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|  <b>MLF Experimental Report</b>  | 提出日 Date of Report<br>Aug. 23, 2010   |
| 課題番号 Project No.<br>2009A0084<br>実験課題名 Title of experiment<br>Prompt Gamma-ray Analysis on NOBORU<br>実験責任者名 Name of principal investigator<br>Yoshimi Kasugai<br>所属 Affiliation<br>Japan Atomic Energy Agency | 装置責任者 Name of responsible person<br>Fujio Maekawa<br>装置名 Name of Instrument/(BL No.)<br>BL10<br>実施日 Date of Experiment<br>Nov. 24, 2009<br>May 30, 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.

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| 1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.<br>(1) Metal foils of Au, Ta, Co, Ag, In and Mo<br>(2) An big-size Japanese gold coin used in "Tenpo" era from 1837 to 1859 in Japan<br>Components: Au and Ag; coating gold on silver<br>(3) Others: Polyethylene resin and Boron rubber |
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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。)<br>Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.   |
| <p><b>Outline</b></p> <p>In order to establish the PGA (Prompt Gamma-ray Analysis) using BL10, "NOBORU", we acquired test data of some elements on gamma-ray energy and neutron time-of-flight (TOF). In addition, for the demonstration of the neutron resonance PGA, we performed nondestructive elemental analysis of a big-size old Japanese gold coin with a nonuniform composition along its thickness.</p> <p><b>Experiment</b></p> <p>The experimental setup of the PGA (Prompt Gamma-ray Analysis) is shown in Fig. 1. A portable n-type germanium detector was used for the detection of prompt gamma-rays, and the detector was covered with lead blocks and LiF tiles, as shown in Fig.1, for shielding the detector from background gammas and scattered neutrons, respectively. The samples were set at the distance of 45 cm from the germanium detector with a Teflon frame.</p> |

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

### Results

The test data of H (Polyethylene resin), B (Born rubber), Cd, Ag, In, Ta, Au were acquired on both gamma-ray and TOF spectra. The gamma peaks were clearly observed in the gamma-ray spectra for H, B and Cd. On the other hand, for the samples of Ag, In, Ta and Au, neutron resonance peaks could be obviously seen in the TOF spectra though no clear peak was observed in the gamma-ray spectra.

In order to check the performance of the PGA system, an elemental analysis of a koban used in “Tenpo” era from 1837 to 1859 was carried out. The composition ratio of gold in the koban is known to be 57% in average. The photograph of the koban is shown in Fig. 2. The obtained TOF spectrum is shown in Fig. 3 with those of single elements of Au and Ag for reference. For obtaining the component fraction of gold in the koban, the intensity ratios of a Ag peak at 0.25 ms of the complex peak at 0.45 ms was compared with that for a standard samples made by sandwiching a Ag foil between Au foils. As the results, the ratio of the gold composition was analyzed to be  $54\pm 1\%$ . This value is sufficient in the viewpoints of the accuracy and the comparison with the old analysis. This result showed that our PGA system has an advantage in bulk analysis of a sample with inhomogeneous-composition distribution because it is well known that only a surface-analysis can be made by using X-ray and charged particles.

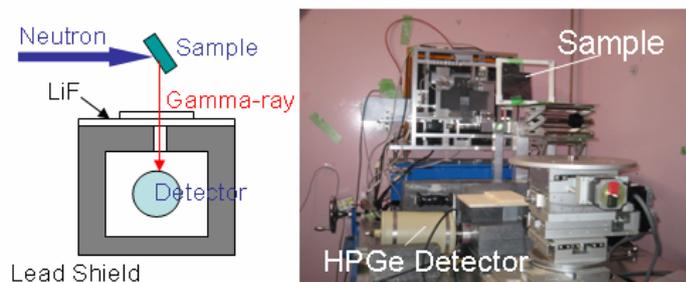


Fig. 1 Experimental Set up



Fig.2 "Tenpo" koban

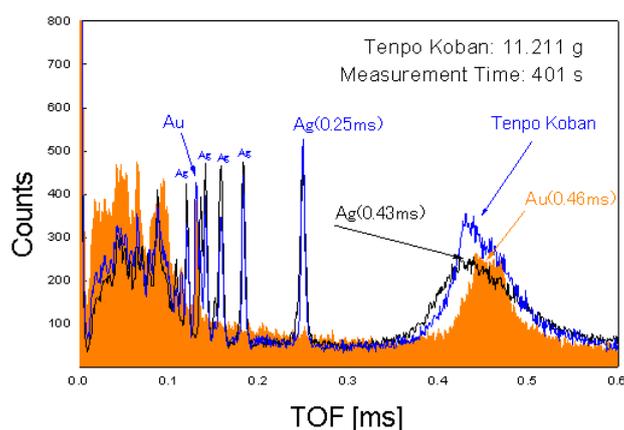


Fig. 3 TOF spectra of Au, Ag and Tenpo koban. The spectra of Au and Ag were normalized with that of koban at the resonance peaks of 0.13 ms and 0.25 ms, respectively.