【Grant-in-Aid for Scientific Research (S)】

Science and Engineering (Mathematical and Physical Sciences)

Title of Project： Searching for a sterile neutrino at J-PARC MLF

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Research Area：Physics
Keyword：Experimental research for the elementary particle physics

【Purpose and Background of the Research】

The discovery of the neutrino oscillation phenomena provides the Novel Prize to Dr. Takaaki Kajita and Dr. Art Mcdonald in 2015. The neutrino oscillations provide the flavor (electron, muon, tau, (**sterile**)) changing of neutrinos as a function of their energy and flight length. This research aims to search for the sterile neutrino 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 should be changed drastically based on the fact.

The search for the sterile neutrino is performed using the neutrino oscillation between active and sterile neutrinos. There are some indications for the phenomena with the experiments using neutrinos from accelerator, reactor and radioactive source, but the definite conclusion of the existence has not yet been obtained. This research aims to have a conclusion with the fastest time-scale among the planned experiments in the world.

【Research Methods】

Figure1 shows the setup of the experiment, which consists of MLF building and a detector. From right hand side, 3GeV protons are injected to the mercury target, which creates not only neutrons for life and material science but also number of

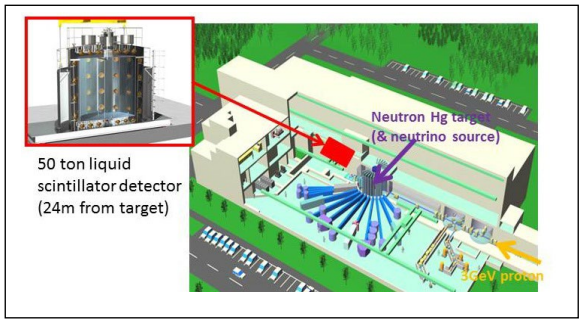

Fig1 setup at MLF

neutrinos. After the proton injections to the target, μ^+ is created and stopped, and it decays to e^+, ν_e and anti-ν_μ. We put the detector with 50 tons of liquid scintillator to the red box in the figure (on the 3rd floor of the MLF) and the baseline from the target is about 24 meters. We search for the anti-ν_μ to anti-ν_e oscillation with 24 meters. This oscillation phenomena with such a short distance is only happened in the case that sterile neutrinos exist.

【Expected Research Achievements and Scientific Significance】

Figure2 shows the sensitivity of this research. The horizontal axis shows the oscillation fraction from anti-ν_μ to anti-ν_e, and the vertical axis shows the squared of eigen-state mass difference of 4th

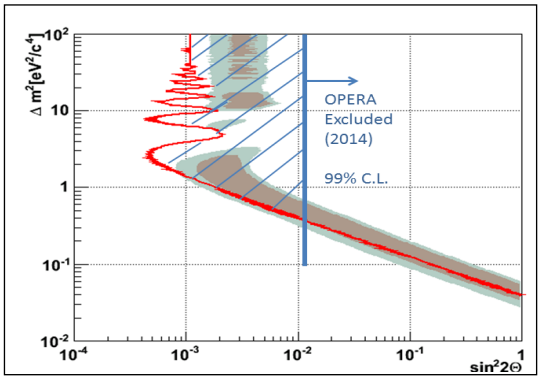

Fig.2　sensitivity

and other neutrinos. The shaded region can be searched with this experiment while the brown (99%C.L) and the green (90%) show the indication regions from prior experiments. We can conclude most of the region of interest with 90%C.L.

【Publications Relevant to the Project】

- S. Ajimura et al, PTEP 2015 6, 063C01 (2015)
- M. Harada et al, arXiv:1310.1437 (proposal)

【Term of Project】FY2016-2020
【Budget Allocation】140,100 Thousand Yen
【Homepage Address and Other Contact Information】
http:// research.kek.jp/group/mlfnu/