Recent Improvements in Nuclear Data

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NEA/WPEC recent work (1/2)

- 'LEU Reactivity Underprediction' : SG-22 (A. Courcelle et al. CEA-ORNL)

  $\Rightarrow$ new evaluation ^{235}U and ^{238}U (adopted in JEFF3 and ENDF/B-VII)

- 'Evaluated Data library for FP' : SG-23 (P. Oblozinsky NNDC-BNL) :
  - Follow-up of the NEA/WPEC SubGroup-21 (completed in 2004)
  - SG23 created the 219 FP materials accordingly to SG21 recommendations
  - Additional improvements from BNL325 «Atlas of Neutron Resonances»

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Library (data source)	Full file	Resonance region	Fast region
ENDF/B-VI.8, released in 2001	1	3	13
New evaluations for ENDF/B-VII.0	74	74	–
JEFF-3.1, released in 2005	1	–	–
JENDL-3.3, released in 2002	47	7	56
CENDL-3.0, released in 2001	11	–	15
BROND-2.2, released in 1992	1	–	–
Total number of materials	**135**	**84**	**84**

NEA/WPEC recent work : FP evaluations SG-23 (2/2)

- Adopted in full by ENDF/B-VII (Dec 2006)
- Experimental validation by FP reactivity worth measurements in CERES (UKEA-CEA collaborative program) : C. Dean, ND2007 Conf

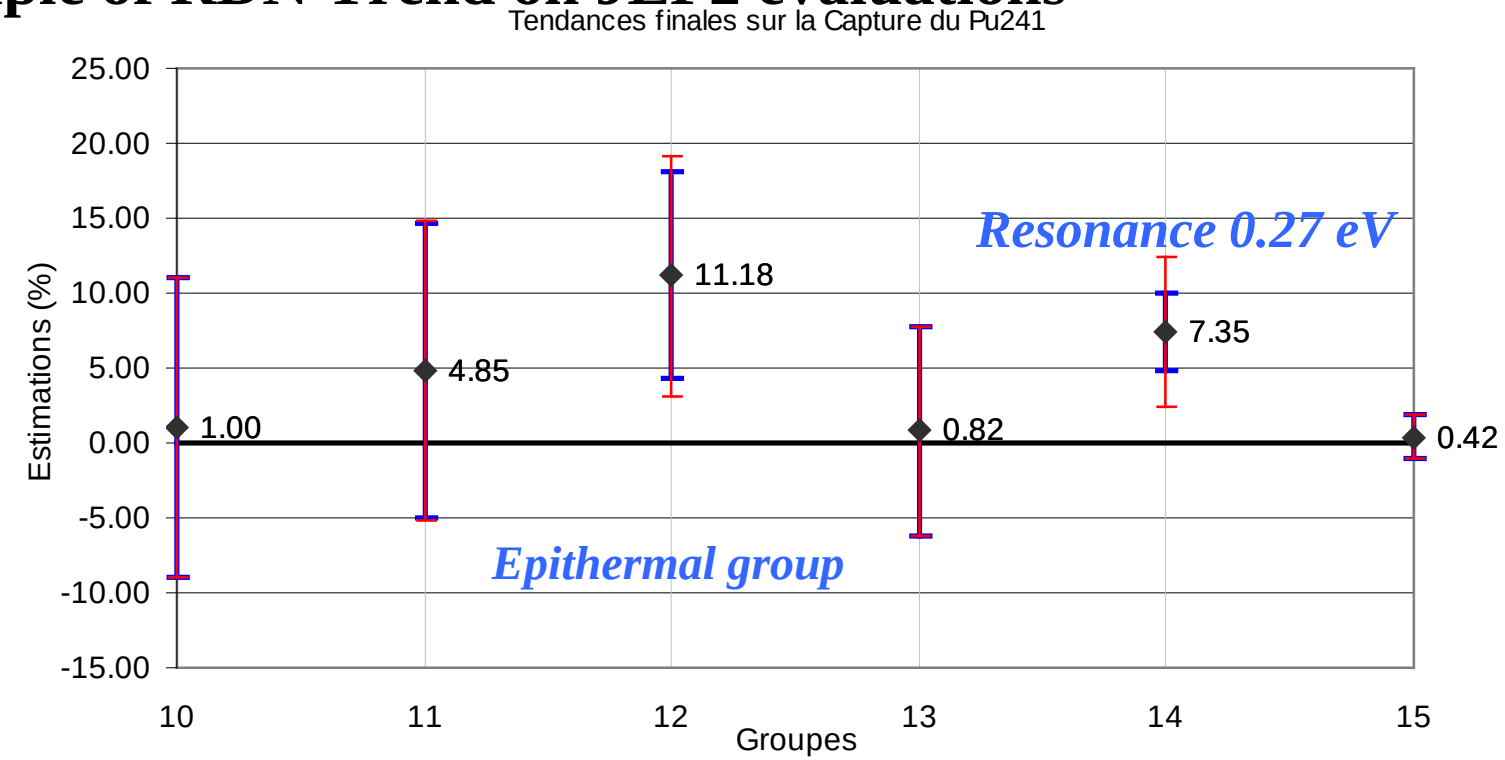
Fission Product	JEF2.2	JEFF3.1	WPEC23
Mo-95	+2	0	0
Tc-99	+3	+8	+10
Rh-103	+10	+6	+8
Ag-109	+2	+2	+2
Cs-133	+10	+10	+10
Nd-143	-6	-3	-6
Nd-145	0	+1	+11
Sm-147	+2	+4	0
Sm-149	-6	-4	-6
Sm-152	0	0	0
Eu-153	-10	-6	-6
Gd-155	+3	+3	+3

