

# Status of SG-41

May 13, 2016

WPEC meeting

H. Harada (JENDL)

# 2<sup>nd</sup> WS of SG-41 at 11 & 12 May 2016



## 2<sup>nd</sup> SG-41 WS

OECD Headquarters, Conference Center  
2 Rue André Pascal, Paris 75016

Room CC 16

Starting at 09:00 am – Ending at 06:00 pm

Tuesday, May 10, 2016

9:00 – 9:10	Welcome	H. Harada
9:10 – 10:00	Fast neutron PGAA approach at Garching	M. Rossbach
10:00 – 11:00	New Np-237 and Am-241 evaluation	O. Iwamoto
11:00 – 12:00	Np-237 and Am-241 JEFF evaluation	G. Noguere
12:00 – 13:30	Lunch Break	
13:30 – 14:20	Recent Am-241 measurement with cold neutrons	C. Genreith
14:20 – 15:10	Capture measurement of Am-241 in MINERVE	P. Leconte
15:10 – 15:20	Coffee Break	
15:20 – 16:10	Systematic study on reactor spectrum averaged data	G. Žerovnik
16:10 – 17:00	On reactor spectrum calculations at KUR	T.Sano
17:00 – 18:00	Discussions	All

## Wednesday, May 11, 2016

<b>9:00 – 10:00</b>	Capture measurement of Am-241 in n_TOF	D. Cano Ott
<b>10:00 – 11:00</b>	Re-analysis of DANCE data (tentative)	M. Jandel
<b>11:00 – 11:10</b>	Coffee Break	
<b>11:10 – 12:00</b>	Overview of energy dependent data	P. Schillebeeckx
<b>12:00 – 13:30</b>	Lunch Break	
<b>13:30 – 14:30</b>	Discussions on equations used to deduce cross sections	H. Harada + P. Schillebeeckx
<b>14:40 – 15:20</b>	Feedback from EGIEMAM-II « Summary of FCA-IX cores benchmark» by K. Tsujimoto (JAEA)	O. Cabellos
<b>15:20 – 15:40</b>	Coffee Break	
<b>15:40 – 16:20</b>	New decay data measurements	A. Kimura
<b>16:20 – 17:20</b>	Status of the recommended nuclear decay data	M. Kellett
<b>17:20 – 18:00</b>	Discussions on the preparation of report	All

Highlights from Presentations at SG-41 2<sup>nd</sup> WS

# FAST NEUTRONS FOR PGAA APPLICATIONS

*M. Rossbach<sup>1</sup> – E. Mauerhofer<sup>1</sup> – A. Hable<sup>1,2</sup>*

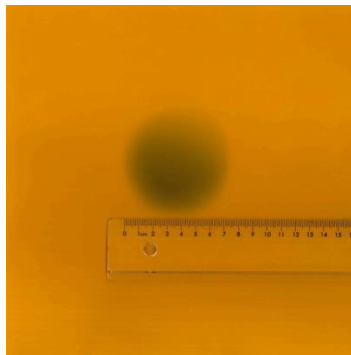
<sup>1</sup> Institute for Energy and Climate Research, EX-6, Nuclear Waste Management and Reactor Safety, Forschungszentrum Jülich GmbH, Germany

