

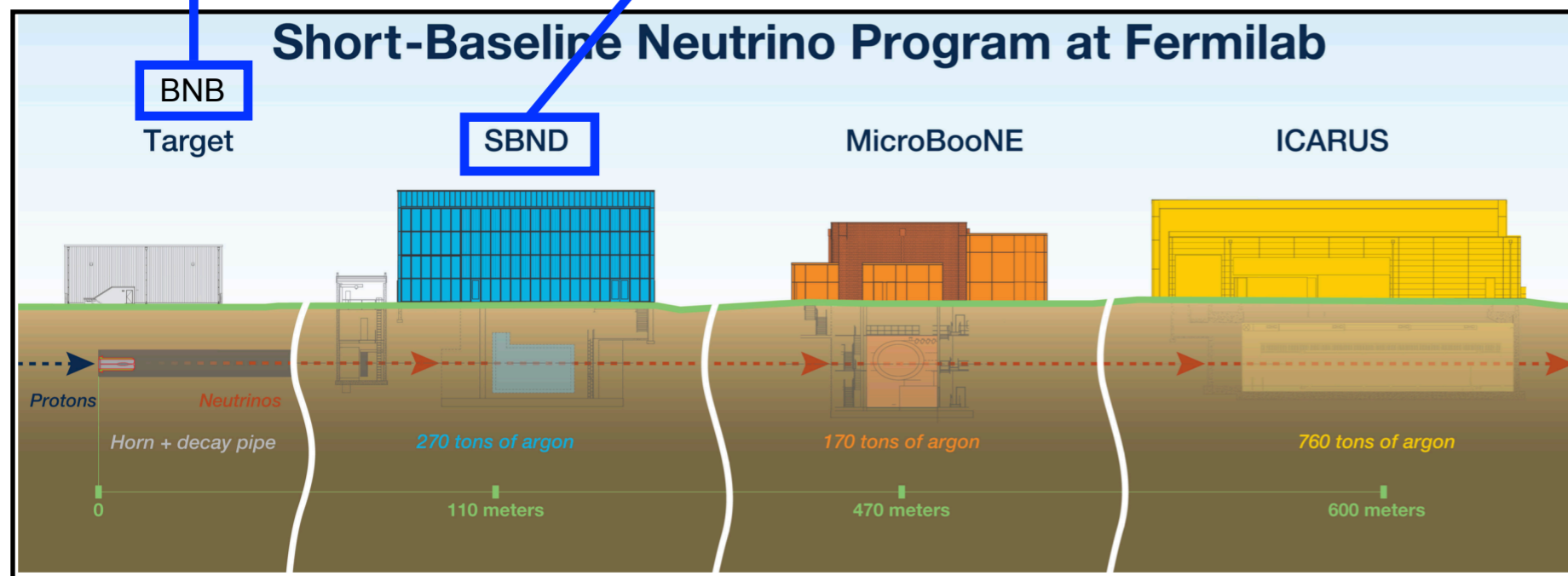
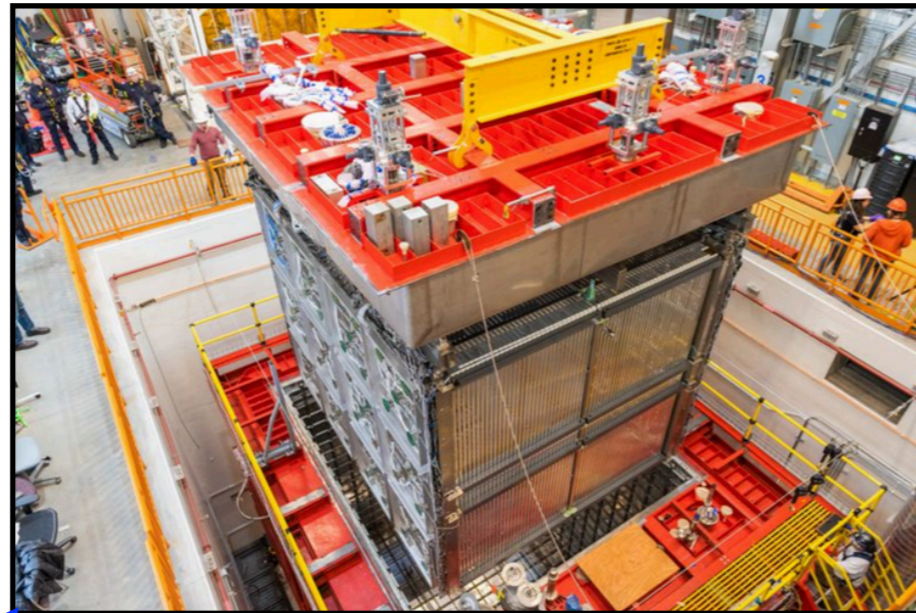
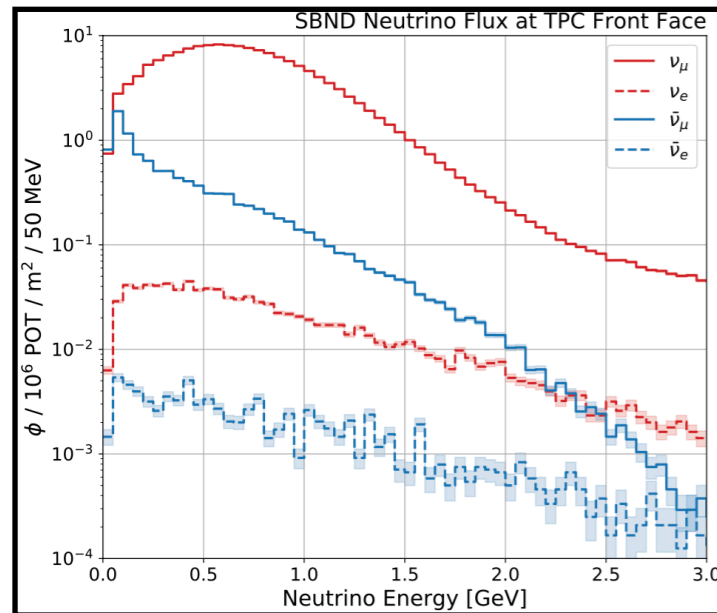
# Short-Baseline Near Detector (SBND): Neutrino Interactions Program

