Status Report: A Search for Sterile Neutrino at J-PARC MLF

April 30, 2014

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1 Introduction

At the previous J-PARC PAC, which was held on Septenber 2013, we proposed the sterile neutrino search at J-PARC MLF [1].

PAC requests us to have a background measurement at the candidate site of the detector of the experiment in their PAC report [2]. The PAC also argues that another PAC, MLF-PAC, will discuss the feasibility of the experiment, such as the interference between the maintenance works of the MLF facility and the experiment since the detector candidate site is the maintenance area of the facility.

Therefore, the collaboration efforts have been focused for these two items mainly after the PAC.

2 Background Measurment

2.1 Approval Process of the 2013BU1301 Experiment

The candidate site of the detector is the 3rd floor of the MLF building (Fig. 1).

As mentioned, this is the maintenance area of the facility, such as for the target exchange or beam-line equipments maintenance, thus there has been no experiments using this area.

Due to the reason, J-PARC has no specific committee to discuss the feasibility of the experiment using the MLF 3rd floor. Then number of the explanations of the test experiment for the background measurement to the facility people, the neutron source group, the muon group and user group has been performed intensively.

It takes more than four months to obtain an approval of the test experiment, and the 2013BU1301 experiment was approved on Feb-2014 officially.

It takes one more month to have an approval of the safety from each facility groups before the installation of the detector equipments. At the end of the March-2014, we installed the detector equipments to the 3rd floor and started the preparation works for the measurement.

2.2 Detector Design (Test Experiment)

At the previos measurement in the 1st floor of the MLF [1], the detector has

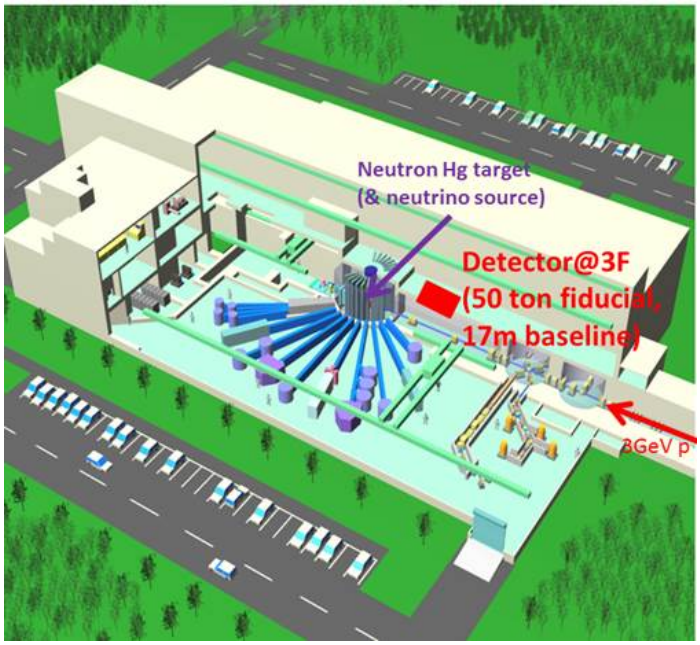

Figure 1: A schematic view of the detector candidate site at the MLF facility in J-PARC (Note: Detector location is still under discussion).

large dead spaces between plastic scintillators. This makes the ambiguity of the vertex reconstruction. At this time, we borrow the plastic scintillators from LEPS2 experiment to compensate it.

Fig.2 shows the schematic view of the detector. There are twenty-four plastic scintillators surrounded by cosmic veto scintillators. (inner vetos and outer vetos). Each scintillator has two light guides and PMTs in one side, and 4 light guides and PMTs in total for both side. Each layer has four scintillators and there are six layers in total. Central two has narrower width than others.

As seen, dead spaces are minimized, and the rejection power of the cosmic rays are much better than the previous experiment.

At the test eperiment, we use 500MHz FADC with copper boards. (65 MHz FADC was used at the previous 1st floor experiment.) Thie will improve the performance of the detector. In the real experiment, we would like to use 500 MHz FADC, therefore the experience provides good demonstration.

2.3 Preparation and Data Taking

During April, we have intensive preparation works in the MLF, such as stacking the scintillators, attaching the PMTs to scintillators, cabling, adjusting the electronics. From the end of the April, we finally start the data taking using MLF beam. Note that the beam was the first resumed beam from the hadron hall accident in 2013.

