A Search for Sterile Neutrino at J-PARC Materials and Life Science Experimental Facility

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In 2013, we proposed definite search for the existence of neutrino oscillations with Δm^2 near $1eV^2$ at the J-PARC Materials and Life Science Experimental Facility (MLF) [1]. With the 3 GeV Rapid Cycling Synchrotron (RCS) and spallation neutron target, an intense neutrino beam from muon decay at rest (*μDAR*) is available. Neutrinos come predominantly from μ^+ decay : $\mu^+ \rightarrow e^+ + \bar{\nu}_\mu + \nu_e$. The oscillation to be searched for is $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ which is detected by inverse β decay interaction $\bar{\nu}_e + p \rightarrow e^+ + n$ followed by gammas from neutron capture.

The unique features of the proposed experiment, compared with the prior experiment at LSND [2] and experiments using conventional horn focused beams, are;

1. The pulsed beam with about 600 ns spill width from J-PARC RCS and muon long lifetime allow us to select neutrinos from *μDAR*. This can be easily achieved by gating out for about 1μs from the start of the proton beam spill. This eliminates neutrinos from pion and kaon decay-in-flight.
2. Due to nuclear absorption of π^- and μ^-, neutrinos from μ^- decay are suppressed to about the 10^{-3} level. The resulting neutrino beam is predominantly ν_e and $\bar{\nu}_\mu$ from μ^+ decay with contamination from other neutrino species at the level of 10^{-3}.

Currently, we plan to use Gd-loaded liquid scintillator detector with 50 tons of the target volume for the neutrinos at 3rd floor in MLF. In order to design the detector, we started to

measure backgrounds around the actual candidate site of the detector location with a plastic scintillator detector with 0.5 tons of mass this March. Mainly, we measure beam-related neutrons and gammas from thermal neutron capture in materials around the site. After finishing the detector construction, data taking is going well. In this symposium, we present overview of the real experiment and status of the background measurement at the actual candidate site of the detector location.

References

[1] M. Harada et al., arXiv:1310.1437.
[2] A. Aguilar et al., Phys. Rev. D64, 112007 (2001).