IAEA 60 Years
Atoms for Peace and Development

IAEA-Nuclear Data Section Status Report

NSDD Scientific Secretary:
Paraskevi (Vivian) Dimitriou: 2015 - present

Nuclear Data Section

- Personnel changes
  - Section Head: Arjan Koning (since July 2015)
  - Data Services Unit Head: Jean-Christophe Sublet (since March 2017)-replaced S. Simakov
  - Atomic+Moelcular Data Unit: Bas Brahms retired (Nov. 2016) – replace by H.K. Chung until Oct. 2017

Nuclear Data Section efforts

- Coordination – European effort (*Balabanski's talk*)
- Organisation of meetings (NSDD, Technical and Consultant Meetings)
- Training
- Technical support: codes, editors, web tools (Codes/Formats sessions)
- Financial support
- Coordinated Research Projects (Medical isotopes, beta-delayed neutrons, photonuclear data) – (*Tuesday afternoon*)
- Dissemination tools (Live Chart, Isotope Browser, Decay Data Portal)
- Bibliography access (NSR+EXFOR PDF database)

Meetings 2015-2017

- TM on Improvement of Analysis Codes for NSDD evaluations, 8-10 Oct. 2015, IAEA
  - Assess progress in developing new codes (JGAMUT, ALPHAD_new, Java-NDS, T-RULER, BrICCemis, BetaShape, uncertainties package, MYENSDF Webtool, Tree-editor) and discuss maintenance issues
  - Recommendation: develop editor that will integrate editing and codes, clarify/introduce policies/procedures for treating asymmetric uncertainties
  - Summary Report: INDC(NDS)-0696

Training 2015-2017

- Specialized Workshop for NSDD Evaluators, 27-29 April 2015, IAEA
  - Directors: E.A. McCutchan, F.G. Kondev
  - Lecturers: M. Martin, J. Tuli, B. Singh, T. Kibedi, R. Firestone
  - Participants: S. Basunia, S. Singh, A. Negret, C. Nesaraja, J. Timar, A. Hurst, K. Abusalem

- Main activity: revision of Evaluators Guidelines, updating of General Policies, specific issues with over-precise data, normalization

- Feedback: more hands-on approach next time!!!

- Workshop summary: INDC(NDS)-0688

- Next workshop: 2019

Training 2015-2017

- ICTP-IAEA Workshop on NSDD: Experiment, Theory and Evaluation, 22 Aug.–2 Sept. 2016
  - Directors: P. Dimitriou, E.A. McCutchan, M. Thoennessen
  - Lecturers: P. Van Isacker, B. Singh, J. Tuli, S. Basunia, T. Kibedi, F. Kondev, H. Sakurai, P. Regan, M. Verpelli, V. Zerkin

We expect support from Universities and Labs with access to PhD students and post-docs!

  - Evaluation of mass chain A=217 (week 2)-in review
- Feedback:
  - XUNDL (week 1)+ENSDF (week 2) recommended
  - More emphasis on codes and web applications with exercises
  - Lectures should focuss on experimental and theoretical aspects relevant to ENSDF evaluation
- Next workshop: in 2018

Technical Support

- ENSDF codes, editor, web tools
  - Dissemination (ensure all codes are running on all platforms)
  - Editor: tree-graph editor by V. Zerkin (see Friday's talk)
  - MyEnsdf Web tool by V. Zerkin (see Friday's talk)

Financial support

- Mass chain evaluations:
  - *Pascu (ROM): new in 2017*
  - Abusaleem (JOR): ended in 2016
  - Dhindsa (IND) : ended in 2016
  - Timar (HUN): ended in 2014
  - Negret (ROM): ended in 2013

‘Seed’ contracts for mass chains:
60% success rate

- Horizontal evaluations:
  - Singh (2016-2017): beta-delayed neutron $T_{1/2}$ and P_n for Z>28
  - Stone (2017-): Tables of Evaluated Nuclear Moments

