The J-PARC KOTO experiment aims to observe the rare decay of long lived kaon, $K_L \rightarrow \pi^0 \nu \nu$. In the KOTO experiment, identification of the $K_L \rightarrow \pi^0 \nu \nu$ decay is made by detecting of only 2 gammas from π^0 in the final state. To confirm only 2 gammas exist in the final state, the KL decay region is fully covered by detectors. The number of background depends on the inefficiency of these detectors. To reduce the number of background, we should reduce the inefficiency of these detectors.

To reduce background, we plans to reduce inefficiency of photon by adding another photon detector named “Inner Barrel”. Inner Barrel is a lead/scintillator sandwich-type photon detector to veto extra photons. Inner Barrel consists of 32 modules, forming a 1.9 m-diameter cylinder. Scintillation light from each module is read out through wavelength-shifting fibers (WLS-fibers) and detected with PMTs. The requirement for Inner Barrel is that the number of photoelectrons which are detected at PMT is more than 5 when deposit energy by incident particle is 1 MeV .

The purpose of my work is to make a one module of Inner Barrel which satisfies the requirement. To achieve the purpose, I made a system for measuring the light yield of WLS fibers because the number of photoelectrons at PMT depends on the light yield of WLS fibers. By using the system, I measured the light yield of WLS fibers and observed that the light yield distribution of WLS fibers was broad. Because of the broad light yield distribution of WLS fibers, some WLS fibers do not satisfy the requirement. To solve this problem, I devised two countermeasures. One of them is using Polymer Light Guide to reduce the amount of low light yield WLS fibers using for Inner Barrel. The other is assigning WLS fibers to scintillators for all scintillators to satisfy the requirement, based on the result of light yield measurement of WLS fibers. Applying these countermeasures, I made the one module of Inner Barrel and measured the number of photoelectrons at PMTs of the module. The number was 5.6 ± 0.2 p.e./MeV by the test using cosmic rays and satisfied the requirement for Inner Barrel. I also measured the light attenuation length of the module, the speed of light in the module and the timing resolution of the module as basic performance of the module.