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CANDLES project for the study of neutrino-less double beta decay of 48Ca

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There is, presently, strong evidence that neutrinos undergo flavor oscillations,and hence must have finite masses. Neutrino-less double beta ($0\nu\beta\beta$) decay measurement offers a realistic opportunity to establish the Majorana nature of neutrinos and gives the absolute scale of the effective neutrino mass. CANDLES is the project to search for $0\nu\beta\beta$ decay of ^{48}Ca. A distinctive characteristic of ^{48}Ca is the highest Q value (4.3 MeV) among $0\nu\beta\beta$ isotopes. Therefore it enables us to measure $0\nu\beta\beta$ decay signals in background free contribution. The CANDLES system consists of undoped CaF_2 scintillators (CaF_2),liquid scintillator (LS), and large photomultiplier tubes (PMTs). A large number of CaF_2 crystals in the form of 10 cm cubes are immersed in the LS. Scintillating CaF_2 crystals work as an active source detector for $0\nu\beta\beta$ decay of ^{48}Ca, together with LS as a multi-purpose detector component to both reject backgrounds and to propagate scintillation photons. PMTs are placed around the LS vessel to detect photons from both scintillators. The simple design concept of CANDLES enables us to increase the ^{48}Ca source amount. ^{48}Ca enrichment is also effective for the high sensitive measurement, because natural abundance of ^{48}Ca is very low (0.19%). We have studied ^{48}Ca enrichment and succeeded in obtaining enriched ^{48}Ca although it is a small amount. Now we have developed the CANDLES III system, which contained with 300kg CaF_2 crystals without enrichment, at the Kamioka underground laboratory. New light collection system was installed in 2012, and accordingly photo-coverage has been enlarged by about 80%. Further improvement will be expected in 2014 by installing a detector cooling system in order to increase light emission from CaF_2 crystals. The detail of the latest CANDLES III (U.G.) system and its performance will be presented. Recently, we found that gamma rays from neutron captures on materials surrounding detector could be dominant background. These background estimation and prospects of backgrounds shielding will be also discussed.