



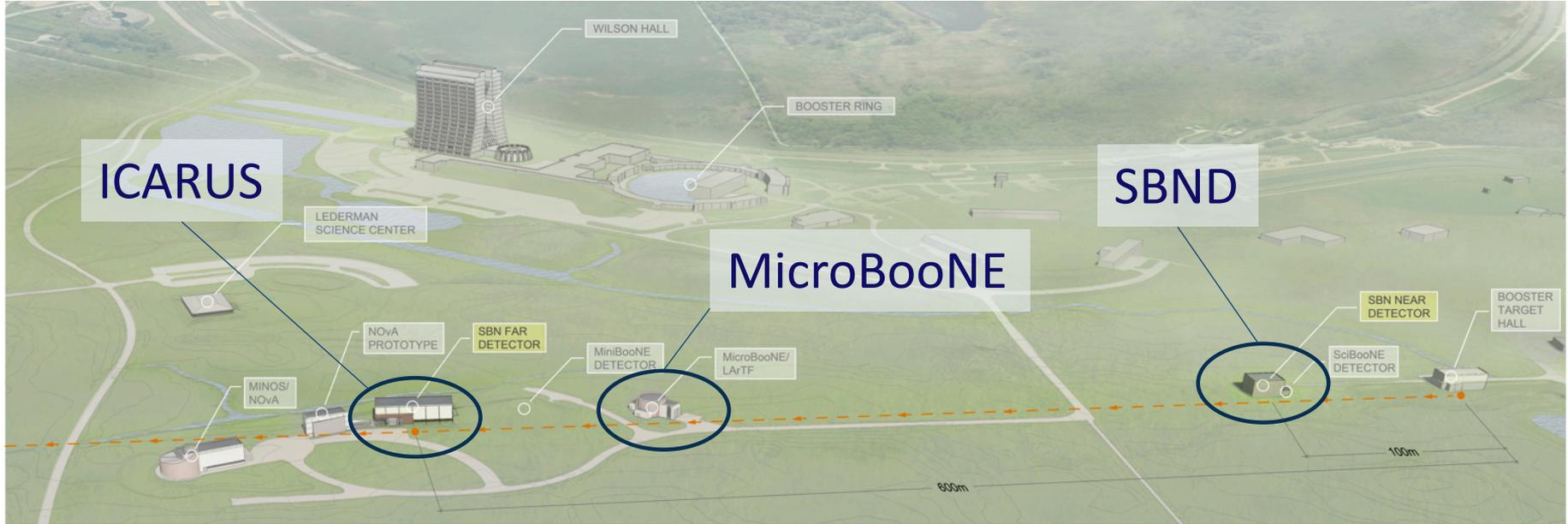
SBND in 10 minutes

New Perspectives

June 5th 2017

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Short Baseline Near Detector

