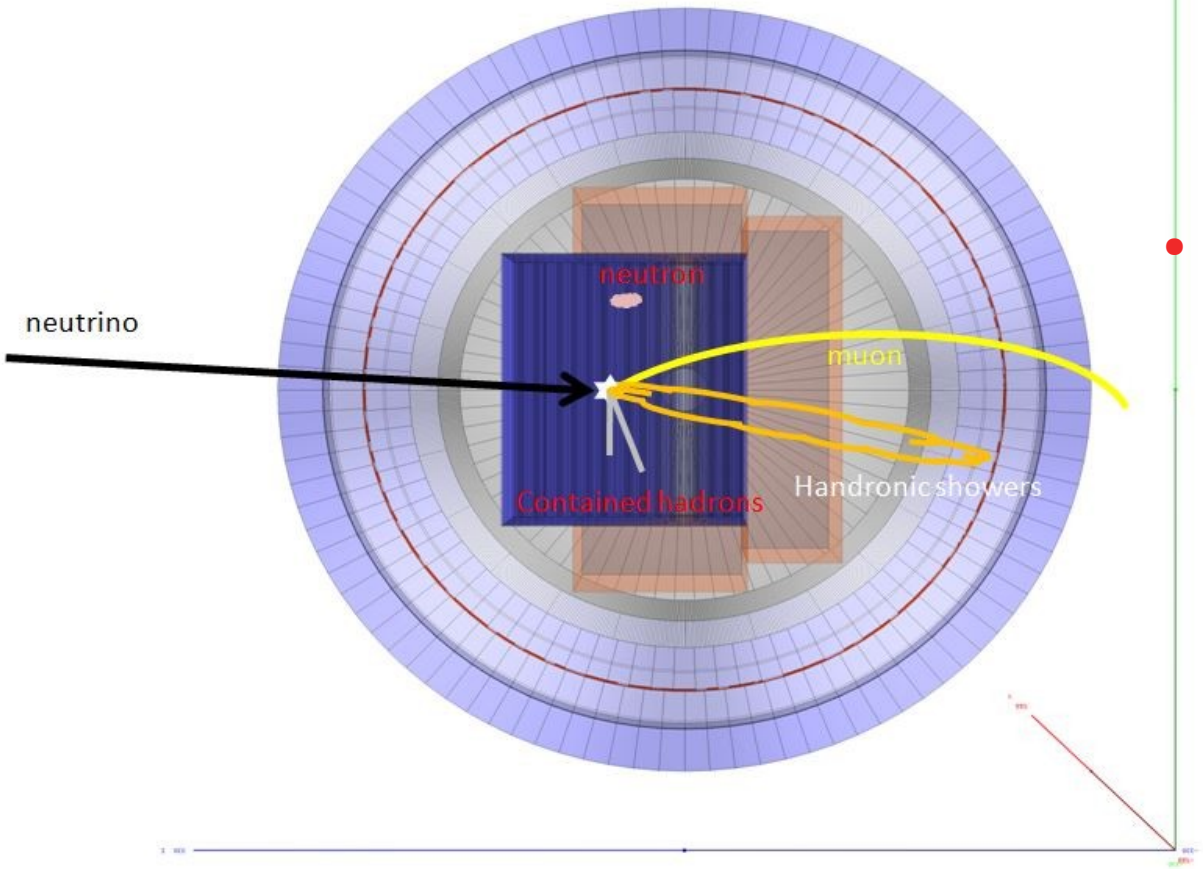
Stony Brook University

Status of the LANL beam test with 3DST prototypes

Guang Yang

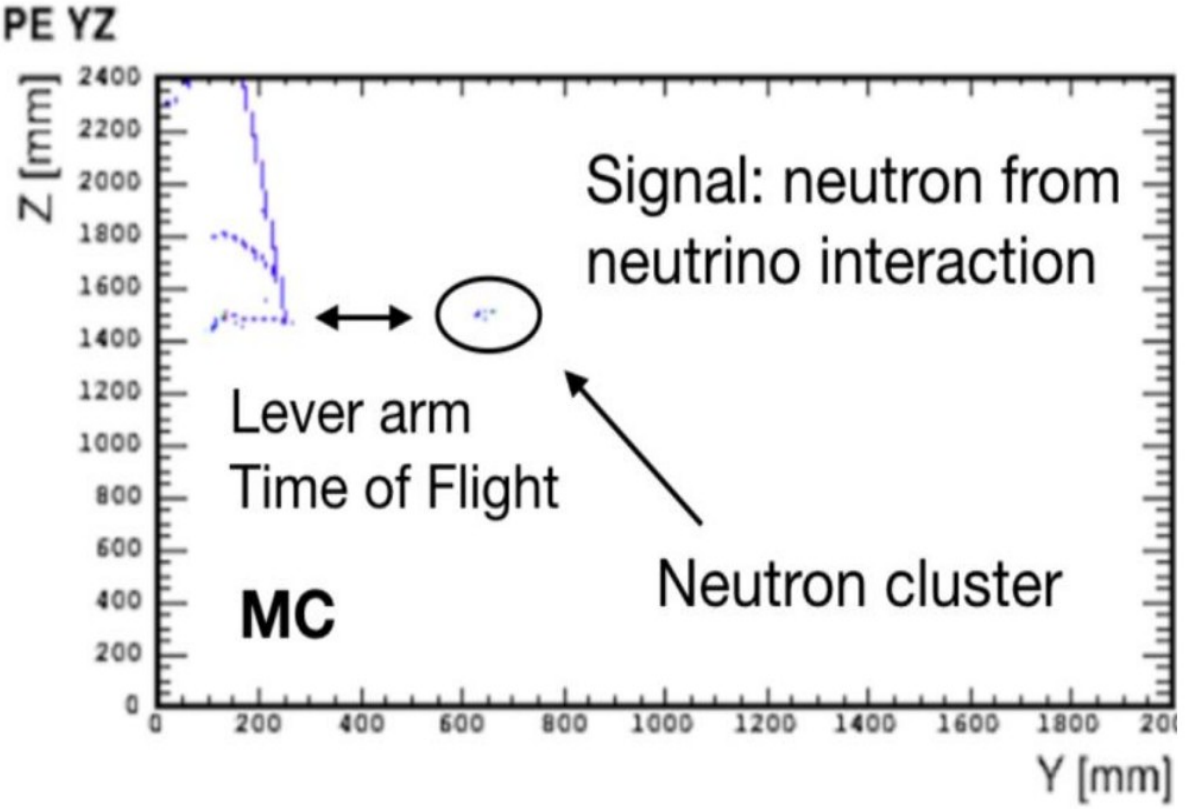
Neutrino interaction



- Final state particles are key to extract the incident neutrino flux information
- Goal in short: get all final state particle information in good precision for each desired exclusive channel in order to constrain the neutrino flux and cross section model

