Liquid Argon TPC neutrino detector

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The liquid Argon time projection changer (liquid-Ar TPC) allows us to reconstruct tracks with three dimensional views, as a charge imaging detector. Based on this imaging potential, we can measure neutrino energy up to a few GeV and can distinguish the neutrino interactions by detecting all the secondary particles from the interaction. A large size liquid-Ar TPC detector (larger than 20 kton) is a candidate of neutrino far detector in future long-baseline neutrino oscillation experiments and a nucleon decay search experiments. For example, such good performance of the energy reconstruction up to a few GeV enables to study on the neutrino oscillation physics such as CP violation in lepton sector, determine neutrino mass hierarchy and new physics beyond the standard model by looking the detail energy distribution after the neutrino oscillation.

Toward the large size detector, it is essential to have a long drift length more than 5 m which size is also necessary to fully contain all the particle tracks and showers in the detector. Since the ionization electrons could be reduced during the long drift due to impurity of liquid argon (e.g. 1/e after 4.8 m drift in 500V/cm electronic fields with 0.1 ppb purity of liquid argon), key development items to realize the long drift are (1) stable operation of high purity liquid argon (less than 0.1 ppb) and (2) readout system for the ionization electrons with low noise and high signal gain. Moreover, one of other important development items is to realize (3) high voltage more than 250 kV which corresponds to 500V/cm in the 5 m drift length.

We are studying those key development items using a small setups (e.g. 6.4 cm x 6.4 cm x 5.5 cm of fiducial volume) at KEK. In this talk, we will report a present status and future plan of the detector R&D.