

# Neutron beam test at LANL



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# Introduction

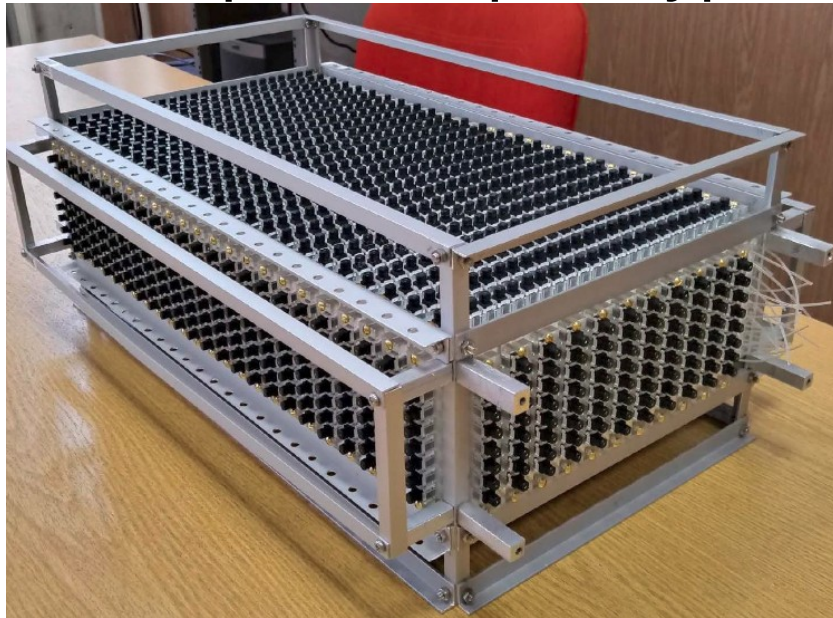
- A key advantage of 3DST is neutron detection
- Neutron detection is being demonstrated by two prototypes functional identical to 3DST
- Neutron beam data is being taken in Los Alamos National Lab (LANL)
- Aim to understand the neutron response to neutrons in the prototypes
- An effort shared by DUNE 3DST and T2K SuperFGD groups



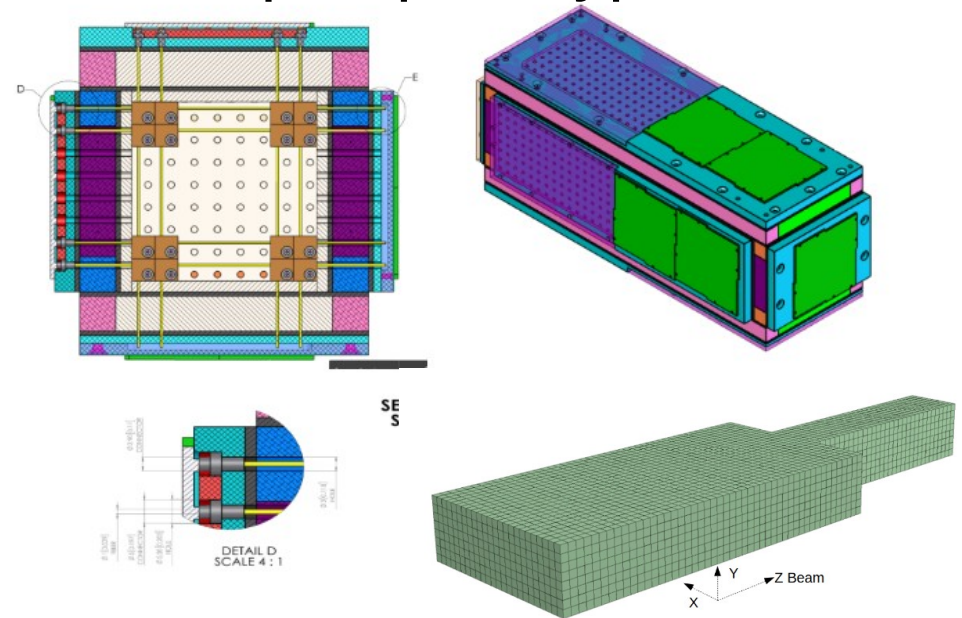
# Two prototypes

- SuperFGD prototype being used for the charged particle beam test in CERN (24x8 48)
- 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