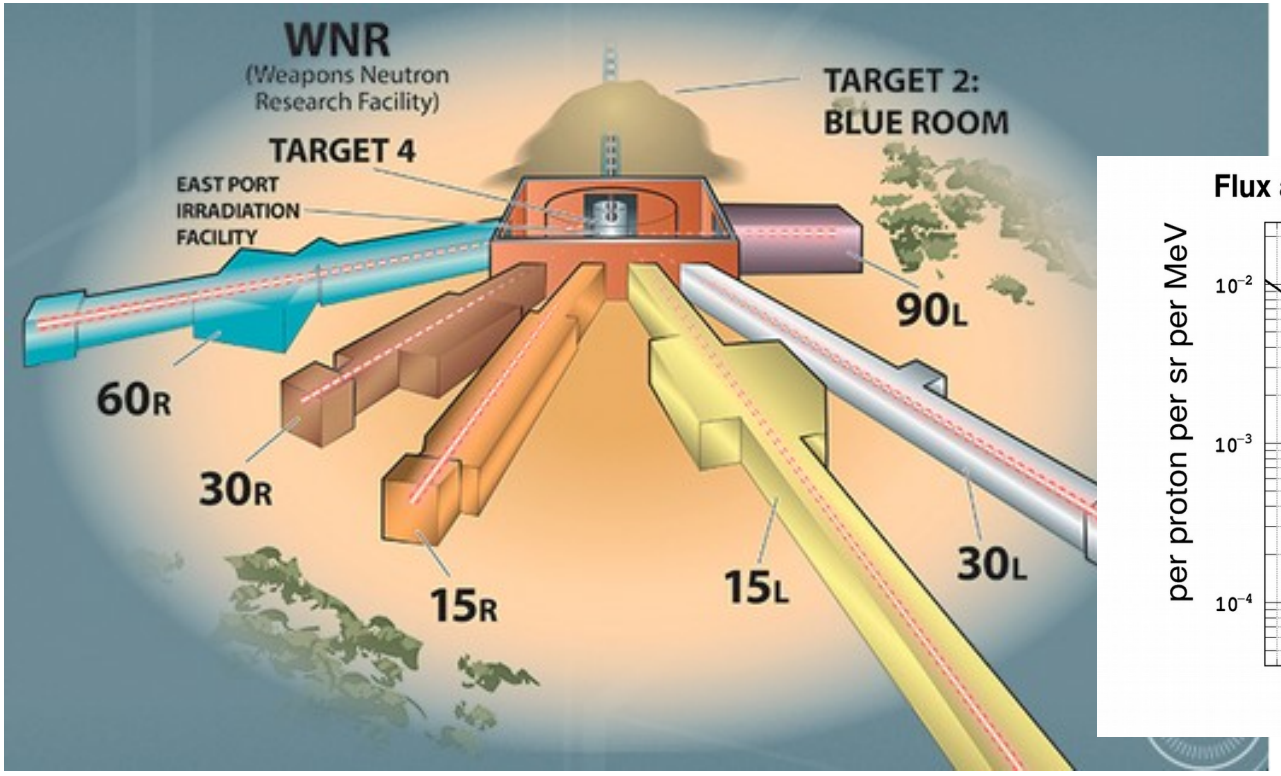
Neutron detection in cubes

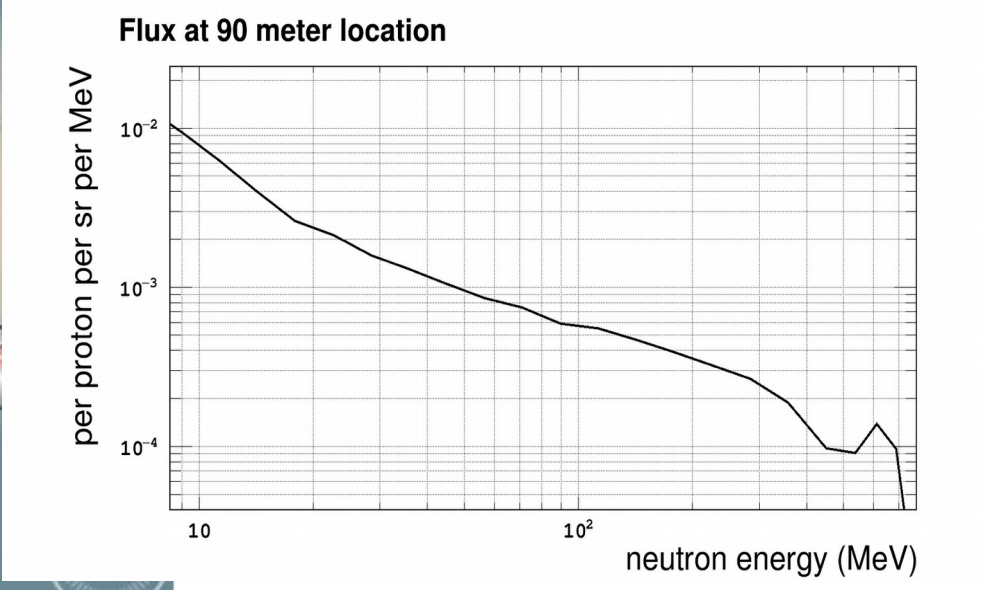
- Neutron is the last and important piece to fully reconstruct the neutrino energy
- With super good time resolution, time-of-flight can be used to measure the neutron kinetic energy.
- Thus, we can do flux constraint and cross section model tuning with this neutron energy measurement.



Neutron beam test facility

- LANL provides neutron beam ranged from 0 -800 MeV
- We have two run time: ~ 3 weeks at 15L 90 m location
  ~ 3 days at 15R 20 m location

