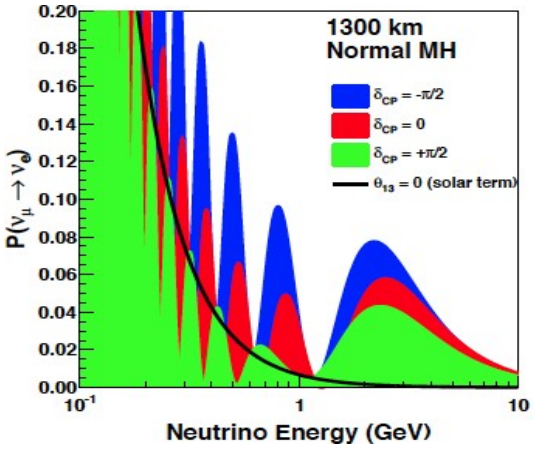
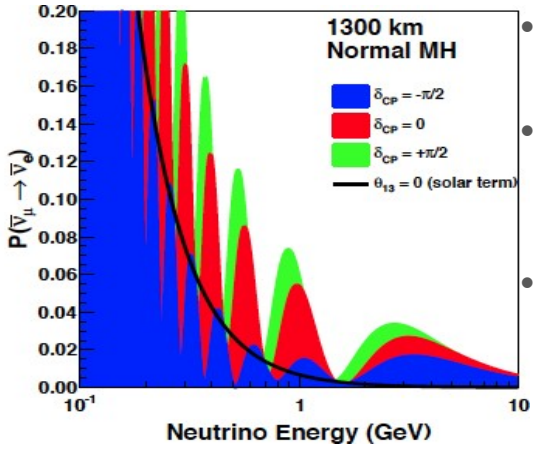
NU_AT_FNAL

