Halo neutron measurement for KOTO experiment

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The $K_L \to \pi^0 \nu\bar{\nu}$ decay is a rare direct CP-violationg process and powerful probe to search for new physics beyond the Standard Model [1]. The KOTO experiment aims to observe this decay using an upgraded KEK-E391a detector and a high intensity K_L beam line constructed at J-PARC.

In E391a experiment, a pilot experiment of KOTO, there were remaining neutrons around the narrow K_L beam, called "halo neutron", and π^0's generated by the interaction of halo neutron with the E391a detector became a main background[2]. In KOTO experiment, we developed a gamma and neutron counter, called Neutron Collar Counter (NCC) to suppress and estimate this neutron background.

NCC modules are made of undoped CsI crystals, divided into 3 parts along beam direction and read with wavelength shifting fibers. NCC was designed to veto halo neutron backgrounds by detecting the energy deposited in neutron interactions. NCC was also designed to measure the flux and energy of halo neutrons, distinguishing neutron events from other KL-decay events using the difference of three-dimensional shower shapes.

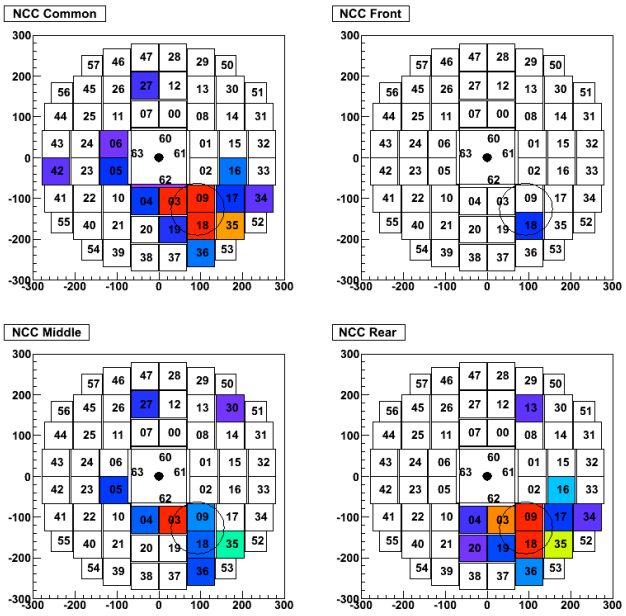

Fig. 1 an event display of halo neutron candidate. Total energy(top left),front energy(top right) middle energy(bottom left), and rea energy(bottom right) are shown.

Construction of NCC was finished in Nov. 2012.It was installed inside the KOTO detector in December 2012. Data taking for halo neutron measurement was performed in March 2013 and April 2013.This presentation mainly shows an analysis method by which we distinguish halo neutron events from γ events generated by K_L decays, and an estimation of K_L decay contamination for the halo neutron measurement .

References

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