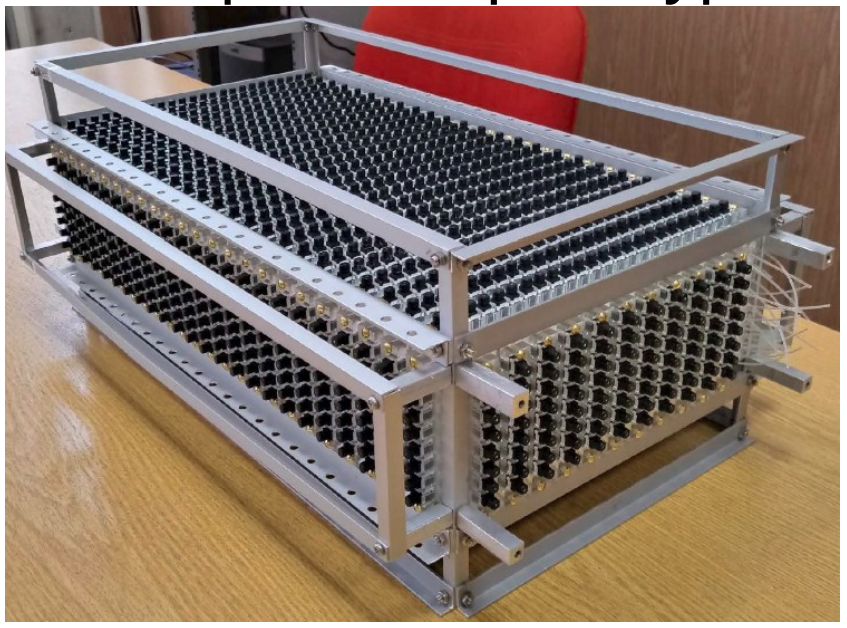




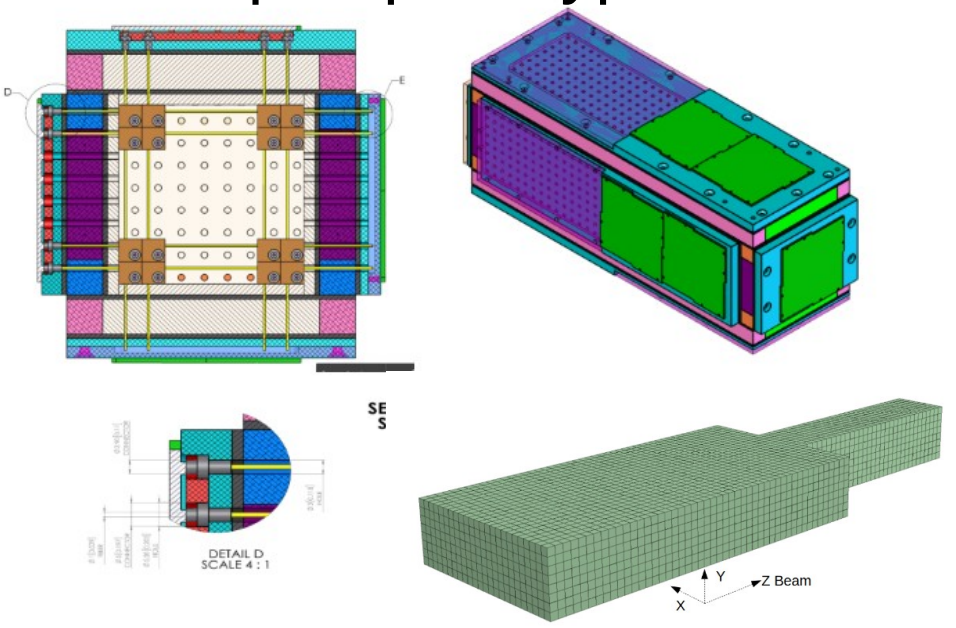
Two prototypes

- SuperFGD prototype being used for the charged particle beam test in CERN (24x8x48)
- US-Japan prototype uses some new designs that will be used in the T2K upgrade, probably 3DST (8x8x32)
- They can be combined in a number of ways

SuperFGD prototype



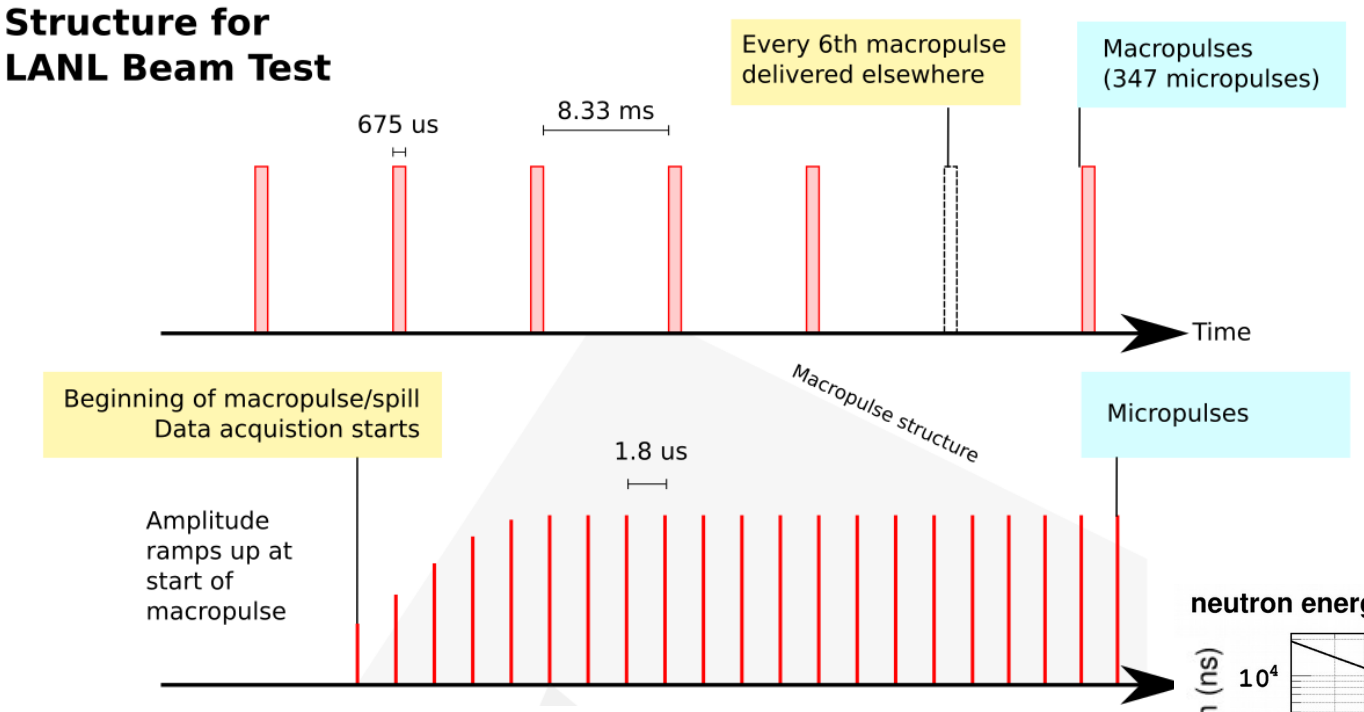
US-Japan prototype



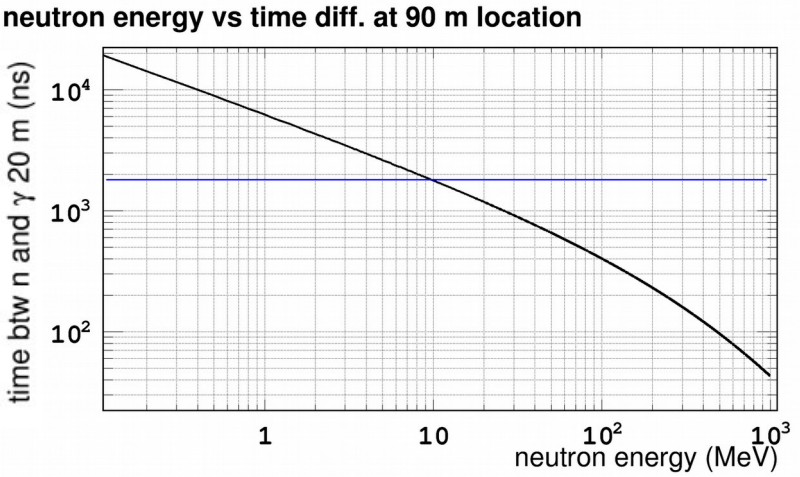
Two prototypes and acknowledgment

- SuperFGD prototype being used for the charged particle beam test in CERN (24x8x48)
- US-Japan prototype uses some new designs that will be used in the T2K upgrade, probably 3DST (8x8x32)
- SuperFGD prototype was put together by INR, U. Tokyo, Geneva and CERN. Funds are from each of those groups.
- US-Japan ptorotype was funded by U.S.-Japan program.
- The LANL run was realized with DOE base grants as well as the Upenn and the support from Imperial, Geneva and Tokyo.
- The beam run facility is supported by DOE and Los Alamos Neutron Science Center, funded by the US Department of Energy under Contract No. DE-AC52-06NA25396.
- Also, special thanks to Keegan Kelly and Hye Young Lee for supporting our efforts in the 4FP15L and 4FP15r flight paths.

