Status of SG-41

May 13, 2016
WPEC meeting

H. Harada (JENDL)
2\textsuperscript{nd} WS of SG-41 at 11 & 12 May 2016
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker</th>
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<tbody>
<tr>
<td>9:00 – 9:10</td>
<td>Welcome</td>
<td>H. Harada</td>
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<tr>
<td>9:10 – 10:00</td>
<td>Fast neutron PGAA approach at Garching</td>
<td>M. Rossbach</td>
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<tr>
<td>10:00 – 11:00</td>
<td>New Np-237 and Am-241 evaluation</td>
<td>O. Iwamoto</td>
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<td>11:00 – 12:00</td>
<td>Np-237 and Am-241 JEFF evaluation</td>
<td>G. Noguere</td>
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<td>12:00 – 13:30</td>
<td>Lunch Break</td>
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<tr>
<td>13:30 – 14:20</td>
<td>Recent Am-241 measurement with cold neutrons</td>
<td>C. Genreith</td>
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<td>14:20 – 15:10</td>
<td>Capture measurement of Am-241 in MINERVE</td>
<td>P. Leconte</td>
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<td>15:10 – 15:20</td>
<td>Coffee Break</td>
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<tr>
<td>15:20 – 16:10</td>
<td>Systematic study on reactor spectrum averaged data</td>
<td>G. Žerovnik</td>
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<tr>
<td>16:10 – 17:00</td>
<td>On reactor spectrum calculations at KUR</td>
<td>T. Sano</td>
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<td>17:00 – 18:00</td>
<td>Discussions</td>
<td>All</td>
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<tr>
<td>Time</td>
<td>Topic</td>
<td>Presenter</td>
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<tr>
<td>9:00 – 10:00</td>
<td>Capture measurement of Am-241 in n_TOF</td>
<td>D. Cano Ott</td>
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<td>10:00 – 11:00</td>
<td>Re-analysis of DANCE data (tentative)</td>
<td>M. Jandel</td>
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<td>11:00 – 11:10</td>
<td>Coffee Break</td>
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<tr>
<td>11:10 – 12:00</td>
<td>Overview of energy dependent data</td>
<td>P. Schillebeeckx</td>
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<td>12:00 – 13:30</td>
<td>Lunch Break</td>
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<tr>
<td>13:30 – 14:30</td>
<td>Discussions on equations used to deduce cross sections</td>
<td>H. Harada + P. Schillebeeckx</td>
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<tr>
<td>14:40 – 15:20</td>
<td>Feedback from EGIEMAM-II « Summary of FCA-IX cores benchmark» by K. Tsujimoto (JAEA)</td>
<td>O. Cabellos</td>
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<tr>
<td>15:20 – 15:40</td>
<td>Coffee Break</td>
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<tr>
<td>15:40 – 16:20</td>
<td>New decay data measurements</td>
<td>A. Kimura</td>
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<td>16:20 – 17:20</td>
<td>Status of the recommended nuclear decay data</td>
<td>M. Kellett</td>
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<td>17:20 – 18:00</td>
<td>Discussions on the preparation of report</td>
<td>All</td>
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Highlights from Presentations at SG-41 2nd WS
FAST NEUTRONS FOR PGAA APPLICATIONS

M. Rossbach - E. Mauerhofer - A. Hable

1 Institute for Energy and Climate Research, IEK-6, Nuclear Waste Management and Reactor Safety, Forschungszentrum Jülich GmbH, Germany
2 Technische Universität Wien, Österreich
FaNGaS set-up

Decay position
(17.2 cm)

In-Beam position
(67 cm)

N-beam photo
Evaluation of capture cross section of Am and Np for thermal neutrons at JAEA

Osamu Iwamoto
JAEA
Corrected thermal capture cross section for $^{241}$Am

Discrepancy among the data became smaller.
NP-237 AND AM-241 EVALUATIONS
FOR JEFF AND COMAC