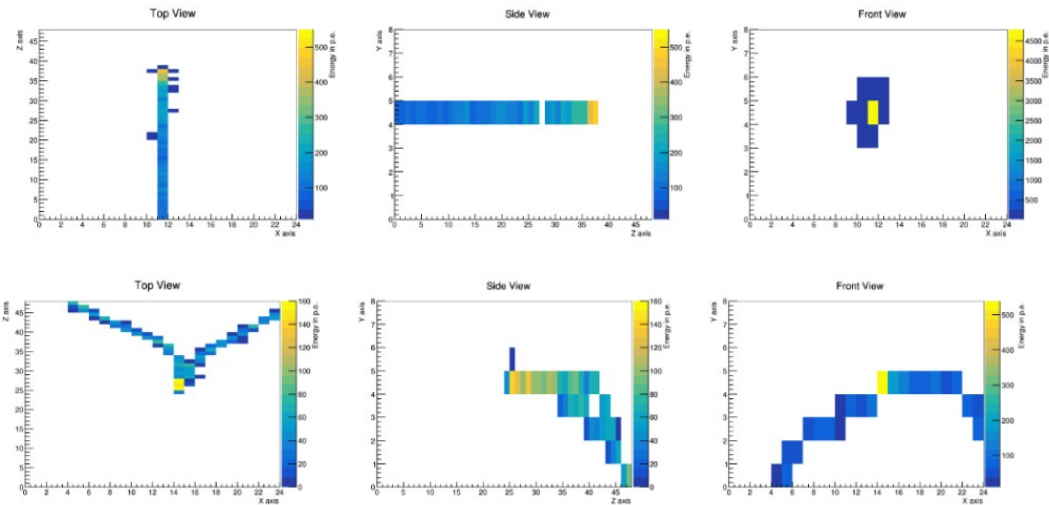
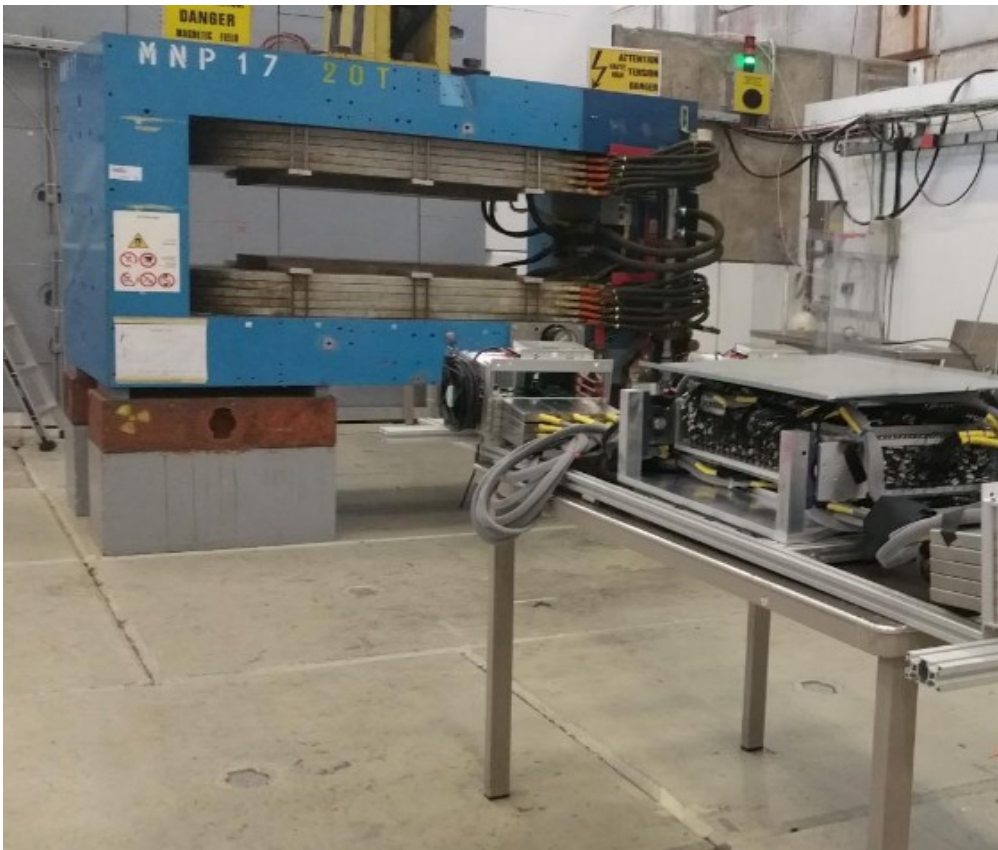
## US-Japan prototype