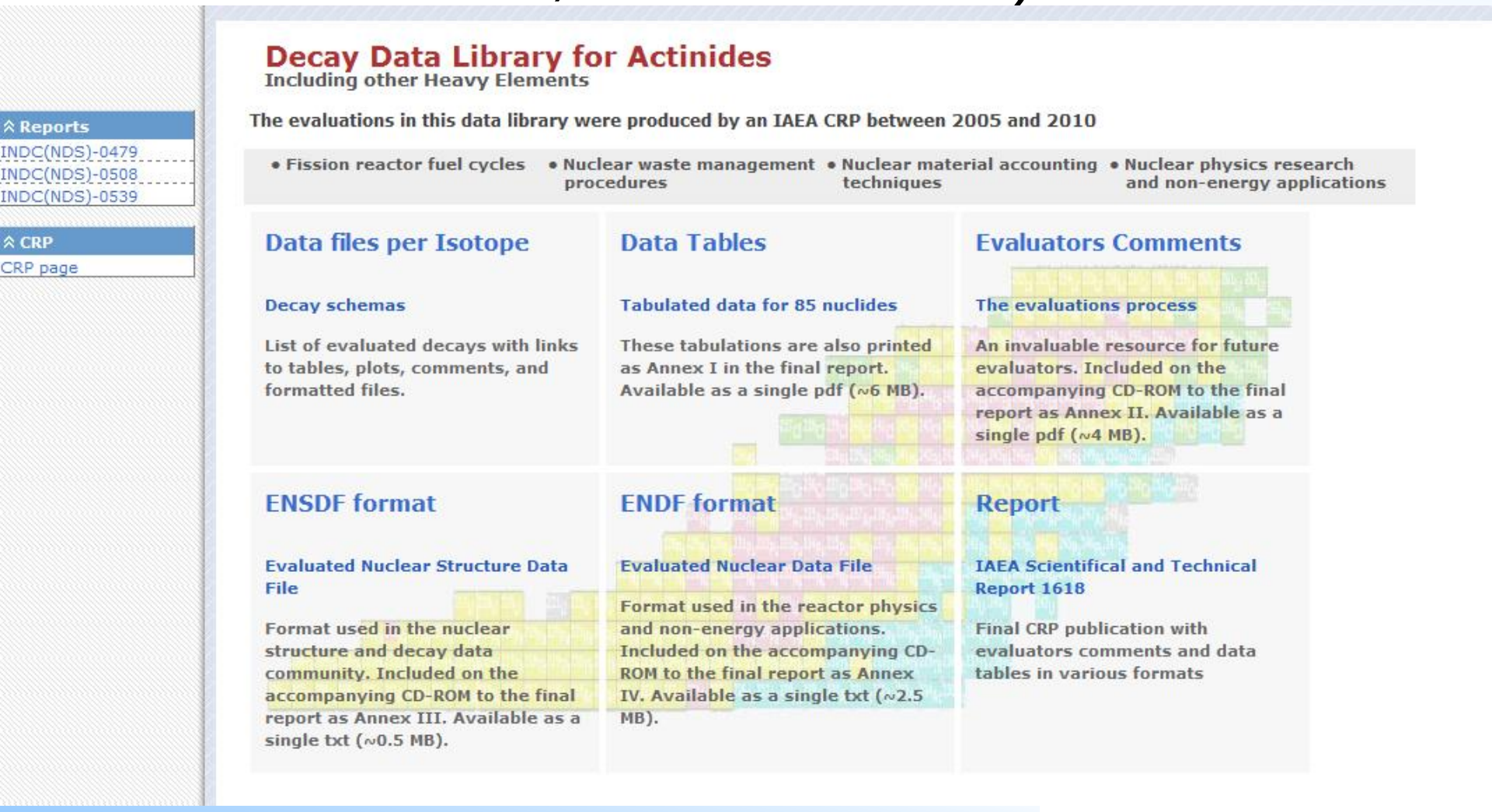
Dissemination tools

- Live Chart (M. Verpelli) 
  - New 2017 masses correctly inserted with proper treatment/calculation of uncertainties

- Isotope Browser (M. Verpelli)
  - Translated in 5 UN official languages (french, spanish, chinese, arabic, russian) + italian, slovenian, traditional chinese

