



Neutron Beam Test of Prototypes of 3D-projection Scintillator Trackers for Long-Baseline Neutrino Oscillation Experiments

Abraham Teklu, Guang Yang

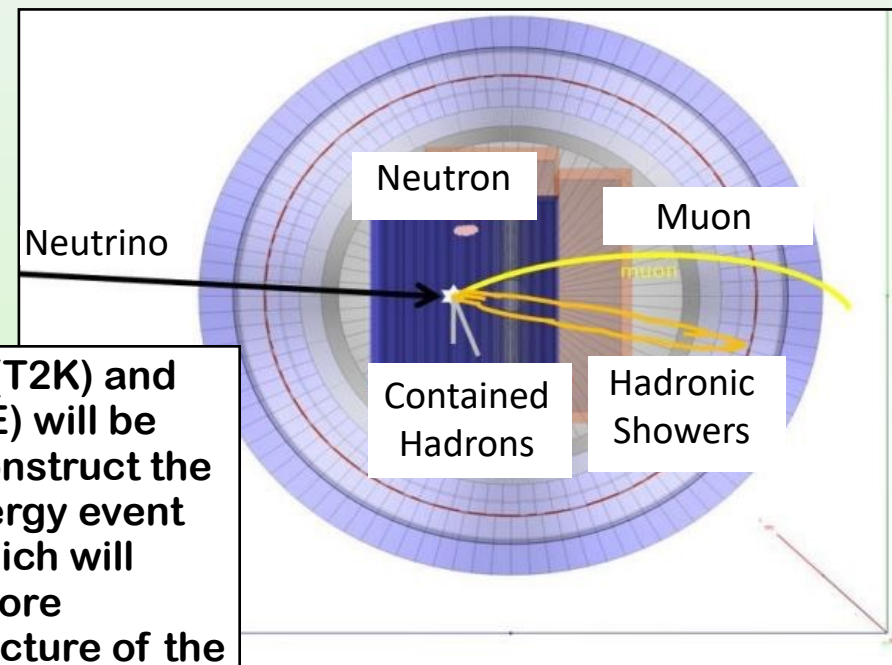
In Collaboration with: The European Organization for Nuclear Research (CERN), Chung-Ang University S. Korea, ETH Zurich Switzerland, University of Geneva Switzerland, Imperial College UK, Institute for Nuclear Research (INR) Russia, The High Energy Accelerator Research Organization (KEK) Japan, Kyoto University Japan, Louisiana State University USA, University of Pennsylvania USA, University of Pittsburgh USA, University of Rochester USA, South Dakota School of Mines and Technology USA, University of Tokyo Japan

Emails:
abraham.teklu@stonybrook.edu
guang.yang.1@stonybrook.edu



Motivation: Last piece in neutrino interaction

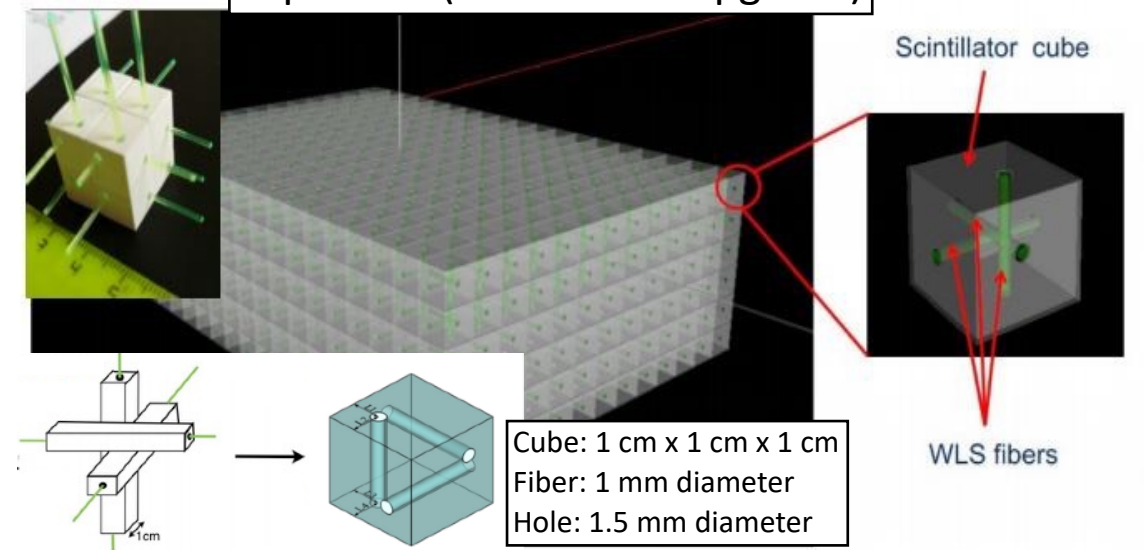
- Neutrons are the least known piece in the neutrino interaction
- Neutrino-Nuclear interaction models need to be tuned based on the neutrino interaction data



-SuperFGD(T2K) and 3DST(DUNE) will be able to reconstruct the neutron energy event by event which will provide a more complete picture of the neutrino interaction.