EU Impressive Work for JEFF-3.1.1 : Actinides (1/3)

- **ND Trend Analysis using Critical Experiments and P.I.E**

Example of RDN Trend on JEF2 evaluations

Pu241
(n,γ)



Clear trend on Capture Integral E_R=0.27eV :

+7.3% ± 2.5%

→ **Correction of the Pu242 underprediction**

EU Impressive Work for JEFF-3.1.1 : Actinides (2/3)

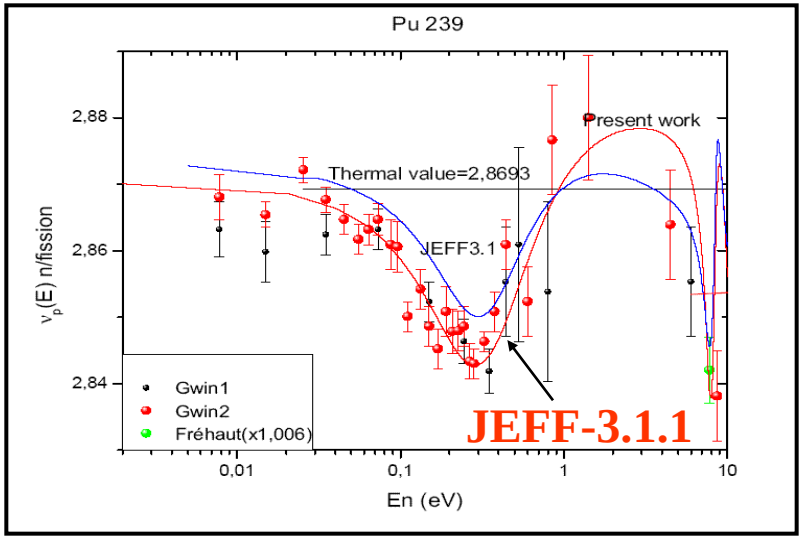
Comparison : RDN Trends / JEFF-3.1.1

	Estimation from RDN	Modifications JEF2.2 to JEFF3
Iγ U235	+12% ±3.2%	+10%
ν_{th} U235	+0.1% ±0.2%	+0.0%
Pu241(n, γ) E < 0.1 eV	+0.4% ±1.5%	+1.4%
[0.5– 0.1eV]	+7.4% ±2.6%	+7.2%
[4 – 0.5 eV]	+0.8% ±7%	+1.5%
[23 – 4eV]	+11% ±8%	+8.4%
$I\gamma^{eff}$ U238	-0.6% ±1.5%	-0.6%
(n,2n) U238	+6.3% ±2.1%	+10%

Consistent results between Trend analysis and new JEFF3 evaluations

EU Impressive Work for JEFF-3.1.1 : Actinides (3/3)