<sup>2</sup> 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

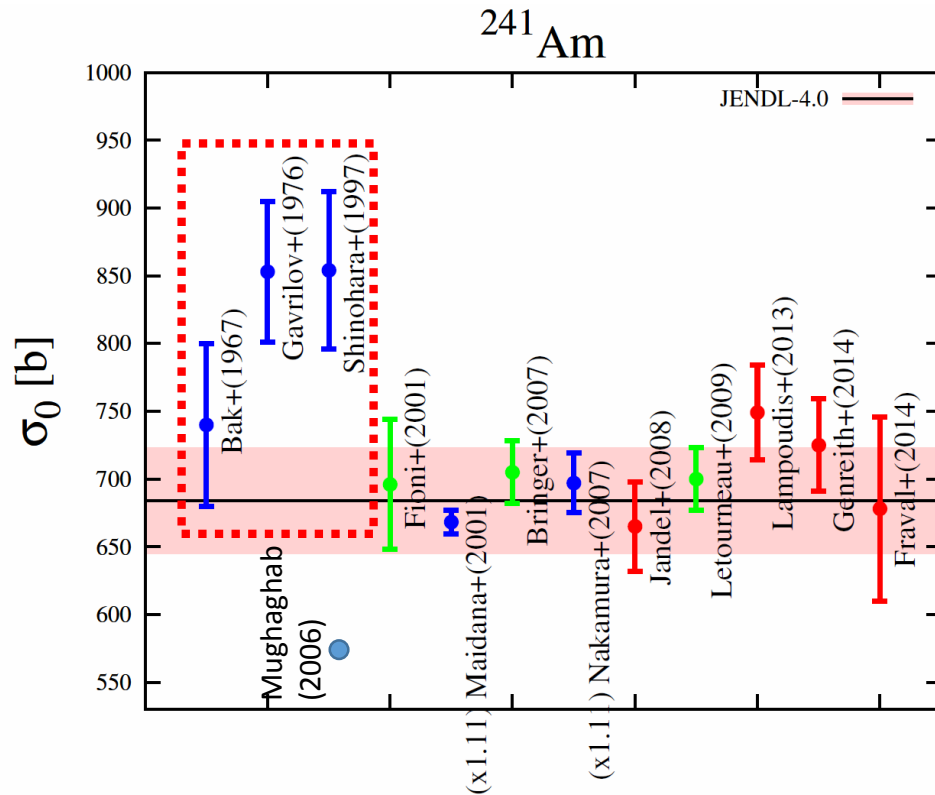


# Corrected thermal capture cross section for $^{241}\text{Am}$

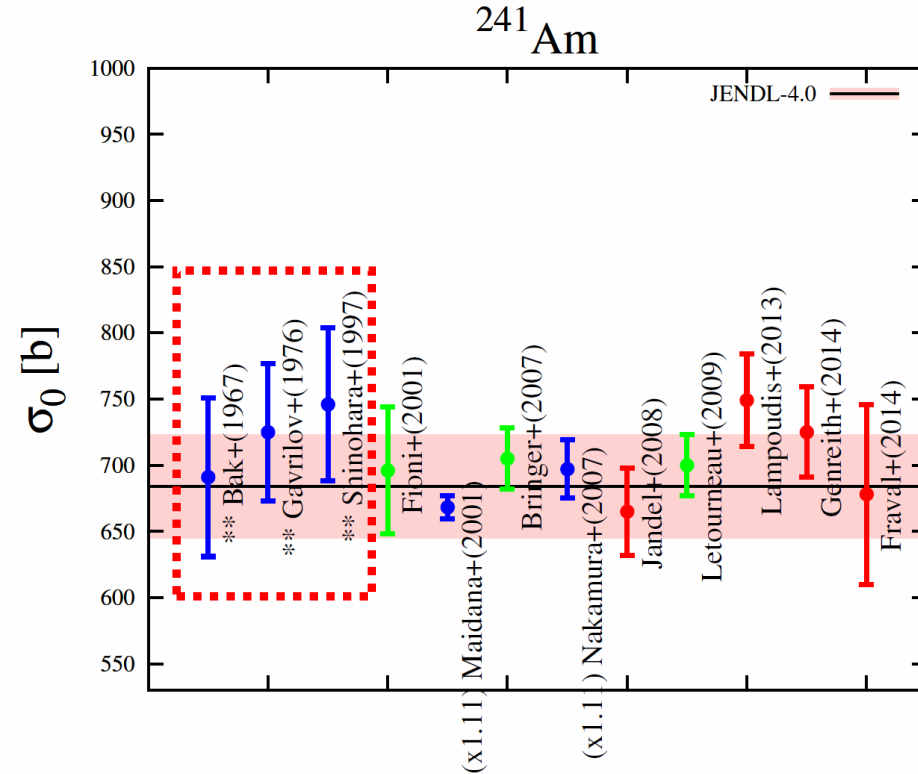
Activation



Before correction



After correction



Discrepancy among the data became smaller.