Gilles NOGUERE

10 May 2016
Thermal capture cross section:
- Determination of $\sigma_0$ based on the OSMOSE experiment (MINERVE facility)
- Thermal capture cross section of Letourneau et al. (Mini-Inca experiment, ILL) was used $\Rightarrow \langle C/E - 1 \rangle \approx 0$

![Diagram showing thermal capture cross section data points and error bars with the equation $y = 0.218\sigma_0^{39.131}$ and the values $171\text{ b}$, $188\text{ b}$, and $180\text{ b}$ highlighted.]
Recent Results of $^{241}$Am and $^{237}$Np cross section measurements with cold neutron PGAA

C. Genreith$^1$, M. Rossbach$^2$

1 Heinz Maier-Leibnitz Zentrum (MLZ), technische Universität München, Lichtenbergstr. 1, 85748 Garching, Germany
2 Institute of Energy and Climate Research, IEK-6, Forschungszentrum Jülich GmbH, 52425 Juelich, Germany
Sample Characterization

Reaction Rate Correction

Reaction rate correction for $^{241}$Am samples is 0.95 with JEFF3.2 and 0.89 with ENDF/B-VII.1. Huge discrepancy!
Capture Measurement of Am241 in MINERVE
- The « AMSTRAMGRAM » project

P. Leconte
A. Gruel, B. Geslot
L. Mathieu
D. Villamarin, V. Becares
A. Plompen, P. Siegler
CEA (SPRC/LEPh)
CEA (SPEx/LPE)
CNRS/CENBG
CIEMAT
IRMM

www.cea.fr
Systematic study on reactor spectrum averaged data

Gašper Žerovnik, Peter Schillebeeckx, Andrej Trkov, Björn Becker, Stefan Kopecky, Hideo Harada, Tamás Belgya, Christoph Genreith, Vladimir Radulović, Tadafumi Sano

WPEC Subgroup 41 Meeting, May 10-11, 2016
OECD Headquarters, Paris, France
Methodologies for neutron activation analysis

- From measured reaction rates - derivation of:
  - thermal cross section $\sigma_0 = \sigma(k_B T)$,
  - resonance integral $I_0 = \int_{E_{tr}}^{E_3} \frac{\sigma(E)}{E} dE$.

- Different neutron spectrum parametrizations:
  - $k_0$ method:
    - magnitude of thermal-to-epithermal flux ($f$)
    - deviation of epithermal spectrum from $1/E$ ($\alpha$)
  - Simplified Westcott method (Nakamura et al., JNST 44 (2007) 1500-1508):
    thermal ($\phi_1$) and epithermal ($\phi_2$) flux
On Reactor Spectrum Calculations at KUR

Kyoto University Research Reactor Institute

Tadafumi SANO

WPEC SG41 meeting, Paris, May 10-11, 2016
Calculational Condition (except LI)

✓ Core Configuration

✓ Burn-up

✓ Position of control rod

12.8% of U235 detraction

A-rod: 42.8 cm, B-rod: 44.2 cm, C-rod: 43.6 cm, D-rod: 40.6 cm
$^{241}\text{Am}$ capture measurement at n_TOF with the Total Absorption Calorimeter

Emilio Mendoza Cembranos, Daniel Cano Ott
The n_TOF collaboration
Nuclear Innovation Unit (CIEMAT, Spain)
Background
Corrections to Am-241 capture cross section measured at DANCE

Marian Jandel
C-NR
Los Alamos National Laboratory
XS status

- Am-241(ng) was measured in 2007 (8)
- Published in PRC (2008)
- Open questions mentioned in the publication:
  - Neutron flux details (5% variations of different beam monitors)
  - Self-shielding and multiple-scattering – assumed in SAMMY but good to revisit
  - Resonance parameters may need to be revisited using a new broadening function
Overview of experimental data for $^{241}$Am

Peter Schillebeeckx

SG-41
10 – 11 May 2016
Observable Z (dimension n) with k sources of correlated uncertainties

\[
\mathbf{V} = \mathbf{Z} \mathbf{Z}^T + \mathbf{D}_Z
\]