Neutron beam time structure



- We have 675 us trigger window to cover each macropulse
- Gamma flash + micropulse t0 are available

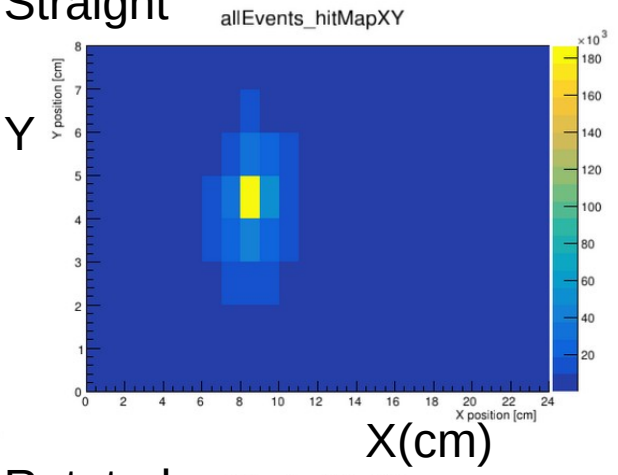


- Wrap-around can be handled with cut on low energy deposit
- Statistically wrap-around is not significant

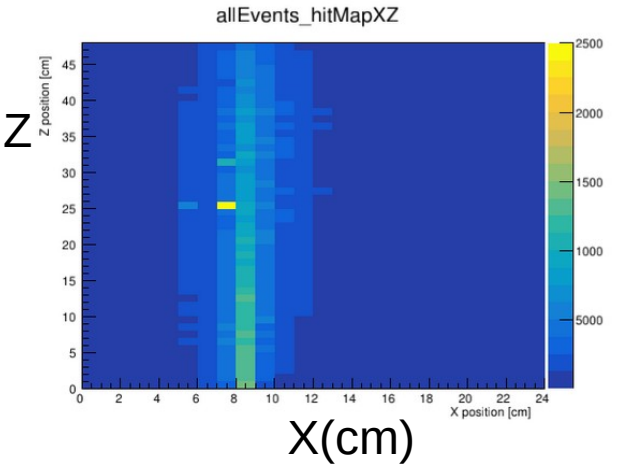
Event topology

- We rotated detector for various angles to understand the fiber/MPPC behaviour

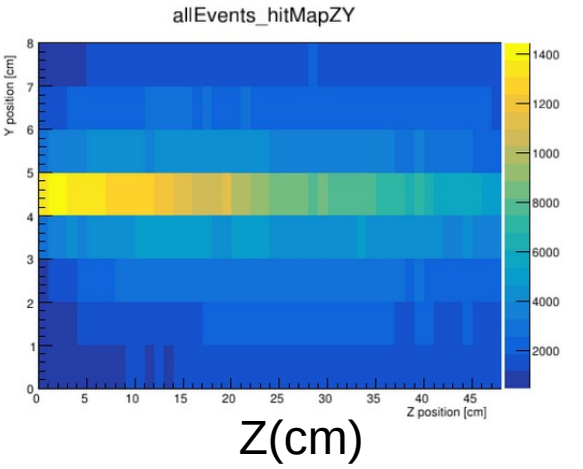
Straight



Y X(cm)

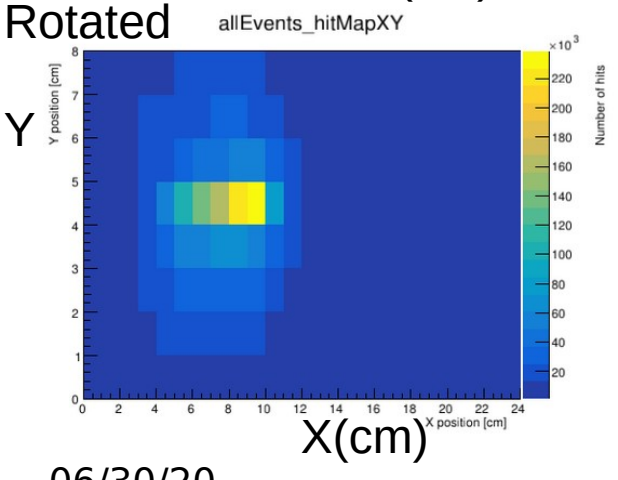


Z X(cm)

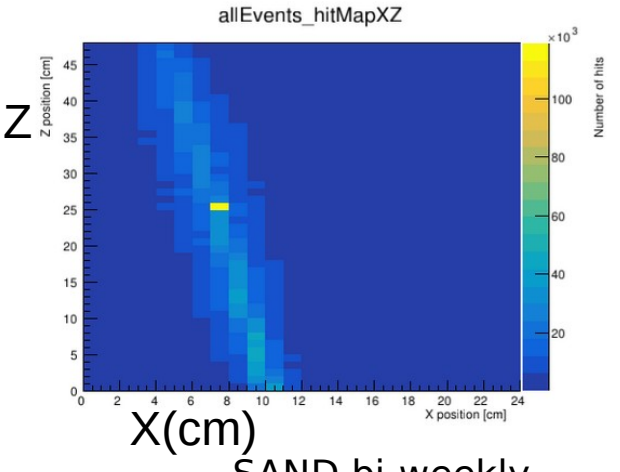


Y Z(cm)

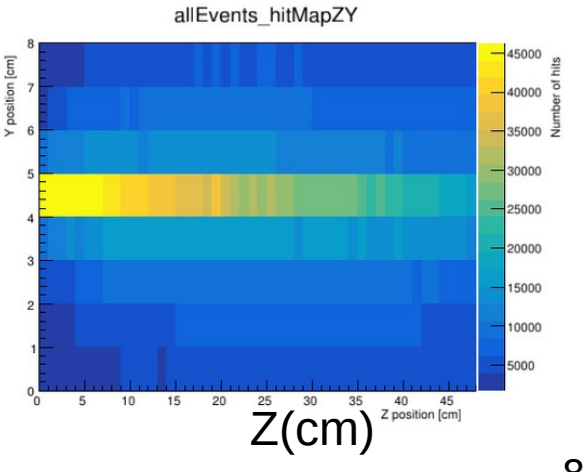
Rotated



Y X(cm)



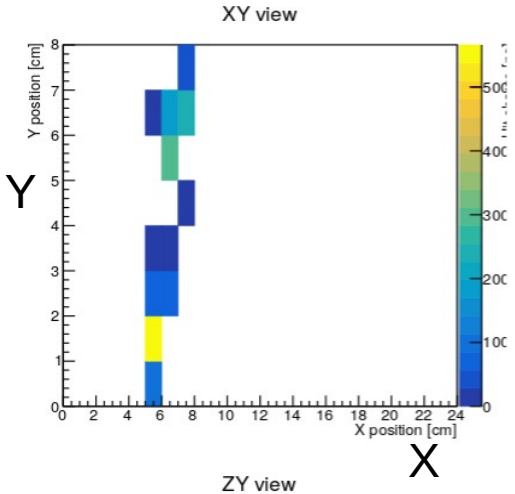
Z X(cm)

