Study of ^{48}Ca double beta decay with CANDLES

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CANDLES is the project to search for double beta decay of ^{48}Ca by using CaF_2 scintillators[1]. Study of double beta decay becomes of particular importance after confirmation of neutrino oscillation which shows that neutrinos have mass. The characterization of neutrino (Majorana or Dirac particle) and the absolute scale of neutrino mass are still unknown. If neutrinos have Majorana mass they violate lepton number conservation and neutrino-less double beta decay (0νDBD) can then take place. Therefore the study of the 0νDBD is one of the most fundamental research to be carried out in a coming decade.

We have been studying the DBD of ^{48}Ca using CaF_2 scintillators. The Q-value of ^{48}Ca is the highest (4.27 MeV) among potential DBD nuclei. The Q-value is far above energies of γ-rays from natural radioactivities (maximum 2.615 MeV from ^{208}Tl decay), therefore we can naturally expect small backgrounds in the energy region we are interested in.

Required performances for the detector system to study DBD are radio-purity, good background rejection efficiency and good energy resolution. We are now constructing CANDLES III detector (Figure 1) in our laboratory at sea level, which consists of 40 PMTs and 60 CaF_2 crystals with the total mass of 191kg. The basic performances of the system, including the light collection, position reconstruction and background rejection, will be further studied with CANDLES III. On the bases of experiences in CANDLES III, the CANDLES project will be scaled up to several tons of calcium to have the sensitivity to the mass region of interest.

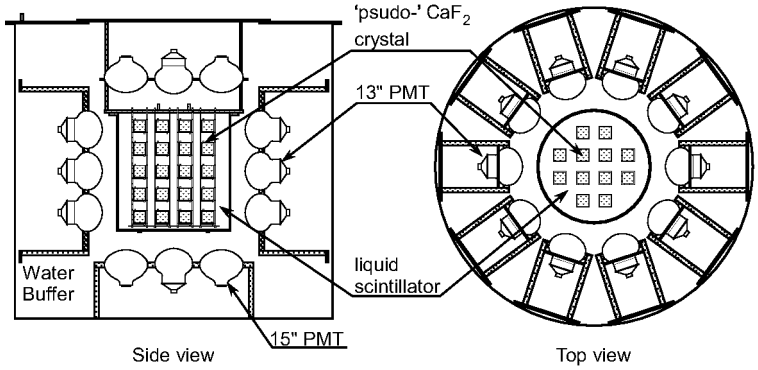

Figure 1: Schematic cross sectional view of the constructing CANDLES III detector.

1. I. Ogawa et al., *Proc. of the 5th Int. Workshop on Neutrino Oscillations and their Origin (NOON2004)* (2005) 260.