MLF Experimental Report	提出日 Date of Report
課題番号 Project 2009A0010 実験課題名 Title of experiment Measurements of nuclear data of minor actinides and long lived fission products for advanced nuclear systems 実験責任者名 Name of principal investigator Yoshiaki Kiyanagi 所属 Affiliation Faculty of Engineering, Hokkaido University	装置責任者 Name of responsible person Masumi Oshima 装置名 Name of Instrument/(BL No.) NNRI/BL04 実施日 Date of Experiment 10:00, 27 Sep. 2008~10:00, 27 Feb. 2010

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.

1) ^{244}Cm, CmO_2 powder packed in an aluminum container
2) ^{246}Cm, CmO_2 powder packed in an aluminum container
3) ^{99}Tc, Metal disk packed in an aluminum container
4) ^{107}Pd, Metal powder packed in an aluminum container
5) ^{93}Zr, ZrO_2 powder packed in an aluminum container
6) ^{241}Am, AmO_2 powder packed in an aluminum container
7) ^{129}I, NaI powder packed in a titanium container
8) stable isotopes of $^{105, 106, 108}$Pd, metal powder packed in a thin aluminum foil
9) stable isotopes of $^{91, 96}$Zr, metal foil for ^{91}Zr, oxide powder for ^{96}Zr packed in a thin aluminum foil

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.

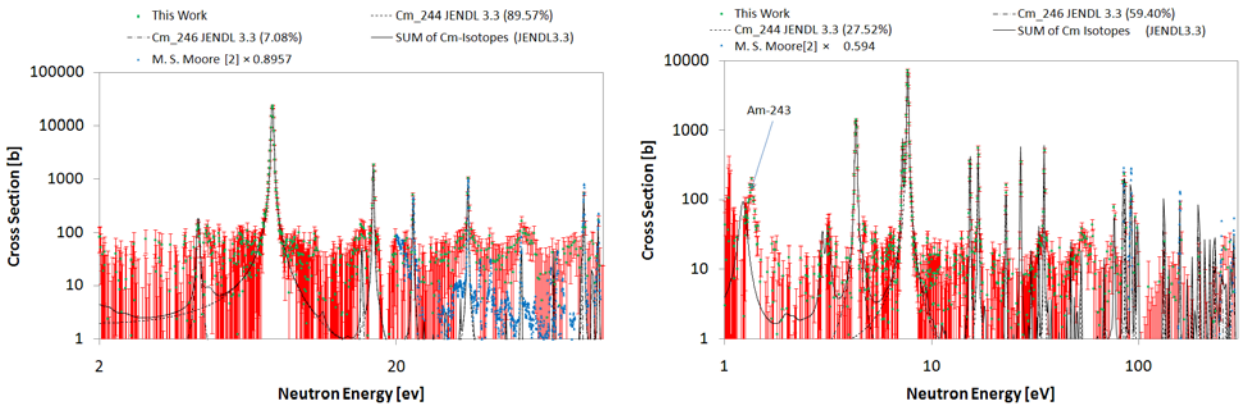
The "4π Ge spectrometer" consisting of two cluster-Ge detectors and eight coaxial-shaped Ge detectors with BGO-Compton-suppression shields was used. All detectors are surrounded by a detector shield made of borax-containing resin, lead, and iron. A 6LiH shield was placed in front of every Ge detector to prevent the Ge crystals from neutron damage. The sum of the full-energy peak efficiencies is 3.64±0.11 %. An average energy resolution of the Ge crystals is 9.18±0.12 keV of FWHM at 1.3-MeV, which is deteriorated by electric noise on the power ground and will be improved in the future.

As representative results obtained by using the samples written above, we here introduce Cm, Zr, Tc data.

1) Capture cross section of Cm

Fig. 1 (a) shows a comparison of our preliminary neutron-capture cross section of ^{244}Cm with the one given by Moore [1], and the evaluated value of JENDL 3.3; and (b) shows a comparison for ^{246}Cm. These results are the first experimental results of ^{244}Cm and ^{246}Cm obtained with an accelerator facility in the world.

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



(a) Deduced capture cross section of the 244Cm-sample. (b) Deduced capture cross section of the 246Cm-sample.

Fig. 1. Deduced capture cross sections of Cm and comparison to the one measured by Moore and JENDL 3.3.

Further study will be made to determine more accurate values of background than the present, to measure the efficiency of the detectors for the absolute cross-section value, and to analyze the resonance peaks by the SAMMY code.

2) Capture cross section of ^{93}Zr

We have measured the neutron capture cross sections of ^{93}Zr, which is one of the most important long-lived fission products. We have obtained preliminary results of capture cross sections of ^{93}Zr in the neutron energy range from 0.01 eV up to 5 keV with a ground-state transition method as shown in Fig. 2. The present results support the thermal-neutron capture cross section obtained by Nakamura *et al.* The evaluated thermal value of JENDL-3.3 is about four times larger than the present result. In the keV region, the data measured by Macklin *et al.* are in good agreement with the present results in the range of experimental uncertainties.

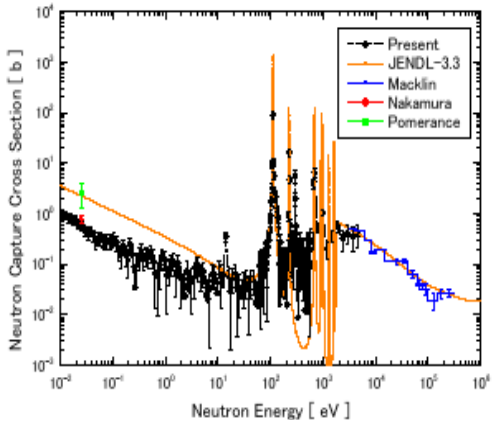


Fig. 2 Preliminary results of absolute neutron capture cross sections of ^{93}Zr.

3) Capture cross section of Tc

We measured the capture cross section of ^{99}Tc. Figure 3 shows the result of NNRI (black line) with the nuclear data library JENDL3.3 (red line) and the other experimental data by Kobayashi et al. (blue data points). The present data are consistent with the nuclear data by JENDL3.3 in the resonance structures up to neutron energy of 1 keV. We could improve the cross section data in quality and quantity compared to the ever-obtained experimental data.

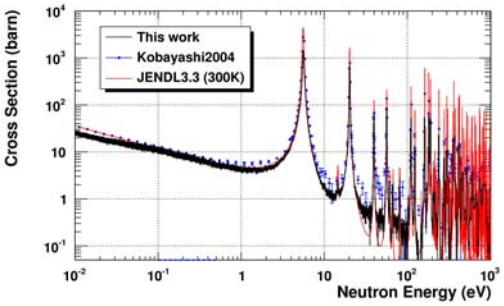


Fig. 3 Measured capture cross-section of ^{99}Tc.

Present study is the result of "Study on nuclear data by using a high intensity pulsed neutron source for advanced nuclear system" entrusted to Hokkaido University by the Ministry of Education, Culture, Sports, Science and Technology of Japan (MEXT).