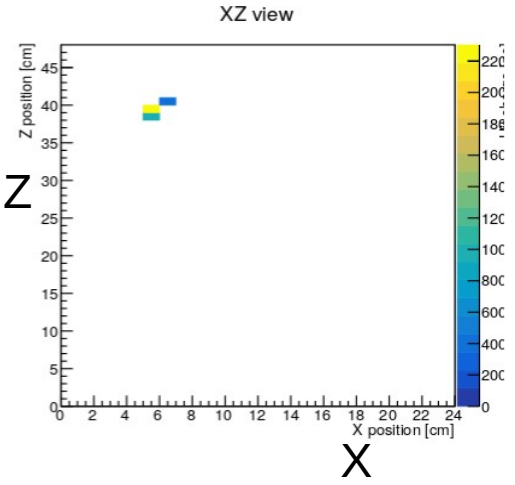


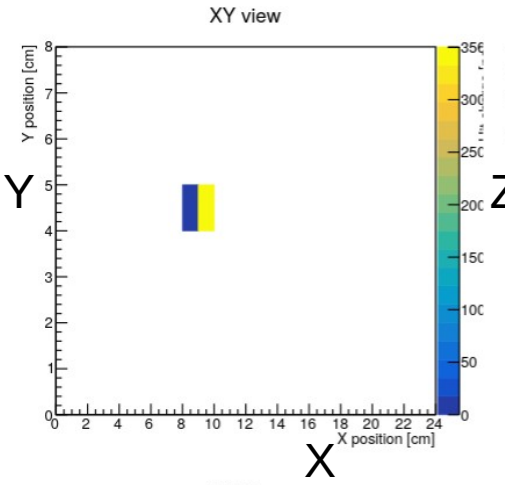
Y Z(cm)

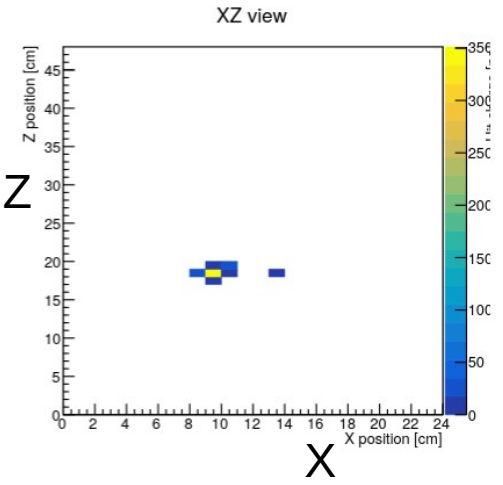
Stony Brook University

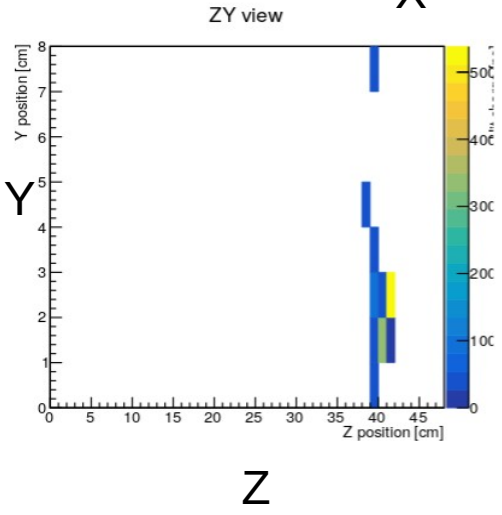
Single event displays

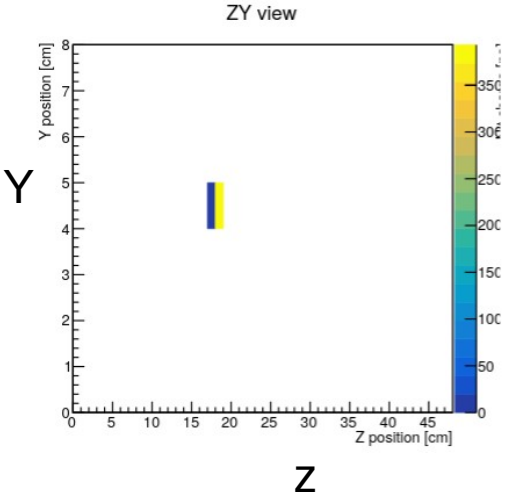












20 m location

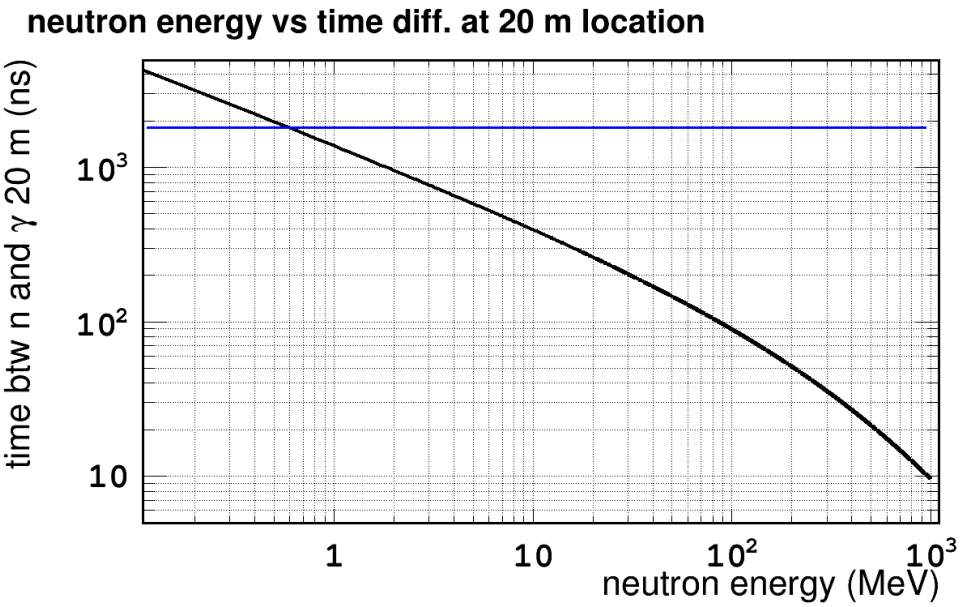
- In order to:

