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Search for the rare decay of $K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$ with the KOTO detector ($10^9 + 5$)

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The goal of the J-PARC KOTO experiment is to observe the $K_L^0 \rightarrow \pi^0 \nu \bar{\nu}$ decay and measure its branching ratio. The prediction for the branching ratio from (SM) processes is 2.4×10^{-11} with a theoretical uncertainty of 2.5% [1], and the previous experimental limit is 2.6×10^{-8} , set by the KEK E391a collaboration [2]. A comparison of experimentally obtained results with SM calculations permits a test of the quark flavor region and a search for physics beyond the SM.

In spite of the success of the KEK E391a collaboration, it highlighted the need for further upgrades with the anticipated increase of beam power, and motivated the development of the KOTO detector. A characteristic of the process of interest is a pair of photons from the π^0 decay and no detected particles. KOTO uses a Cesium Iodide (CSI) electromagnetic calorimeter as the main detector to measure the energies and positions of the two photons, and hermetic veto counters to guarantee that there is no extra detectable particle.

The first data was collected in spring 2013, and since then we have four additional data runs in 2015 at beam powers of roughly 24 and 39 kW respectively. In this talk, we present a description of the upgrades and improvements to the detector, recent results, and aim to reach the sensitivity of the Grossman-Nir [3] for the larger 2015 data.

[1] J. Brod;..et al.: Phys. Rev. D, 83, 034030 (2011)

[2] J. Ahn et al., Phys. Rev. D, 81, 072004 (2010)

[3] Y. Grossman;..et al.: Adv.Ser.Direct.High Energy Phys.15:755-794,199

Author: Dr BECKFORD, Brian (University of Michigan)

Presenter: Dr BECKFORD, Brian (University of Michigan)

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