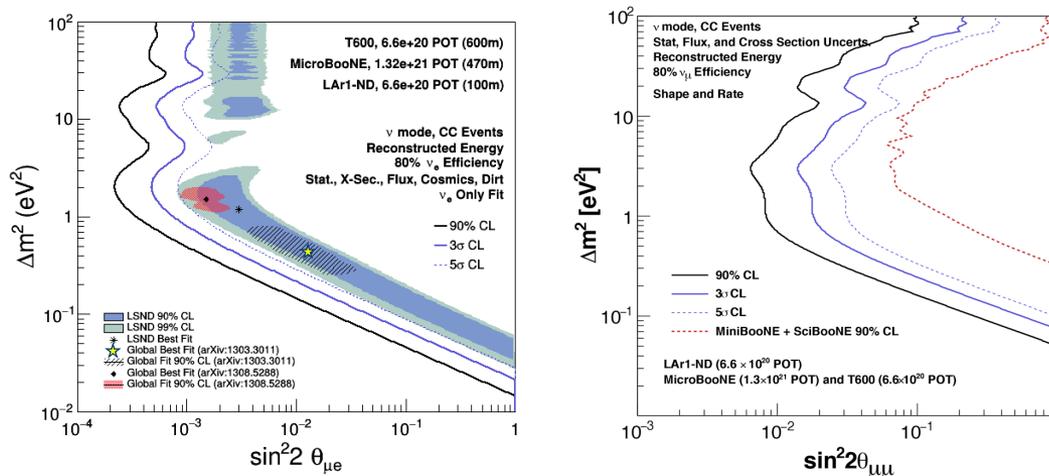


- ❑ Near detector for the Short Baseline Neutrino program at Fermilab
- ❑ Booster Neutrino Beam:
 - Muon neutrinos produced from protons at 8 GeV on a Beryllium target
- ❑ 3 LAr TPCs: SBND, MicroBooNE, ICARUS T-600

SBN Motivation: Sterile Neutrinos



- ❑ The standard model has 3 flavours of neutrinos
- ❑ Over the past 20 years experimental anomalies have been observed in short baseline (<1km) neutrino experiments
 - LSND: measured an 3.8σ excess in $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ appearance channel
 - MiniBooNE: measured a 3.4σ excess in $\nu_\mu \rightarrow \nu_e$ and a 2.4 excess in $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ appearance channels
- ❑ Hypothesis for a fourth neutrino state: a “sterile” neutrino

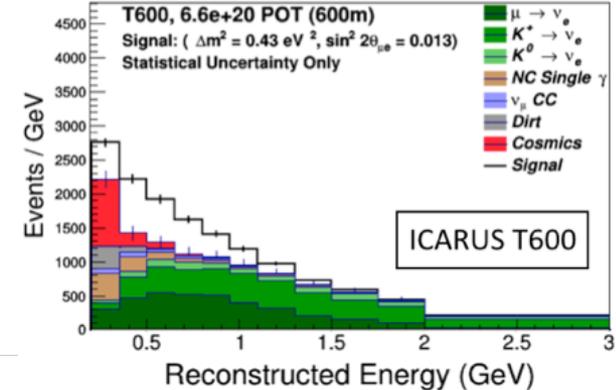
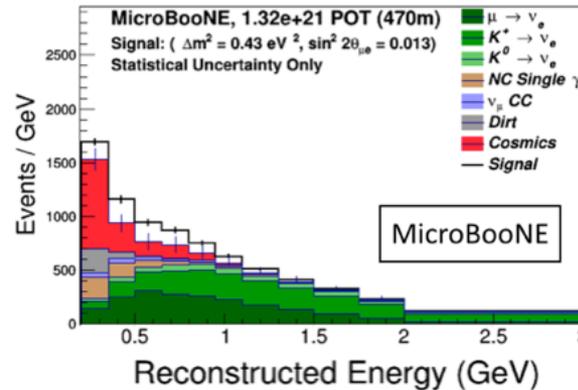
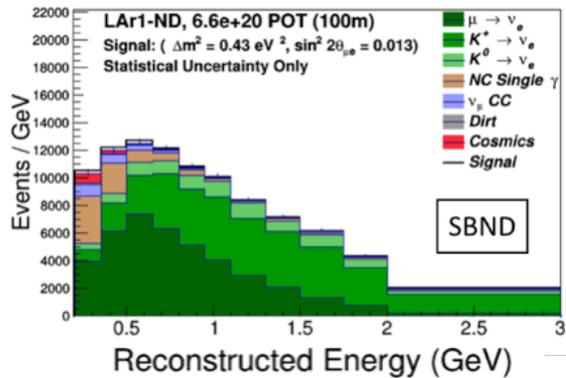


- ❑ Oscillations at $\Delta m^2_{41} \approx 1 \text{ eV}^2$
- ❑ SBN aims to either confirm or definitively refute these results, with major implications for neutrino physics!