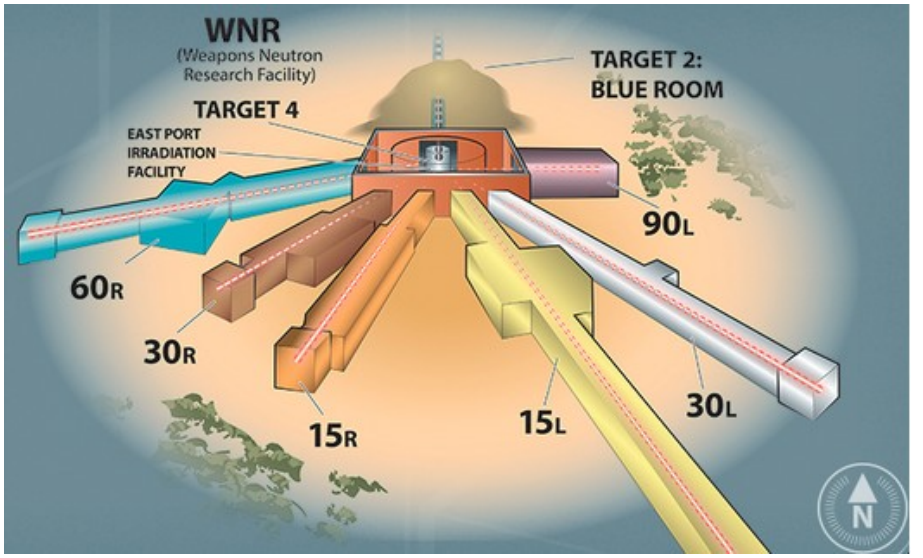
  - lower the wrap-around energy

  - free to enter the facility

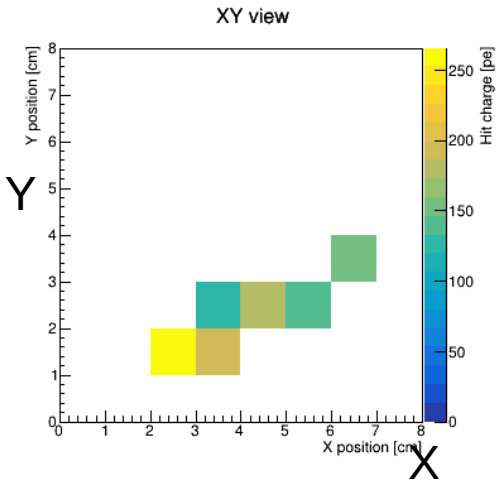
- With the same setup for superFGD prototype, but added US-Japan prototype

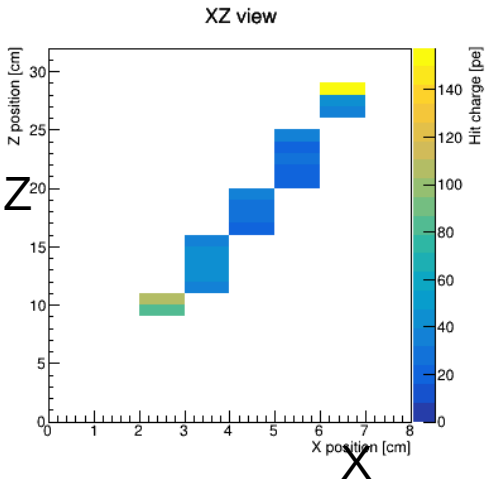
- SuperFGD took similar amount of data in two locations (more time at 90 m higher rate at 20 m)

