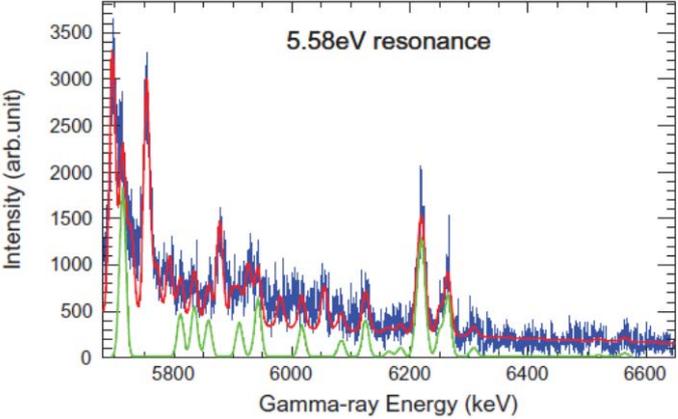
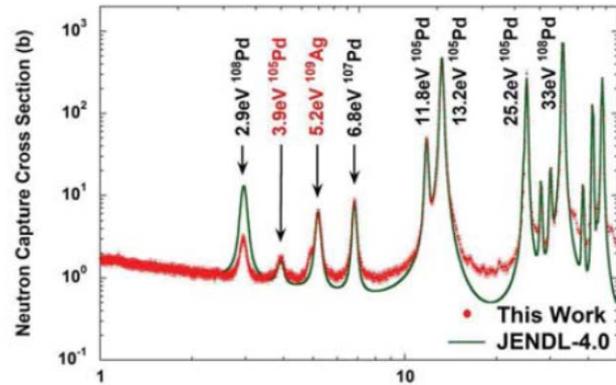


 <b>MLF Experimental Report</b>	提出日 Date of report 2016.1.4
実験課題番号 Project No. 2012P0701 実験課題名 Title of experiment Research on nuclear astrophysics, nuclear data, and trace-element analysis using pulsed neutrons 実験責任者名 Name of principal investigator Hideo Harada 所属 Affiliation Japan Atomic Energy Agency	装置責任者 Name of responsible person Hideo Harada 装置名 Name of Instrument/(BL No.) BL-04 利用期間 Dates of experiments

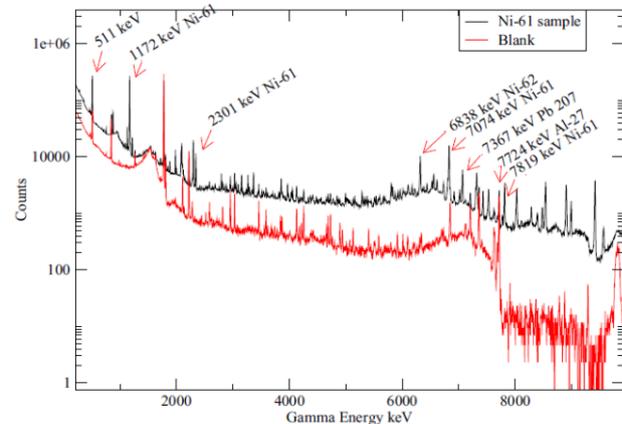
<p>1. 研究成果概要(試料の名称、組成、物理的・化学的性状を明記するとともに、実験方法、利用の結果得られた主なデータ、考察、結論、図表等を記述してください。</p> <p>Outline of experimental results (experimental method and results should be reported including sample information such as composition, physical and/or chemical characteristics.</p>
<p>On nuclear data, systematic capture cross section measurements have been started of Cm-244, Cm-246, Am-241, Np-237, Pd-107, Zr-93, I-129, Tc-99, and their stable isotopes by utilizing techniques developed previous years. We have also analyzed data obtained up to now of Tc-99 and stable isotopes of Sn, Se, Pd, Cs.</p> <p>On Tc-99, primary gamma rays from the neutron capture resonances were measured at the J-PARC/ANNRI. The analysis showed that the transition pattern from the first resonance is similar to that from the capture reaction of thermal neutrons. On the other hand, transition patterns from the higher energy resonances are completely different, and there is no clear dependence on the spin-parities of the resonances. Figure shows fitting of the prompt gamma-ray spectrum from the 5.58 eV resonance state as an example. (published in Nuclear Data Sheets)</p>  <p>On tin isotopes, the neutron-capture cross sections of Sn-112 and Sn-118 were measured by the time-of-flight method in the energy range from 10 meV to 2 keV with an array of germanium detectors of ANNRI at J-PARC. Twelve new resonances for Sn-112 were identified, whereas the 21.02-, 40.38- and 166-eV resonances for Sn-112 and the 289-eV resonance for Sn-118 which are listed on JENDL-4.0 and/or ENDF/B VII.1 were not observed. This gave a strong evidence of miss assignment of these resonances in nuclear data libraries JENDL-4.0 and/or ENDF/B VII.1.</p>

## 1. 研究成果概要(つづき) Outline of experimental results (continued).

On Pd isotopes, the measurements of the neutron-capture cross sections were performed for the radioactive Pd-107 and stable Pd-105, 108 nuclei by the time-of-flight method in the low energy region from the thermal to a few hundreds eV. From the measurements, new assignments were also obtained for some resonances of these Pd nuclei. Right figure shows an example showing resonance miss assignment. These results together with tin isotopes resonance assignments showed the needs of systematic study of neutron resonance assignments not only for radioactive nucleus but also stable isotopes. (published in Nuclear Data Sheets)



On astrophysics study, neutron-capture cross section of Ni-61 and Nb isotopes were measured using the Ge spectrometer of ANNRI. The preliminary data are slightly discrepant compared to the JENDL-4.0 library in the energy range from 10 eV to 1000 eV. It might be due to underestimation of the background subtraction. Figure shows  $\gamma$ -ray pulse-height spectra for Ni-61 sample (black curve) and Blank (red curve). Multi-scattering neutron corrections are needed in future analyses.



Mono-element samples and standard samples are prepared for development of prompt gamma ray analysis (PGA) by using a pulsed neutron beam by taking into account neutron capture cross sections, resonance energies, etc. in the selection procedure. The background spectrum in time-of-flight PGA measurement with Ge spectrometer at ANNRI has been evaluated. The sources of a particular gamma-ray in the background spectrum are Al-28 (1779keV) and B-10 (478keV) in B-10 ( $n, \alpha$ )Li-7 reaction. A LiF neutron shield, which is inserted into the Al alloy beam duct, could reduce the gamma rays from the beam duct. The gamma rays of B-10 are mainly emitted from the neutron shield that is used for Ge detectors. Therefore, the replacement of the B neutron shield with a Li neutron shield can suppress these gamma rays. Accurate elemental analysis is important in any scientific research. The effects of neutron attenuation and scattering have to be determined to achieve accurate and precise quantitation. The correction factors were calculated by simulation code PHITS and provided accurate and reliable results. Thus, we conclude that neutron attenuation and scattering can be accurately corrected with simulation. Data analysis software, which is a beta version, has been developed. Some mono-element and standard samples were measured at ANNRI, and analyzed with the developed software.

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