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[www.cea.fr](http://www.cea.fr)

# NP-237 AND AM-241 EVALUATIONS FOR JEFF AND COMAC

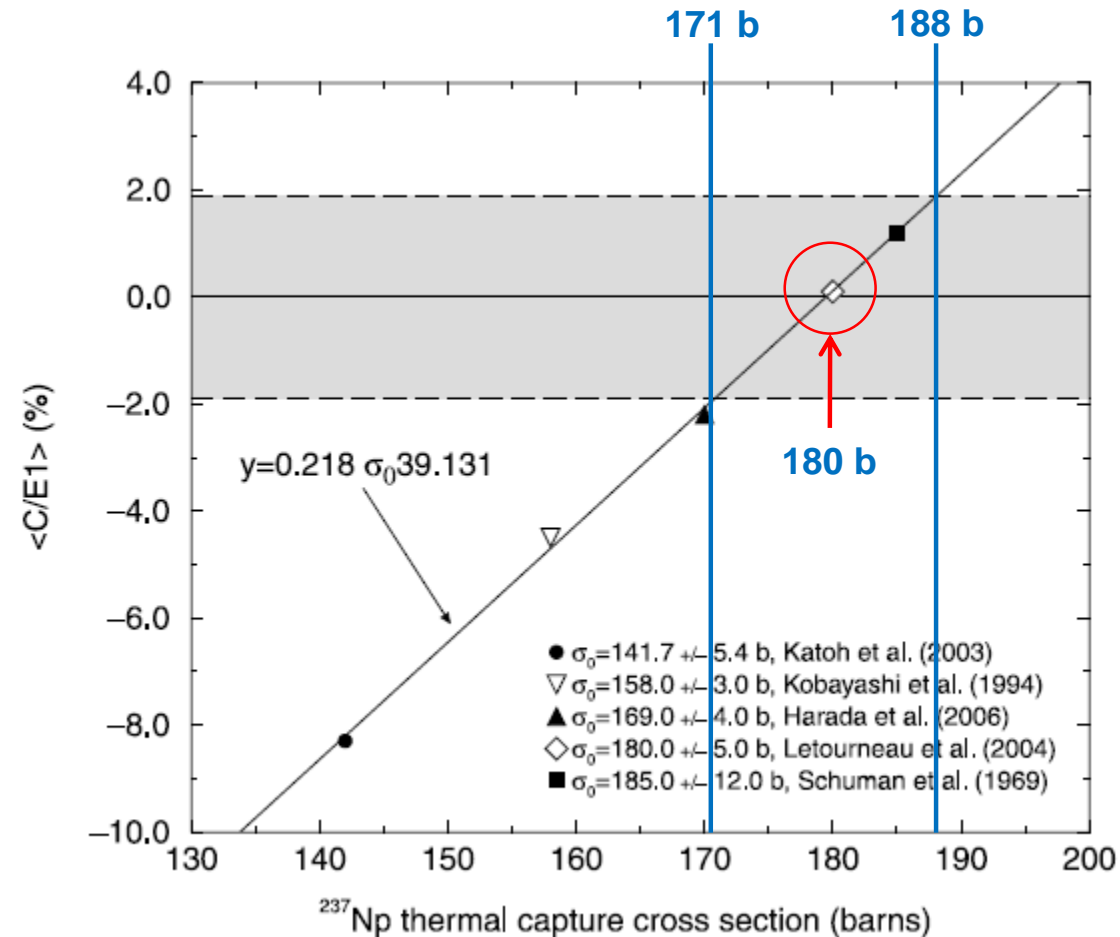
Gilles NOGUERE

10 May 2016

20 mai 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  $\Rightarrow \langle C/E-1 \rangle \approx 0$



