Neutron Beam Test with 3D-Projection Scintillator Tracker Prototypes for Long-Baseline Neutrino Oscillation Experiments

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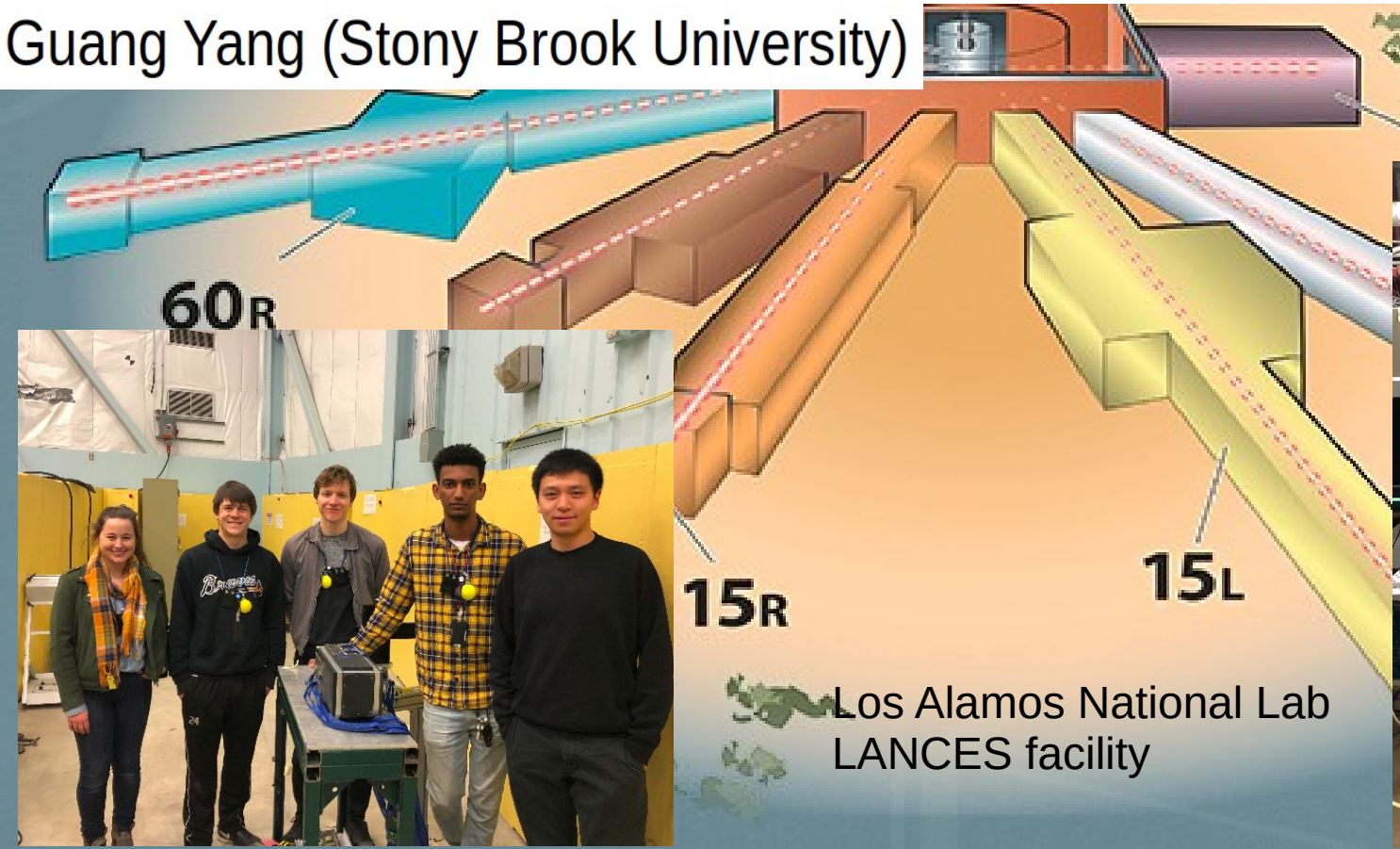
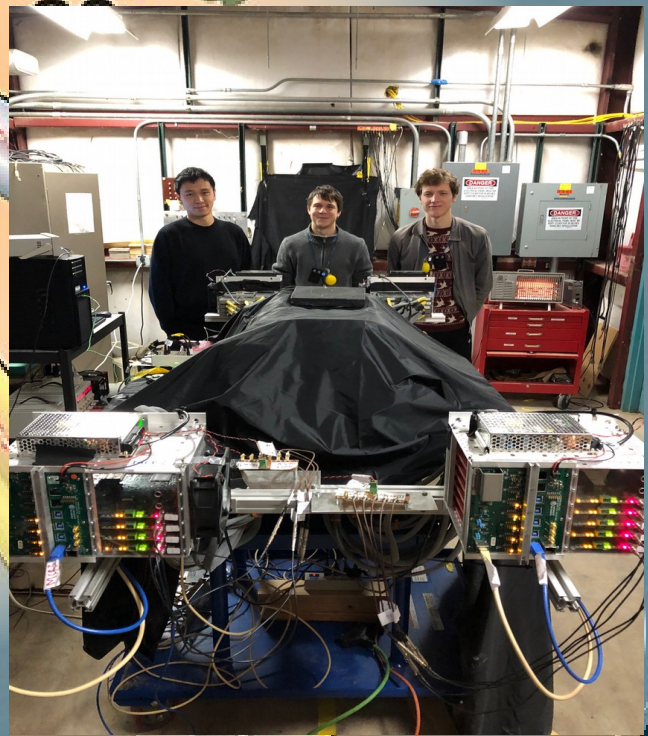


