PROCEEDINGS OF SCIENCE

Status of $K_L^0 \to \pi^0\gamma\gamma$ in the KOTO Experiment at J-PARC

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A preliminary report on the study of the rare decay $K_L^0 \to \pi^0\gamma\gamma$ at the J-PARC KOTO experiment was presented. We introduced a new trigger that counts the number of electromagnetic showers in the CsI calorimeter. By analyzing the data collected in 2017, the estimated number of signal events is 187.

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1. Introduction

The branching ratio of the $K_L^0 \to \pi^0\gamma\gamma$ decay has been predicted by the $\mathscr{O}(6)$ calculation in chiral perturbation theory [1]. Fermilab E832 [2] and CERN NA48 [3] have measured the branching ratio and the pole parameter α_V.

2. Principle

The KOTO detector shown in Fig. 1 consists of a CsI calorimeter to measure the energy and position of incident photons, and hermetic veto counters to capture extra particles from other K_L^0 decays. A trigger based on the number of electromagnetic showers was commissioned to collect the $K_L^0 \to \pi^0\gamma\gamma$ events. Events with four showers in the calorimeter without any in-time extra hits in other detector components were selected and reconstructed with the π^0 and K_L^0 mass constraints. After imposing veto requirements, one of the main background sources is the $K_L^0 \to 3\pi^0$ decay because multiple photons can be merged into a single shower. A pre-generated shower shape library from the Monte Carlo simulation was developed and was compared with the data to suppress such merged shower clusters in the calorimeter. Another background source, $K_L^0 \to \pi^0\pi^0$, can be removed by requiring the invariant mass of the two photons in the final state of $K_L^0 \to \pi^0\gamma\gamma$ to be away from the π^0 mass.

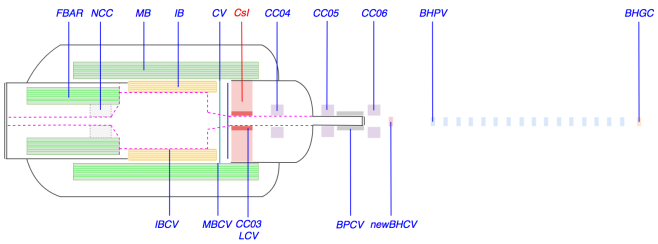

Figure 1: KOTO detector.

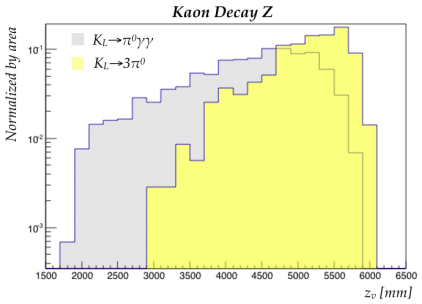

Figure 2: Kaon decay Z distribution of signal is different from that of background in Monte Carlo.

3. Results

Because the $K_L^0 \to 3\pi^0$ events preferentially populate the downstream region as shown in Fig. 2. By fitting the data with the signal and the background probability density functions, we estimated that we collected 187 signals events in 2017.

References

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