Vishvas Pandey  
*for the SBND Collaboration*



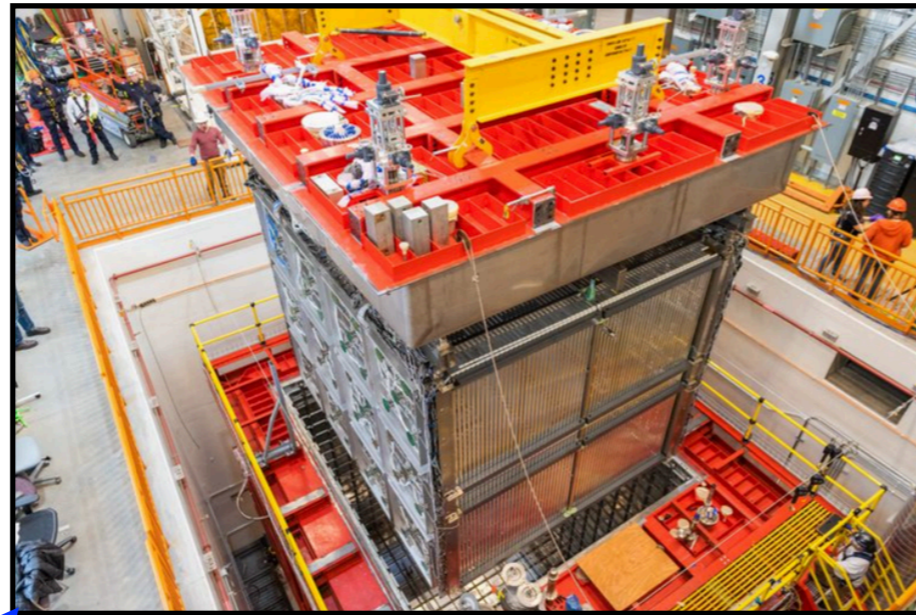
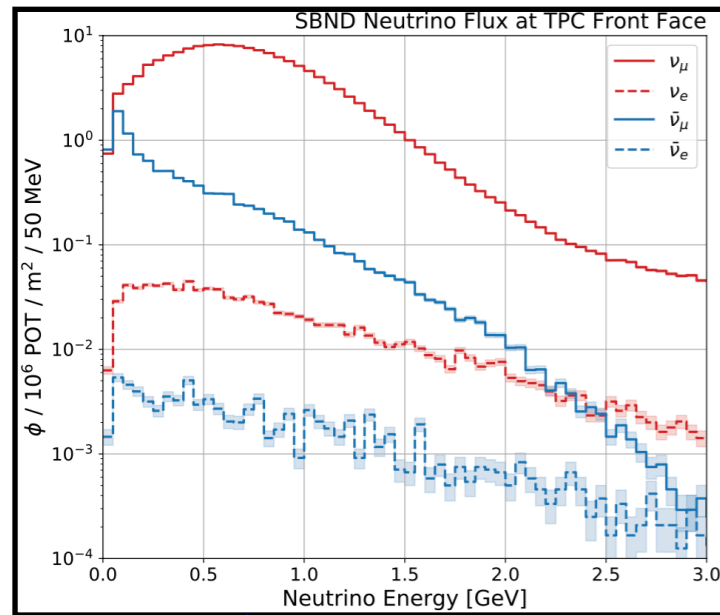
# Short-Baseline Near Detector (SBND)

- The Short-Baseline Near Detector (SBND) is the near detector of the Short-Baseline Neutrino (SBN) program located along the Booster Neutrino Beamline (BNB) at Fermilab.
- SBND has broad science goals as part of SBN program and on its own, addressing alternative explanations of the short-baseline anomaly, BSM searches and **precision studies of neutrino-argon interactions**.