# CERN charged particle beam test

- SuperFGD used in the CERN beam test

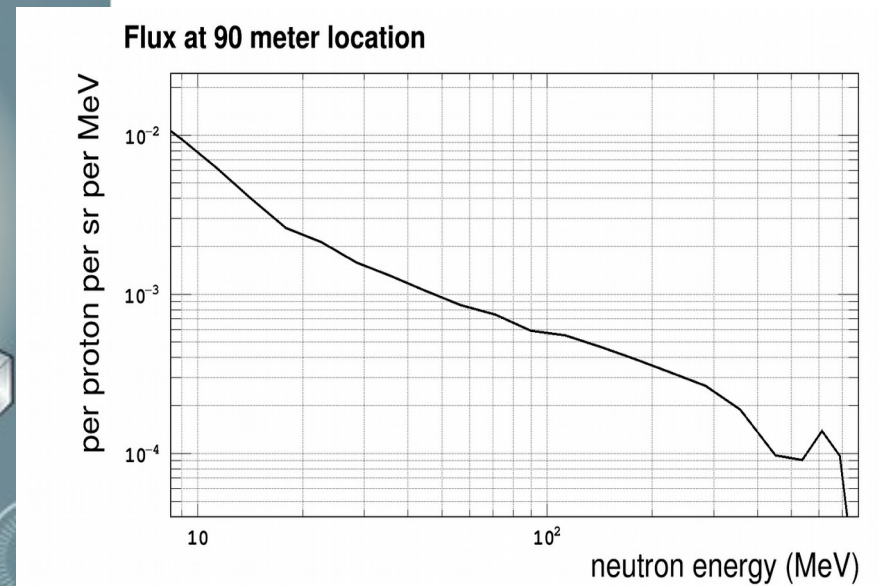
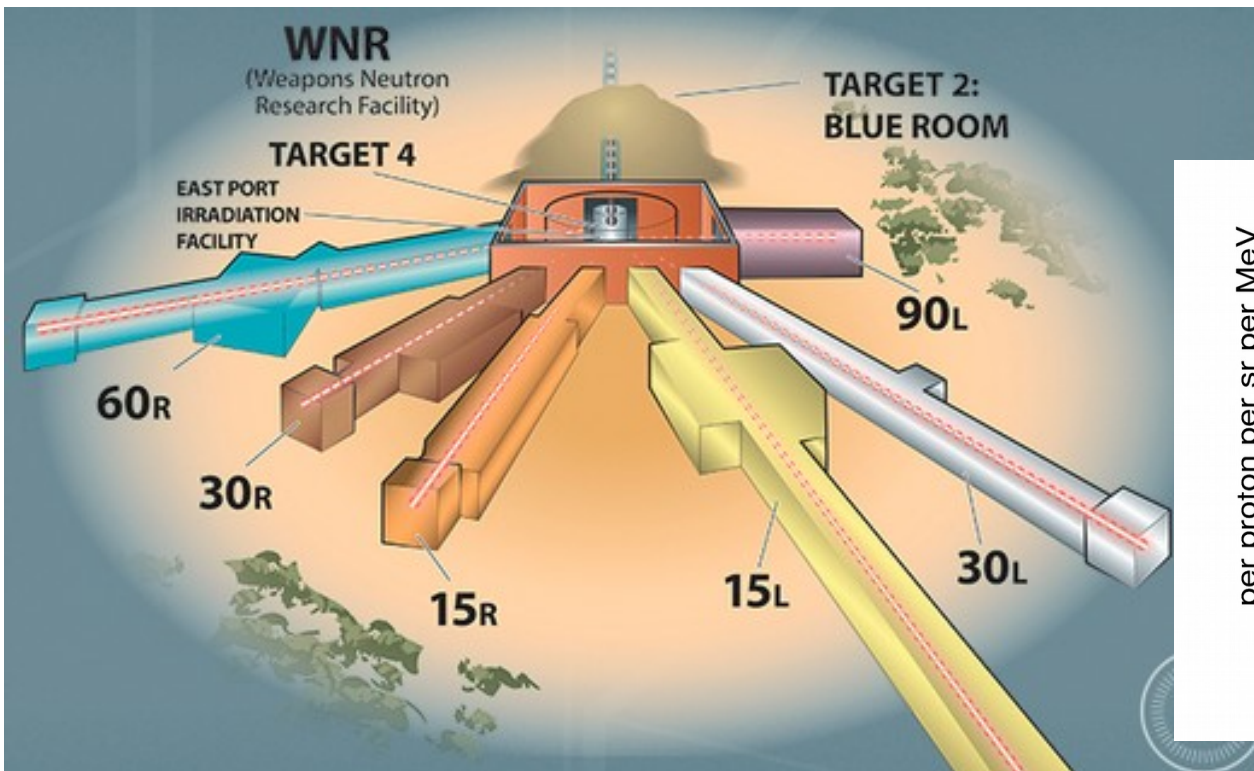