Dissemination Tools cont'd/

- Recommended Actinide Decay Library (IAEA CRP 2007-201, STI/PUB-1380)



Dissemination Tools cont'd/

- Recommended Actinide Decay Library (IAEA CRP 2007-201, STI/PUB-1380)

Parent	Energy [keV]	Half-life	Jⁿ	Decay	Q [keV]	Daughter
$^{238}_{92}U_{146}$	0.0	4.468 x 10^9 y *5*	0+	α	4269.7 *29*	$^{234}_{90}Th_{144}$

Evaluation: V. Chiste' **Publication cut-off**: 01-APR-2006

ENSDF Summary Comments

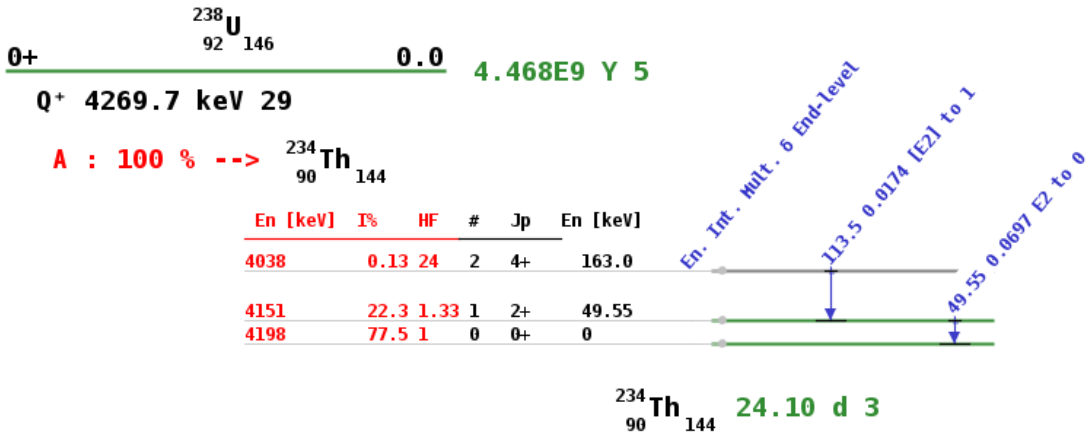
Alpha

E_α [keV]	I_α(abs) [%]	Daughter level [keV]	Jⁿ	HF
4038 *5*	0.13 *3*	163.0 *1*	4+	24
4151 *5*	22.3 *5*	49.55 *6*	2+	1.33
4198 *3*	**77.5 *5***	0 *0*	0+	1

