Efforts for Launching JSNS² Experiment at J-PARC

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Poster: 355

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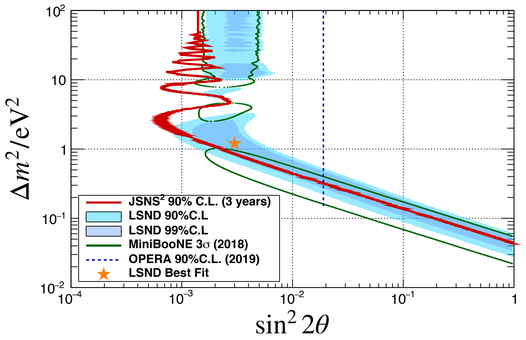
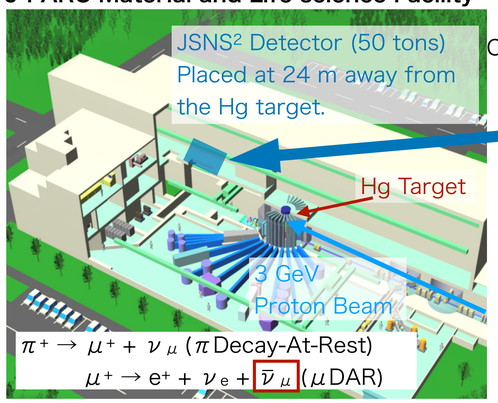
1. JSNS² (J-PARC; E56)

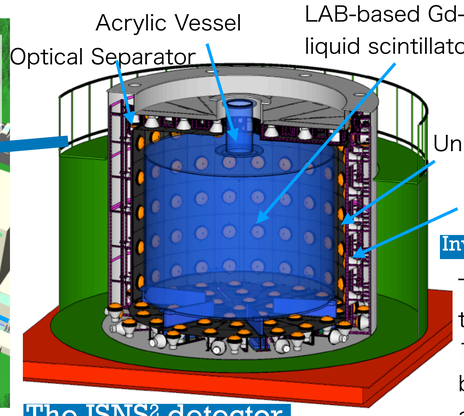
JSNS²[1] is a short baseline neutrino oscillation experiment searching for $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ appearance oscillation indicated by



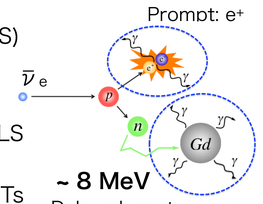
LSND[2] and MiniBooNE[3], which is interpreted as an effect of mixing with non-weakly interacting neutrinos (sterile neutrinos). A goal of JSNS² experiment is to make a conclusion on the sterile neutrino controversy. The unique feature of JSNS² experiment is a direct test to LSND with improved techniques, e.g., Gd-LS detector, the characteristic $\bar{\nu}_\mu$ beam at MLF, and Oscillation shape analysis.

J-PARC Material and Life science Facility



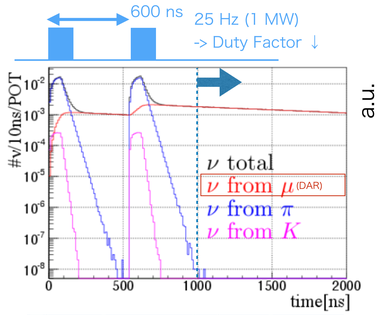


The JSNS² detector

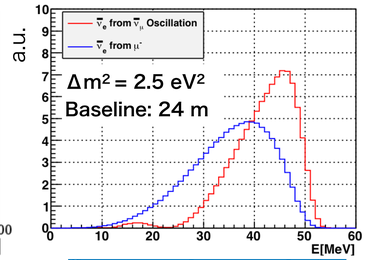


Inverse β decay detection w/ Gd-LS

The detector consists of two types of liquid scintillator (Gd-LS: 17 tons, LS: 33 tons) separated by an acrylic vessel. One of the advantages of the acrylic vessel is capability of physically forming fiducial volume for neutrino detection. Selecting a (quasi-) monochromatic energy (~8 MeV) signal from Gd can tag an event which occurs in the fiducial volume. To sufficiently absorb γ s from the fiducial volume, a layer between the acrylic vessel and the optical separator is filled with the unloaded LS. One of the feature of the JSNS² detector is that the optical separator makes one LS volume two different functional layers.