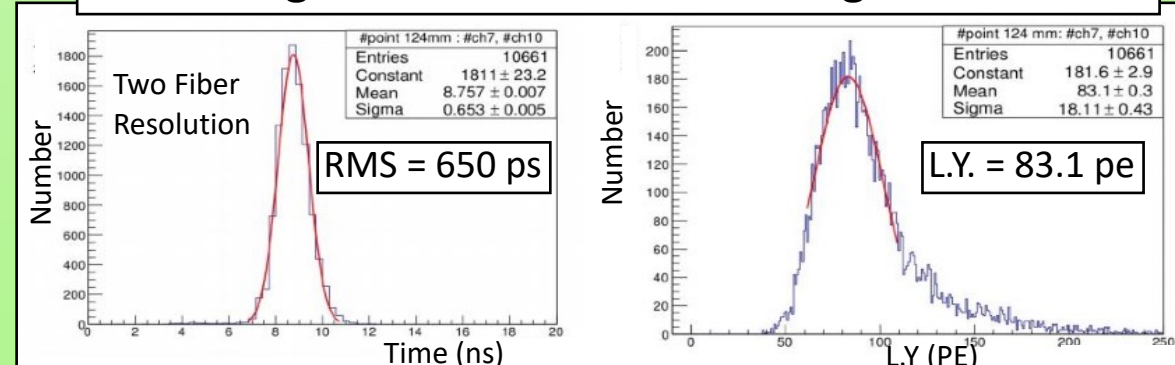
3D Projection Scintillator Tracker

SuperFGD (T2K ND280 Upgrade)



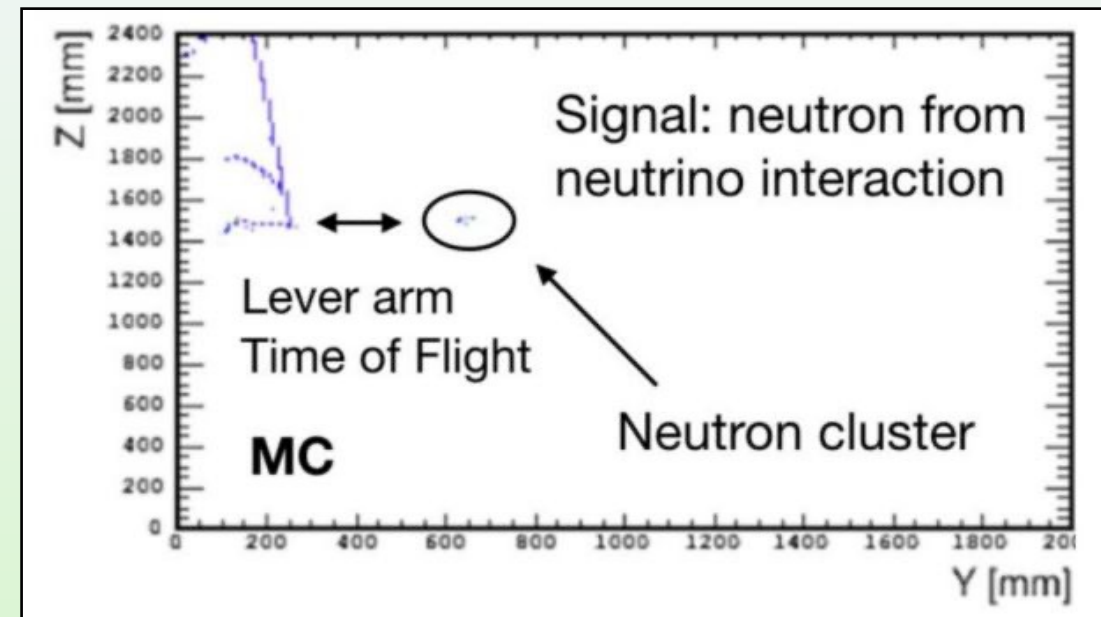
Timing Resolution

Light Yield



CERN-SPSC-2019-001 (SPSC-TDR-006)

Neutron Detection



- Time of flight is from the lever arm information is used to detect the neutron kinetic energy.
- Good timing resolution and fine granularity are needed to detect the neutron and reconstruct its energy way.