# Neutron beam test facility

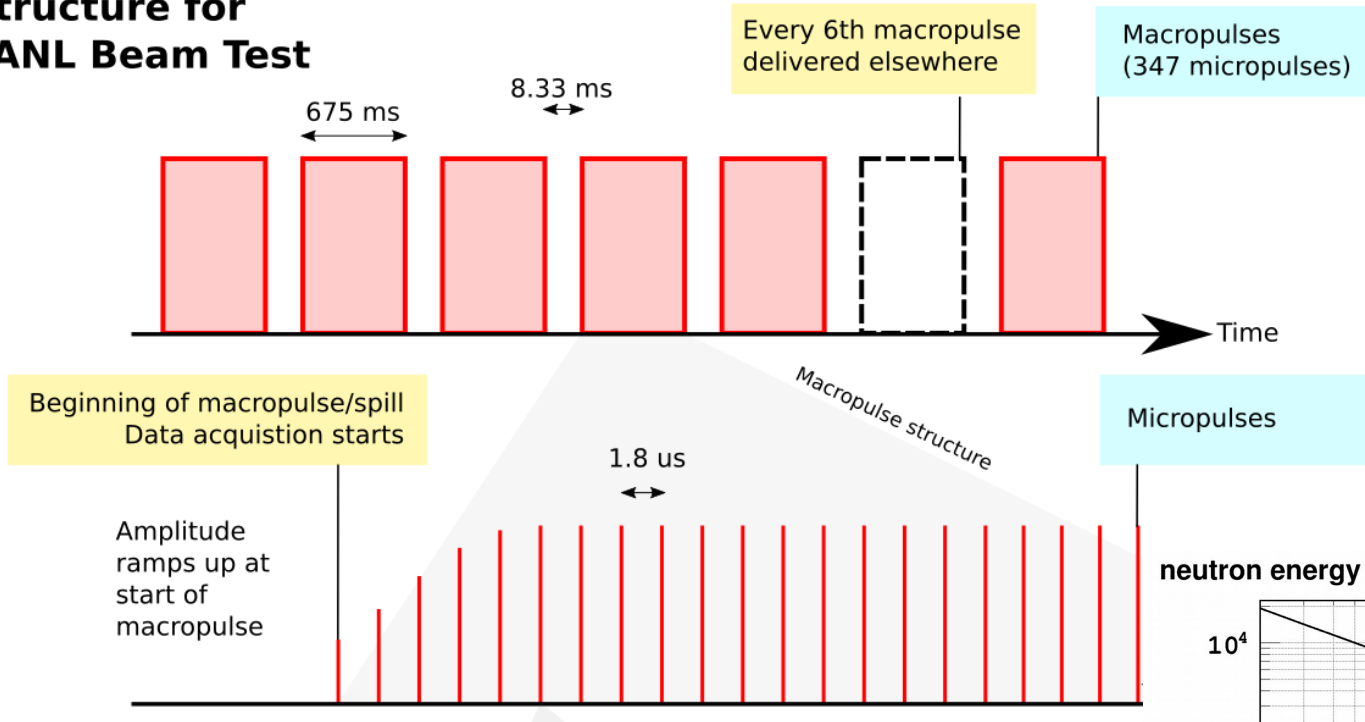
- LANL provides neutron beam ranged from 0 -800 MeV
- We have two run time: ~ 3 weeks at 15L 90 m location  
~ 3 days at 15R 20 m location