- **New evaluations : example of Pu239 (D. Bernard and AS, ND2007)**

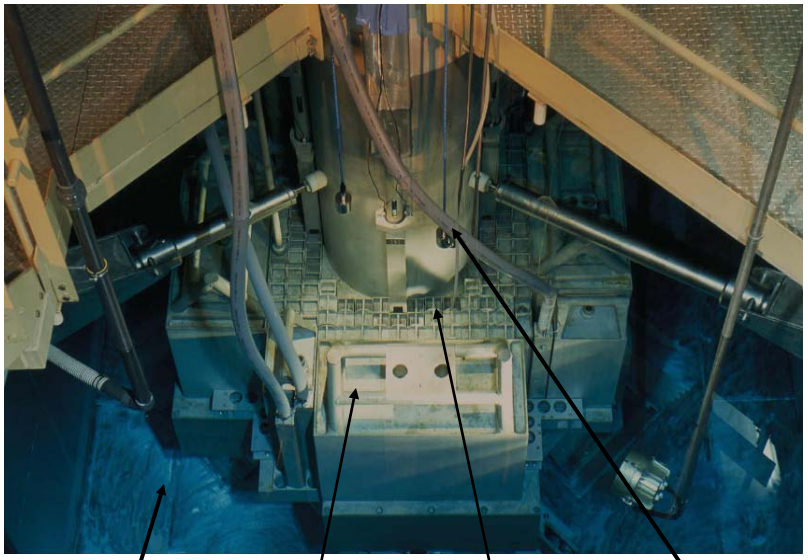


EOLE mock-up	JEFF-3.1 C-E ± δE (pcm)	JEFF-3.1.1 C-E ± δE (pcm)
MH1.2 (PWR-MOx)	**280 ± 250**	**160 ± 250**
MISTRAL-2 (PWR-MOx)	**630 ± 250**	**490 ± 250**
MISTRAL-3 (PWR-MOx)	**710 ± 250**	**560 ± 250**
BASALA-H (BWR-MOx)	**610 ± 250**	**470 ± 250**
BASALA-C (BWR-MOx)	**700 ± 250**	**540 ± 250**
FUBILA-H (BWR-MOx)	**250 ± 250**	**110 ± 250**

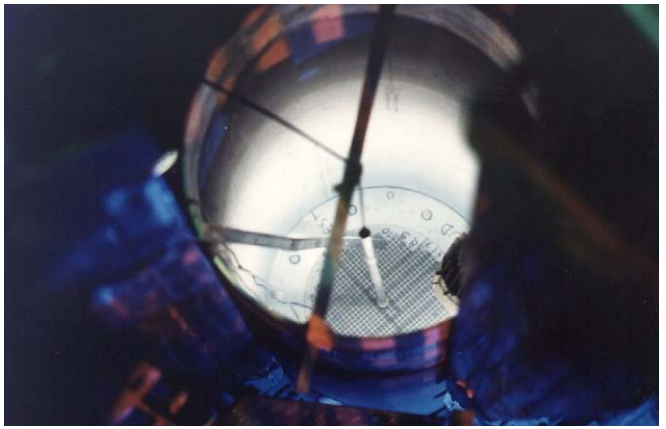
EU Impressive Work for JEFF-3.1.1 : FPs (1/4)

Oscillation in Minerve : FP separated isotope, LWR spent fuels

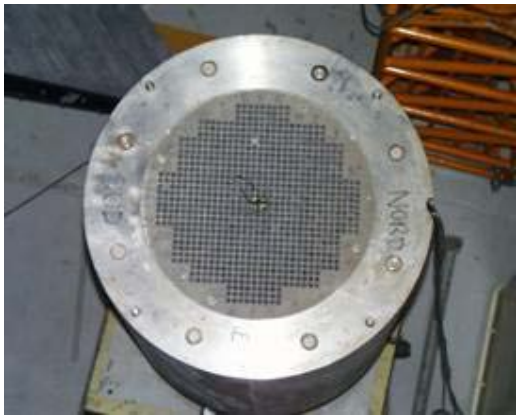
Minerve core



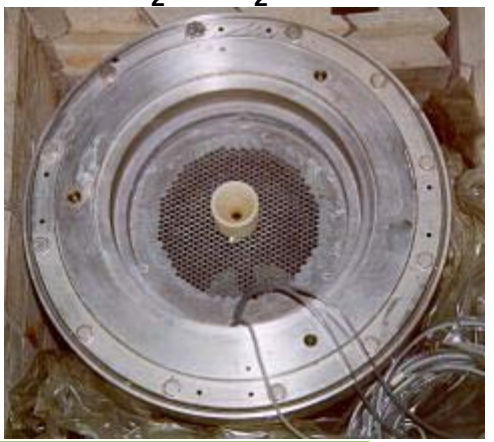
Test lattice



MELODIE PWR lattice:
800 UOX-3%^{235}U pins



MORGANE HCR lattice:
UO_2-PuO_2 11%Pu



EU Impressive Work for JEFF-3.1.1 : FPs (2/4)