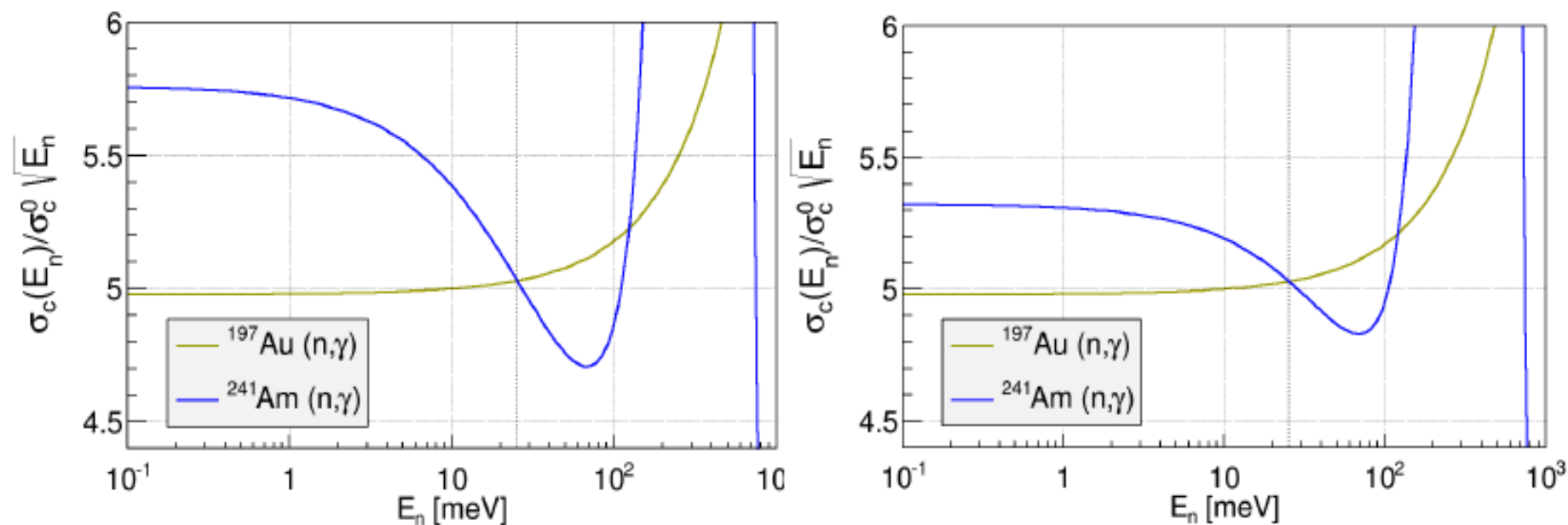
# Recent Results of $^{241}\text{Am}$ and $^{237}\text{Np}$ cross section measurements with cold neutron PGAA

C. Genreith<sup>1</sup>, M. Rossbach<sup>2</sup>

- 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

MLZ is a cooperation between:

## Reaction Rate Correction



**Reaction rate correction for  $^{241}\text{Am}$  samples is  
0.95 with JEFF3.2 and 0.89 with ENDF/B-VII.1  
Huge discrepancy!**

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# 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](http://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*

