Status Report of SG-41

May 19, 2017

WPEC meeting

H. Harada (JENDL)

Outcomes of this SG_41 (From comments by PS (monitor) (selected and modified a bit by HH))

The most important is a much better understanding of possible bias effects on published spectrum averaged cross section data and the way to correct for it. The work done at JAEA/Tokai and JRC Geel (independent from each other) reduced drastically the discrepancies between the published data.

We also clarified a systematic underestimation in results from TOF transmission measurements due to the use of powder samples. Unfortunately the correction for this effect is not evident. It requires information about the sample properties (which is not always available).

To combine data we need to account for all correlated effects.
This requires that we first define the correlated components together with their uncertainties and properly propagate them.

Through the work of the SG-41, we have learned that it is of primary importance that all experimental details required for a proper analysis of the data are reported. A proper reporting of data will used to reduce bias effects and avoids that we need to repeat measurements.

Actions after the 2nd WS of SG-41

2016/05/20	Starting the discussion on the arrangement of chapters of the SG-41 report	H. Harada
2016/11/01 2016/11/14	Draft of the spectrum averaged data (chapter 4) for SG-41 report Revised	M. Rossbach+3
2016/11/25	Draft of the introduction (chapter 1) for SG-41 report	H. Harada
2016/11/26	Draft of the joint SG-41 paper for ND2016	G. Zerovnik
2017/01/27	Starting discussions on the 3rd WS of SG-41	H. Harada
2017/04/12 2017/04/17	Draft of the TOF data (chapter 3) for SG-41 report Revised	P. Schillebeeckx
2017/05/16 2017/05/17	The 3rd WS of SG-41	All

Agenda of the 3rd WS of SG-41

Tuesday, May 16, 2017 Room CC 16		
9:50 – 10:00	Welcome	H. Harada
10:00 – 11:00	Re-evaluation of the reactor neutron spectrum measurements-1	G. Zerovnik
11:00 – 12:00	Re-evaluation of the reactor neutron spectrum measurements-2	O. Iwamoto
12:00 – 13:00	Lunch Break	
13:00 – 14:00	Progress in the analysis of recent Am241 pile oscillation experiments	P. Leconte
14:00 – 15:00	New measurement of the decay data at JAEA	A. Kimura
15:00 – 15:30	Coffee Break	
15:30 – 16:30	New data of capture and total at J-PARC/ANNRI	A. Kimura
16:30 – 18:00	Discussions on the SG-41 report using draft for each chapter	All