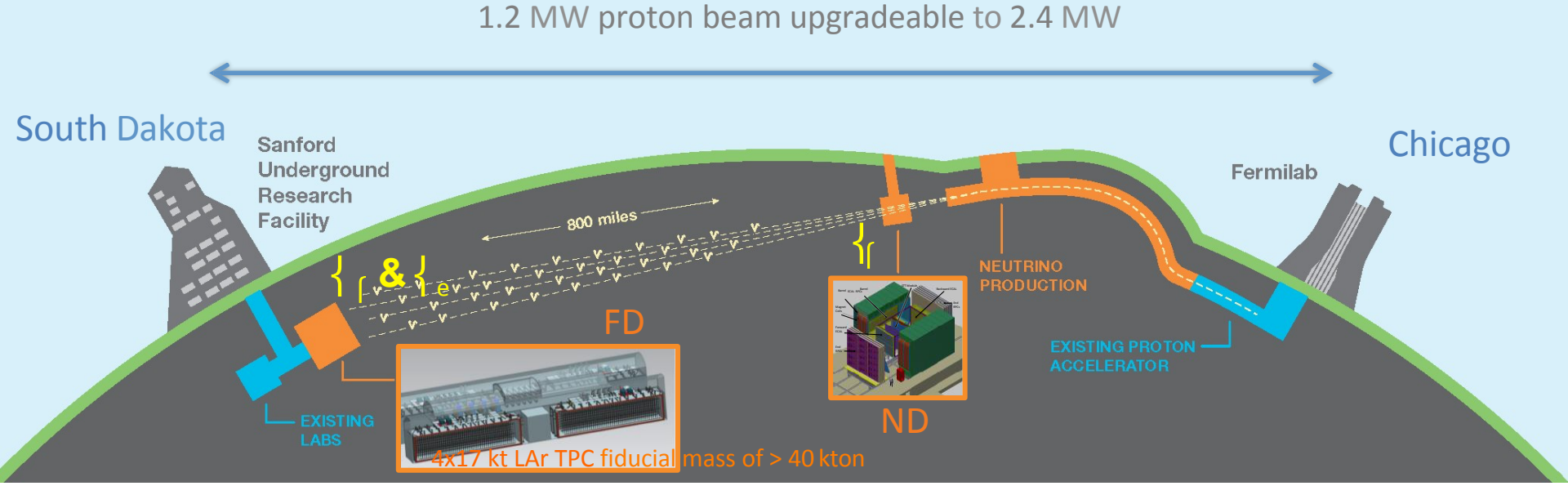
Riunione Gruppo 2 LNS, 24 Giugno 2019

CP violation in DUNE



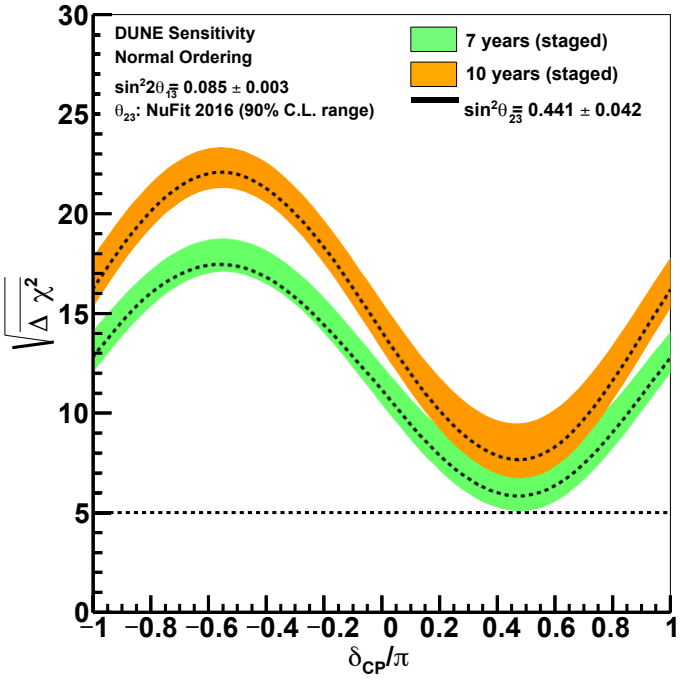


- Measure neutrino spectra at 1300 km in a wide-band beam (nm e anti nm)
- ν_e appearance probability depends on θ_{13}, θ_{23}, δ_{CP}, and matter effects. All four can be measured in a single experiment.
- wide-band beam and long baseline break the degeneracy between CP violation and matter effects

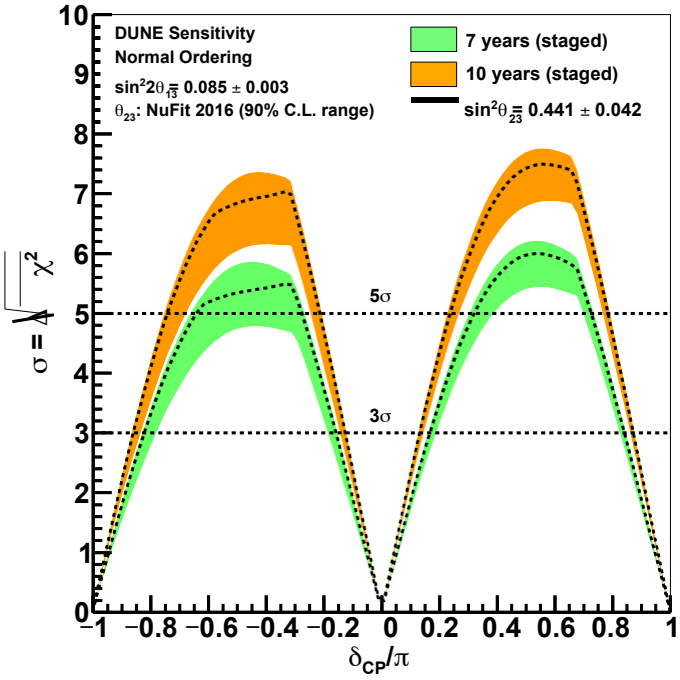


Mass Hierarchy and CP Violation

Mass Hierarchy Sensitivity



CP Violation Sensitivity



After 7 years (staged):

- CP Violation: 5σ if δ_{CP} near $-\pi/2$; 3σ over 65% of δ_{CP} range
- Mass hierarchy determination: > 5σ for all parameter values

DUNE Near Detector

Interesse principale del gruppo INFN nel near detector (ND) per suo apporto cruciale al potenziale di scoperta di DUNE, ma anche per le grandi potenzialità di fisica in sè

