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CANDLES - Search for neutrino-less double beta decay of ^{48}Ca -

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CANDLES is the project to search for neutrino-less double beta decay ($0\nu\beta\beta$) of ^{48}Ca. $0\nu\beta\beta$ is acquiring great interest after the confirmation of neutrino oscillation which demonstrated nonzero neutrino mass. Measurement of $0\nu\beta\beta$ provides a test for the Majorana nature of neutrinos and gives an absolute scale of the effective neutrino mass.

Among double beta decay nuclei, ^{48}Ca has an advantage of the highest Q-value (4.27 MeV). This large Q-value gives a large phase-space factor to enhance the $0\nu\beta\beta$ rate and the least contribution from natural background radiations in the energy region of the Q-value. Therefore good signal to background ratio is ensured in the measurement of $0\nu\beta\beta$.

In order to search for $0\nu\beta\beta$ of ^{48}Ca, we proposed CANDLES system by using CaF_2 scintillators[1]. The CANDLES system aims at a high sensitive measurement by a characteristic detector structure and ^{48}Ca enrichment. The detector structure realizes a complete 4π active shield by immersion of the CaF_2 scintillators in liquid scintillator. The active shield leads to a low background condition for the measurement. On the other band, ^{48}Ca enrichment is also effective for the high sensitive measurement, because natural abundance of ^{48}Ca is very low (0.19%). This means that an improvement of sensitivity by enrichment is a maximum of 20 times for the neutrino mass. However ^{48}Ca enrichment is generally difficult and expensive. Therefore we started the study of ^{48}Ca enrichment and succeeded in obtaining enriched ^{48}Ca although it is a small amount.

We installed the CANDLES III system, which contained 350 g of ^{48}Ca without enrichment, at the Kamioka underground laboratory. Now we installed a light-concentration system to a good energy resolution. A photo-coverage was about twice larger than the one without the light-concentration system. And we started a $0\nu\beta\beta$ measurement and have data of a measurement time for 3 months.

Here we will report the result of the measurement in 2012 and the expected sensitivity with the light-concentration system.

[1] T. Kishimoto et al., Proc. of 4th Workshop on Neutrino Oscillations and their Origin, 338 (2003);