

# High precision analysis of isotopic composition for samples used for nuclear cross-section measurements

*Yuji Shibahara<sup>1,\*</sup>, Jun-ichi Hori<sup>1</sup>, Koichi Takamiya<sup>1</sup>, Toshiyuki Fujii<sup>1</sup>, Satoshi Fukutani<sup>1</sup>, Tadafumi Sano<sup>1</sup>, Hideo Harada<sup>2</sup>*

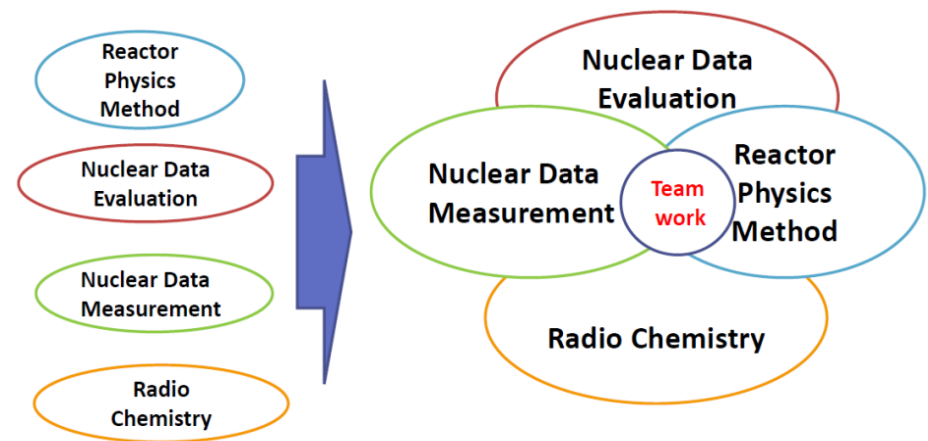
<sup>1</sup> Kyoto University, Research Reactor Institute,  
590-0494, Kumatori-cho, Sennan-gun, Osaka, Japan

<sup>2</sup> Japan Atomic Energy Agency, Nuclear Science and  
Engineering Center, 319-1195, Tokai-mura, Naka-  
gun, Ibaraki, Japan

## Background

- There are large gaps on capture cross sections of minor actinides between current uncertainty and required accuracy as shown in Table.  
⇒ For overcome these gap, “**Research and development for Accuracy Improvement of neutron nuclear data on Minor Actinides (AIMAC)**” project has been started.
- AIMAC project consists of four research field groups such as differential nuclear data measurement, integral nuclear data measurement, nuclear chemistry, and nuclear data evaluation (right down).

| Nucleus       | Current uncert. | Required accuracy |
|---------------|-----------------|-------------------|
| Np-237        | 6%              | 3%                |
| <b>Am-241</b> | 8%              | 2%~3%             |
| Am-242m       | 25%             | 12%               |
| <b>Am-243</b> | 10%             | 2%                |
| Cm-244        | 20%             | 6%                |



## Presented titles by AIMAC project in ND2016

| #           | Title   |
|-------------|---|
| I034        | Research and development for accuracy improvement of neutron nuclear data on minor actinides                              |
| S033        | Experimental verification of neutron capture cross section of $^{237}\text{Np}$ in variable neutron field at KURRI-LINAC  |
| S055        | Analysis of energy resolution in the KURRI-LINAC pulsed neutron facility  |
| S111        | Measurement of the neutron capture cross section of $^{99}\text{Tc}$ using ANNRI at J-PARC                                |
| S114        | Application of modified REFIT code for J-PARC/MLF to evaluation of neutron capture cross section on $^{155,157}\text{Gd}$ |
| R130        | Developments of a new data acquisition system at ANNRI  |
| S185        | Evaluation of neutron total and capture cross sections on Tc-99 in the unresolved resonance region                        |
| R300        | Technical developments for accurate determination of amount of samples used for TOF measurements                          |
| <b>S301</b> | <b><i>High precision analysis of isotopic composition for samples used for nuclear cross section measurements</i></b>     |

The objective of our team is to obtain the isotopic composition data of samples contributing to the analysis of nuclear cross-section measurement data by mass spectrometry etc.