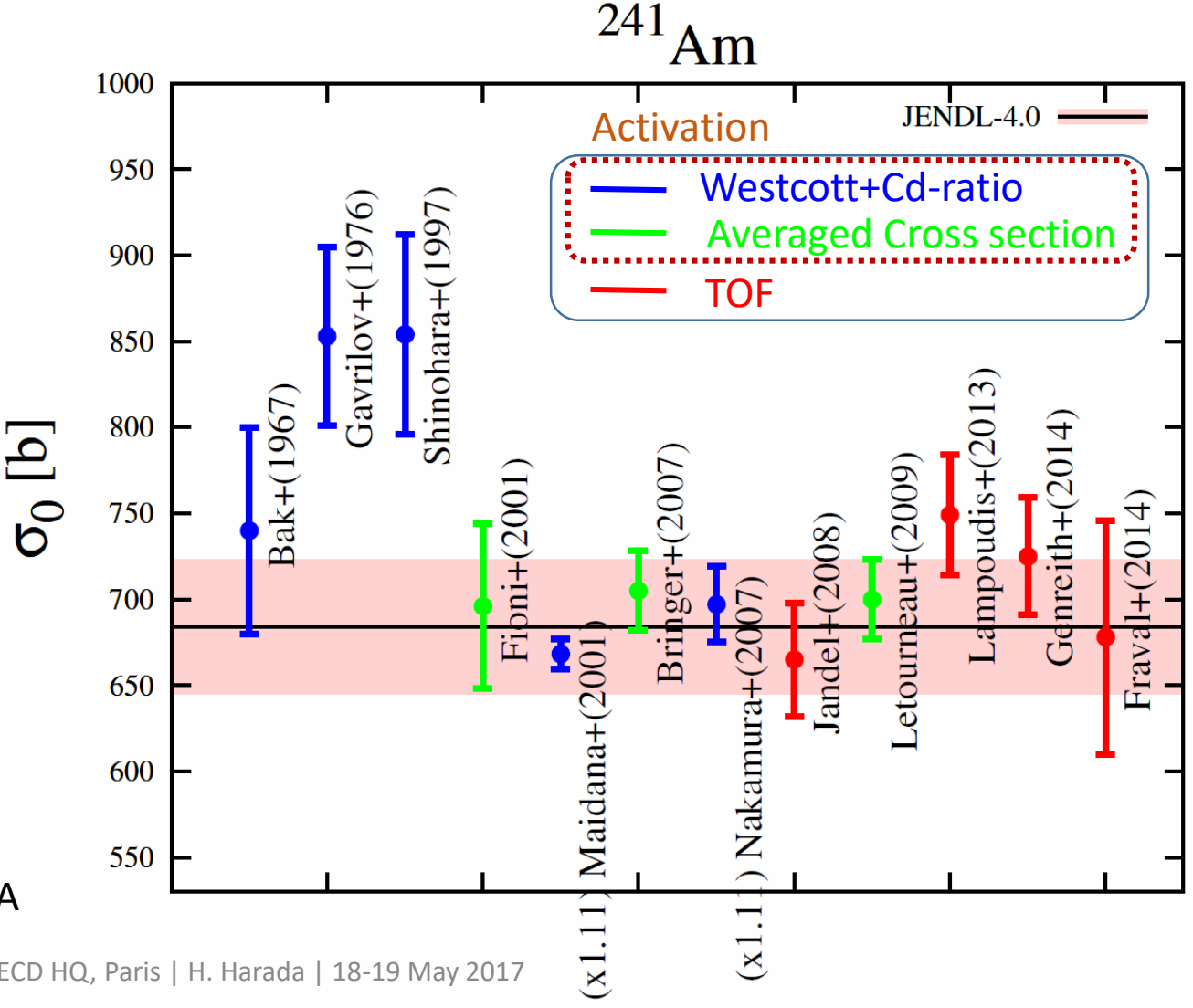
Wednesday, May 17, 2017 Room CC 16		
9:30 – 11:00	Discussions on the SG-41 final report	All
11:00 – 11:20	Coffee Break	
11:20 – 12:00	Discussions on a new SG proposal (experimental)	All

Highlights from Presentations at SG-41 3rd WS

Re-evaluation of the reactor neutron spectrum measurements-2

Current status of the thermal neutron capture cross section of MAs (e.g. ^{241}Am)