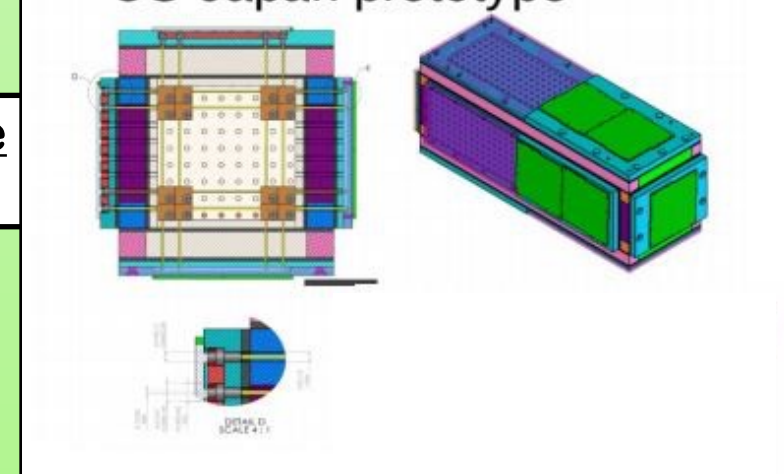
Prototypes

SuperFGD prototype



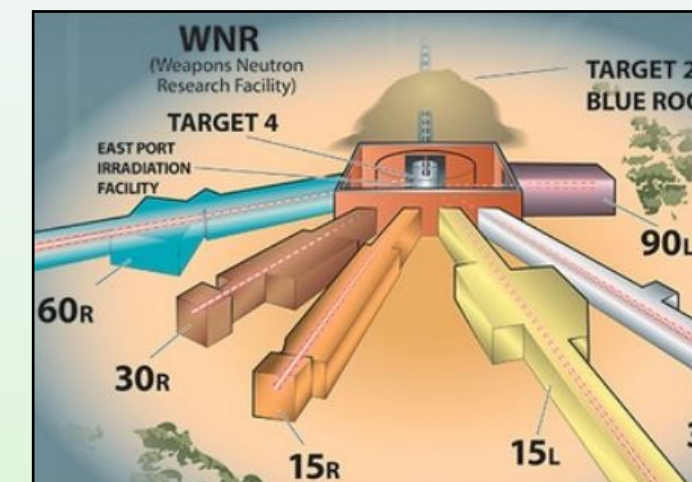
SuperFGD Prototype
24x8x48 cubes

US-Japan prototype



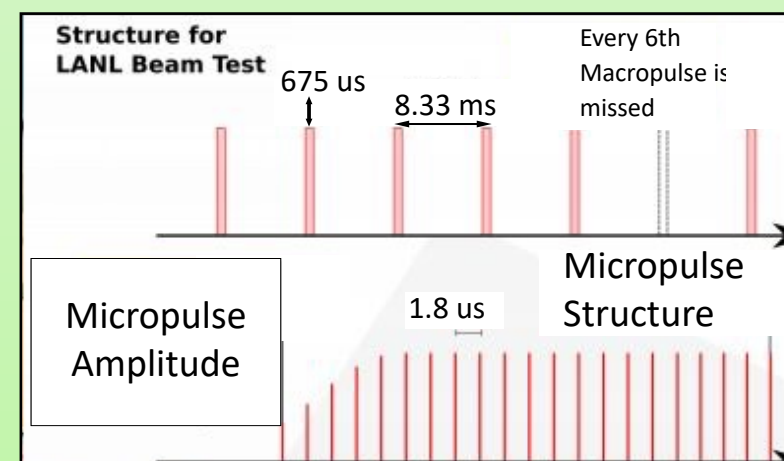
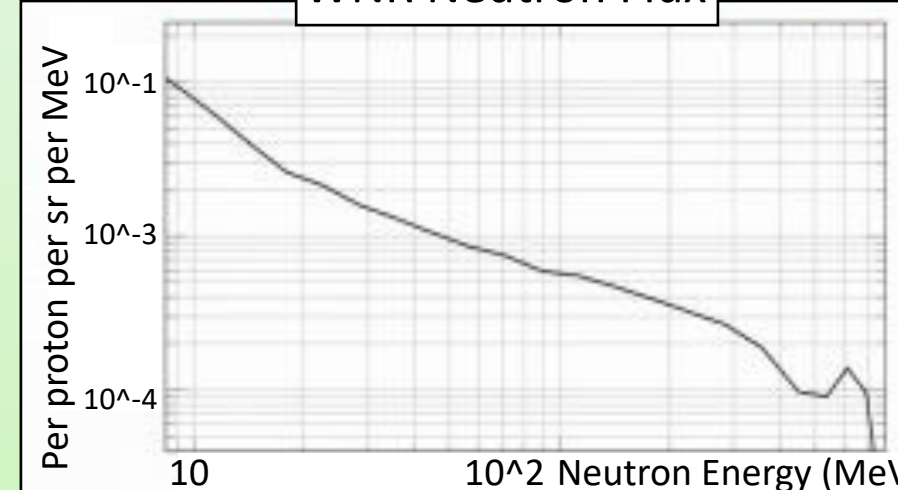
USJ Prototype
8x8x32 cubes