- n: number of data points (TOF)
- k: number of quantities introducing correlated uncertainty components
- \(\mathbf{D}_Z\): uncorrelated part (n values)
- \(\mathbf{S}_Z\): matrix dimension (n x k) contains the contribution of each quantity creating a correlated uncertainty component

Becker et al., J. Instrumentation 7 (2012) P11002
New decay data measurements

Atsushi Kimura (JAEA)

Measurements of gamma-ray emission probabilities of $^{241}$,$^{243}$Am and $^{239}$Np

Kazushi Terada$^a$, Shoji Nakamura$^a$, Taro Nakao$^a$, Atsushi Kimura$^a$, Osamu Iwamoto$^a$, Hideo Harada$^a$, Koichi Takamiya$^b$ and Jun-ichi Hori$^b$

$^a$Japan Atomic Energy Agency, Ibaraki, Japan; $^b$Kyoto University Research Reactor Institute, Osaka, Japan

ABSTRACT

Gamma-ray emission probabilities of $^{241,243}$Am and $^{239}$Np have been precisely measured with gamma- and alpha-ray spectroscopic methods. The activities of the samples were determined by measuring alpha particles using a Si semiconductor detector. Gamma rays emitted from the samples were measured with a planar type High-Purity Germanium (HPGe) detector. An efficiency curve of the HPGe detector was derived with uncertainties from 0.7% to 2.5% by combining measured efficiencies and Monte Carlo simulation. The gamma-ray emission probabilities for the major gamma rays of these nuclides were determined with uncertainties less than 1.2%.
Detection Efficiencies

Using the obtained parameters, the efficiencies are obtained by the PHITS simulations with uncertainties ranging from 0.7 to 2.5%.

A dominant contribution to the uncertainties
- Below 50keV: the dead layer thickness
- around 100 keV: the radius
- Above 200keV : the detector length

Efficiency

Difference

Uncertainties: 0.7-2.5%
Experiments Data for Minor Actinide (MA) Management (EGIEMAM-II)

Chair: K. TSUJIMOTO (JAEA, Japan)
Secretariat: Y. NAKAHARA (NEA)

- EGIEMAM-II website:

- EGIEMAM website:
  - [https://www.oecd-nea.org/science/ma/](https://www.oecd-nea.org/science/ma/)
Brief Description of CFRR Measurements

Experimental Cores

- 7 different core configurations
  - Simple in geometry
  - Simple core configurations
    - 2 regions: core & blanket regions
    - Configuration of core region
      - IX-1 to -6: HEU and C/SS
        - (diluent material)
      - IX-7: LEU
  - Systematic change of neutron spectrum
  - Measurements were carried out in 1981 - 1982
Status of the recommended nuclear decay data for WPEC SG-41

Mark A. KELLET
WPEC SG-41: Improving Nuclear Data Accuracy of Am-241 and Np-237 Capture Cross-Sections

Nuclear decay data are required for a small number of nuclei in relation to the capture cross-section measurements, specifically the gamma-ray emission intensities.

Data are required for the following nuclei:

Np-237 measurements: Np-238, Pu-238, Np-237, Pa-233

Am-241 measurements: Am-242g, Am-242m, Cm-242, Am-241

Standards are also required for detector calibration (in the energy range of 20 keV to about 1 MeV)

The goal of this task is to recommend the relevant nuclear decay data.
Summary

Details on Decay data, Differential data, Energy integrated data, and Evaluations have been discussed, which are related to capture cross sections of Am-241 and Np-237.

Important bias effects (origins of errors) have been identified for each measurement methods.

Importance of Up-to-dated Decay data and Differential data information were recognized for re-analysis of Energy integrated data.

Importance of sample quality including impurity information, precise quantification, and availability have been recognized.

Future actions needed for data improvements were discussed.

Schedule

- Recommendation of energy dependent data
- Re-analysis of energy integrated data
- Comments from Evaluation viewpoint

Report, March 2017