Los Alamos National Lab
LANCES facility



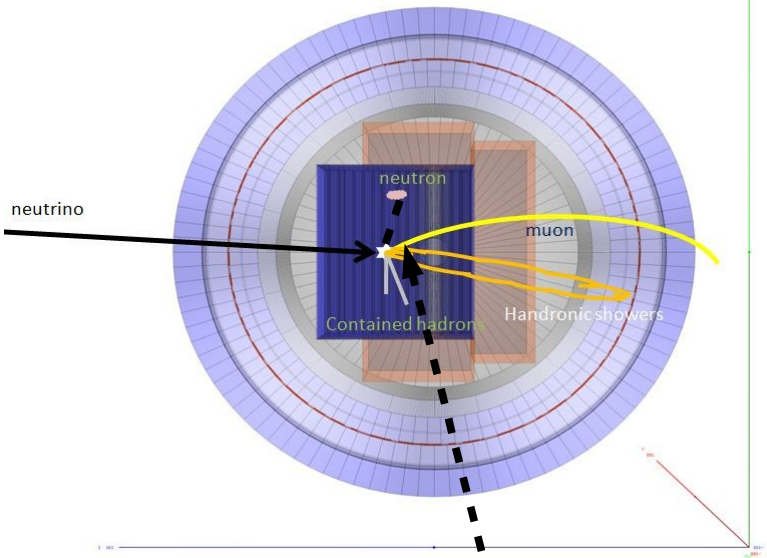
Motivation

- Missing neutron energy : one of the dominant systematic uncertainties in the long-baseline neutrino oscillation analyses

- In the precision era, neutrino interaction measurement including neutron information desired in the near detectors of the long-baseline experiments

- Neutron kinetic energy measurement enabled by the ToF technique with a low-threshold, fast-timing and fine-granularity 3D projection tracker

