【Grant-in-Aid for Specially Promoted Research】

Science and Engineering

Title of Project： Development of the JSNS2 experiment at J-PARC Material and Life science research Faciliy (MLF)

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Keyword：Neutrino, Sterile Neutrino, Liquid scintillator detector

【Purpose and Background of the Research】

The discovery of the neutrino oscillation provides the Novel Prize to Dr. Kajita and Dr. Mcdonald in 2015. The neutrino oscillations provide the flavor (electron, muon, tau, (sterile)) changing of neutrinos as functions of their energy and flight length. This research aims to search for the sterile flavor in the oscillation with high precision.

The sterile neutrinos have no weak interactions, thus the standard model of the elementary particle physics can't explain them. Once the existence of the particle is established, the standard model will be changed drastically.

The search for the sterile neutrino is performed using the neutrino oscillation between active and sterile neutrinos. There are some indications from some experiments, but the certain conclusion has not yet been obtained. This research aims to have a conclusion with the fastest time-scale among the experiments in the world with various upgrades.

With the upgrades of this project, we also aim to strengthen the capability of J-PARC MLF as a facility.

【Research Methods】

Fig.1 shows the setup of this project. The current JSNS2 experiment uses one detector located on MLF 3rd floor with the baseline of 24 m from the mercury target. Total 50 tons of liquid scintillator is immersed in the detector, and search for the anti-ν_e signal oscillated from anti-ν_μ during 24m. The data taking was started from 2020 June.

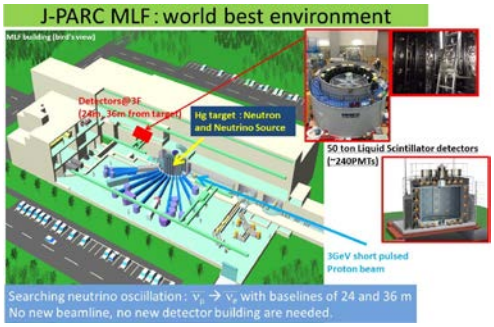

Fig.1 ; The setup of the JSNS2

We improve the sensitivity putting the new 50 tons of detector with 36 m baseline. The different oscillation pattern of the signal, and the better understanding of backgrounds are available from this upgrade.

The upgrades of liquid scintillator, electronics, the proton beam final focus, and precise cross section meas. for parent particles of neutrinos and neutrons in Hg-proton reaction also provide not only significant improvement of the sensitivity but also that of the facility capabilities.

【Expected Research Achievements and Scientific Significance】

Fig.2 shows the improved sensitivity with all upgrades. The horizontal axis corresponds to the mixing angle between anti-ν_μ to anti-ν_e, and the vertical one shows the square of difference between 4th and other mass eigen-states. The shaded region can be searched with this experiment while the blue areas (99%, (90%) C.L.) show the indicated regions from prior experiments. We improve the most important region of indicated region (lower Δm^2: recent stronger indicated region (dashed ellipse)) compared to the current JSNS2 (dashed red lines).

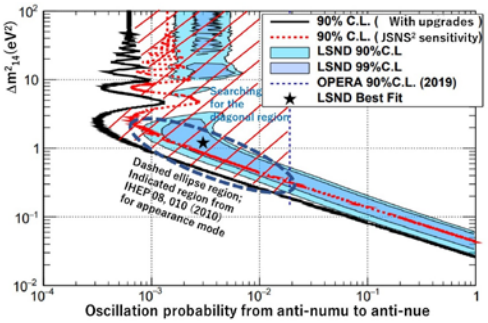

Fig.2: The improved sensitivity of JSNS2 with upgrades

In addition, we upgrade the MLF capability as mentioned, and the xsec of the monochromatic 236 MeV ν_μ (created at Hg in Kμ2) and LS can also be measured precisely.

【Publications Relevant to the Project】

・ S.Ajimura et al, arXiv:1705.08629 (TDR)
・ M. Harada et al, arXiv:1310.1437 (Proposal)

【Term of Project】 FY2020-2024

【Budget Allocation】 474,500 Thousand Yen

【Homepage Address and Other Contact Information】

https://research.kek.jp/group/mlfnu/eng