Gamma

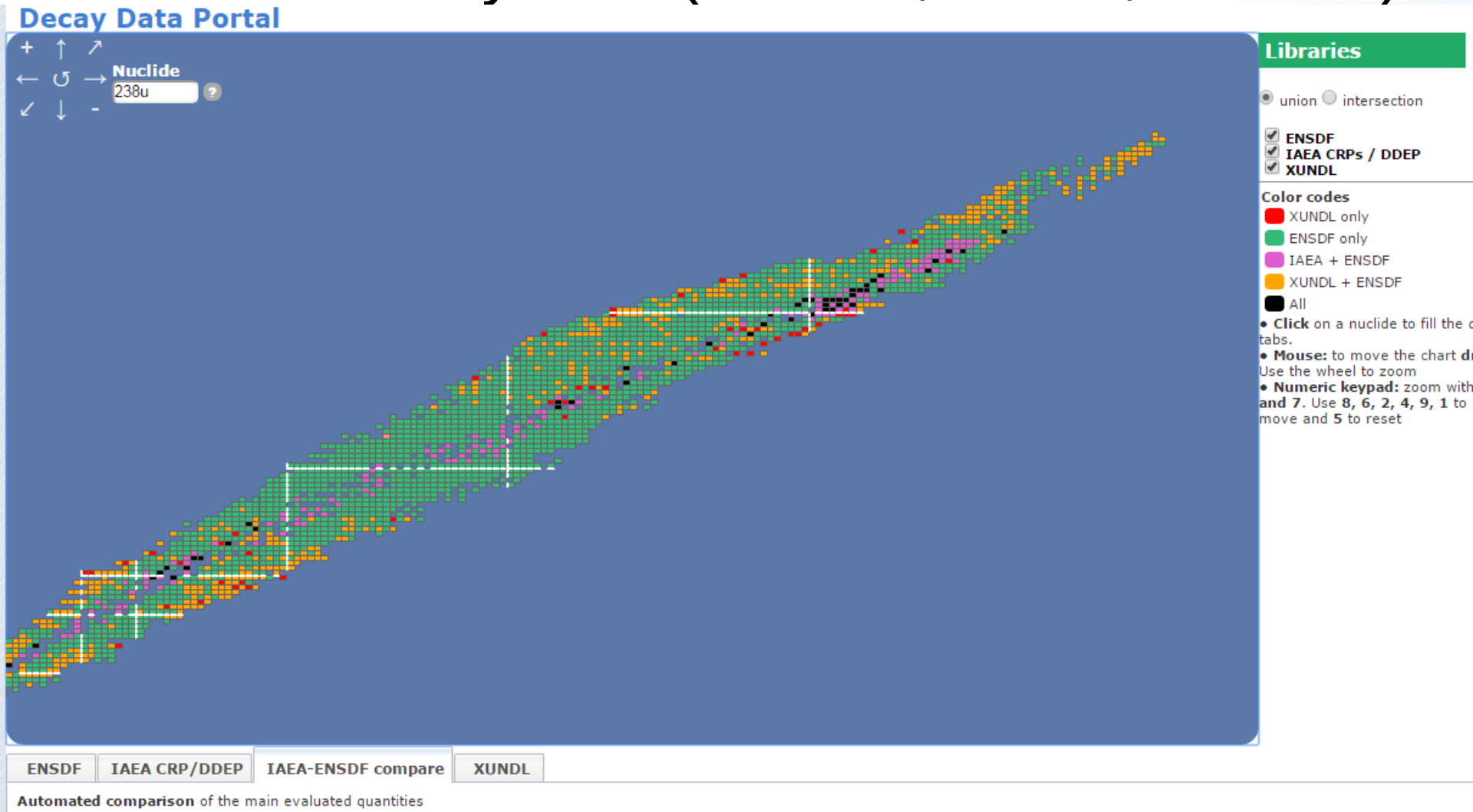
E_γ [keV]	I_γ-(abs) [%]	Initial level [keV]	Jⁿ	Final level [keV]	Jⁿ	Mult.	δ	α_T
49.55 *6*	**0.070 *3***	49.55 *6*	2+	0 *0*	0+	E2		321 *10*
113.5 *1*	0.017 *5*	163.0 *1*	4+	49.55 *6*	2+	[E2]		6.47 *19*

pop out Highlight: (keV) level Image Height: Image Width: Replot



Dissemination tools cont'd.

- Decay Data Portal: collect and compare available decay data (ENSDF, CRPs, XUNDL)



Dissemination tools cont'd.

ENSDF | IAEA CRP/DDEP | IAEA-ENSDF compare | XUNDL

Automated comparison of the main evaluated quantities

- ^{238}U α decay to ^{234}Th

Half-life		Level energy		Branching ratio		Q value		Authors		Cut-off date	
ENSDF	IAEA	ENSDF	IAEA	ENSDF	IAEA	ENSDF	IAEA	ENSDF	IAEA	ENSDF	IAEA
4.468E+9 *3* Y	4.468E9 *5* Y	0.0	0.0	1.0	1	4269.7 *29*	4269.7 *29*	E. BROWNE, J. K. TULI	V. Chiste'	1-Jun-2006	01-APR-2006