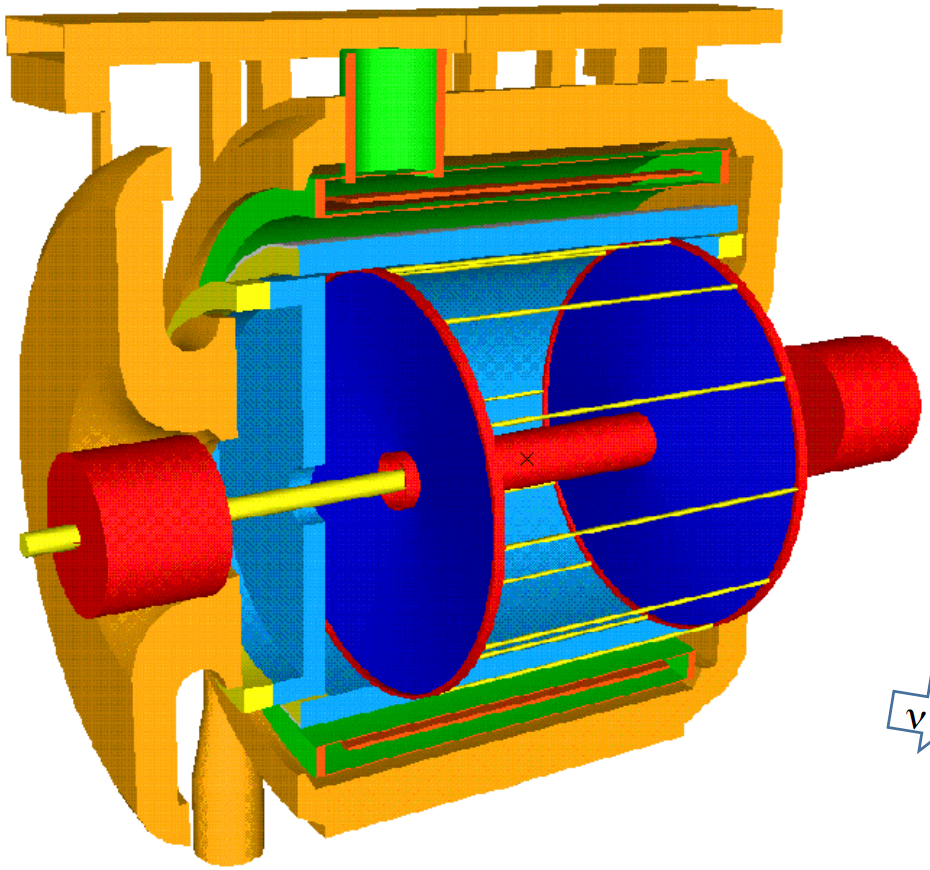
Il gruppo INFN participa inoltre light collection consortium del Far Detector

Soluzione attuale per il ND prevede un rivelatore LAr e una HPTPC all'interno di un magnete

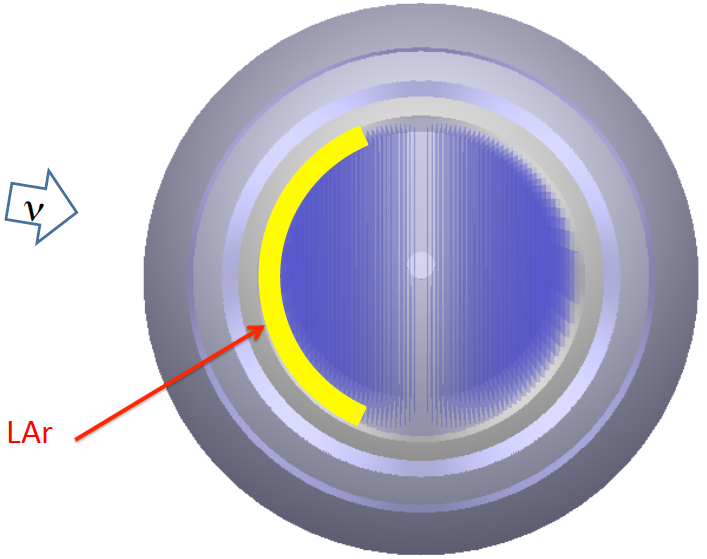
La proposta di utilizzo di KLOE con straw tubes all'interno e un menisco di LAr è stata al momento rigettata. L'utilizzo di KLOE come rivelatore off-axis è di grande interesse e attualmente allo studio

Non è esclusa una futura partecipazione a disegno e realizzazione del magnete pricipale. A tal proposito è stata accolta all'ultimo meeting ND internaziolae a LNF una presentazione di P. Fabricatore di diverse innovative possibilità

Recycling the KLOE experiment for the DUNE ND



Superconducting coil (5 m bore)
B = 0.6 T ($\int B\,dl$ = 2.2 T·m)
Electromagnetic calorimeter
Lead/scintillating fibers
4880 PMT's
Drift chamber (4 m ∅ × 3.3 m)
90% helium 10% isobutane
12582/52140 sense/total wires