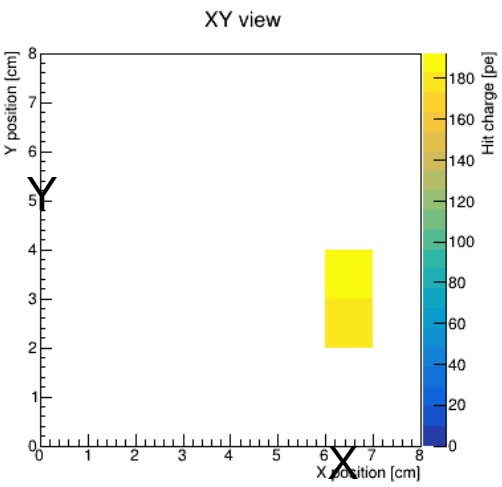


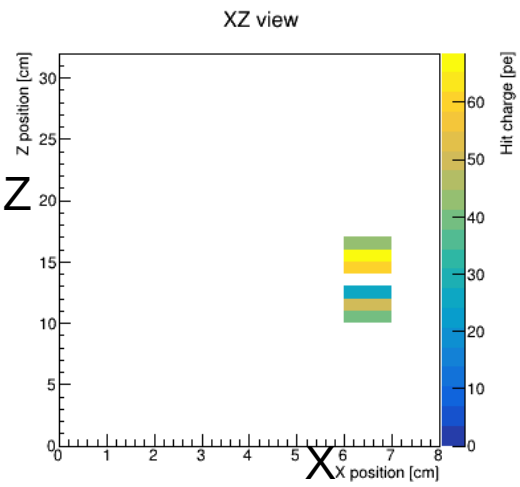


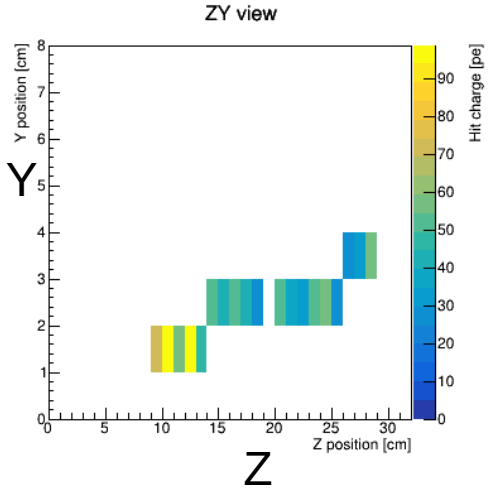
US-Japan Neutron candidates

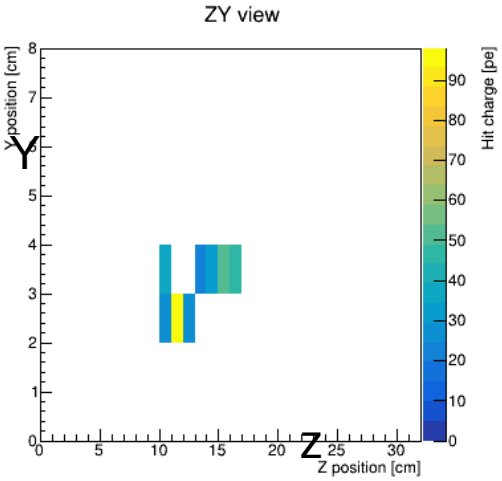










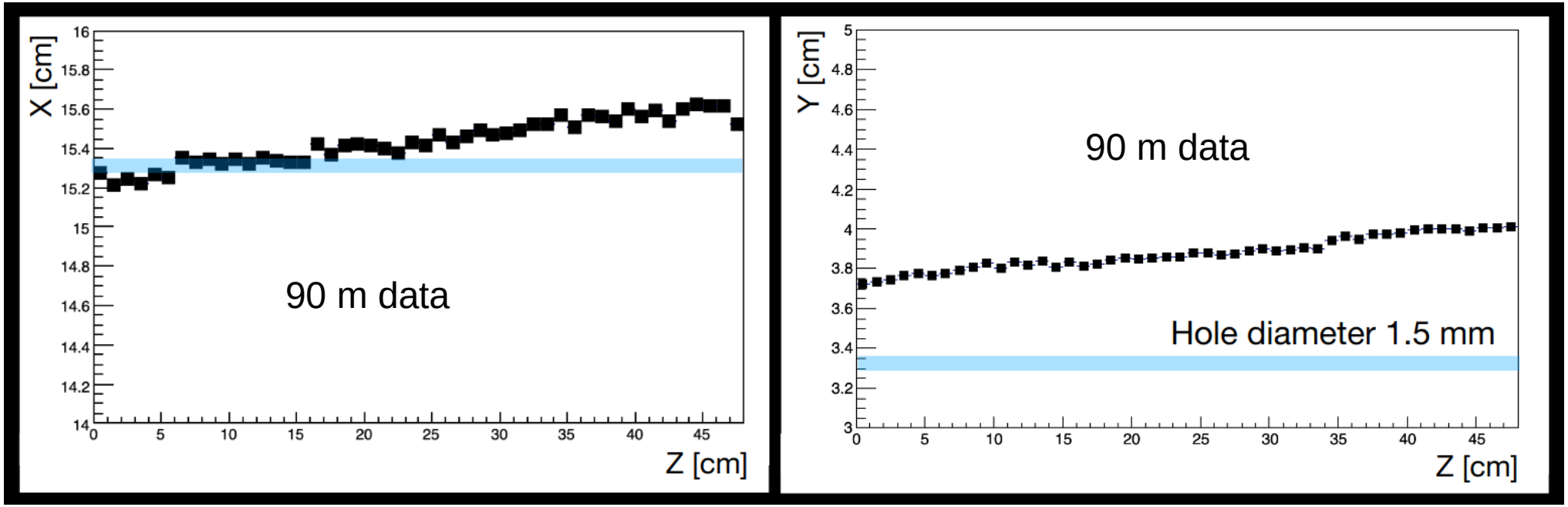


Analysis procedure

- 1. Define FV: reduce the beam-uncorrelated and secondary neutron background

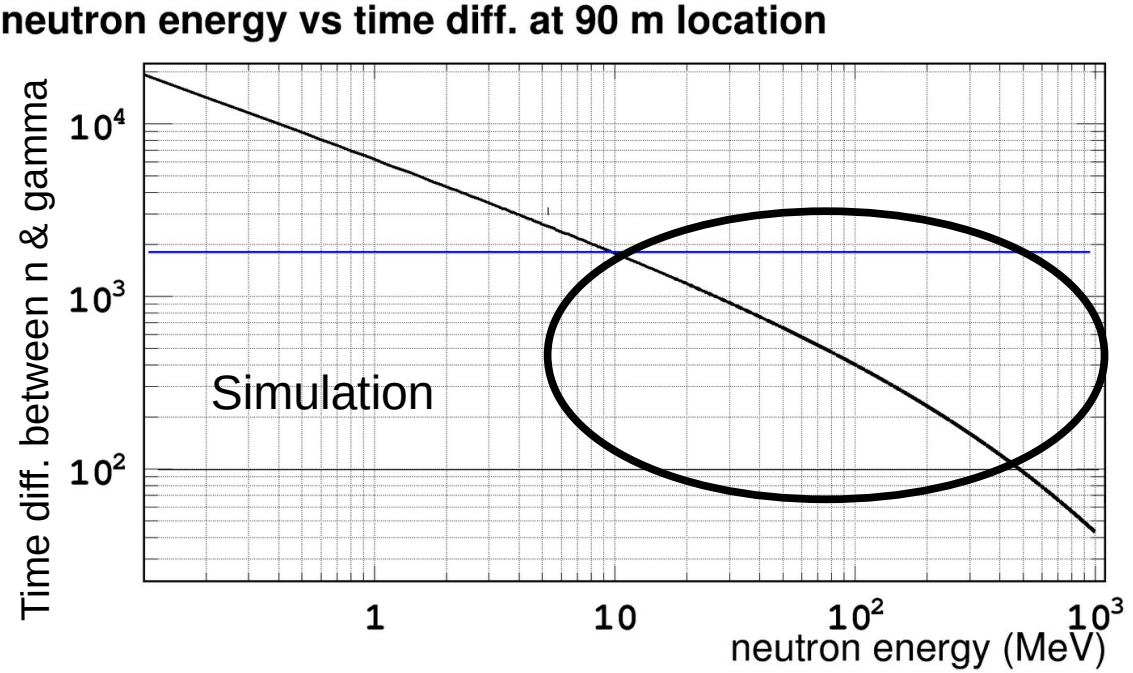
  - find the beam center and use the relevant row of cubes along z as the FV.

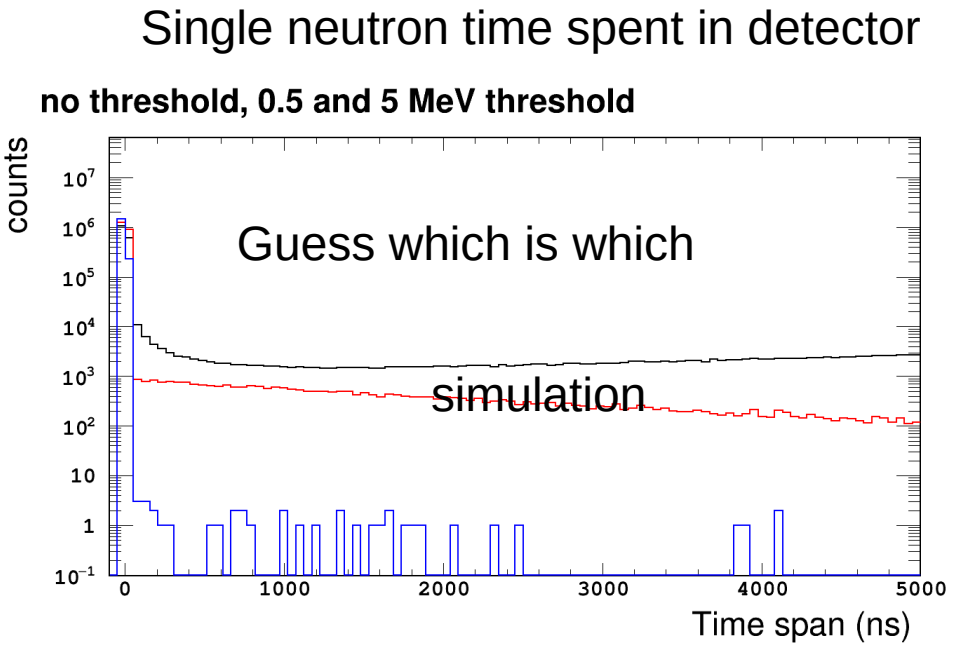
Beam center for superFGD prototype at 90 m location