# Computational Condition (except LI )

## ✓ Core Configuration



## ✓ Burn-up

➡ 12.8% of U235 detractation

## ✓ Position of control rod

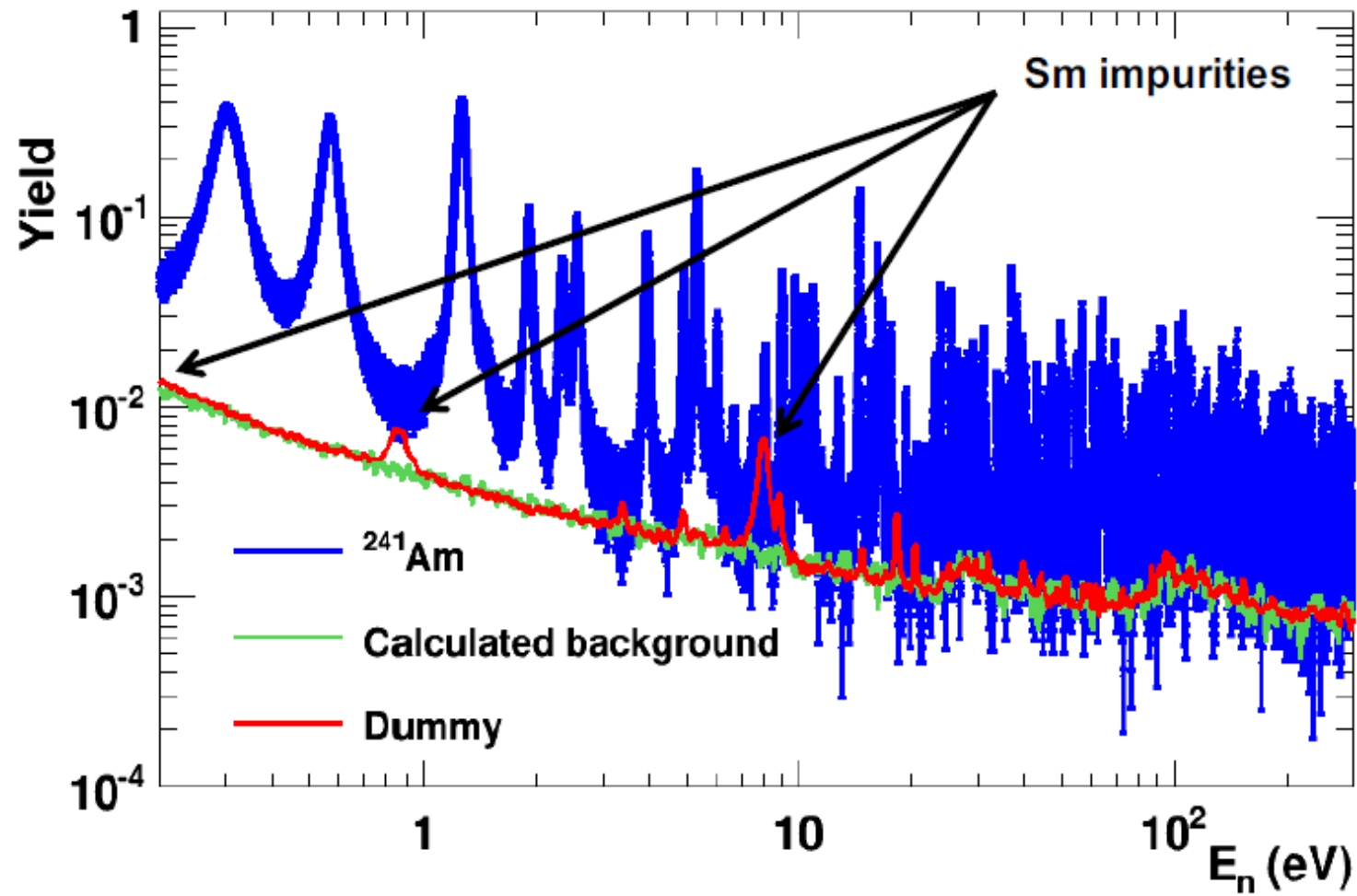
➡ A-rod : 42.8cm、 B-rod : 44.2cm、  
C-rod : 43.6cm、 D-rod : 40.6cm

	1	2	3	4	5	6	7	8	9	
	G	R-rod	F	F	F	F	SSS	G	G	II
SLANT	G	F	F	A-rod	F	B-rod	F	F	G	RO
	G	G	F	F	HYD	F	F	PI	G	HA
	G	G	F	C-rod	F	D-rod	F	G	Pn-2	NI
	G	G	F	F	F	F	F	G	Pn-3	HO
	NS	G	G	G	G	G	G	G	Pn-1	HE