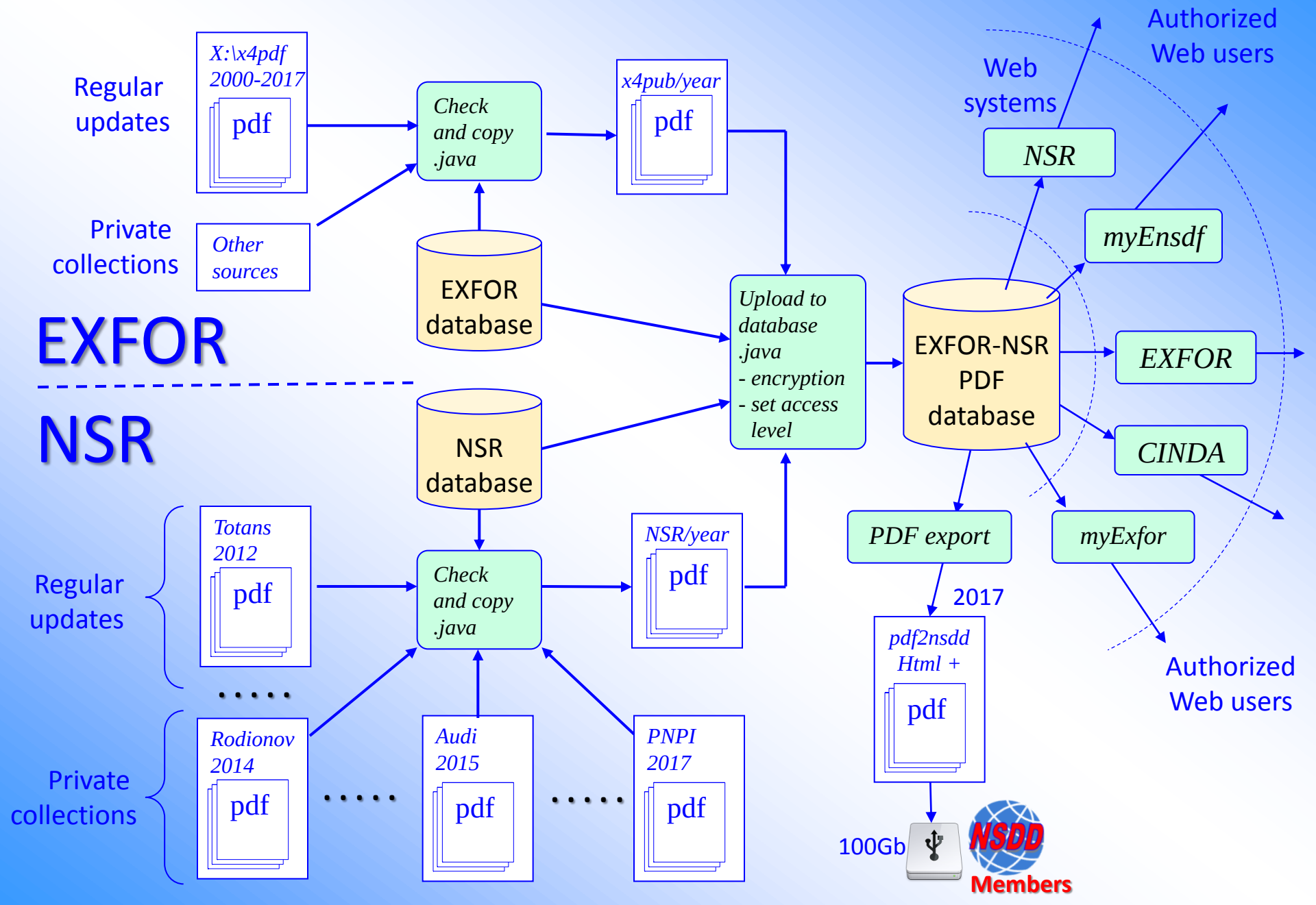
γ

E_γ		I_γ(abs)		δ		α_T	
ENSDF	IAEA	ENSDF	IAEA	ENSDF	IAEA	ENSDF	IAEA
49.55 *6*	49.55 *6*	0.064 *8*	0.070 *3*			326.4	321 *10*
113.5 *1*	113.5 *1*	0.0102 *15*	0.017 *5*			6.63	6.47 *19*

