Contribution ID: **128** Type: **Poster**

A new method for the neutron lifetime measurement

According to the PDG, the neutron lifetime is reported as 880.3 ± 1.1 s in 2015. Although the neutron lifetime is a crucial parameter for the unitarity in the CKM matrix, there is a 1% discrepancy, i.e., 8.4 ± 2.2 s, between two methods: counting surviving ultra-cold neutrons after storing (879.6 ± 0.8 s) and counting trapped protons from the neutron decay (888.0 ± 2.1 s).

A experiment at J-PARC employs an electron-counting method, based on a experiment at ILL by R. Kossakowski et al; Pulsed neutron beams pass through a time projection chamber (TPC) which detects electrons from the neutron decay, and also measures the neutron flux with mixed ^{3}He via the $^3\mathrm{He}(\mathrm{n},\mathrm{p})^3\mathrm{H}$ reaction. The performance of the TPC was recently published – Nucl. Instr. and Meth. A 799, 187-196 (2015).

A new TPC housed in a solenoid coil is also considered. The TPC is divided into three regions by anode and cathode wires. The main systematic uncertainties on the experiment at ILL and J-PARC are related to the subtraction of background events against electrons from the neutron decay, and the separation between the neutron decay and the $^3\mathrm{He}(\mathrm{n},\mathrm{p})^3\mathrm{H}$ reaction. The newly introduced magnetic and electric fields for the TPC reduce these uncertainties, which would reach a 0.1% accuracy and offer a clue to help resolve the 1% discrepancy among the neutron lifetime measurements. In this talk, our current status and prospect will be presented.

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Track Classification: Miscellaneous