# $^{241}\text{Am}$ 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

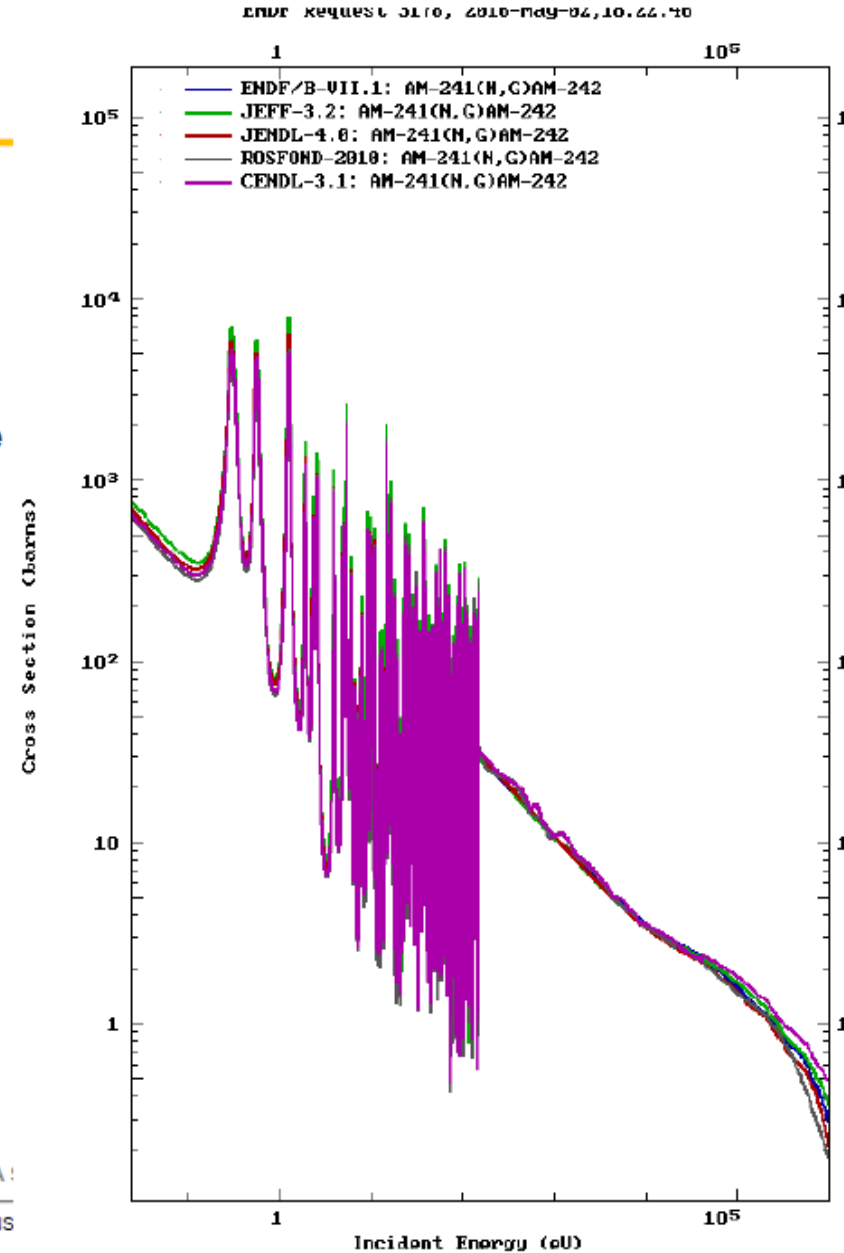
Marian Jandel

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



# Joint Research Centre

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Overview of experimental data for  $^{241}\text{Am}$

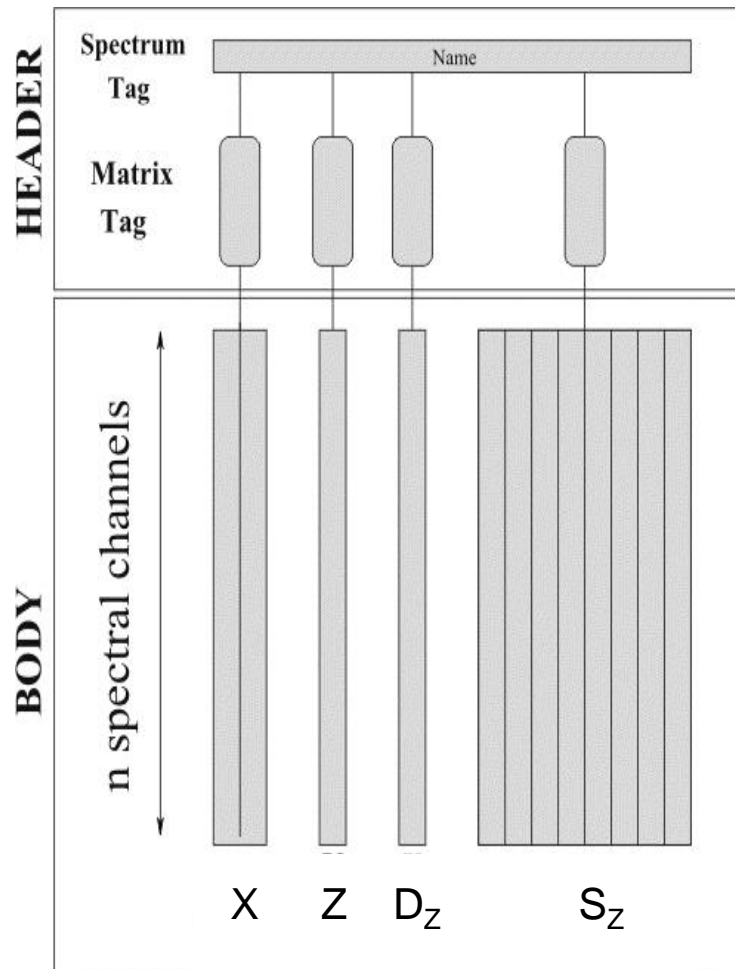
Peter Schillebeeckx

SG-41

10 – 11 May 2016

[www.ec.europa.eu/jrc](http://www.ec.europa.eu/jrc)