α

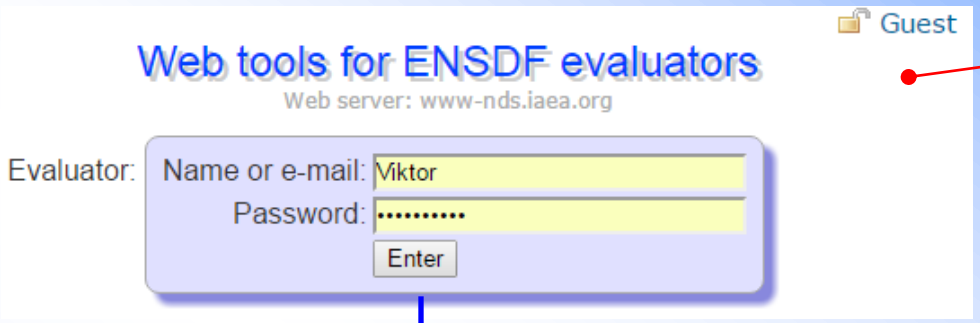
E_α		I_α(abs)		HF	
ENSDF	IAEA	ENSDF	IAEA	ENSDF	IAEA
4038 *5*	4038 *5*	0.078 *12*	0.13 *3*	40	24
4151 *5*	4151 *5*	21 *3*	22.3 *5*	1.4	1.33
4198 *3*	4198 *3*	79 *3*	77.5 *5*	1.0	1

