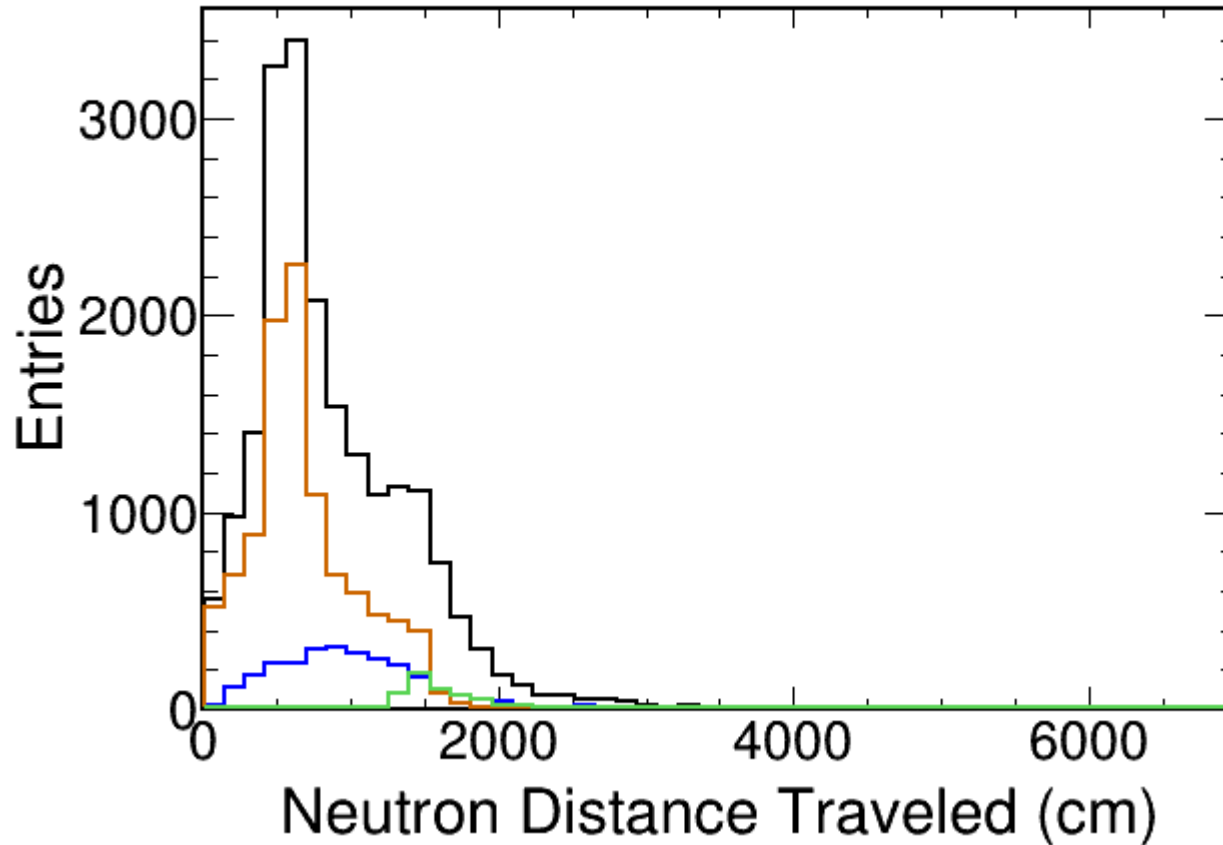
end y position



* Does not include realistic angular distribution

Travel Distances

Neutron Travel Distance

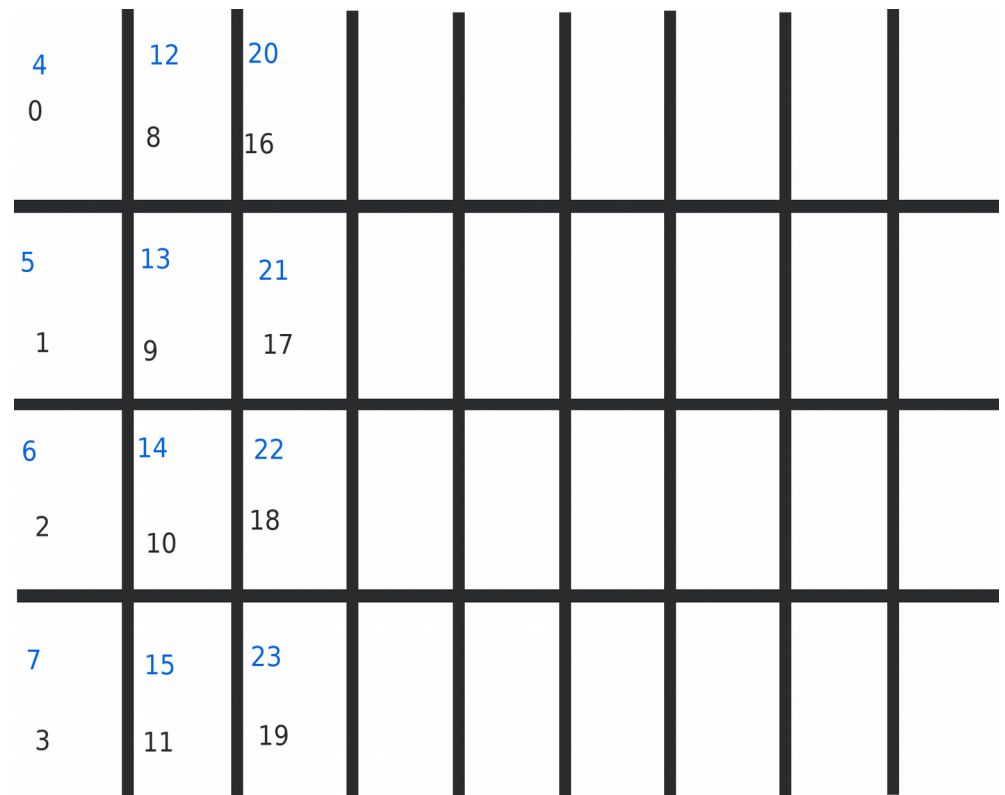


* Does not include realistic angular distribution

- Neutrons ending upstream of active volume
- Neutrons captured in active volume
- Neutrons ending below active volume

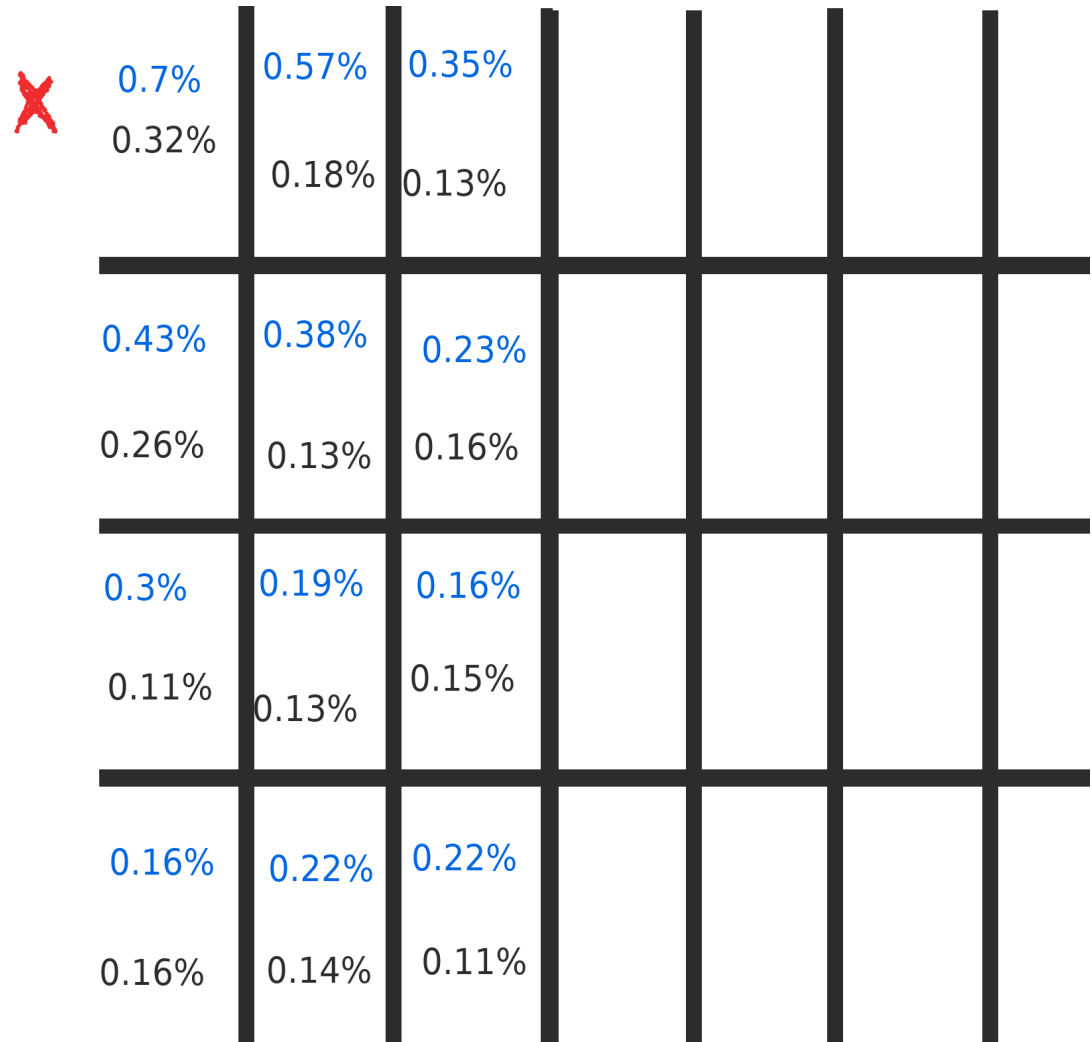
What fraction reach different parts of the detector?

- Using “voxels” the size of a TPC volume (3.6m x 2.3m x 6m)
- Numbering follows Larsoft convention
 - 0 is the bottom left most upstream “voxel”
 - 0,1,2,3 are increasing in x position
 - 0,8,16, are increasing in z position



- Lower “voxels”
- Upper “voxels”

- TPC's closer to the manhole position (red x) have more neutrons captured.
- Lower "voxels"
- Upper "voxels"



Conclusion

- Neutrons with realistic energy are simulated in a large (full fd) volume.
- Next steps / need feedback
 - Precise location of manhole
 - Add realistic angular distribution to simulated neutrons (I have a histogram from Jingbo)
 - **Add in FR4 Cathode components**