

Underground Experimental Program in Korea

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ABSTRACT

Yangyang Underground Laboratory (Y2L) was constructed in 2003 in a tunnel of Yangyang Pumped Storage Power Plant operated by Korea Hydro and Nuclear Power Co. Ltd. The laboratory is accessed by a car driving on a paved road of 2 km from the entrance of the tunnel. The vertical earth overburden above the tunnel is approximately 700 m. The muon flux measured in the laboratory is consistent with 2000m water equivalent depth. Y2L was originally constructed to carry out an experiment for direct search for Weakly Interacting Massive Particles (WIMPs), the Korea Invisible Mass Search (KIMS) experiment. KIMS successfully developed radio-pure CsI(Tl) crystals. KIMS result on WIMP search using four crystal detectors was published in 2007. KIMS installed 12 crystals (~100kg) and have been taking data since 2008. The period of the stable data taking approaches two years by the end of August 2011. A new result from the pulse shape analysis for one year data is reported here. The Annual Modulation (AM) analysis is also in progress and two-year data is expected to be used for the AM analysis.

KIMS operates an HPGe detector to measure the internal background level of various materials including CsI powders and crystals. The HPGe detector is also utilized in searches for neutrinoless double beta decays to excited states of the daughter nuclei and also EC/ β^+ decays. In addition, EC/ β^+ decay of ^{92}Mo is searched by using CaMoO_4 crystals surrounded by CsI(Tl) crystal detectors for the gamma tagging.

A new collaboration, AMoRE (Advanced Molybdenum based Rare Process Experiment) was formed recently to carry out an experiment searching for neutrinoless double β decay of ^{100}Mo using $^{40}\text{Ca}^{100}\text{MoO}_4$ crystal detectors. The collaboration consists of researchers from Russia, Ukraine, China and Korea. An extensive R&D program on the development of the CaMoO_4 crystals with the natural and with the enriched materials has been carried out. CaMoO_4 crystals made of enriched ^{100}Mo and Ca depleted in ^{48}Ca were successfully grown and are being tested at Y2L. We are also developing cryogenic detector based on CaMoO_4 crystal and Metallic Magnetic Calorimeter (MMC) sensor. Excellent energy resolution was achieved with cryogenic detector made of small sized crystals. Cryogenic detector with large volume of 250 g mass is also being developed. Progress and prospects of AMoRE and possibility of the extension of the laboratory space will be presented.