Neutrini sterili allo Short Base Line

Il quadro delle indicazioni sperimentali a favore dell'esitenza di un 4° neutrino sterile con $\Delta m^2 \sim 1 eV^2$ è molto complesso/controverso:

1. eccesso in (anti-)ne appearance agli acceleratori in LSND e MiniBooNE (non del tutto consitenti)

2. deficit in (anti-)ne disappearance in sorgenti radioattive (Gallium) e ai reattori (quest'ultime mitigate da nuovi calcoli del flusso)

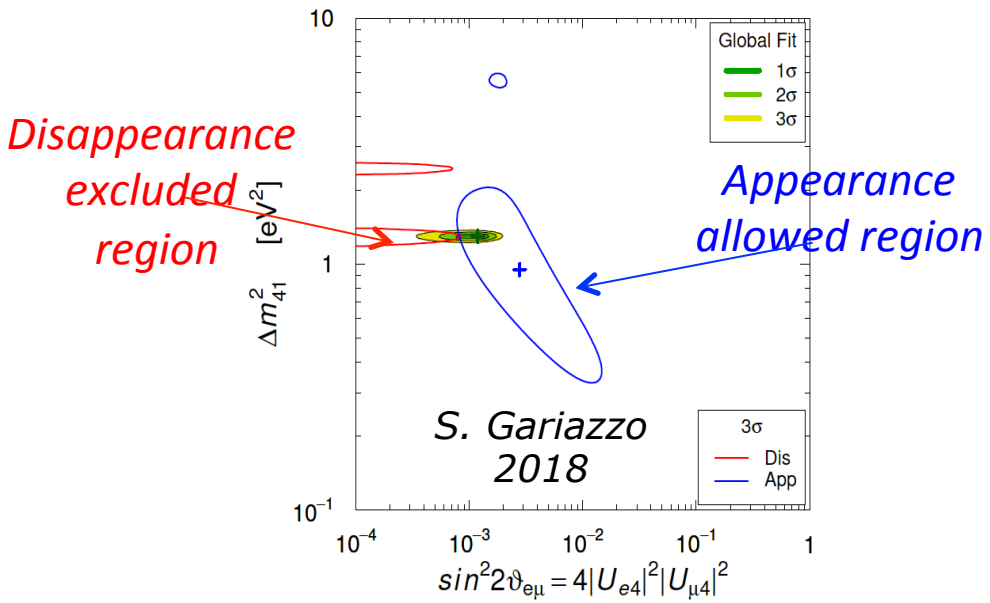
3. mancata osservazione di una corrispondente disappearence num negli esperimenti MINOS e Icecube

4. attuali modelli cosmologici lasciano poco spazio all'esistenza di ulteriori speci di neutrino

The sterile neutrino physics case and the SBN project at FNAL

- Need of a definitive clarification: measuring both appearance/disappearance channels with the same experiment at accelerator by comparing the neutrino fluence with L/E~ 1 km/GeV at the far detector with the corresponding at the near detector will be crucial
- ICARUS LAr-TPC will allow the detection/measurement of n CC events while rejecting background from NC interactions;

SBN project at FNAL satisfies these requirements: a crucial role in solving the sterile neutrino puzzle!



