Short-baseline Electron Antineutrino Disappearance Study by Using Neutrino Sources from $^{13}C + ^{9}Be$ Reaction

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Over the past few decades, a considerable number of studies has been done on the neutrino oscillation with a great success of measuring neutrino mixing angles. However, some experiments (LSND, MiniBoone, reactor experiments and gallium experiments) for the neutrino oscillation revealed more or less disagreements with the three-flavor neutrino model, which termed as neutrino anomalies. One of the approaches for explaining the anomalies is to presume the existence of the hypothetical fourth neutrino (sterile neutrino) because the sterile neutrino does not interact with other particles except for a mixing with active neutrinos.

In our work [1], to investigate the existence of sterile neutrino, we propose new experimental setup (see figure 1) and electron antineutrino source using ^{13}C beams based IsoDAR concept. The neutrino source is obtained through β^- decays of unstable isotopes which are generated from the $^{13}C + ^{9}Be$ reaction. Main isotopes (^{8}Li, ^{9}Li, ^{12}Be, ^{12}B, and ^{13}B) for neutrino production have similar half-lives and reaction Q values of β^- decay, and thus the neutrino energy spectrum with a single broad peak is expected.

The production yields of those isotopes are calculated using three different nucleus-nucleus (AA) reaction models [1]. Even though different yields of the isotopes are obtained from the models, the neutrino spectra are almost identical. This unique feature gives a realistic chance to neutrino oscillation study through shape analysis, regardless of the theoretical AA models considered.

Ratios of the expected total event rate for the P_{3+1} model to that for the P_3 model (R_{3+1}-to-R_3) at L = 13 m and L = 21 m show distinguishable features of the event rates (see Figure 2), and thus it can also give a meaningful signal for the existence of the hypothetical ν_s. The expected deviation between the maximum and the minimum values is approximately 17 %, and thus it can give an effective answer of whether P_{3+1} models is the most appropriate model for the sterile neutrino.

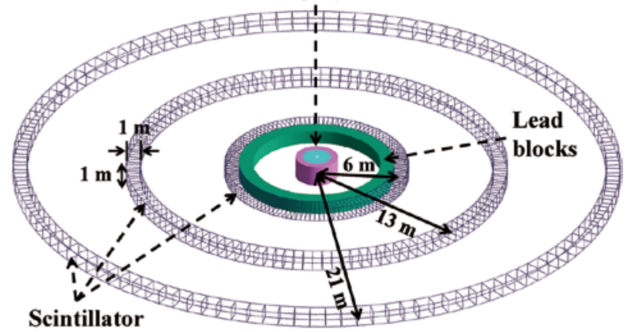

Figure 1: A schematic view showing proposed short baseline experiment setup.

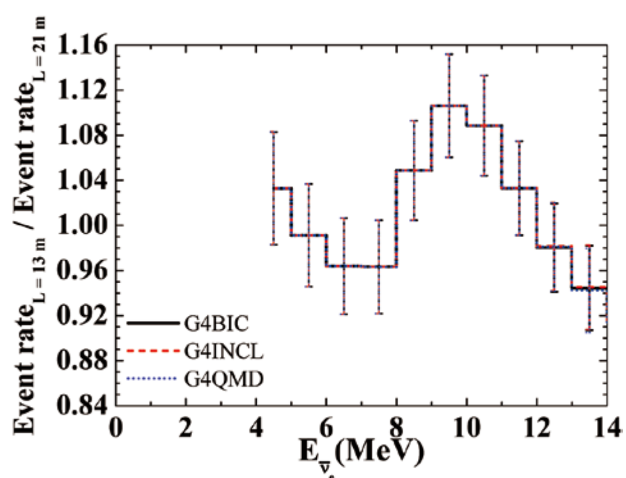

Figure 2: Ratios of R_{3+1}-to-R_3 with respect to $E_{\bar{\nu}_e}$ at different L are shown.

Reference

[1] Shin, J. W., et al.: 2017, *J. Cosmol. Astropart. Phys.*, **04**, 044.