Time characteristics ν beam

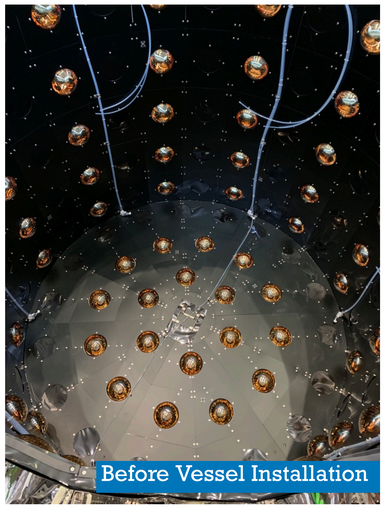


Spectrum shape analysis

2. Detector Construction

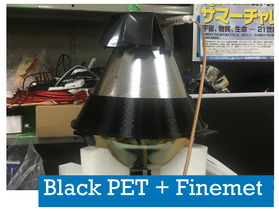
The JSNS² detector has 120 Hamamatsu R7081 photomultiplier tubes (PMTs) whose diameter is 10 inch. 96 out of 120 observe scintillation light from points inside of the optical separator (Inner Detector = ID), other 24 are placed outside of the optical separator to observe light generated when cosmic muon passing through the region as a cosmic-ray anti-counter layer (Veto). Each PMT is surrounded by covers except for its photocathode; a black PET sheet as a local optical separator around PMT, finemet as a magnetic fi-eld shielding and reflector to enhance light collection in the veto layer.

Installation of PMTs and other components, such as LED calibration modules and optical separation materials, was done in the middle of January, 2020. The components were pre-assembled in the same way as PMTs except for magnetic shielding.



Before Vessel Installation

Acrylic Vessel Install



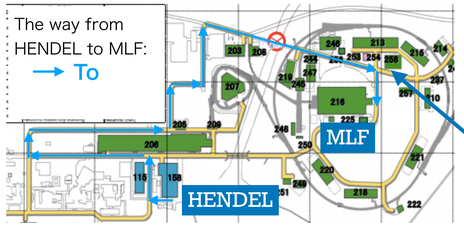
Black PET + Finemet

Reflector

Installation work

As a final sequence of construction, the acrylic vessel was installed at the center of the detector after PMT installation. We successfully completed all installation work and sealing the lid.

After construction at HENDEL, the detector was transported to MLF using a low -bed trailer truck in J-PARC. Vibration exposure was monitored during the entire transportation, and the magnitude of vibration was small compared to the result of the mockup test [5]. This indicates that transportation can not be a cause of a hardware break.



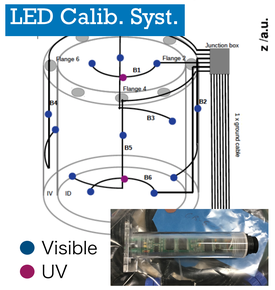
Transportation to MLF

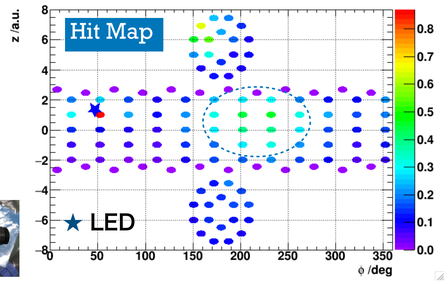
3. Commissioning @MLF

Before filling the detector with Gd-LS/LS, commissioning to check response from PMTs channel per channel was done using LED calibration system mounted in the detector.

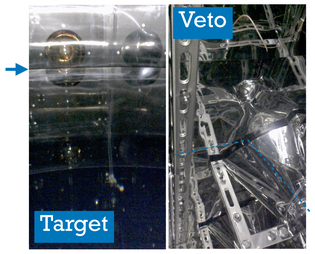
The hit map clearly reflects an angular characteristics of the LED illumination and indicates there is no mistake on mapping. More results are presented at Poster 353 and 444.

LED Calib. Syst.





4. Gd-LS/LS Filling



Filling the detector with Gd-LS and LS began at MLF first floor in the end of May, 2020.

We monitored liquid level in "target" (inside of the acrylic vessel) and veto (out-side of the acrylic vessel) to keep level difference between target and veto within 30 cm which is equivalent to a tolerance pressure of the acrylic vessel.

The average flow rate of Gd-LS and LS was 36 L/min, and we completed filling in 4 days. After filling, the detector was moved to the experimental position in MLF third floor.

5. Status & Summary

- The detector has been constructed and installed into MLF.
- **10 days data-taking has been completed.**
- See more reports from other posters (353, 444) and a talk.

The detector at MLF

6. Reference

[1] S. Arimura et al., arXiv:1705.08629 [physics.ins-det]
[2] A. Aguilar et al., Phys. Rev. D64, 112007 (2001)
[3] A. A. Aguilar-Arevalo et al., (MiniBooNE Collaboration), Phys. Rev. Lett.110.161801 (2013)
[4] N. Agafonova et al., (OPERA Collaboration), Phys. Rev. D100, 051301(R) (2019)
[5] Y. Hino et. al., 2019 JISNT 14 T09010