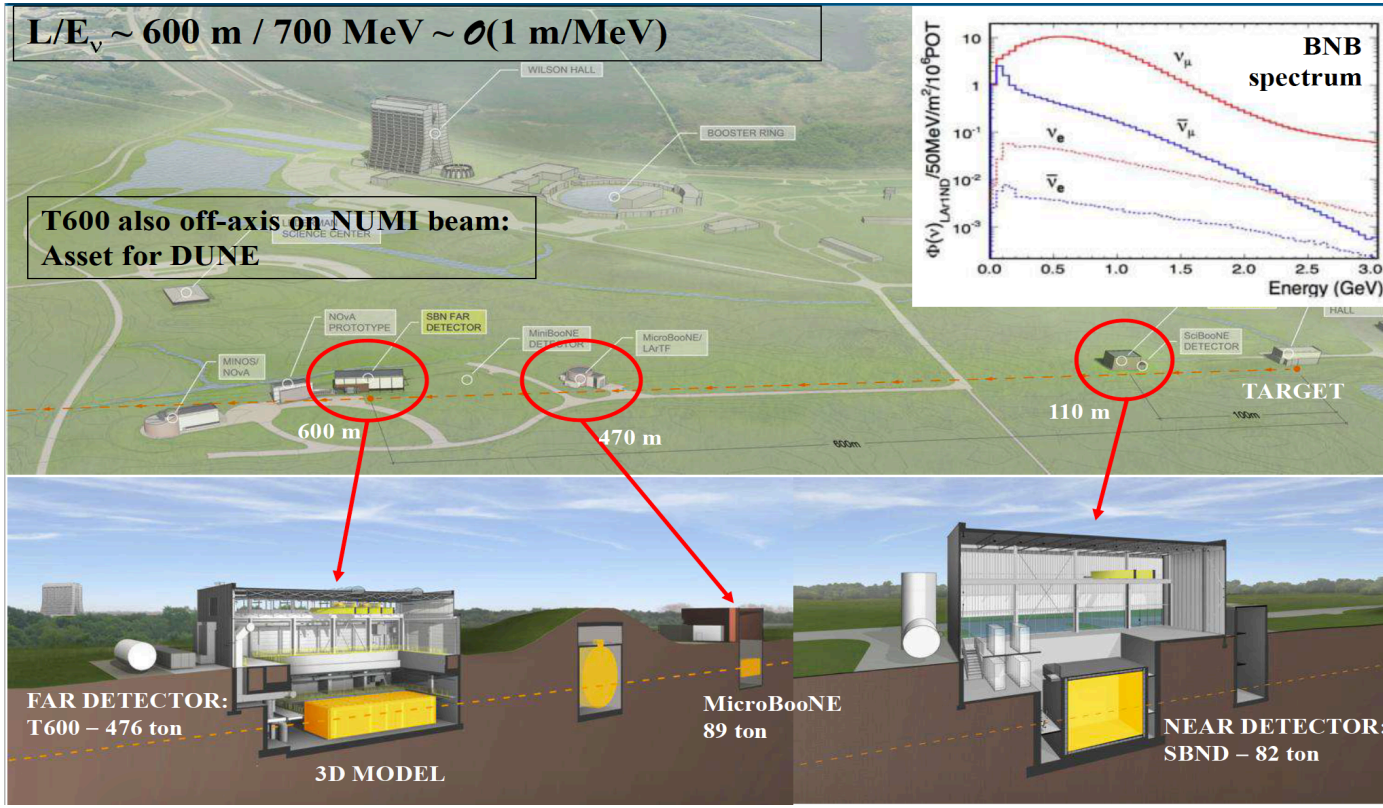
Attività LNS in NU_at_FNAL

- Simulazioni del Near Detector di DUNE, in particolare GENIE
- Partecipazione sviluppo SiPM per FAR detector di DUNE
- Partecipazione costruzione e test CRT ai LNF
- Nel 2020 si parteciperà alla presa dati SBL