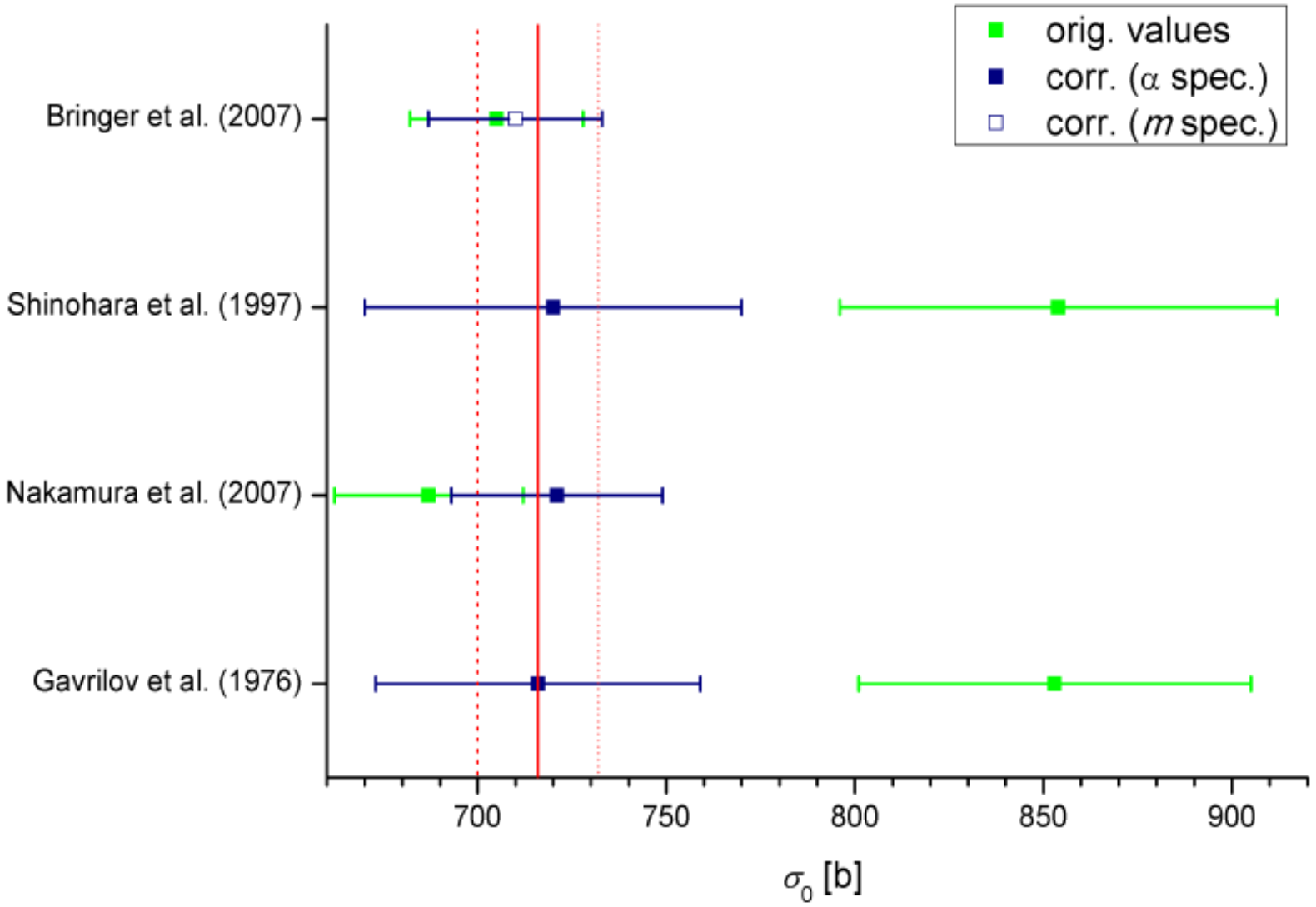
- ✓ **Large discrepancy** among the reported data of MAs.
- ✓ The data measured by **activation** were overestimated maximally by 20% from JENDL-4.0.