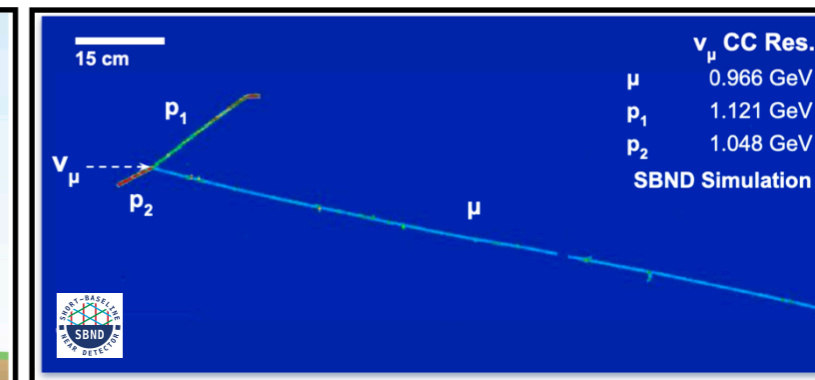
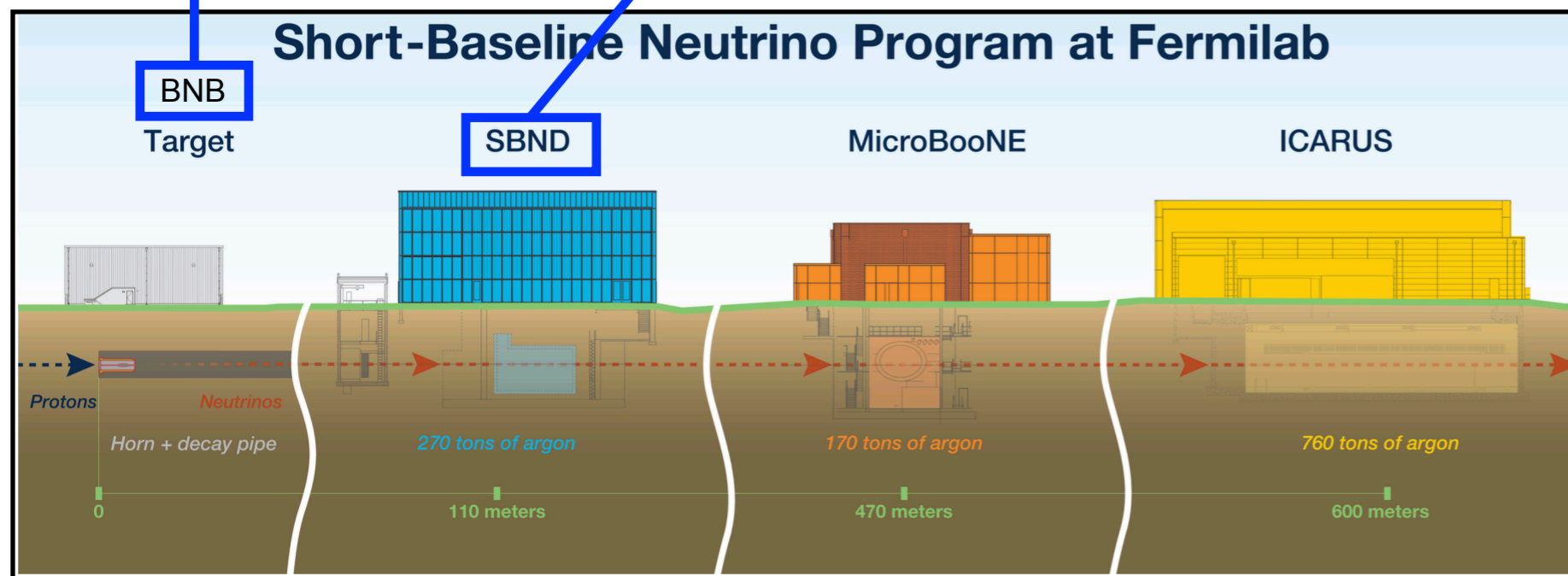


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- SBND is a **LArTPC** detector combined with a **unique photon detection system**
  - Event imaging
  - Fine granularity calorimetry and particle identification
  - Good timing resolution
  - Low energy threshold