LANSCE Beamline



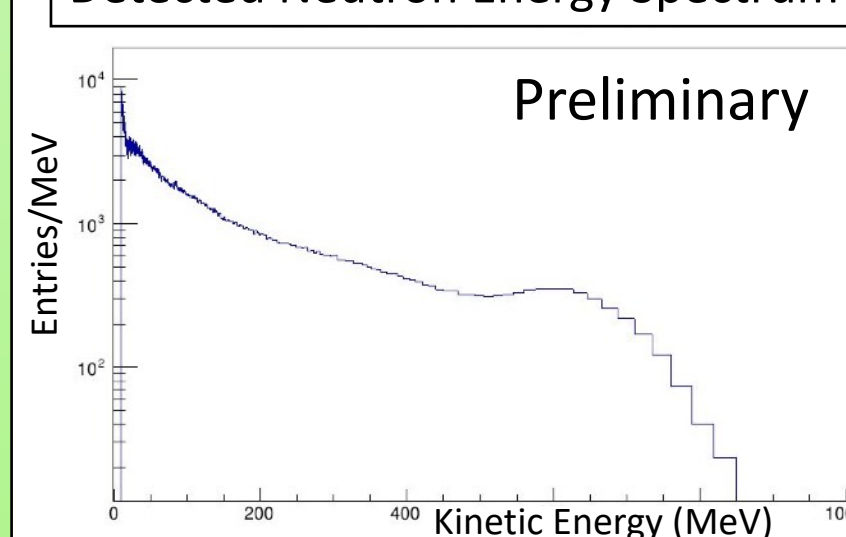
-LANSCE provides an intensive neutron beam with energy ranged from 0 to 800 MeV.

WNR Neutron Flux

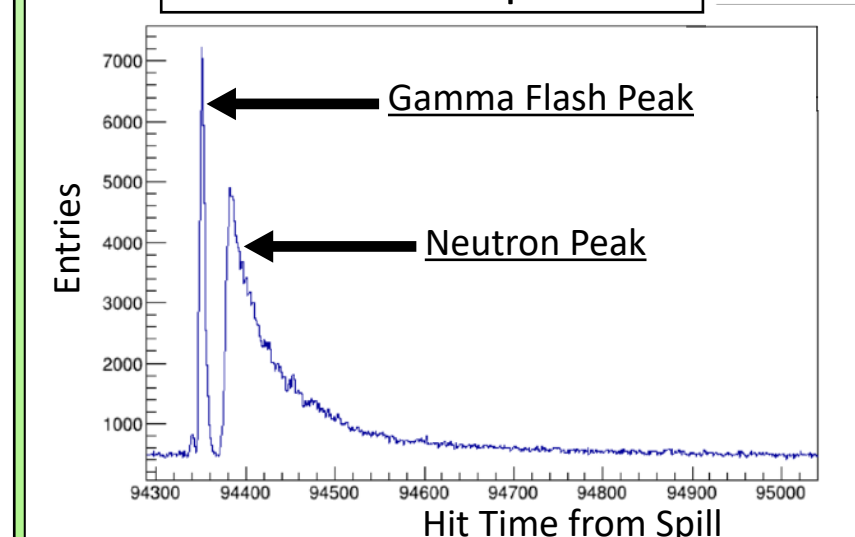


- We are aiming at a total cross section measurement by the end of the summer using the extinction method.
- Exponential fit to the event rate along the beam direction for each energy bin.
- Exclusive cross-section analysis will be done afterward.