SBN Physics Goals



- The Short Baseline Neutrino program will measure neutrino oscillations in the Booster Neutrino Beam



- SBND will characterise the beam – sampling the unoscillated neutrinos

- ν_e charged current, ν_μ charged current, neutral current interactions

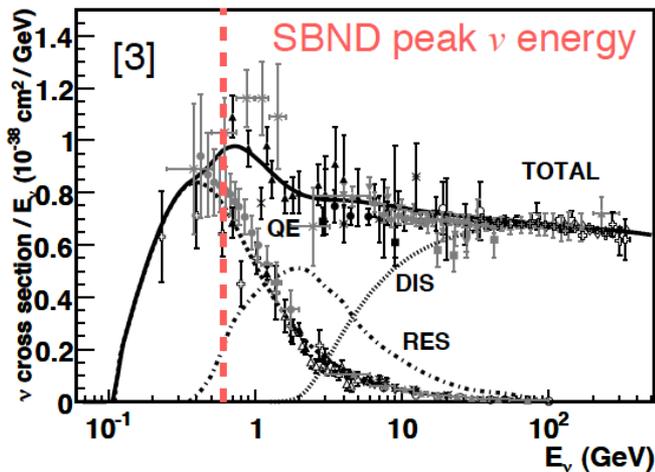
- Enables precise sterile neutrino oscillation searches

- Sensitivity to sterile neutrinos in the $1\text{eV}/c^2$ mass region, from same beam as MiniBooNE

SBND Physics Goals – Cross Sections



- ❑ SBND will record ~ 1.5 million ν_μ CC and $\sim 12,000$ ν_e CC interactions per year
 - For comparison: three years of MicroBooNE data in 1 month...
- ❑ Measuring ν -Ar interactions with unprecedented statistics!
- ❑ Sensitivity to rare (and unmeasured) channels



- ❑ Interaction cross section measurements are crucial for making neutrino oscillation measurements
 - Dominant systematic for SBN and DUNE
- ❑ Characterisation of how the neutrino is interacting with the argon atoms in the detector
 - Nuclear effects significantly alter final state topology/kinematics
 - High statistics measurements allow us to quantify nuclear effects in ν -Ar interactions

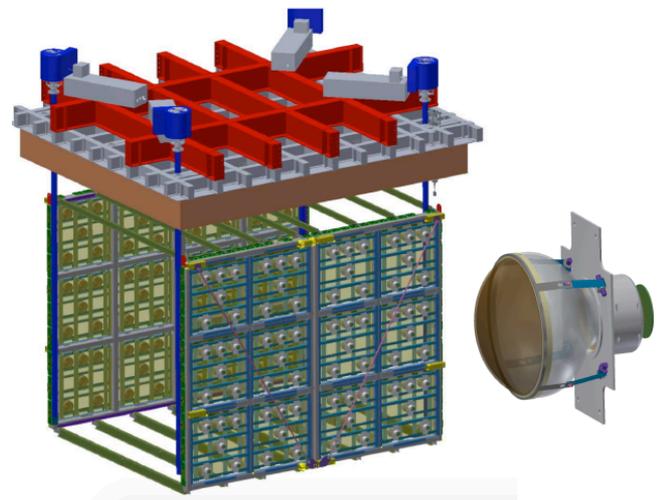
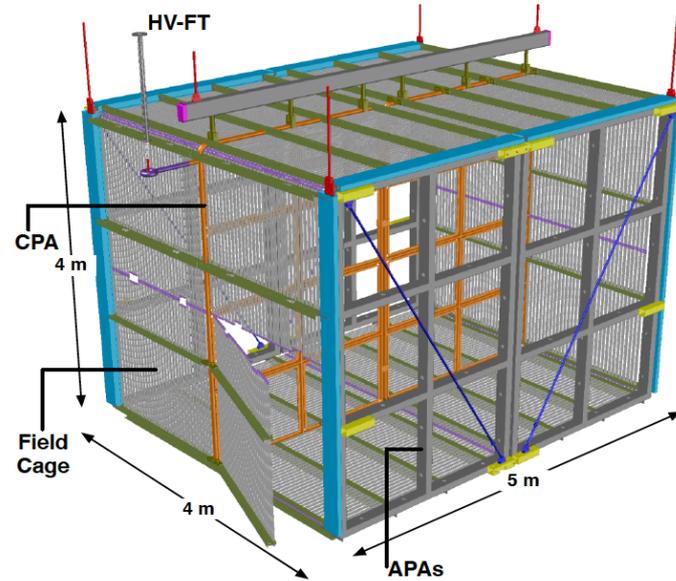
Detector Technology