# Neutrino Interactions in SBND

- Due to its proximity to neutrino source, SBND expects approximately **2 million  $\nu_\mu$  CC and 15 thousand  $\nu_e$  CC** interactions per year, with around **7,000 total neutrino interactions observed per day**
  - Every ~3 months, SBND will collect a dataset equivalent to the full MicroBooNE BNB five-year run
- SBND will record ~20–30x more neutrino–argon interactions than is currently available

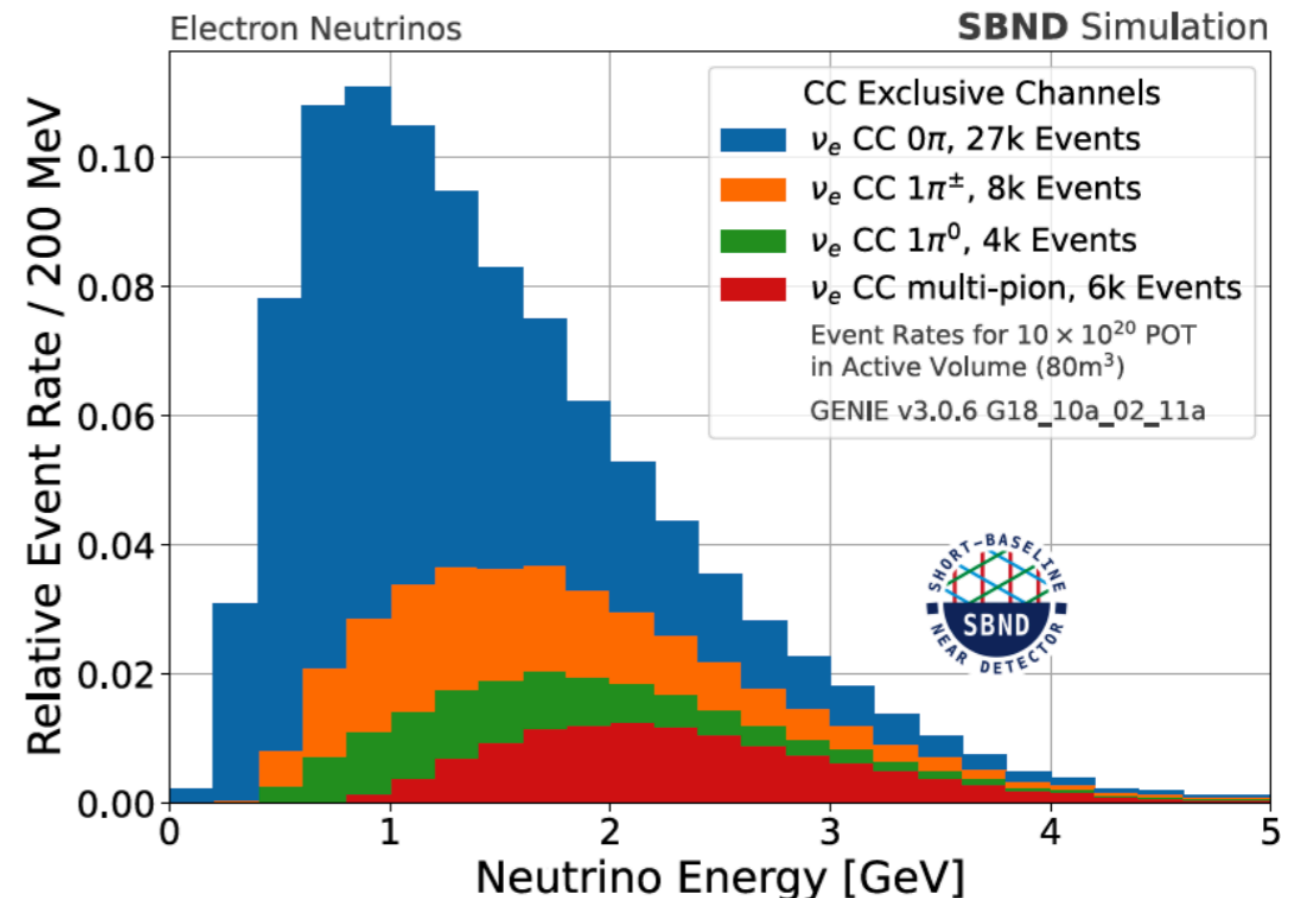
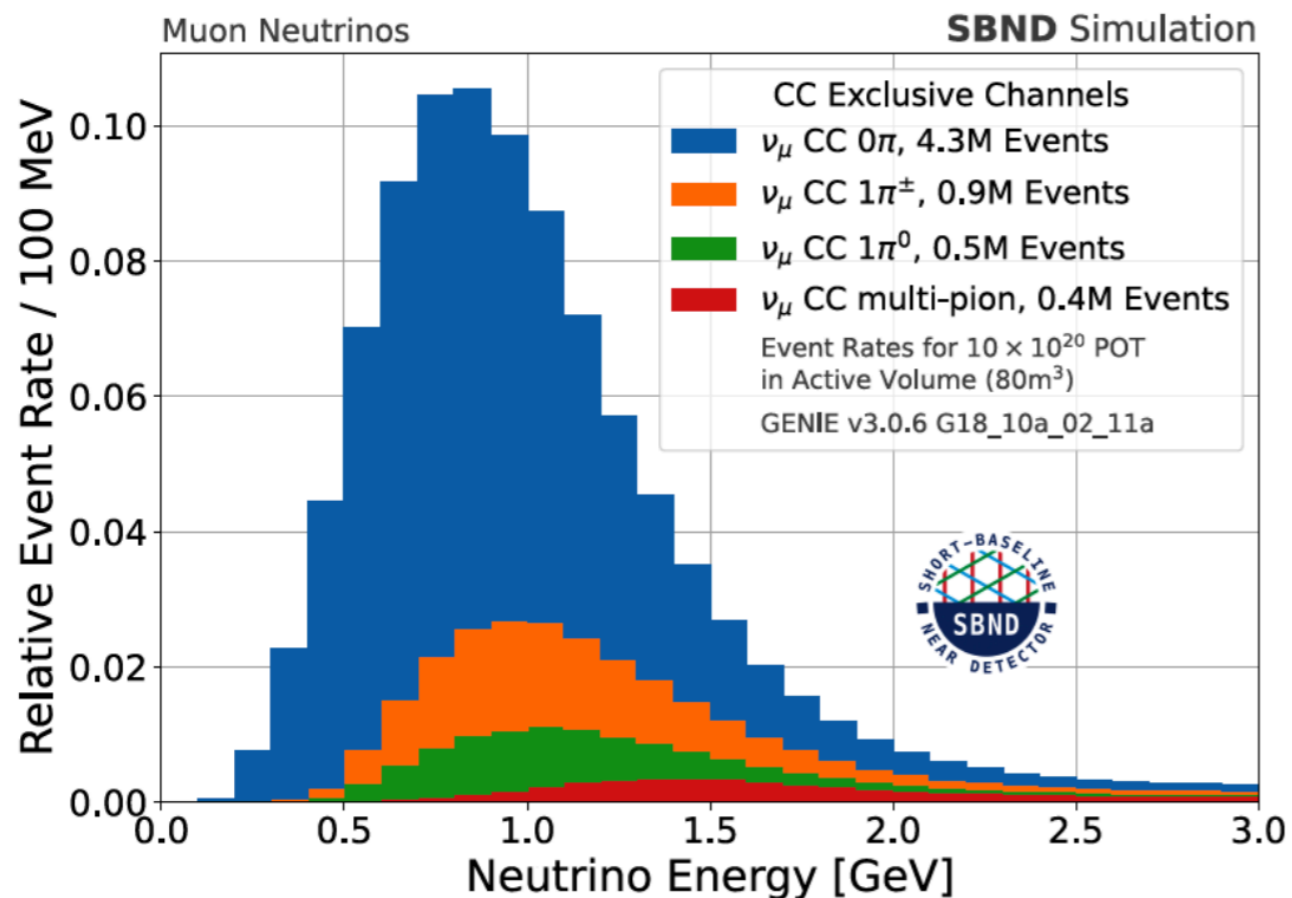