Functioning of EXFOR-NSR PDF database

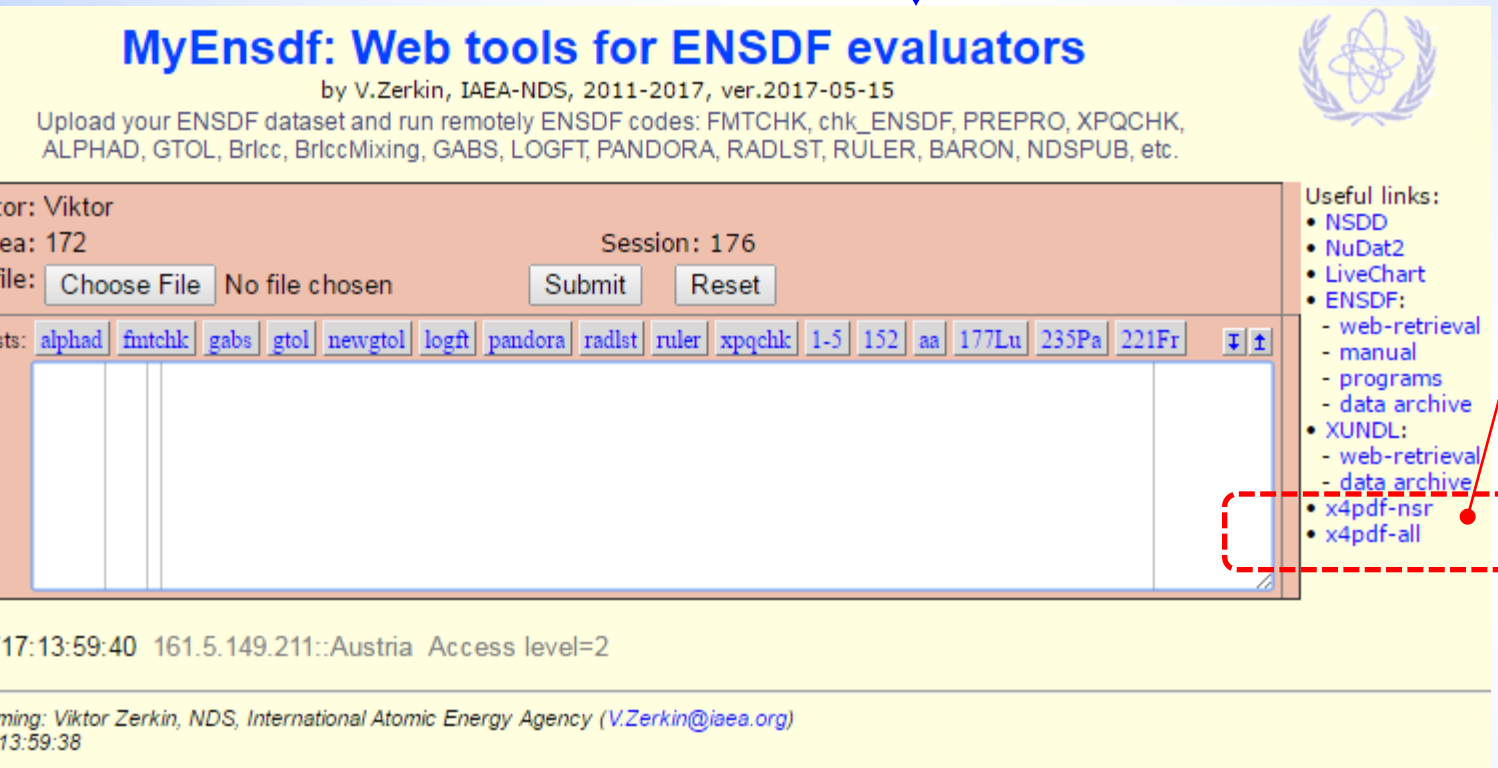


Access to full EXFOR-NSR PDF Database

http://www-nds.iaea.org/exfor/myensdf.htm



1) Enter to MyEnsdf as Evaluator



2) Go to PDF database:
- NSR PDF database
- Joined EXFOR-NSR database

Joined EXFOR-NSR PDF database by years

X4-NSR PDF collection.

Database updated: 2017-05-12. Files: 101637 from 2000-04-19 to 2017-05-12.

Total: 101637 files from 2000-04-19 to 2017-05-12. NSR files: 73875 files

-	-	-	-	-	-	1896:3	-	1898:4	1899:1	[1890-1899]:8
1910:4	1911:2	1912:1	-	-	-	-	-	1918:2	1919:1	[1910-1919]:10
1920:2	1921:2	-	-	1924:1	-	-	-	1928:4	1929:4	[1920-1929]:13
1930:2	1931:3	1932:5	1933:2	1934:4	1935:20	1936:18	1937:31	1938:29	1939:58	[1930-1939]:172
1940:52	1941:40	1942:18	1943:14	1944:19	1945:23	1946:74	1947:148	1948:161	1949:286	[1940-1949]:835
1950:386	1951:418	1952:379	1953:469	1954:544	1955:587	1956:658	1957:677	1958:901	1959:881	[1950-1959]:5900
1960:969	1961:1009	1962:1214	1963:1523	1964:1377	1965:1593	1966:1708	1967:1251	1968:1292	1969:2191	[1960-1969]:14127
1970:1814	1971:1953	1972:1651	1973:2047	1974:1614	1975:1449	1976:1402	1977:1360	1978:1401	1979:1545	[1970-1979]:16236
1980:1432	1981:1419	1982:1302	1983:1221	1984:1224	1985:1215	1986:1290	1987:1028	1988:1093	1989:1068	[1980-1989]:12292
1990:1257	1991:1072	1992:1118	1993:1344	1994:1540	1995:2144	1996:2050	1997:2133	1998:2193	1999:2396	[1990-1999]:17247
2000:2554	2001:1802	2002:1941	2003:1846	2004:2326	2005:2404	2006:2497	2007:3026	2008:2141	2009:1924	[2000-2009]:22461
2010:1904	2011:2129	2012:2069	2013:1919	2014:1747	2015:1714	2016:760	2017:94			[2010-2017]:12336

Years: 101 Publications: 101637

Full volumes: [conferences and books] [theses] [reports]

Checking mode //contributions to NSR-PDF

PDF's by years and decades with reference, title, authors, link to NSR, publishers web sites

Filter and check:

1) 201200_Totans	/3662/	16) 20170322_PNPI	/11229/
2) 201300_Totans	/1000/	17) 20170327_PNPI	/305/
3) 201400_Totans	/559/	18) 201703_Totans	/374/
4) 201500_Totans	/618/	19) 201704_Totans	/117/
5) 201510_Balraj	/263/	20) 201704_Zerkin	/132/
6) 201510_nndc2corr	/11/	21) 20170508_Kondev	/44/
7) 201510_Rodionov	/2620/	22) 20170512_Zerkin	/31/
8) 201512_Audi	/2626/	23) 201705_Totans	/841/
9) 201600_Totans	/2065/		
10) 201603_Rodionov	/325/		
11) 201603_Shulyak	/13469/		
12) 201604_Kondev	/1145/		
13) 201611_PNPI	/31969/		
14) 201701_Totans	/284/		
15) 201702_Totans	/186/		