- ❑ SBND is a Liquid Argon Time Projection Chamber (LArTPC)
 - 112 tonnes of LAr
 - 4m x 4m x 5m active volume
 - Drift direction perpendicular to beam direction

- ❑ Charge and light readout:
 - Wire anodes (APA) readout charge
 - 3 wire planes: vertical (Y-layer) and $\pm 60^\circ$ (U-layer and V-layer)
 - 3mm wire pitch and 3mm wire plane spacing
 - Composite light collection system
 - Photomultipliers (PMT)
 - Light guide bars
 - Arapuca

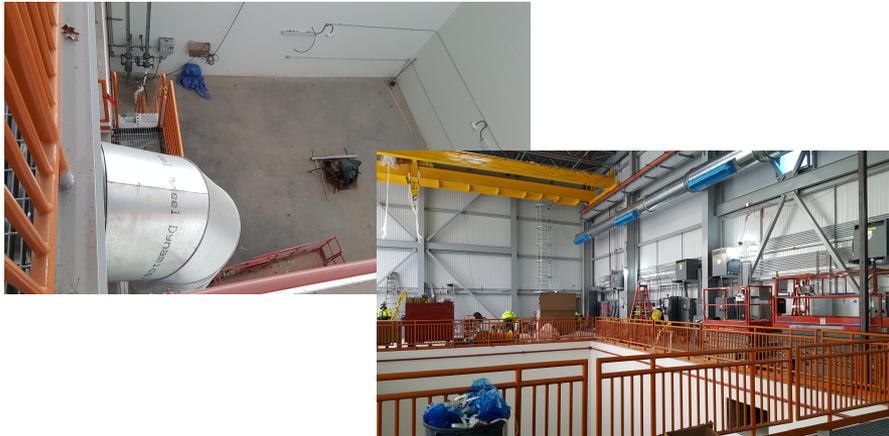
- ❑ Housed in a Membrane Cryostat



Current status