# IAEA recommendation: AGS, reporting of uncertainties



Observable Z (dimension n) with  
k sources of correlated uncertainties

$$\underline{V}_Z = \underline{S}_Z \underline{S}_Z^T + \underline{D}_Z$$

n : number of data points (TOF)

k : number of quantities introducing correlated  
uncertainty components

D<sub>Z</sub> : uncorrelated part (n values)

S<sub>Z</sub> : matrix dimension (n x k)  
contains the contribution of each quantity  
creating a correlated uncertainty component

# New decay data measurements

Atsushi Kimura (JAEA)

JOURNAL OF NUCLEAR SCIENCE AND TECHNOLOGY, 2016  
<http://dx.doi.org/10.1080/00223131.2016.1174167>



Taylor & Francis  
Taylor & Francis Group

ARTICLE

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

Kazushi Terada<sup>a</sup>, Shoji Nakamura<sup>a</sup>, Taro Nakao<sup>a</sup>, Atsushi Kimura<sup>a</sup>, Osamu Iwamoto<sup>a</sup>, Hideo Harada<sup>a</sup>, Koichi Takamiya<sup>b</sup> and Jun-ichi Hori<sup>b</sup>

<sup>a</sup>Japan Atomic Energy Agency, Ibaraki, Japan; <sup>b</sup>Kyoto University Research Reactor Institute, Osaka, Japan

### ABSTRACT

Gamma-ray emission probabilities of  $^{241,243}\text{Am}$  and  $^{239}\text{Np}$  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%.

### ARTICLE HISTORY

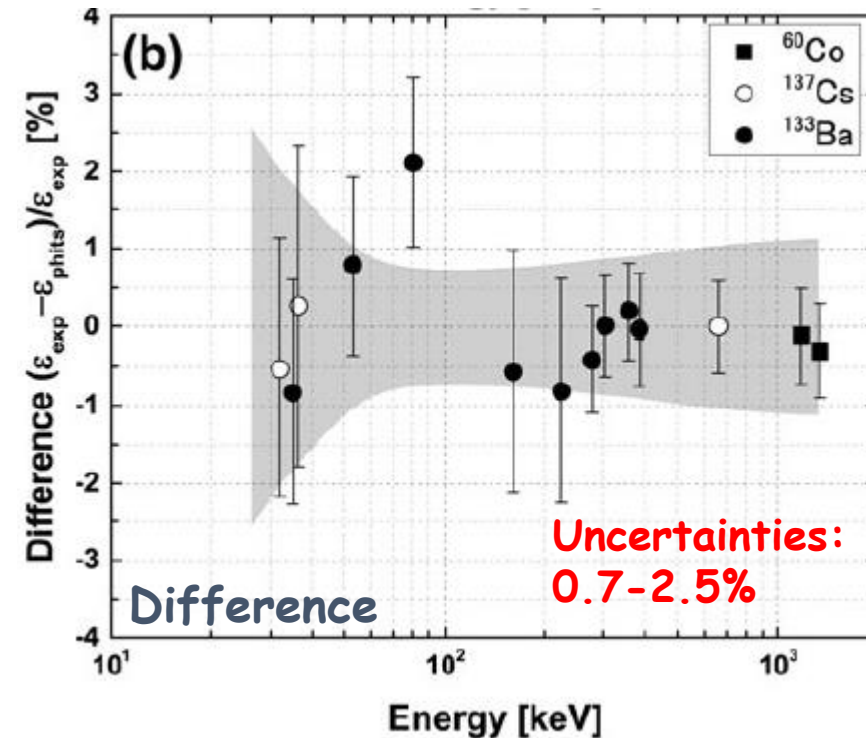
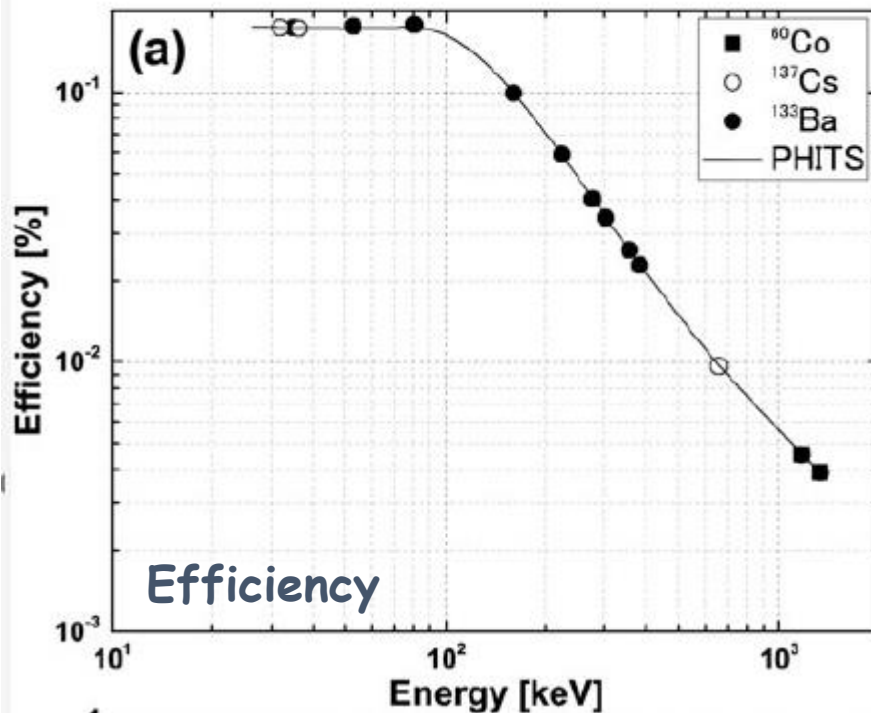
Received 13 January 2016  
Accepted 25 March 2016