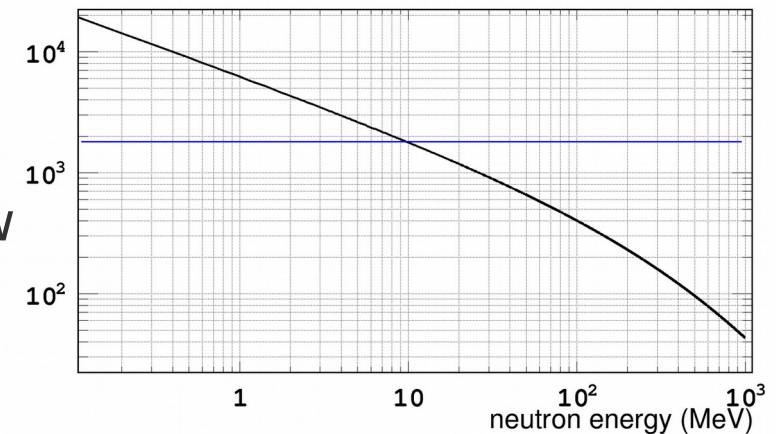
# Neutron beam time structure

## Proton Beam Structure for LANL Beam Test



- We have 650 μs trigger window to cover each macropulse
- Gamma flash + micropulse t0 are available

neutron energy vs time diff. at 90 m location

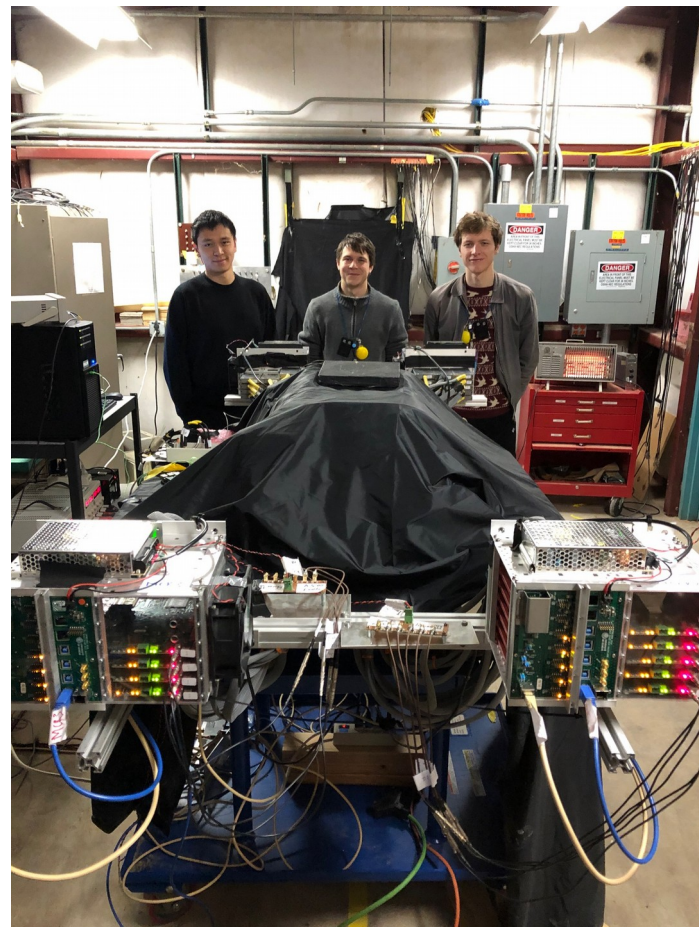


- Wrap-around can be handled with cut on low energy deposit
- Statistically wrap-around is not significant





