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Development of Scintillating Bolometers for Neutrinoless Double Beta Decay of Ca-48

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The observation of neutrino-less double beta decay(0nbb) would be the most practical way to prove the Majorana nature of the neutrino and lepton number violation. CANDLES studies Ca-48 double beta decay using CaF2 scintillator. The detector is currently operating with CaF2 crystals in the Kamioka underground observatory, Japan.
As a next generation detector of the CANDLES experiment, we develop a simultaneous detection method for heat and light signals from CaF2 crystals at mK temperatures. The simultaneous detection using a scintillating bolometer is advantageous for 0vbb search experiments because of its good energy resolutions and strong particle identification capability.
As an R & D of the project, we carried out low temperature experiments with both CaF2(pure) and CaF2(Eu) scintillation crystals using metallic magnetic calorimeter (MMC) technology.
We achieved simultaneous measurement of heat and light signals from a CaF2 crystal for the first time. The signals associated with electron/gamma events were also distinguishable from internal alpha events in the crystal.
We also found ultraviolet scintillation of CaF2(pure) was absorbed in the gold film on the crystal surface resulting in a part of heat signal. The gold film was designed as a phonon collector for the heat channel. This heat signal contribution from light absorption in the phonon-collector film affects the measured energy resolution of about 2% but with some improvement possibility from pulse shape analysis. On the other hand, another set of measurement was made using a CaF2(Eu) which has scintillation in visible region. Improved resolutions and discrimination power were obtained. In the presentation, we discuss the measurement results using both CaF2(pure) and CaF2(Eu) crystals together with future plans for 0vbb applications.

Less than 5 years of experience since completion of Ph.D

N

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N

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