### KEYWORDS

Gamma-ray emission probability; americium 241; americium 243; neptunium 239; neutron capture cross section; PHITS

# 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

# Experiments Data for Minor Actinide (MA) Management (EGIEMAM-II)

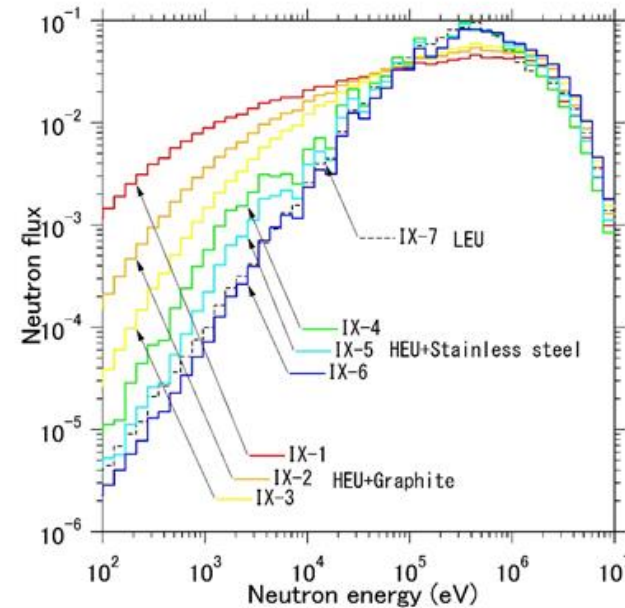
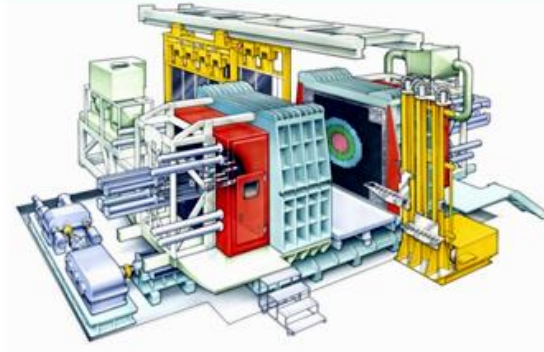
Chair: K. TSUJIMOTO (JAEA, Japan)   
Secretariat: Y. NAKAHARA (NEA)

- EGIEMAM-II website:
  - <https://www.oecd-nea.org/science/ma-ii/>
- EGIEMAM website:
  - <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. KELLETT

**list**

## 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