# 90 m location : taking data now

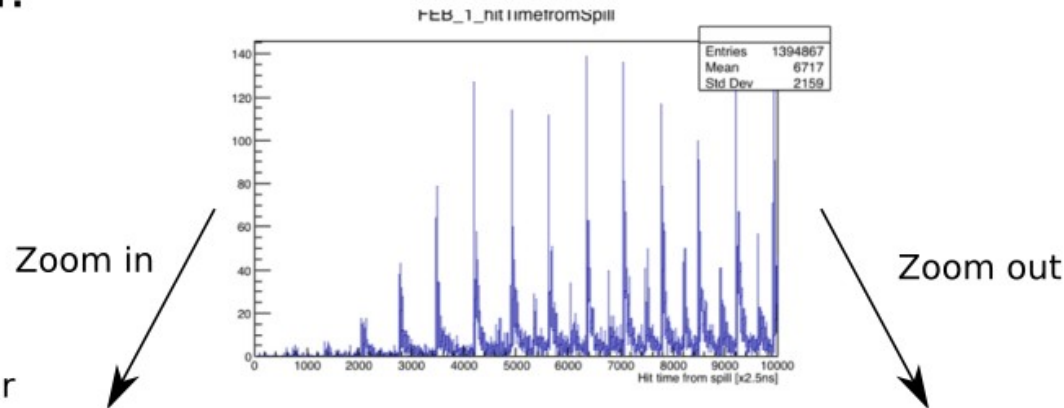


- SuperFGD prototype taking data; US-Japan being prepared



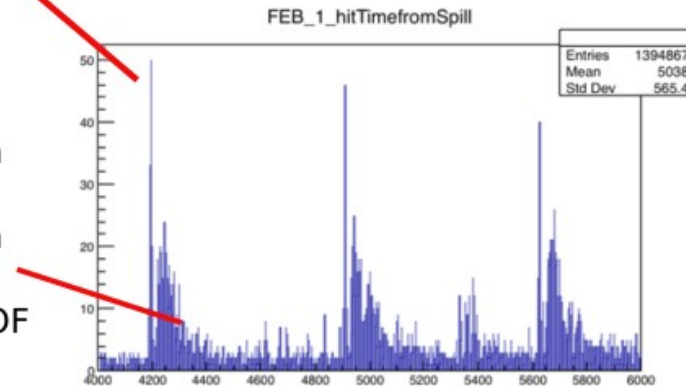
# Time structure in data

What we see in the detector:

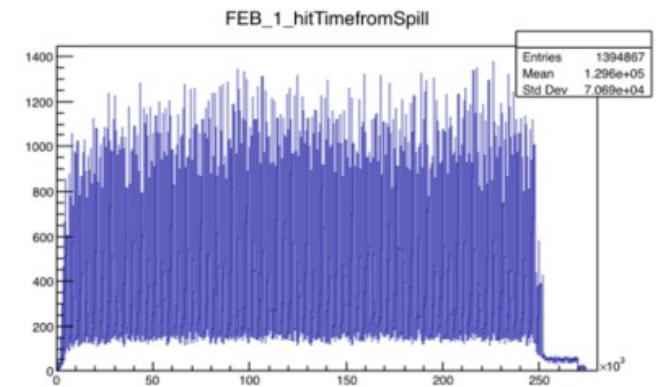


Hits produced by gamma flash which reaches detector before neutrons

Hits produced by neutrons. Could be high energy neutrons with slightly longer TOF than gammas or low energy neutrons that have a TOF longer than the micropulse separation



Micropulse separation:  $\sim 700 \times 2.5e-9 = \sim 1.75 \text{ us}$



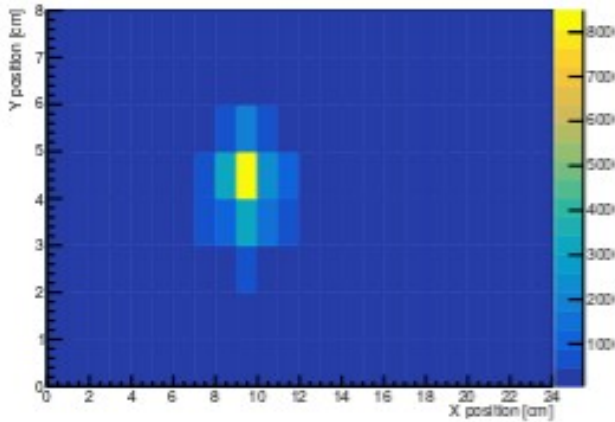
Macropulse width:  $250 \times 1e3 \times 2.5e-9 = 625 \text{ us}$