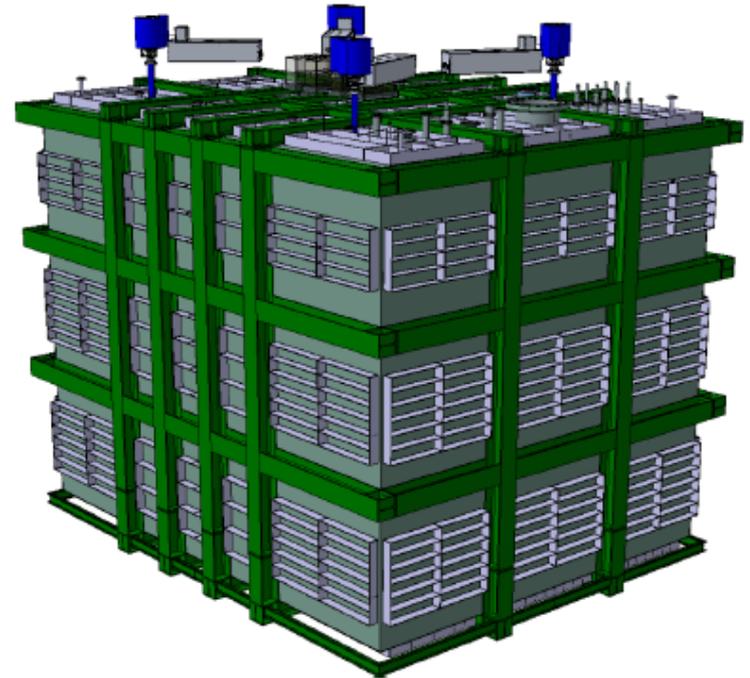


- ❑ SBND Building completed



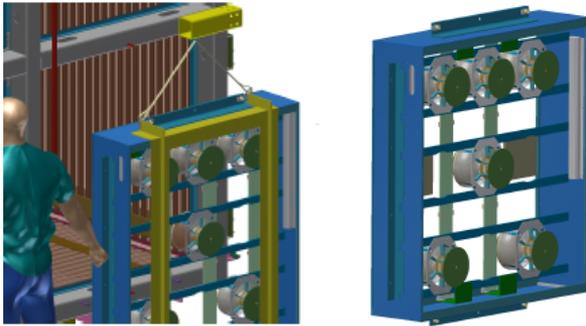
- ❑ Membrane Cryostat under design

- Concrete with metal beams
- 3rd generation prototype for DUNE



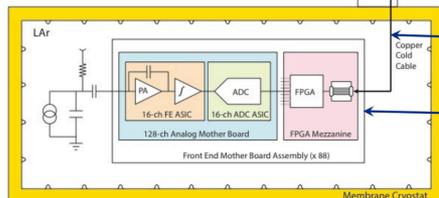
❑ Light detection system

- PMTs in hand and installation system under design

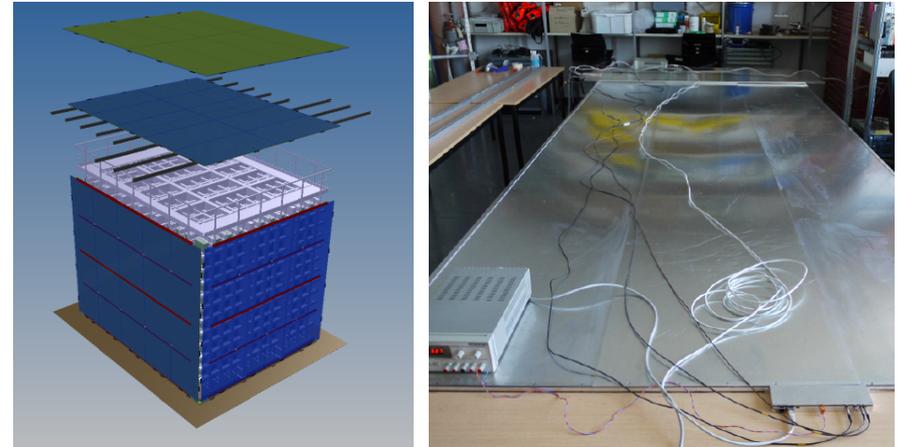


❑ Cold electronics

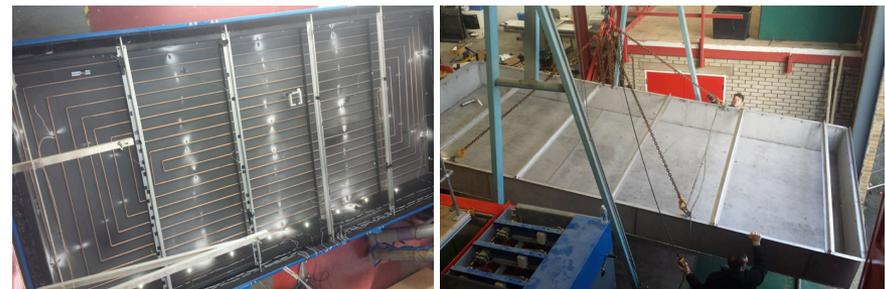
- Plan to use cold ADC and FE ASIC
- Currently in the testing and development phase



