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論文題目：Search for neutrinoless double beta decay of 48Ca in CANDLES

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This dissertation reports searched for neutrinoless double-beta decay ($0\nu\beta\beta$) of ^{48}Ca with the CANDLESⅢ experiment. Observation of this decay demonstrates existence of a process beyond the Standard Model and it requires lepton number violation which is vital for understanding of the baryon asymmetry in our universe. This decay demonstrates Majorana nature of neutrino and its rate gives neutrino mass scale since the decay is very rare process. The experiments for its observation requires large target nuclear mass, low background techniques and high energy resolution. Reduction of backgrounds for given target mass is the most challenging part of the experiments. The Q value of ^{48}Ca 4.3 MeV is the highest among all $0\nu\beta\beta$ candidate nuclei, which has the potential to give least backgrounds. Taking of this advantage, we aim to achieve background free measurement.

The CANDLESⅢ experiment starts operating from June 2016 at Kamioka observatory after construction of passive shield. The events of gamma ray from the (n, γ) reactions, which were dominant backgrounds at Q value region are reduced drastically. Currently, gamma ray outside of the detector is negligible. Radioactive contamination contained in CaF_2 crystals is left to be reduced by an analysis described in this thesis. Among many radioactivity ^{232}Th chain gives most serious background which are ^{212}Bi-Po sequential decay and ^{208}Tl beta decay. Half-life of ^{212}Bi-Po 0.3 μsec is shorter than the time constant of CaF_2 as 1 μsec. Therefore, beta and alpha waveform are combined and its sum energy reaches to Q value region. ^{212}Bi-Po is removed by double pulse shape discrimination using this characteristic of waveform. The Q value of ^{208}Tl 5.0 MeV is and its sum energy of beta and gamma ray also reaches to Q value region. ^{208}Tl is removed by delayed coincidence analysis. ^{212}Bi alpha ray is selected by Pulse Shape Discrimination. Then, all events within 18 min which is longer than half-life of ^{208}Tl 3 min after observing 212Bi alpha ray in same crystal are vetoed.

The detection efficiency of $0\nu\beta\beta$ decay and the number of expected backgrounds are evaluated by Monte Carlo simulation. A new limit on the half-life of $0\nu\beta\beta$ decay of $T_{1/2} > 0.33 \times 10^{23}$ yr at 90 % C. L. is obtained using 93 crystals. In using 26 crystals that are low radioactivity, we achieve background free measurement and lower limit on the half-life of 0nbb decay of $T_{1/2} > 1.08 \times 10^{23}$ yr at 90 % C. L. is obtained.