FP oscillation : JEF2 C/E Bias and Feedback to JEFF Group

σ_{Sm149} underestimated by -5±2%
⇒ Γ_n (E_R=0.1eV) increased by 3%

σ_{Nd143} underestimated by -5±2%
⇒ Γ_n (bound level) increased by 4%

σ_{Cs133} overestimated by +7±2%
⇒ Res. parameters from Nakajima

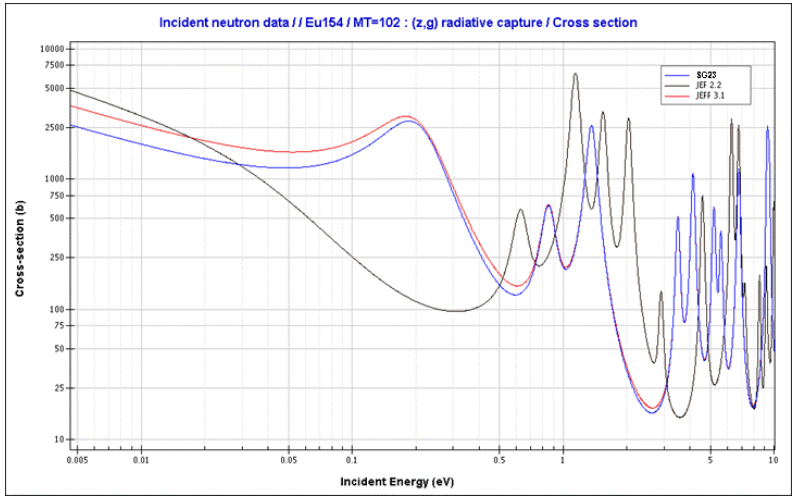
σ_{Rh103} overestimated by +10±3%
⇒ Measures at Gelina

FP	Mass (g)	LWR : R1-UO_2 (C-E)/E in %	LWR : R1-UO_2 Uncertainty 1σ (%)	Thermal : R2-UO_2 (C-E)/E in %	Thermal : R2-UO_2 Uncertainty 1σ (%)
Sm	0.026	**- 4.5**	2.9	**- 3.3**	3.6
^{149}Sm	0.004	**- 6.0**	2.9	**- 4.9**	3.6
^{147}Sm	1.008	**+ 1.3**	4.3	**+ 2.7**	4.7
^{152}Sm	0.586	**- 1.6**	2.9	**- 1.8**	3.7
Nd	3.602	**+ 0.4**	3.0	**- 3.3**	3.7
^{143}Nd	0.574	**- 7.1**	3.1	**- 8.5**	3.8
^{145}Nd	2.325	**+ 0.4**	3.8	**+ 1.1**	4.4
^{155}Gd	0.008	**- 2.5**	2.9	**- 6.1**	4.0
^{153}Eu	0.431	**- 4.2**	4.0	**- 1.3**	4.6
^{99}Tc	2.142	**+ 4.1**	3.8	**+ 3.4**	3.5
^{95}Mo	3.650	**- 3.1**	3.4	**- 3.7**	3.8
^{133}Cs	3.076	**+ 8.5**	3.2	**+ 7.6**	3.8
^{133}Cs	2.200	**+ 7.6**	3.5	**+ 9.3**	3.8
^{103}Rh	0.376	**+ 11.0**	4.0	**+ 8.0**	4.2
^{109}Ag	0.640	**- 3.6**	4.3	**- 4.5**	4.3
^{109}Ag	0.073	**- 4.6**	9.0	**+ 2.8**	6.9
Ag	1.105	**- 4.7**	4.2	**+ 0.3**	4.7
Ru	5.850	**+ 10**	3.8	**-**	**-**