K. Mizuyama et al., PHSOR2016, Sun Valley, USA

Re-evaluation of the reactor neutron spectrum measurements-1

Corrections of identified bias effects on Am-241 capture

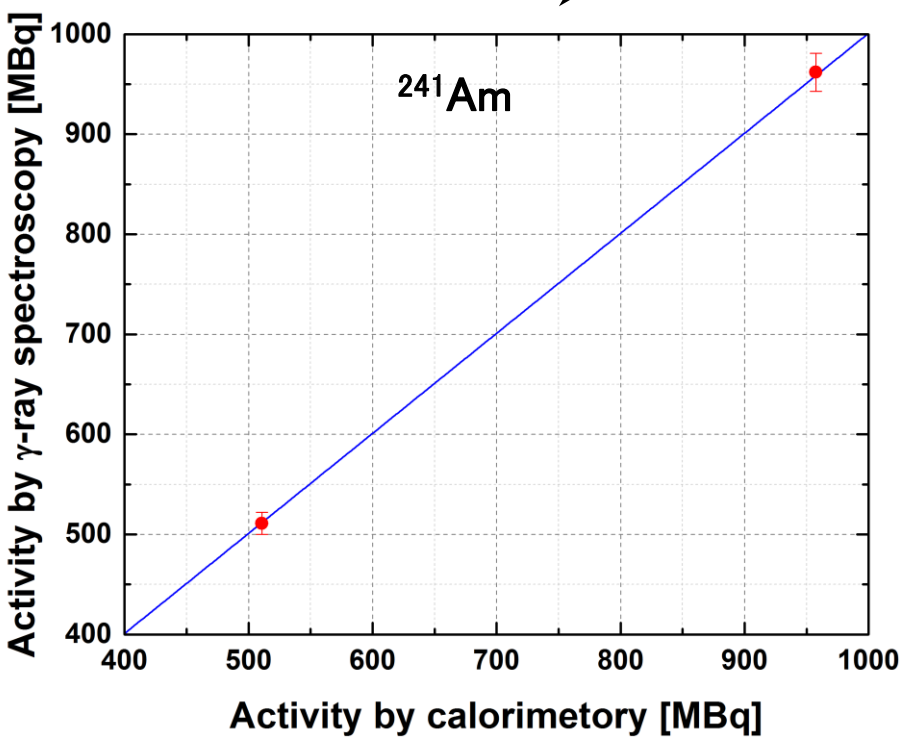


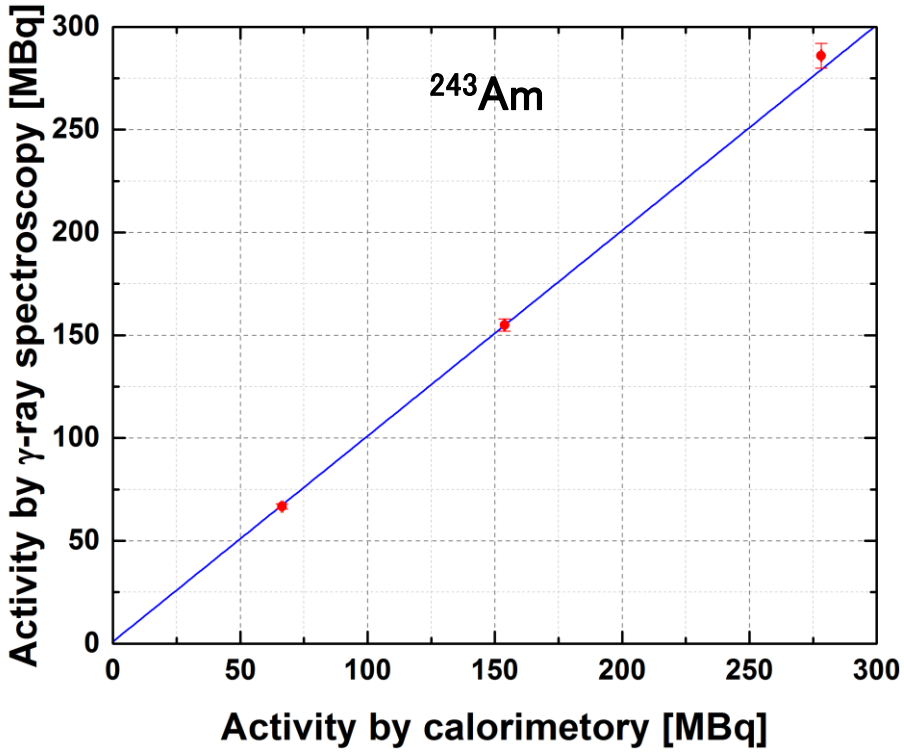
New measurement of the decay data at JAEA (New tool for higher accuracy)