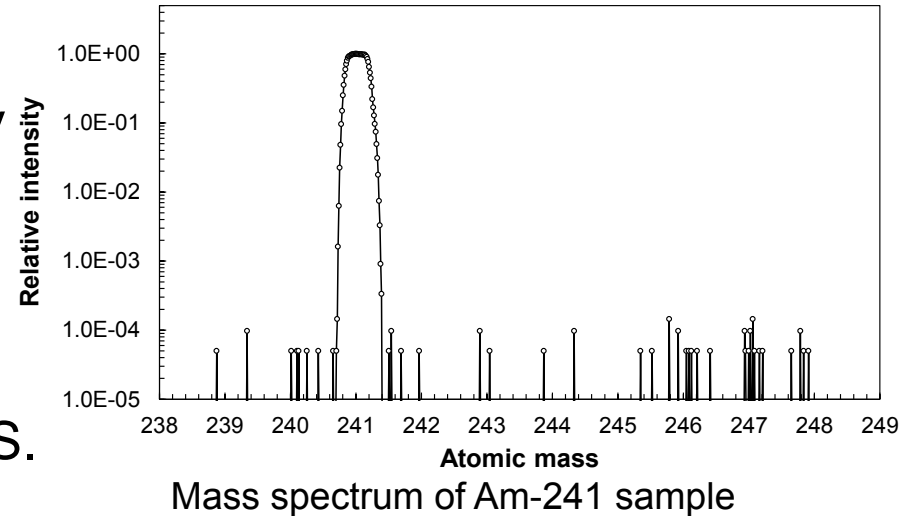
In this study, we analyzed the isotopic composition of two Am samples ( $^{241}\text{Am}$  sample and  $^{243}\text{Am}$  sample) by thermal ionization mass spectrometry.

Because there is no suitable standard reference material for the isotopic ratio analysis of Am, the isotopic ratio analysis of U standard reference material was conducted as the performance check of the Am sample analysis.

In this study, we obtained following results;

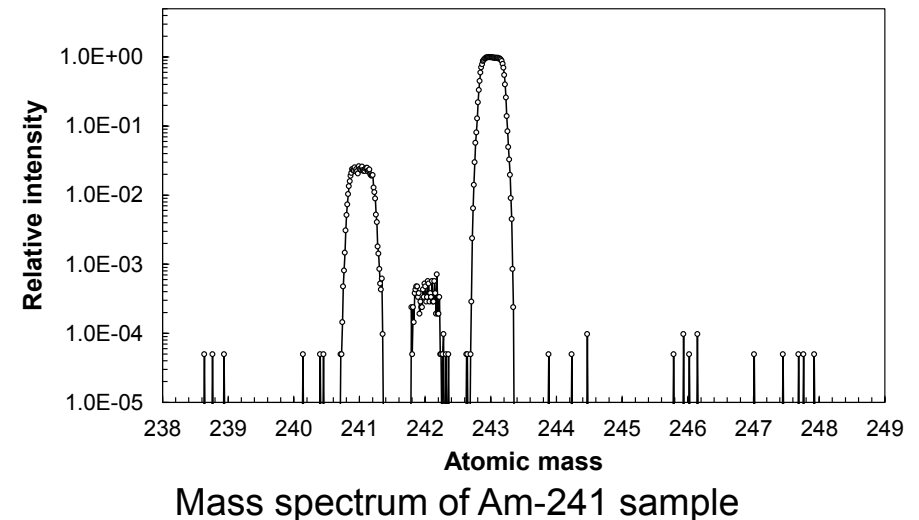
U analysis: Accuracy of isotopic composition of Am would be improved by mass spectrometry with loading amount of 1 ng.

Am-241 sample: Significant figure of isotopic impurity of Am-241 sample was improved **from 0.1%** in warranty card **to 0.0004%** by TIMS.



Am-243 sample: There are three differences between analytical results and warrantied card.

1. Isotopic composition of Am-241 (**2.7%** in warranty card vs **2.3%** by TIMS)
2. Existence of unreported 3<sup>rd</sup> isotope of **Am-242m** (ca. 0.04%)
3. Existence of unreported impurity of **Pu**



⇒ Candidates for unexpected error at nuclear cross-section analysis of Am-243 were confirmed