Analysis procedure

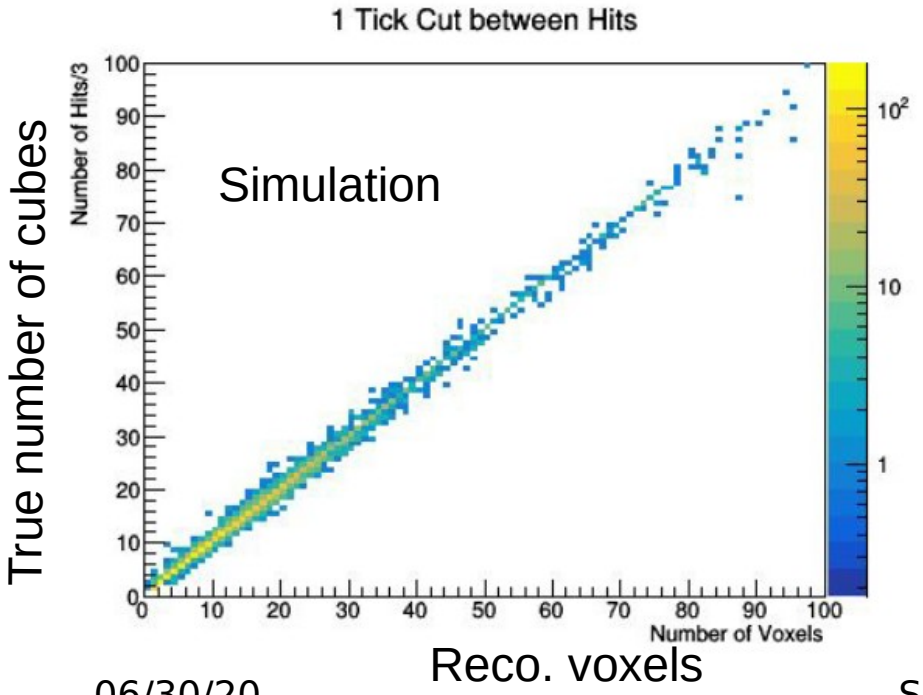
- 2. define a wrap-around cut
- 3. Define time window: exclude the gamma peak (neutron energy will be < 500 MeV) and include single individual events in a micropulse (a cut of 20 ns)

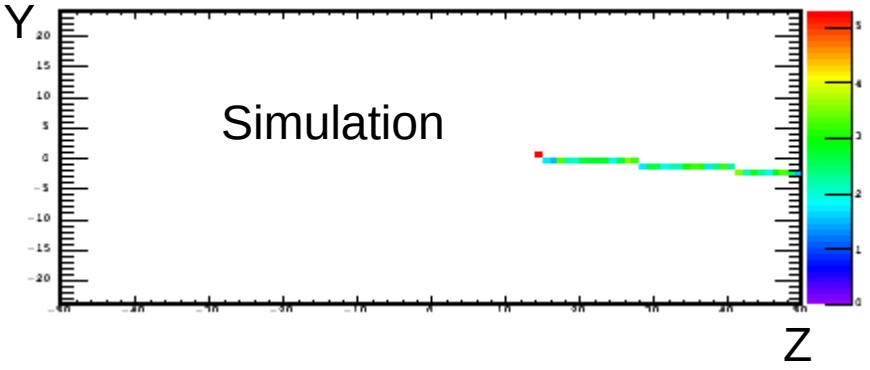




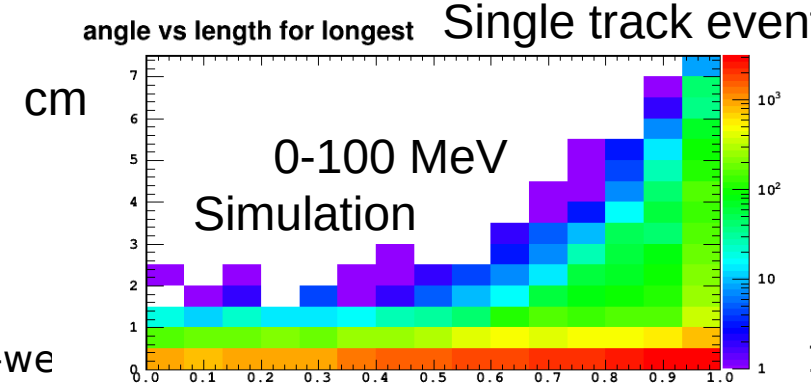
Analysis procedure

- 4. 3D matching three 2D views
- 5. select events with a specific topology and find the vertices (should be single track forward going events)



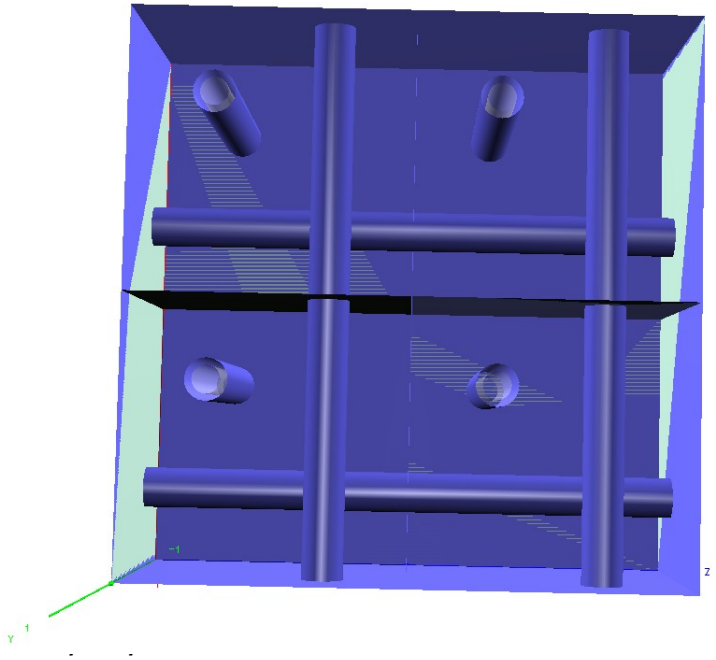


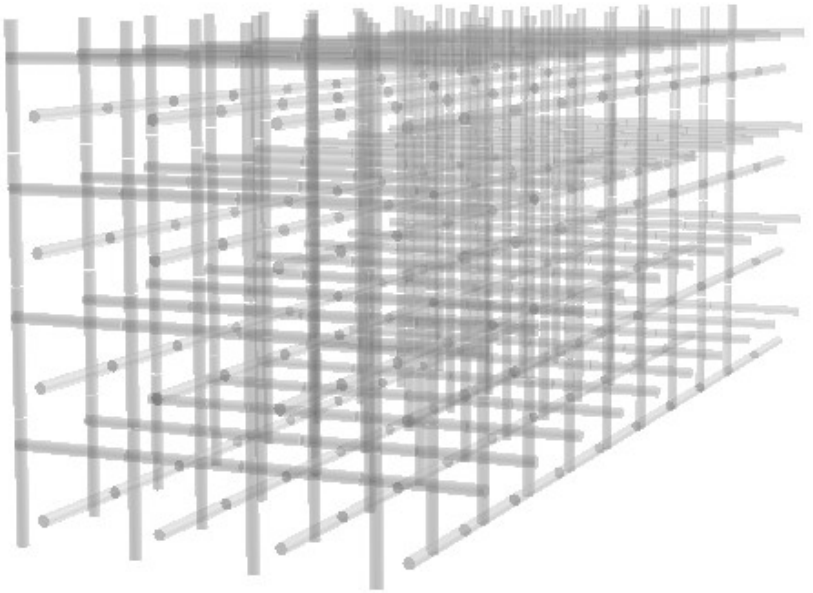
Single track events



Analysis procedure

- 7. fit exponential along z for each energy bin including the systematics
- 8. A comparison to the MC (QGSP-BERT for example)





Summary

- A first result of the total cross section is in progress.
- A second beam test aiming for more data with the US-Japan prototype will happen later this year.