Contribution ID: **107** Type: **Recorded Presentation**

The LiNA experiment: Development of multi-layered time projection chamber

The neutron lifetime is an important parameter for particle physics and cosmology. There are two types of measurement methods carried out so far, but their results are disagreement with 4.1σ. In the beam method carried out at J-PARC, a neutron bunch passes through a gaseous detector Time Projection Chamber (TPC). The TPC counts a beta decay electron and a neutron flux by ^{3}He(n,p)^{3}H reaction. However, the result of this experiment still has large uncertainty. The largest two contributions of the uncertainty are background contamination and signal cut inefficiency. A new experiment, the LiNA experiment, is proposed to overcome the problems. This system suppresses background events that come from the detector wall and improves signal cut efficiency by applying a uniform magnetic field in parallel to the beam axis. The detector system which has three drift layers was developed at Kyushu University. The detector and magnet integration test was carried out at KEK. The β-ray source was installed in the center of the detector to imitate the neutron beta decay electron. The γ-ray source was installed on the side of the detector to evaluate background suppression with the field. It was confirmed that β-ray is confined while γ-ray background is suppressed to 1/30 in the signal region. This system can measure the neutron lifetime with an accuracy of 0.2% by 30 days measurement at J-PARC.

Primary experiment

LiNA

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Track Classification: Gaseous Detectors