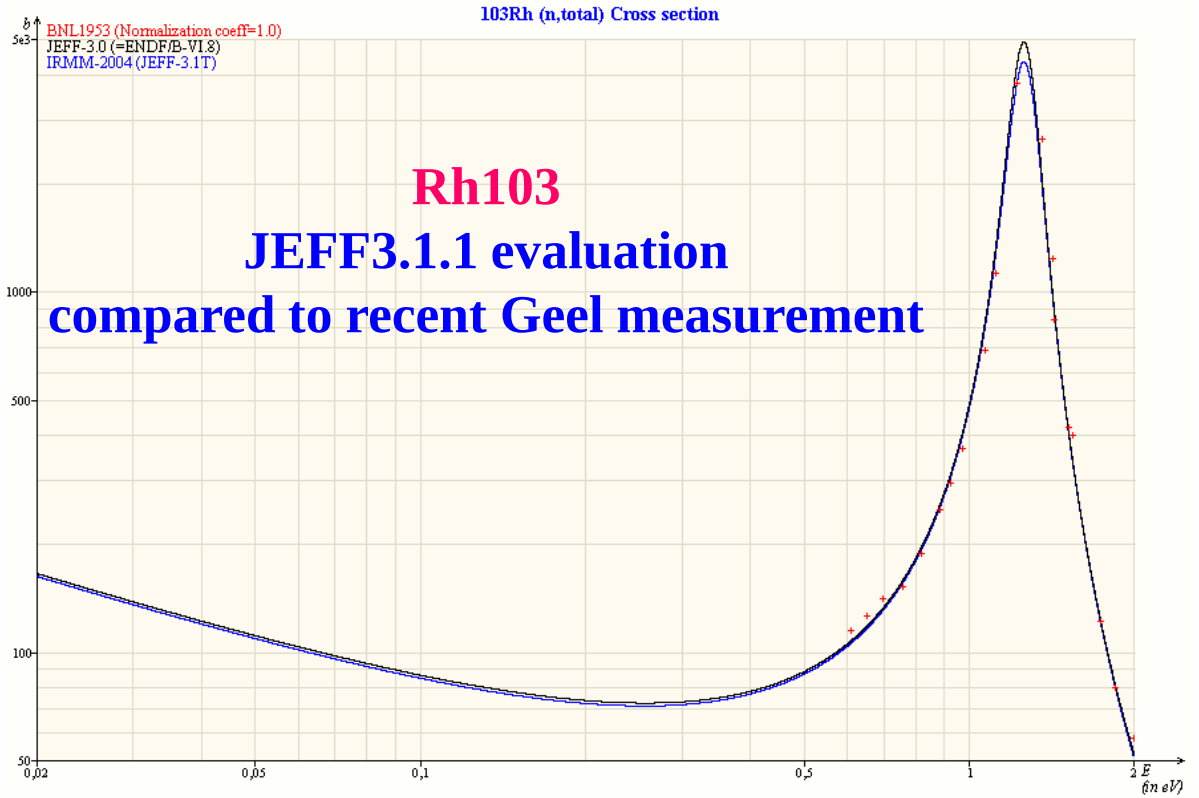
EU Impressive Work for JEFF-3.1.1 : FPs (3/4)

New evaluations for main FPs : Sm149, Nd143, Rh103, Tc99, Cs133…

154Eu(n, γ) (T1/2=8.6y)
JEF2, JEFF3.1.0 and WPEC23



Rh103
JEFF3.1.1 evaluation
compared to recent Geel measurement



EU Impressive Work for JEFF-3.1.1 : FPs (4/4)

Qualification in Minerve BUC experiments

	[*C/E* – 1] (%) JEFF3.1.1	
^{149}Sm	-1.5	2.0
^{147}Sm	6.4	8.0
^{152}Sm	0.3	1.9
^{NAT}Sm	-1.3	2.1
^{143}Nd	-3.0	2.2
^{145}Nd	1.4	2.1
^{NAT}Nd	-1.2	2.2
^{155}Gd	-0.9	2.0
^{103}Rh	8.4	3.3
^{99}Tc	-1.3	3.3
^{133}Cs	-1.4	7.9
^{109}Ag	1.3	4.6
^{NAT}Ag	1.9	3.7
^{NAT}Ru	12.4	6.3
^{95}Mo	-8.4	3.1
^{NAT}Mo	-5.8	3.3

JEFF Report 22: the recommended JEFF-3.1.1

Data Bank ISBN 978-92-64-99074-6

The JEFF-3.1.1 Nuclear Data Library

JEFF Report 22

Validation Results from JEF-2.2 to JEFF-3.1.1

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NUCLEAR ENERGY AGENCY
ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

CONCLUSIONS

- An important international evaluation work has been recently carried out, particularly for FP within NEA/SG23
- An extensive evaluation and experimental validation work has been performed in EU for BUC isotopes (11 actinides and 15 FP)
- Recent libraries such as JEFF-3.1.1 are better suited for BUC calculations