 <b>MLF Experimental Report</b>	提出日 Date of Report 2015/06/13
課題番号 Project No. 2014B0234 実験課題名 Title of experiment Measurement of the neutron capture cross section of Cl-35 実験責任者名 Name of principal investigator Kaoru HARA 所属 Affiliation Hokkaido University	装置責任者 Name of responsible person Yosuke TOH 装置名 Name of Instrument/(BL No.) ANNRI/BL04 実施日 Date of Experiment 2015/03/22 – 2015/03/28

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.  <ul style="list-style-type: none"> <li>• 99% enriched Cl-35 sample (molded NaCl powder with a 1-cm diameter and a 0.2-g weight)</li> <li>• 98% enriched Cl-37 sample (molded NaCl powder with a 1-cm diameter and a 0.2-g weight)</li> <li>• Natural Cl samples (molded NaCl powder with a 1-cm diameter and a 0.2-g weight)</li> </ul>
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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.  <p>The measurement of the neutron capture cross section of Cl-35 in the neutron energy range from 0.02 eV to 100 keV was performed with an NaI(Tl) detector system by using the neutron time-of-flight (TOF) method in ANNRI at J-PARC/MLF/BL04, where NaI(Tl) and Ge detectors were placed at the flight path lengths of 28 and 22 m, respectively. We mainly used the NaI(Tl) detector system because a time response of a NaI(Tl) detector is faster than one of a Ge detector. JSNS operated at a proton beam power of approximately 400 kW. A rotary collimator of 22-mm diameter and x-stage collimator of 27-mm diameter were set for the measurement. The B-10(n,α<sub>1</sub>γ) reaction was measured with B-10 and B-nat samples to obtain the flux of neutron beam at the sample position. Additionally, in order to check an isotope of impurity in the sample, we also used the Ge detector system for measurements of the gamma-ray pulse-height spectra with high-energy resolution. For the Ge detector system, the rotary collimator of a 7-mm diameter was set.</p>
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## 2. 実験方法及び結果(つづき) Experimental method and results (continued)

Three types of NaCl samples which have different compositions for the chlorine isotopes were used. Natural abundances of chlorine isotopes Cl-35 and Cl-37 are 76% and 24%, respectively. To measure the neutron capture cross section of Cl-35, a highly enriched Cl-35 sample was prepared as sodium chloride (NaCl) form. The neutron capture cross sections of Na-23 and Cl-37 below 10 eV are about 1% smaller than one of Cl-35. On the other hand, a highly enriched Cl-37 and natural Cl samples were also prepared as NaCl form in order to estimate the background which is caused by the Na-23, Cl-37(n, $\gamma$ ) reactions above 10 eV. In addition, a natural carbon sample was used to estimate a background which is caused due to the scattering neutron on the NaCl sample (Cl-35, Cl-37 and Na-23).

Fig. 1(a) shows the measured TOF spectrum for the enriched Cl-35 sample in the entire range of TOF. A broad bump of thermal neutrons is observed around 20000  $\mu$ s. In the fast TOF range, the number of counts is increased. The extended spectrum in the fast TOF range of 0–200  $\mu$ s is shown in Fig. 1(b). The resonance peaks of Cl-35 (0.4 keV) and Na-23 (2.9 keV) are observed at approximately 100  $\mu$ s and 40  $\mu$ s as compared to the evaluated nuclear data, JENDL4.0. The data analysis for the neutron capture cross section of Cl-35 is progress.

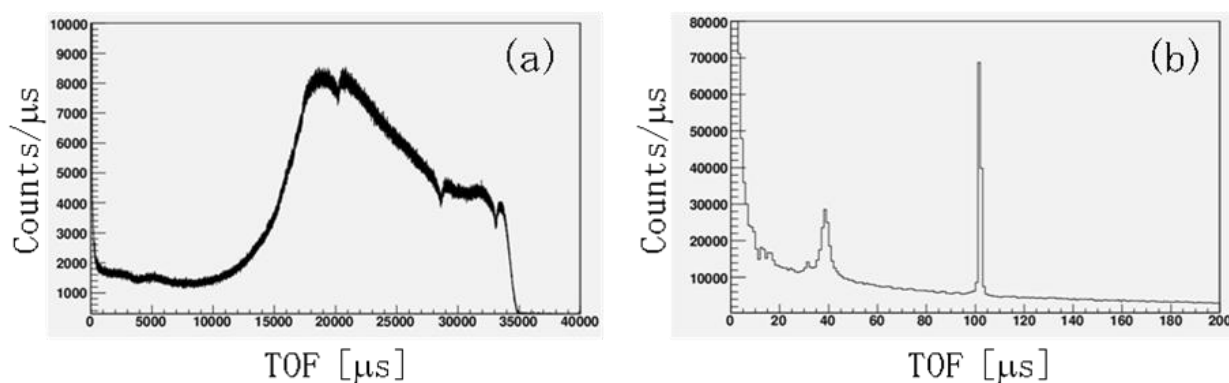


Figure 1: TOF spectra for the enriched Cl-35 sample measurement in the entire range of TOF (a) and the fast TOF range (b).