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  - Every ~3 months, SBND will collect a dataset equivalent to the full MicroBooNE BNB five-year run
- SBND will record ~20–30x more neutrino–argon interactions than is currently available
- Large statistics, combined with LArTPC capabilities, will allow us to study different variables, exclusive and rare channels

$\nu_\mu - {}^{40}\text{Ar}$   
**2M  $\nu_\mu$  CC events in 1 year**

$\nu_e - {}^{40}\text{Ar}$   
**15k  $\nu_e$  CC events in 1 year**

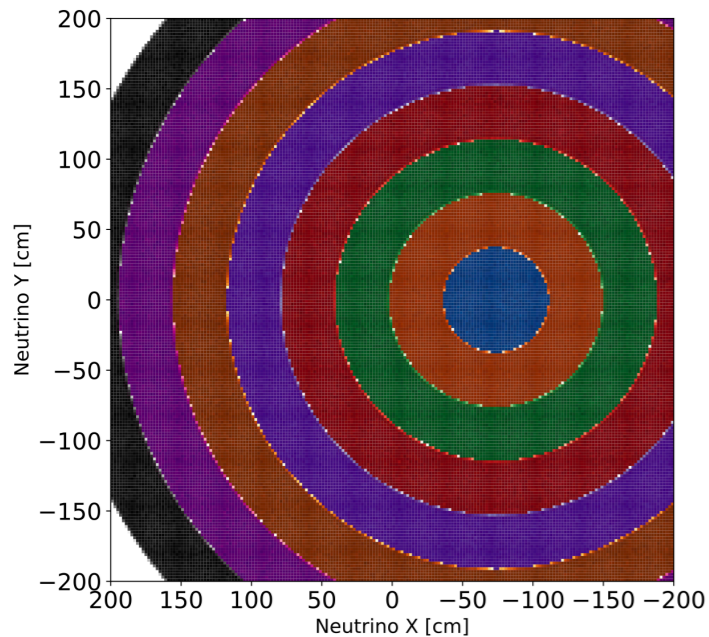


# Neutrino Interactions in SBND

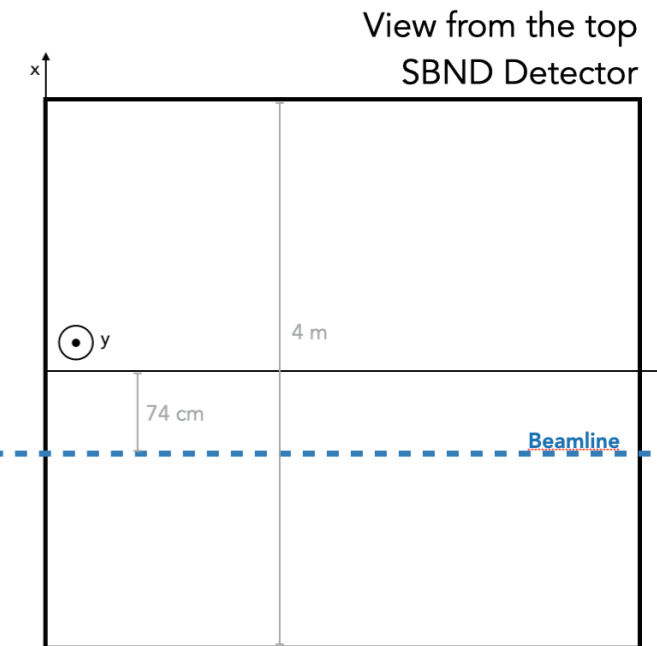
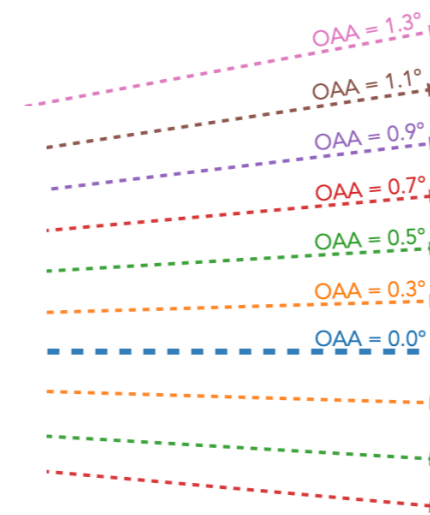
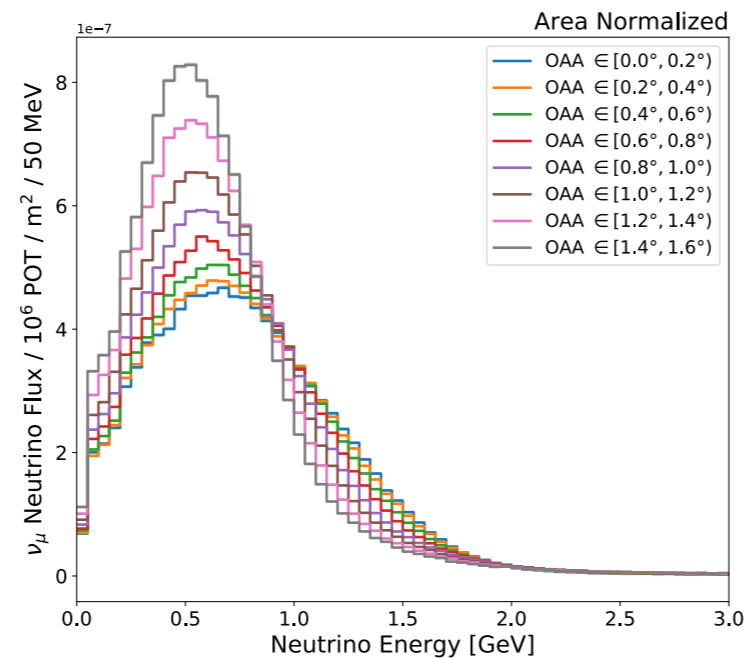
## ■ SBND-PRISM:

- Being close (110 m) to the neutrino source
- Positioned offset relative to the beam center
- SBND sees neutrinos from a range of off-axis angles (OAAs)
- SBND-PRISM will allow studying energy dependent neutrino cross section measurement

View from the beam direction  
SBND Detector



$\nu_\mu$  flux in each of the OAA regions

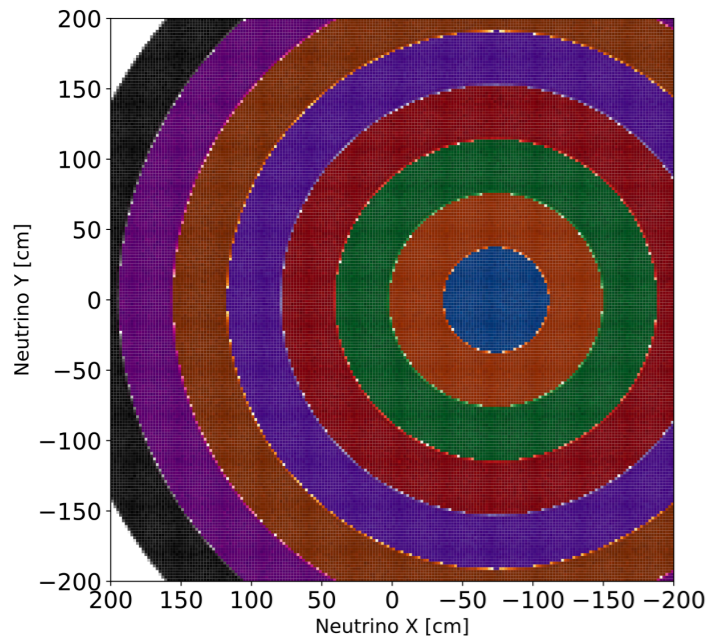


# Neutrino Interactions in SBND

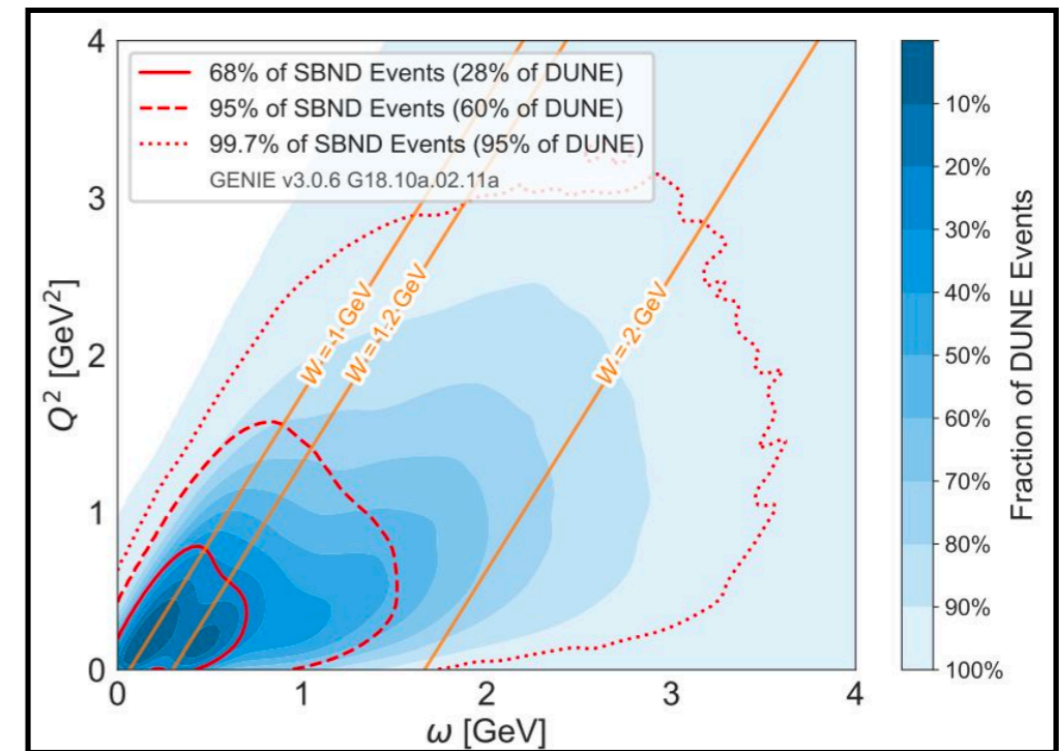
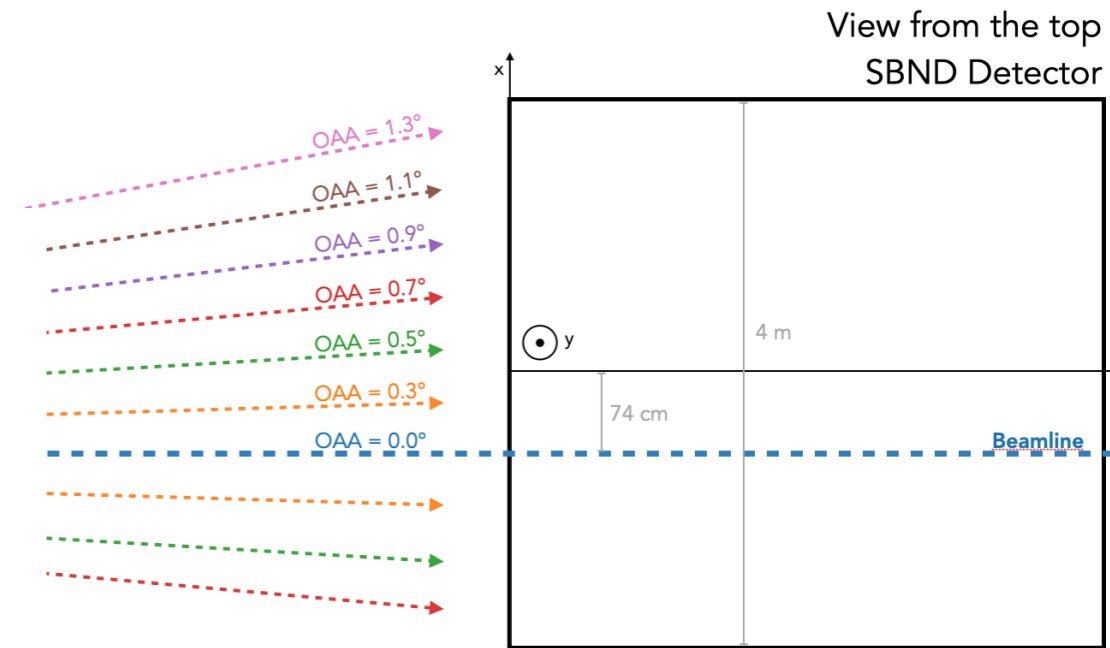
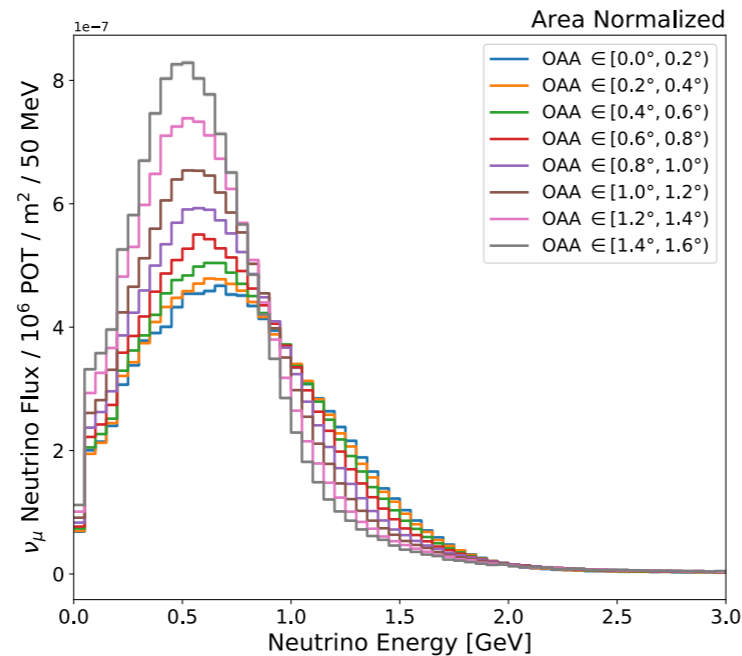
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DUNE kinematic coverage is represented with the blue 2D histogram

SBND kinematic coverage is shown with 3 contours, representing 68%, 95%, and 99.7% of all SBND data.

## SBND and DUNE:

- SBND interactions will cover significant parts of kinematic phase space relevant for DUNE.
- SBND measurements can be used to constrain the same physics DUNE needs to know.



# SBND Status



- The SBND detector installation is completed. The operation is expected to start early in 2024.
- SBND will enable a generational advance in the study of neutrino-argon interactions in the GeV energy range
  - unprecedented statistics
  - unique detector capabilities (large photon detector coverage, low thresholds, ns timing, ...)
  - multiple correlated fluxes (PRISM)
- Stay Tuned!





# Thank you!

**262 Total Collaborators**

**210 Scientific Collaborators**  
(faculty/scientists, postdocs, PhD students)

**40 Institutions**

5 Brazilian Universities

CERN

1 Spanish University, 1 National Laboratory

1 Swiss University

8 UK Universities, 1 National Laboratory

18 US Universities, 4 National Laboratories