Detected Neutron Energy Spectrum



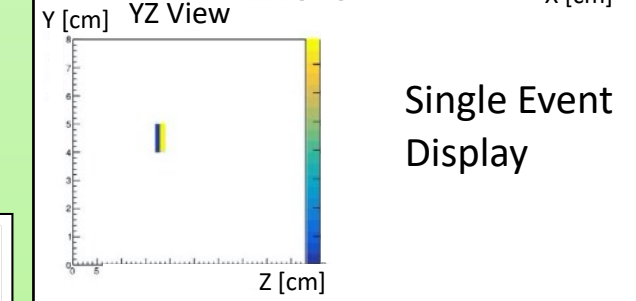
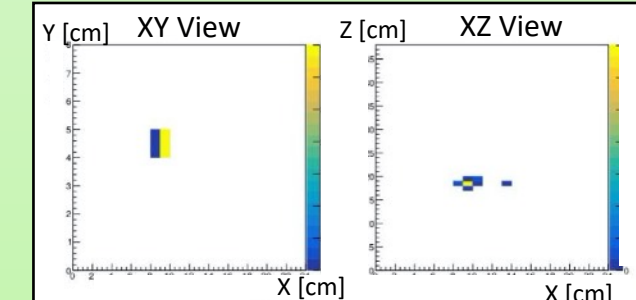
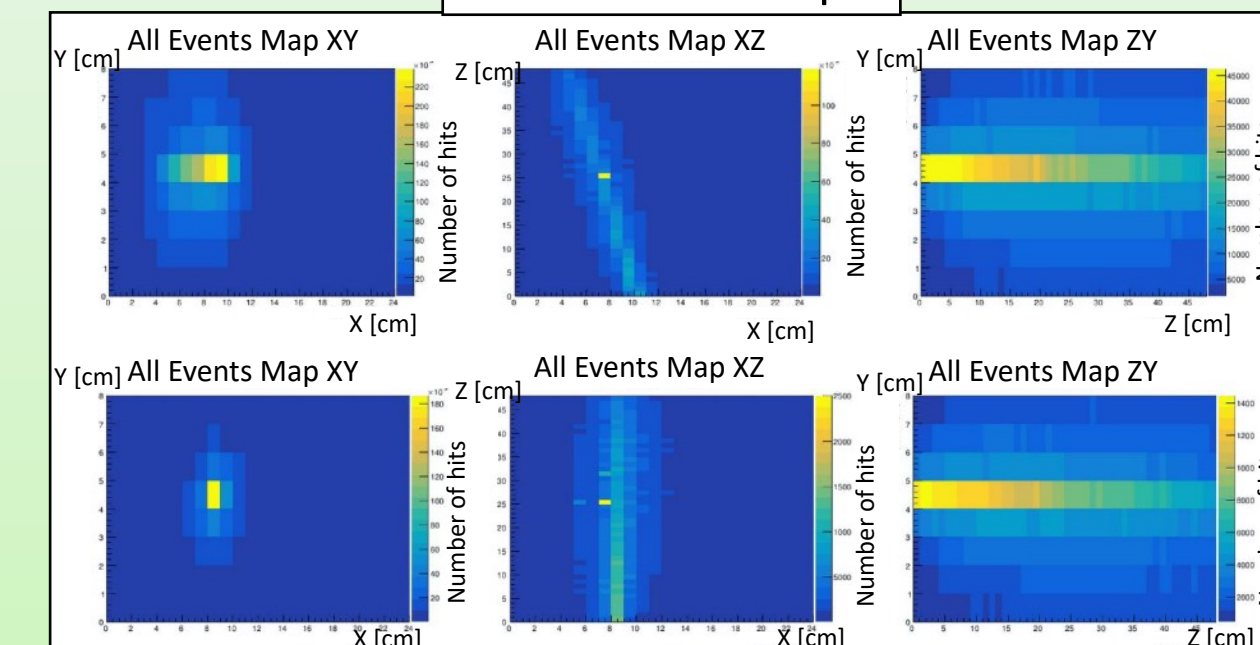
Hit Time from Spill FEBO



Neutron Beam Test

- In total, more than 30 hours (~10E8 triggers) of data at both the 90 m and 20 m (from the target) locations were taken with the superFGD prototype.
- 4 hours (~10E7 triggers) of data was taken with the US-Japan prototype.
- Various detector orientations and combinations have been used in order to understand the detector response.

Detected Beam Spot



-A new beam test in 2020 has been proposed to the LANSCE beamline for more data with the US-Japan prototype as well as for further detailed studies of detector response and neutron scattering.