❑ Cosmic ray tagger module production under way



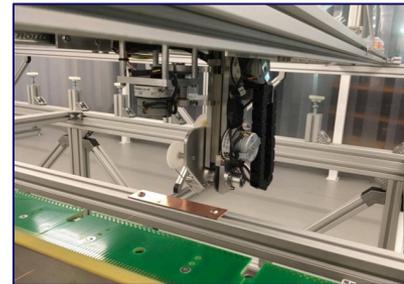
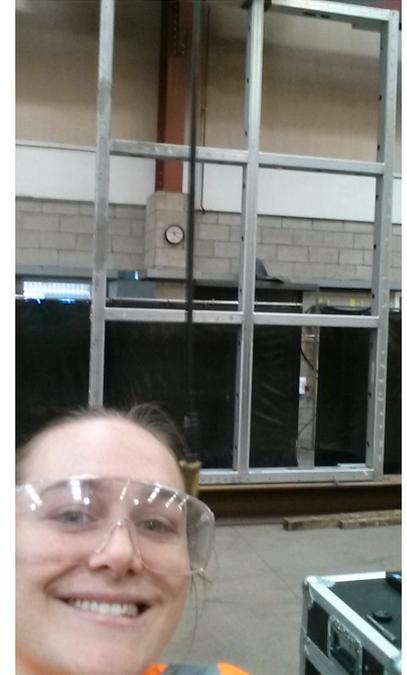
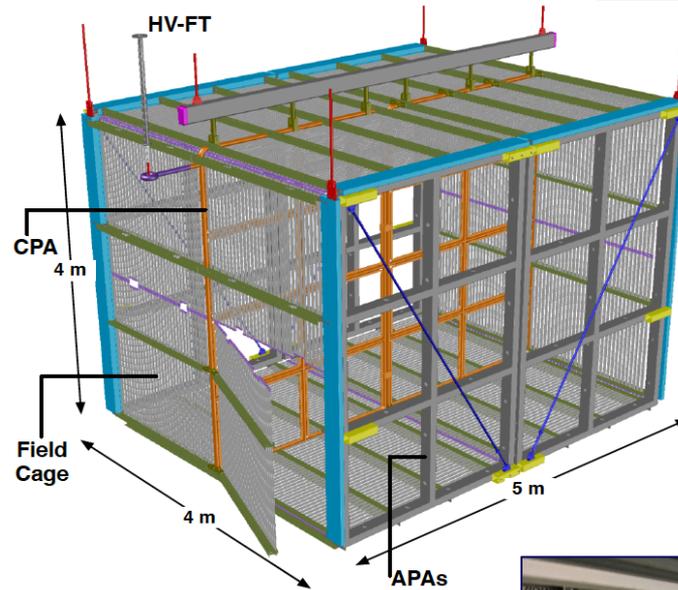
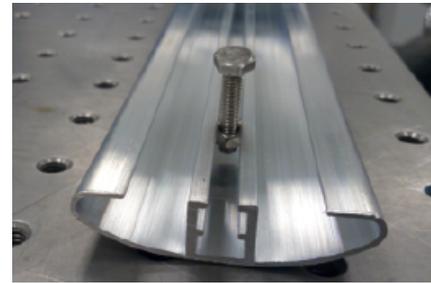
❑ Cold testing box constructed and characterised



Current Status



□ SBND TPC is in production now!





- ❑ SBND is the near detector for the Short Baseline Neutrino program at Fermilab
- ❑ It will measure the unoscillated BNB flux
- ❑ SBND will measure ν -Ar interactions with unprecedented precision due to high statistics
- ❑ It is currently under construction, and will begin commissioning in early 2019!
 - Tune in next year for more exciting progress on detector construction and installation, physics simulations and analysis with SBND!
 - Exciting times are ahead!

Thanks from SBND



178 Collaborators from 33 institutions