The SBN project at FNAL: 3 LAr-TPCs

1. ICARUS T600 (476 ton LAr, 600 m from target)
2. MicroBooNE (89 ton LAr, 470 m)
3. SBND (82 ton LAr, 110 m)

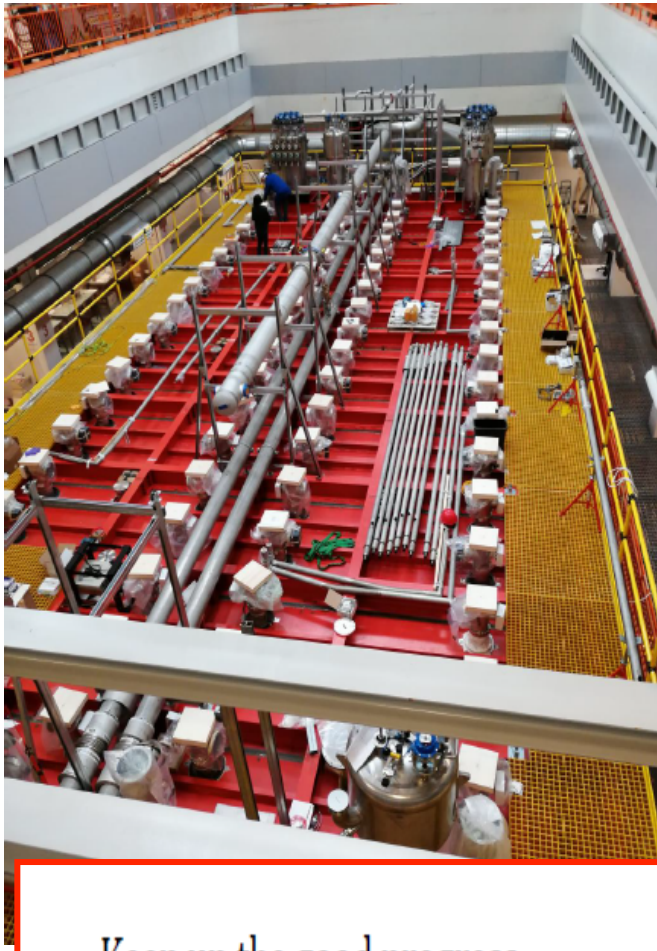
arXiv:1503.01520



- SBN will cover LSND ν_e appearance region at 5σ in 3 years (6.6 10^{20} pot)
- Sensitivity in ν_μ disappearence a factor ~10 beyond the currently excluded region
- ICARUS activation and commissioningìin 2019 first event: beginning 2020
- SBND near detector will start data taking a year later

ICARUS Installation status at FNAL (February 28th, 2019)

- ✓ Two ICARUS modules containing TPC's and PMTs system inserted in the pit;
- ✓ Cable chimneys installed, signal continuity tested;
- ✓ Crosses/electronics feedthrough installation complete;
- ✓ Installation of PMT and optical flanges ~complete;
- ✓ Sealing of manholes, helium leak tightness test done;
- ✓ Top cold shield, warm vessel roof, cryogenics and CRT supports all installed;
- ✓ Electrical connectivity test ~completed;
- ✓ Proximity cryogenics installation is well advancing.



Fermilab

Final Report

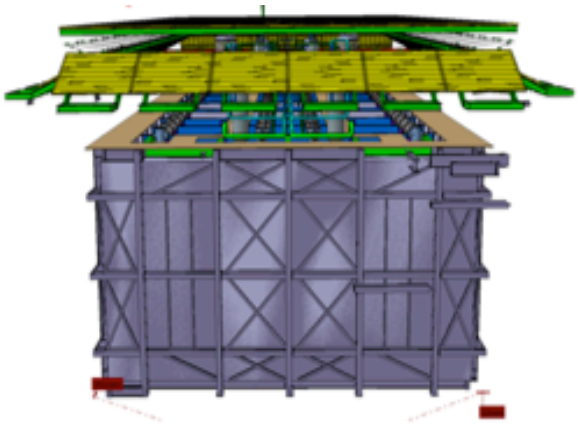
Director's Progress Review of the Short Baseline Neutrino Program

December 17-19, 2018

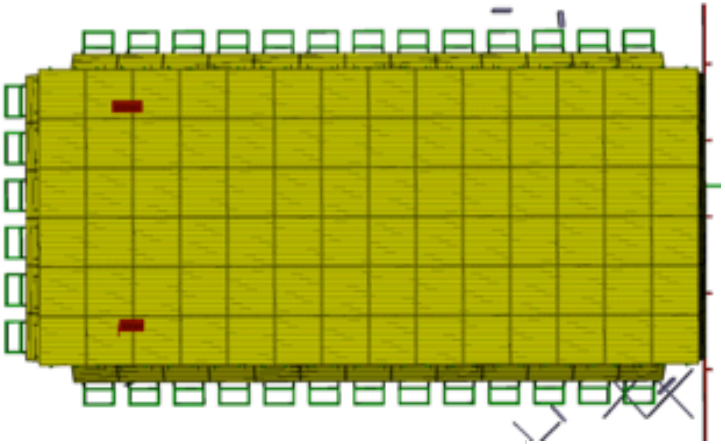
Keep up the good progress.

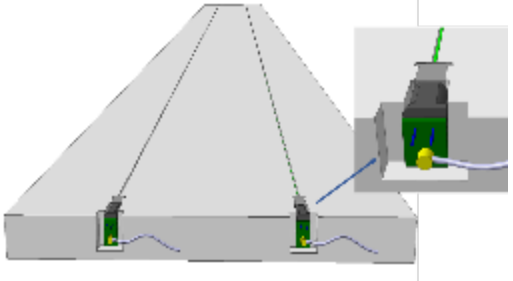
The review committee was pleased with the progress made since the June 2018 review which focussed primarily on schedule. The committee congratulates the team for the great progress in getting the far detector modules installed. Progress on the near detector components is also quite impressive.