Determined activities

	^{241}Am 480 MBq	^{241}Am 950 MBq	^{243}Am 60 MBq	^{243}Am 120 MBq	^{243}Am 240 MBq
Calorimetry	510.7(5)	957.4(5)	66.4(3)	153.8(3)	278.2(3)
Gamma-ray spectroscopy	511 (10)	962(19)	66.7(13)	155 (3)	286 (6)

➢ Their results were in good agreements





New data of capture and total at J-PARC/ANNRI

Capture Cross Section Measurement

- The thermal neutron capture cross section of ^{241}Am was derived as 707±32 b with an uncertainty of 4.5%.
- In the thermal energy region, JENDL-4.0 is smaller than the present results by 3.3%, and JEFF-3.2 is larger by 5.5%.

Total Cross Section Measurement

- The thermal total cross section of ^{241}Am was derived as 730 ± 21 b.
- In the neutron energy region from 4 meV to 25.3 meV, JENDL-4.0 is in good agreement with the present results, and JEFF-3.2 is larger than the present results by 8.5%.

Progress in the analysis of recent Am241 pile oscillation experiments

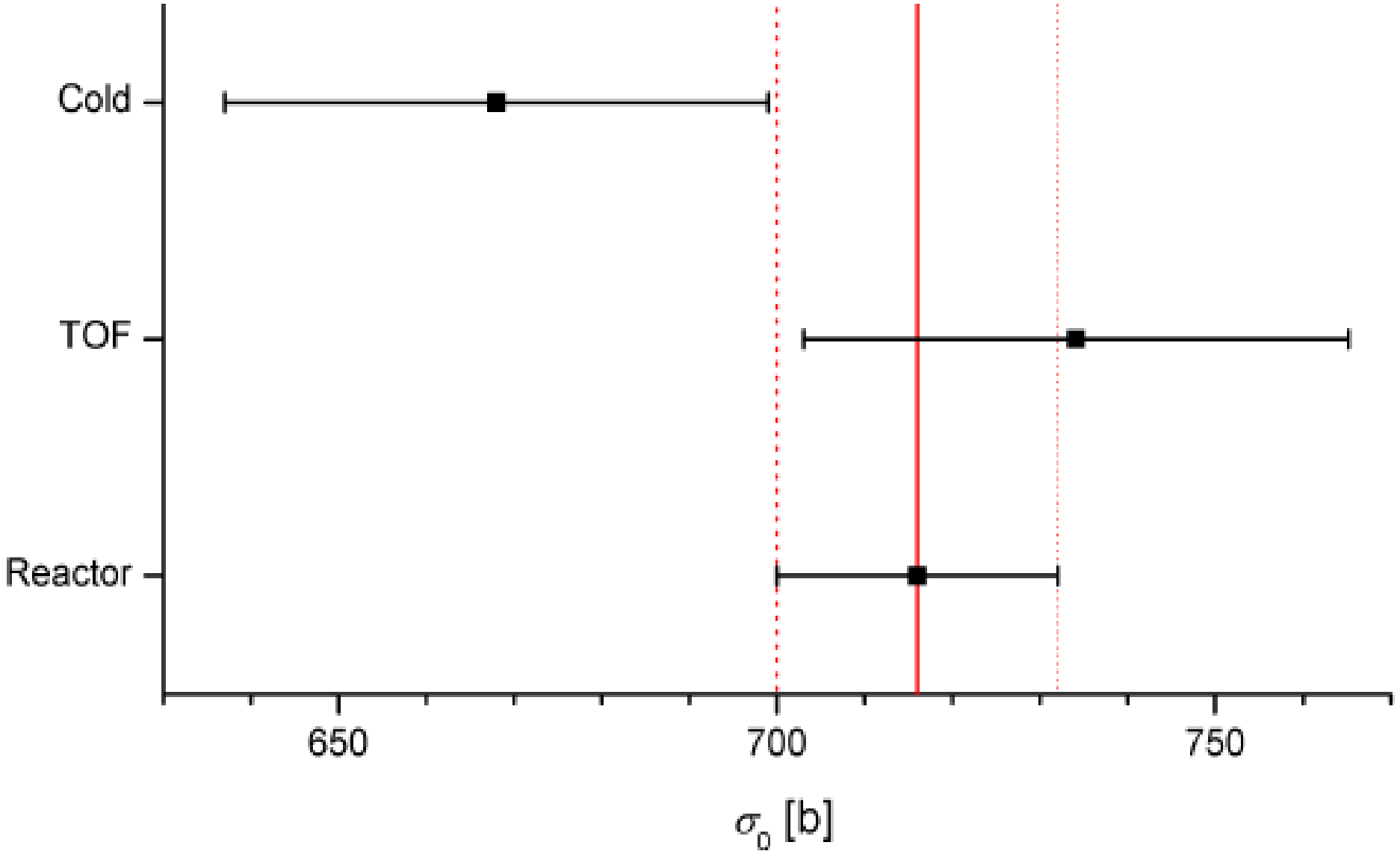
CONCLUSIONS AND PERSPECTIVES

- The two Am241 samples from CEA and JRC are giving consistent conclusions in the thermal spectrum experiment
- The Am241 sample from CEA is giving strongly different trends in the thermal and LWR-type spectrum
- Regarding the difference of sensitivity profiles, it does not seem physically acceptable to satisfy all the integral trends

⇨Under these conditions, it does not seem acceptable to recommend a thermal capture cross section on Am241 based on pile oscillation experiments

⇨Alternative solution: provide [C/E-1] values in the SG41 final report with multigroup sensitivity coefficients

Comparison of three different measurement methods



Recommendation of thermal neutron capture cross section of Am-241 (tentative) by SG-41

method 1 (weighted average by assuming all data are independent):
reactor: 716 +- 16 TOF: 734 +- 31 cold: 668 +- 31
weighted average: 711 +- 13 weighted average (-cold): 719 +- 14

method 2 (conservative on the level of measurement type):
reactor: 716 +- 23 TOF: 734 +- 35 cold: 668 +- 31
weighted average: 707 +- 16 weighted average (-cold): 721 +- 19