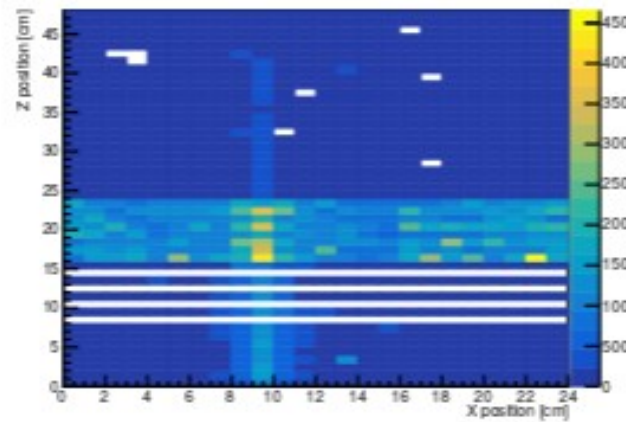


# Event topology

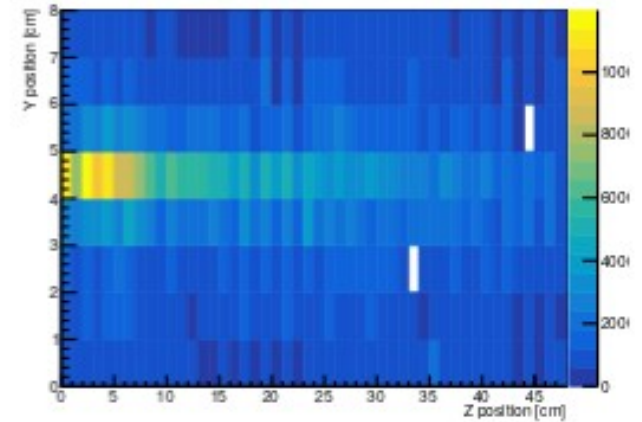
allEvents\_hitMapXY



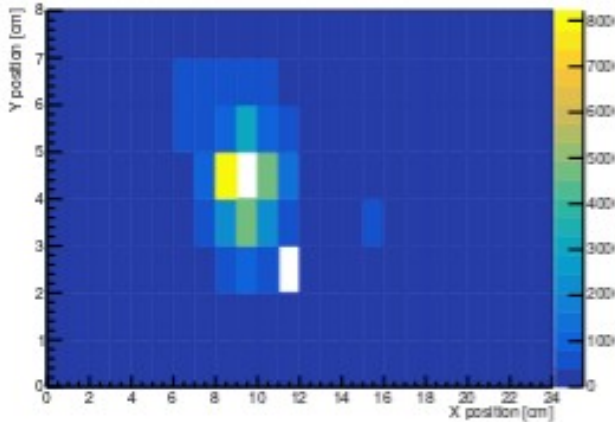
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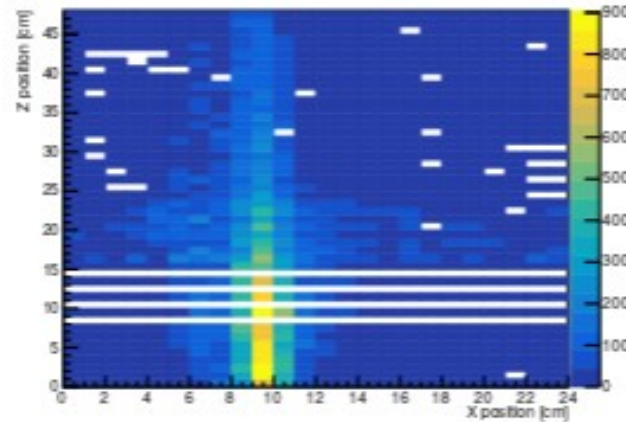
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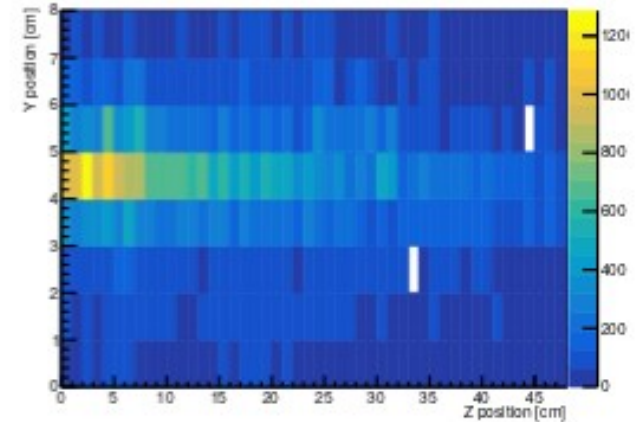
allEvents\_hitMapXYmaxQ