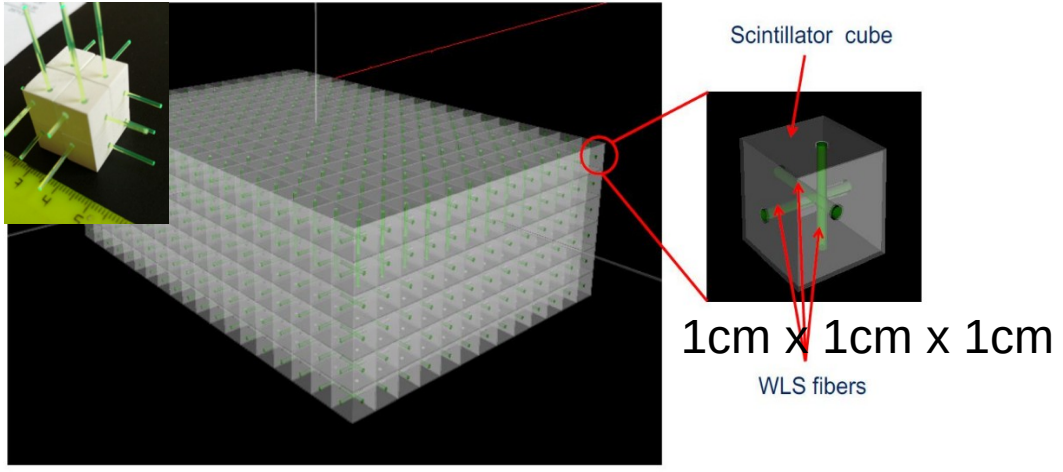
Neutrino interaction



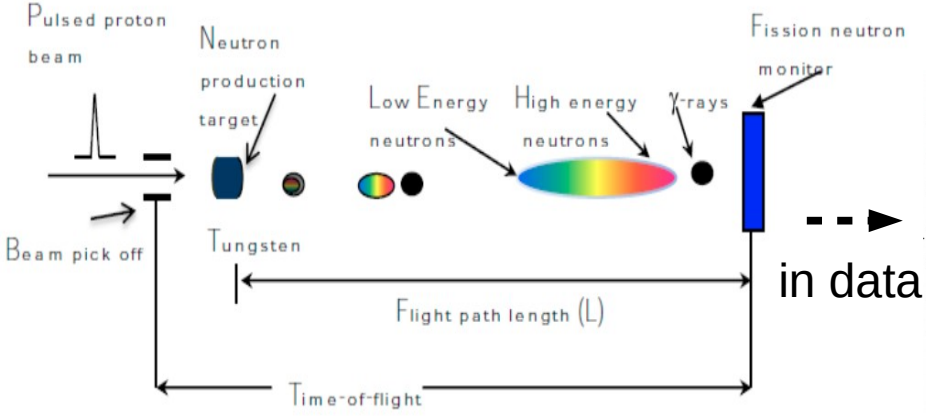
- Neutron kinetic energy can be obtained by measuring the neutron-induced hit distance and time

3D projection scintillator tracker

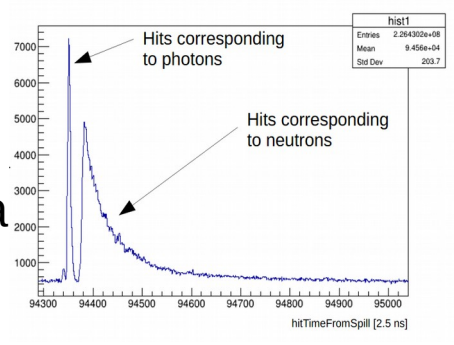
3 fiber light yield: > 100 pe
MIP time resolution ~0.5 ns



Beamline setup



in data



- We have two separate beamline time allocations at 90 m and 20 m locations from the proton target.

- A gamma flash (providing t0) comes before the neutron arrives, which allows a neutron energy measurement with the time-of-flight.

- Two prototypes were proposed and built by a collaboration and exposed to the beamline for a total time of 90 hours.

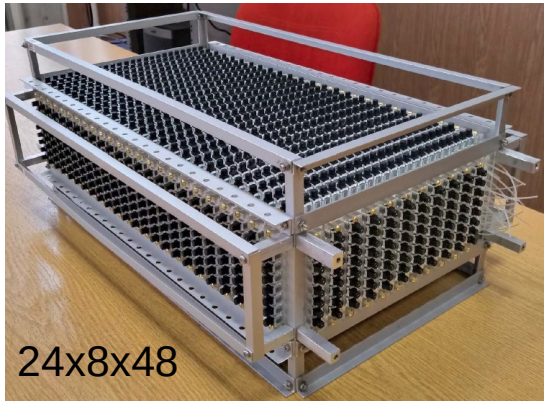
Collaborating institutions

- CERN
- University of Geneva, Switzerland
- High Energy Accelerator Research Organization (KEK), Japan
- Institute for Nuclear Research (INR), Russia
- Imperial College, UK
- Louisiana State University, USA
- University of Pennsylvania, USA
- University of Pittsburgh, USA
- University of Rochester, USA
- Stony Brook University, USA
- University of Tokyo, Japan
- ETH Zurich, Switzerland
- Chung-Ang University, S. Korea
- South Dakota School of Mines and Technology, USA
- A lot thanks to the LANSCE's WNR facility

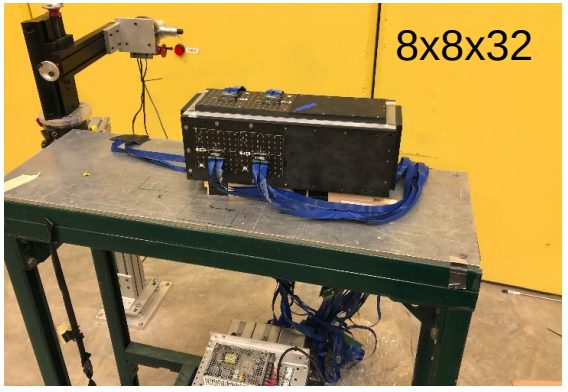
LANSCE neutron beam test

Stony Brook University

SuperFGD prototype



US-Japan prototype



- A ~0-800 MeV KE neutron beam provided by LANSCE in LANL; Our detectors capable to achieve an energy resolution measurement at 2% level
- Goals: Neutron detection response, neutron cross section and neutron double scattering; Data analysis is on-going and we expect a publication by the end of this year.

SuperFGD proto. Beam spot XY and XZ