MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2012A0075 (2009S03) 実験課題名 Title of experiment Measurement of neutron lifetime by using pulsed neutron beam 実験責任者名 Name of principal investigator Kenji Mishima 所属 Affiliation ICEPP, the university of Tokyo	装置責任者 Name of responsible person Takashi Ino 装置名 Name of Instrument/（BL No.） BL05 実施日 Date of Experiment 2012/05/29-2012/06/05

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。（適宜、図表添付のこと）
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

We didn't use any sample. See next paragraph.

2. 実験方法及び結果 （実験がうまくいかなかった場合、その理由を記述してください。）
Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

We are developing a new experiment for the neutron lifetime measurement to be going to achieve to 0.1% accuracy. In this experiment, we determines neutron lifetime as the ratio of decay count of the beta decay to cold neutron beam flux. We use a time projection chamber to count of electrons of the beta decay, and $^{3}He(n,p)^{3}H$ reactions from ^{3}He doped in the gas to estimate the neutron flux. the neutrons are delivered as bunches of 30-40 cm length, shaped by a spin flip chopper, to TPC of 1 m length in order to define fiducial volume and reduce neutron induced background.

In the present state, we have built up an apparatus and are going to evaluate the apparatus for the physics measurements. Based on the state, we carried out measurements to derive neutron fluxes and evaluate them. We calculate the neutron fluxes by using counts of $^{3}He(n,p)^{3}H$ reactions thus the counts should be by only $^{3}He(n,p)^{3}H$ reaction, also all $^{3}He(n,p)^{3}H$ should be counted in the required efficiency.

2. 実験方法及び結果（つづき） Experimental method and results (continued)

The TPC gas composition was ^{nat}He of 85 kPa, CO_2 of 15 kPa, and ^{3}He dopant of order of hundred mPa. The pulse height spectra of TPC by neutrons are shown in Fig.1. A cutoff between electron signals (less than 600 ch) and ^{3}He(n,p)^{3}H signals (more than 600 ch) can be seen well. By normalizing the two measurement of different partial pressure of ^{3}He, we can deduce the electrons and ^{3}He(n,p)^{3}H spectrum. We are analyzing the detail.

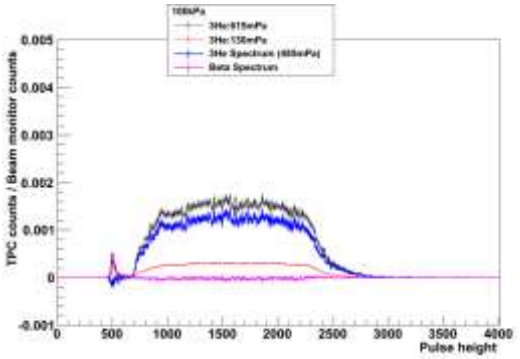

Fig.1. A plot of pulse height spectra with ^{3}He of 615 mPa (black), 130 mPa (red), and their difference (blue) are shown. The pink is difference of spectrum normalized by ^{3}He partial pressure to indicate beta spectrum.

Fig.2 is a 2D plot of time of flight for x axis and event position of TPC of beam passing direction. Note that the event positions were calculated by center of mass of charge on wires. Only ^{3}He(n,p)^{3}H events were selected by taking higher pulse heights shown in Fig.1. Five lines can be seen in 15 ms to 35 ms, which corresponds to beam bunches chopped by the spin flip chopper at the upstream. The lines show that neutron bunches go forward, thus the slopes of lines indicate the velocity of neutron. We can clearly see that the velocities were getting slowly with time of flight. All velocities measured by the slopes were consistent with ones controlled by the spin flip chopper. Unexpected signals were detected at the end of TPC. They are assumed to be caused by ^{6}Li(n,t)^{4}He events from a beam catcher set on the end of the TPC. The beam catcher was made by compound of ^{6}LiF-PTFE to capture neutrons without emission of gamma ray by ^{6}Li(n,t)^{4}He reactions. This reaction emits no gamma rays, but ~2 MeV of alpha and triton, thus we covered the beam catcher by PTFE of 100 μm thickness to stop the ions. A lack of the cover can provide events at the end of TPC.

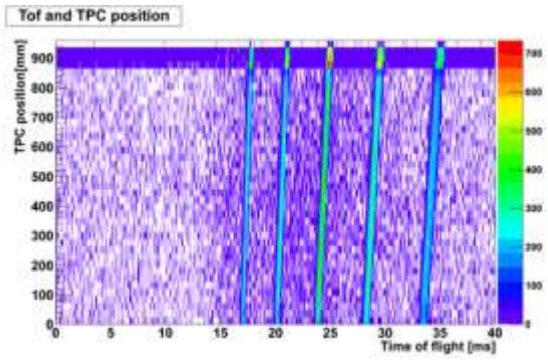

Fig.2. A plot of ^{3}He(n,p)^{3}H events with position on beam axis and TOF of chopped beam. The lines indicate neutron bunches.

A stability of the counts is also important for this experiment. In order to study the stability of the efficiency of ^{3}He(n,p)^{3}H reaction, we measured a time change of a ratio of ^{3}He(n,p)^{3}H to beam monitor, which set at downstream of the spin flip chopper. As a results, the ratio increased only 0.10±0.06 mPa/day in term of ^{3}He pressure in measurement of 4 days with total gas pressure of 100 kPa. This value corresponds to 0.1% change for 4days run with ^{3}He of 500 mPa.