Cosmic Ray Tagger



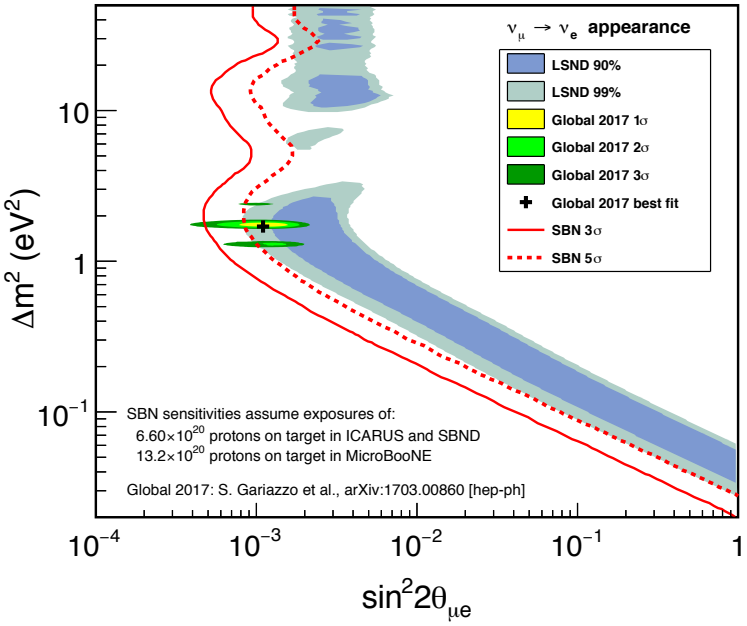
- Top Cosmic Ray Tagger (CRT) system deployed above the ICARUS detector to tag cosmic ray events
- Array of 1.9 x1.9 m^2 modules : 84 modules below concrete plug + 38 modules on sloping parts +spares
- Module design
  - 2 crossed layers of scintillator bars (8 bars/layer)
  - Scintillator bar: 1.84 m long, 23 cm wide , 1 cm (top layer)/1.5 cm (bottom layer) thick ,
  - 2 WLS fibers (Kuraray Y11) - SiPM (Hamamatsu) at one end
  - Light-tight Al boxes
  - Weight: 159 kg
  - Module Readout : 32 channels FEB (Bern design, as SBND) Logical OR of 16-paired channels + coincidence between layers

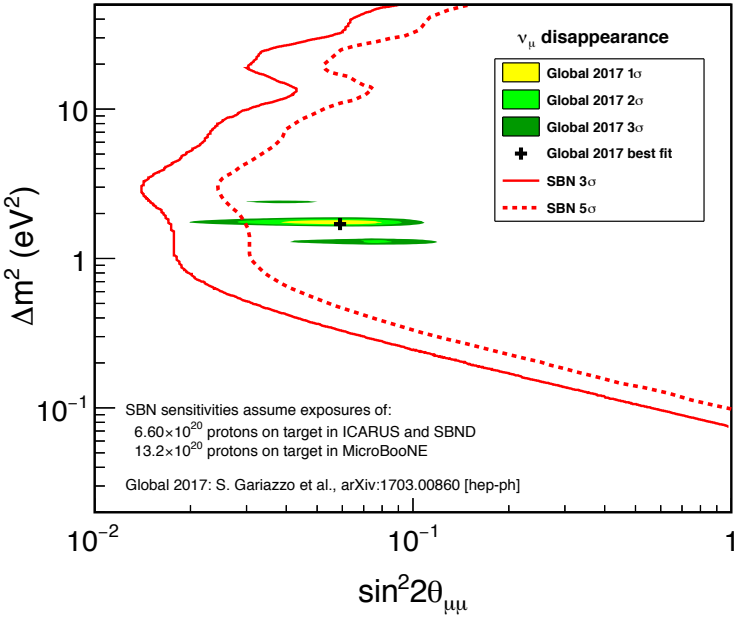




UNDER CONSTRUCTION AT LNF

Expected sensitivity of SBN program





The LSND 99% C.L. region will be covered at ~ 5 σ – level in 3 years of data taking with positive focusing of the BNB (~ 6.6 x 10^{20} pot).

Sensitivity to ν_μ disappearance will cover the current best limits in 3 years of data taking with positive focusing of the BNB (~ 6.6 x 10^{20} pot).