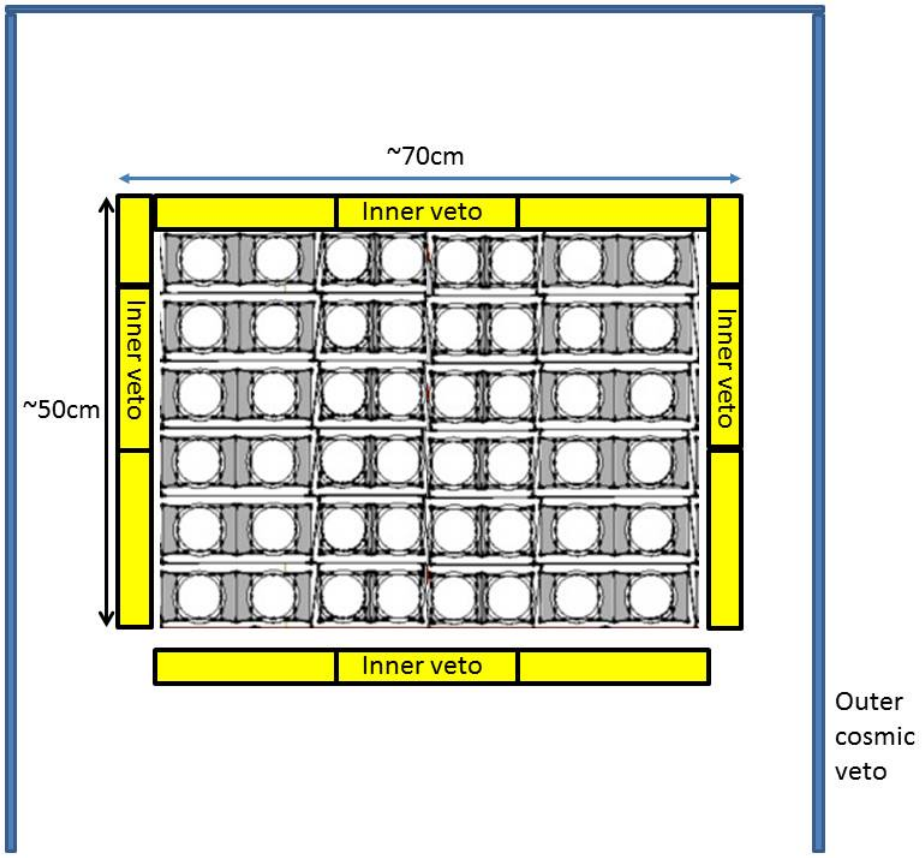

Figure 2: A schematic view of the detector. The main part consists of 24 plastic scintillators (4 / layer, and 6 layers) in the center. Each scintillator has two PMTs in one side and four in total. Yellow part shows the inner cosmic vetos which have thickness of 4.3 cm. The main scintillators and innver vetos have about 180 cm in length. Outer vetos aim to reject cosmic rays around the main part PMTs. They have $\sim$1cm thickness. One plane has more 1m $\times$ 1m or 1m $\times$ 2.3m area.

3 Detector Design for the Real Experiment

The detector design for the real experiment was also being prepared. Especially, the stress calculation during the earthquake and the way to move the detector are studied for the coming MLF-PAC.

Since the area is used to maintain the facility during the shutdown period in summer, the detector has to be moved to the place outside the MLF building at least once per year. This is the most challenging part of the experiment. And we hope to accumulate the constructive discussion with relevant people with MLF-PAC and related meetings.

The current example of the detector design is shown in Fig. 3.

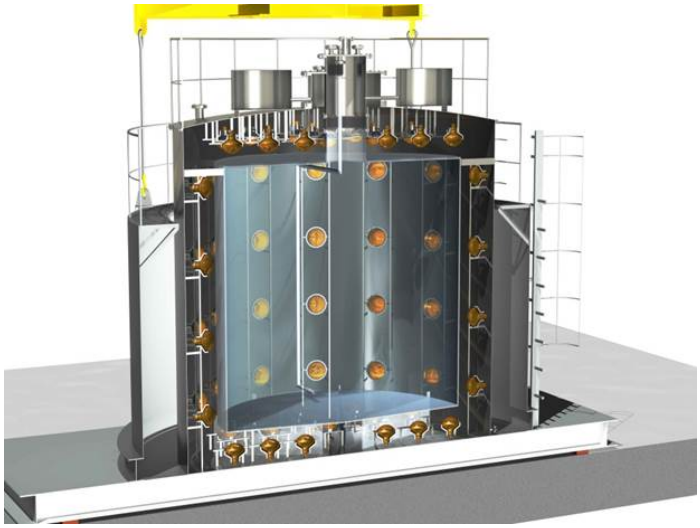

Figure 3: A schematic view of the detector.

We are ready for the first MLF-PAC discussion.

4 Acknowledgements

We warmly thank to MLF people, especially, Prof. Masatoshi Arai, MLF Division leader, the neutron source group, muon group and user facility group for the various kind of supports. LEPS2 experiment provide the opptunity to use good quality scintillators, electronics, cables, PMTs. We deeply appreciate it. We borrow cables, electronics, scintillators from J-PARC Hadron group, University of Kyoto, JAEA, KEK online group, Belle2 experiment and T2K experiment. We would like to express appriciation for their kindness.

Finally, we thank the supports from J-PARC and KEK IPNS.

References

[1] M.Harada, *et al*, arXiv:1310.1437 [physics.ins-det]

[2] `http://j-parc.jp/researcher/Hadron/en/pac_1309/PAC17thMinutes_final_draft.pdf`