allEvents\_hitMapXZmaxQ



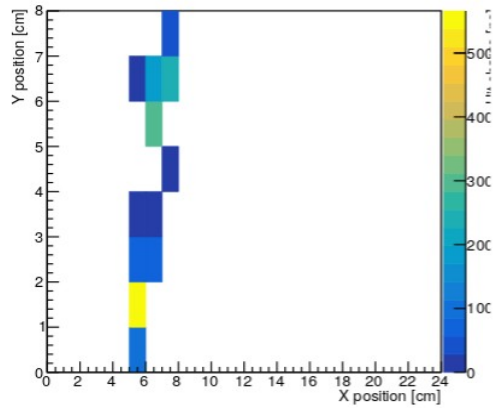
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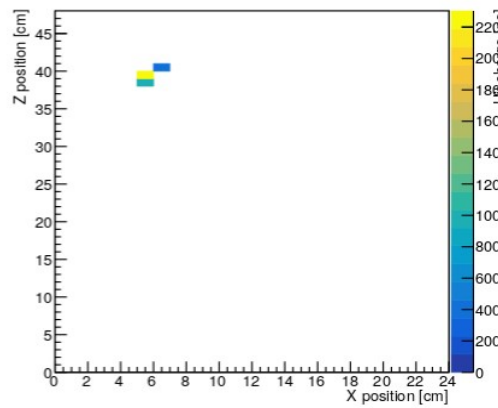


# Some event displays

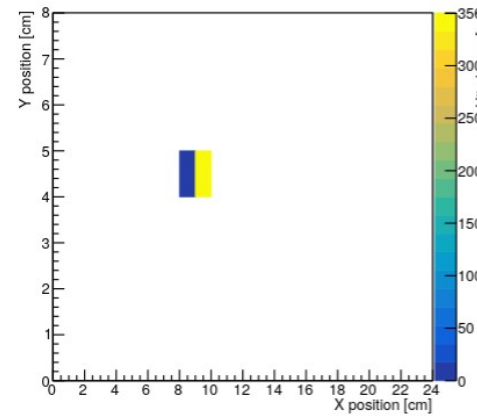
XY view



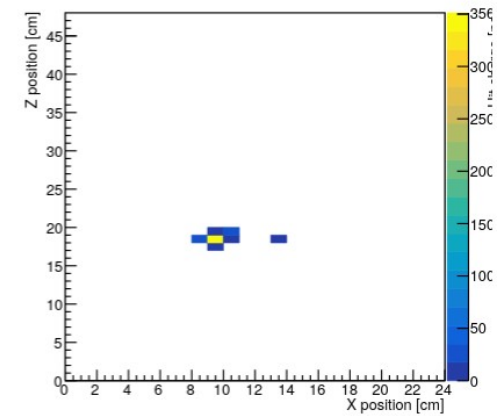
XZ view



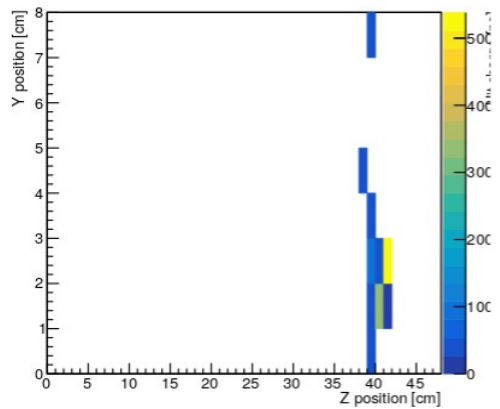
XY view



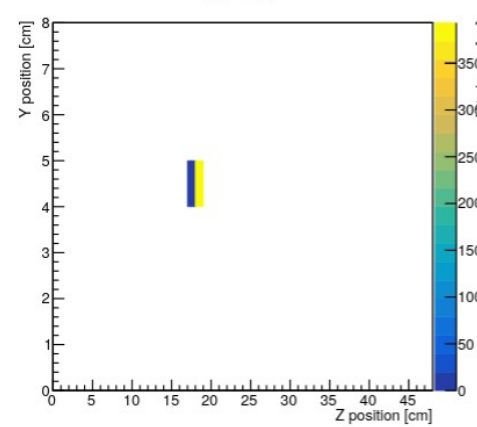
XZ view



ZY view



ZY view





# Summary

- Neutron beam data is being taken with the superFGD smoothly. We will accumulate billions of neutrons with this prototype ranged from few to 800 MeV.
- US-Japan prototype is being prepared to go into the beamline.