method 3 (conservative on the level of final weighted average):
reactor: 716 +- 16 TOF: 734 +- 31 cold: 668 +- 31
weighted average: 711 +- 23 weighted average (-cold): 719 +- 23

Unit: [barn]

Note:

1) To include Cold neutron data or not remains to be discussed.

2) The recommended uncertainty is determined by a conservative way.
For fine evaluation of the uncertainty, we need further investigation,
Accounting for all correlations between data.

3) Recent data (presented at AESJ meeting at 29 March 2017) from J-PARC/ANNRI (AIMAC project) is not included for this evaluation by the deadline limitation.
But it is used to confirm the recommended value.

Further study on item 2) and 3) would supply a finer recommendation value in future.

Discussions on a new SG proposal (experimental)

A next new SG proposal (experimental) including a follow-up activity of SG-41 has been discussed during the 3rd WS of SG-41.

For finer evaluation of the uncertainty, the study accounting for all correlations between selected data was strongly recommended. By concentrating on Am-241, fine evaluation methodology of the uncertainty from plural experimental data & their uncertainties is expected to be developed.

The other interest on Am-241(n, γ) reaction came up: The improvement of isomer production ratio Am-241m/Am-241g. Feasibility of this study need to be checked since it is a so challenging measurement before the proposal.

The action making a list of the samples stocked in institutes was also proposed to accelerate the international experimental collaboration.

Summary

Re-analysis of Energy integrated data have been performed by taking into account the bias effects identified by SG-41.

Carefully selected and corrected data are used for recommending the thermal capture cross section of Am-241
(SG-41 concentrated in Am-241 since the status of Am-241 is more serious than Np-237)

Future action ideas effective for data improvements were collected.
(For example, making a list of the sample stocked in institutes)

Schedule
Discussions and Confirmations of recommended cross section
Revise the draft
↓
Report, End of 2017