Sum: /73875/

PDF's by contributors for checking

2016

1. J,APP/B,47,789,2016 Jour: Acta Physica Polonica, Part B, Vol.47, p.789 (2016) [pdf] DOI: 10.5506/APhys
   NSR: 2016DI02 [pdf] NSR-Reference: Acta Phys.Pol. B47, 789 (2016)
   Measurement of the ^{236}U(n,f) Cross Section with the MicroMegas Detector
   M.Diakaki, A.Kalamara, M.Kokkoris, G.Marangouli, A.Tsinganis, A.Panagiotopoulos, R.Vlastou, E.Berthoumieux,
2. J,APP/B,47,841,2016 Jour: Acta Physica Polonica, Part B, Vol.47, p.841 (2016) [pdf] DOI: 10.5506/APhys
   NSR: 2016MA18 [pdf] NSR-Reference: Acta Phys.Pol. B47, 841 (2016)
   Study of the Near-barrier Scattering of ^{8}He on ^{208}Pb
   G.Marquinez-Duran, A.M.Sanchez-Benitez, I.Martel, L.Acosta, K.Rusek, M.A.G.Alvarez, R.Berjillos, M.J.G.Borge, L.Standylo, I.Strojek, O.Tengblad, R.Wolski, A.H.Zia
3. J,APP/B,47,859,2016 Jour: Acta Physica Polonica, Part B, Vol.47, p.859 (2016) [pdf] DOI: 10.5506/APhys
   NSR: 2016KR03 [pdf] NSR-Reference: Acta Phys.Pol. B47, 859 (2016)
   Gamma Decay of the Possible 1$^-$ Two-phonon State in ^{140}Ce Excited via Inelastic Scattering of ^{17}O
   M.Krzysiek, and the AGATA Collaboration
4. J,ARI,107,391,2016 Jour: Applied Radiation and Isotopes, Vol.107, p.391 (2016) [pdf] EXFOR: D4333 DO
   NSR: 2016TA01 [pdf] NSR-Reference: Appl.Radiat.Isot. 107, 391 (2016)
   Investigation of activation cross sections of proton induced reactions on indium up to 70 MeV for practical applicatio
   F.Tarkanyi, F.Ditroi, A.Hermanne, S.Takacs, M.Baba

Contributions to NSR PDF database as of 2017-05-16

1) 201200_Totans	/3662/	16) 20170322_PNPI	/11229/
2) 201300_Totans	/1000/	17) 20170327_PNPI	/305/
3) 201400_Totans	/559/	18) 201703_Totans	/374/
4) 201500_Totans	/618/	19) 201704_Totans	/117/
5) 201510_Balraj	/263/	20) 201704_Zerkin	/132/
6) 201510_nndc2corr	/11/	21) 20170508_Kondev	/44/
7) 201510_Rodionov	/2620/	22) 20170512_Zerkin	/31/
8) 201512_Audi	/2626/	23) 201705_Totans	/841/
9) 201600_Totans	/2065/		
10) 201603_Rodionov	/325/		
11) 201603_Shulyak	/13469/		
12) 201604_Kondev	/1145/		
13) 201611_PNPI	/31969/		
14) 201701_Totans	/284/		
15) 201702_Totans	/186/		

Sum: /73875/

Thanks to external contributors!!!

PDF Statistics (2017-05-16)

Database	References	PDF's	PDF's incl. links X4-NSR
NSR	224,317	73,831 (**33%**)	83,811 (**37%**)
EXFOR	30,423	21,508 (**71%**)	22,133 (**73%**)
CINDA+X4+NSR	86,300	22,997 (**27%**)	30,685 (**36%**)

Evaluation of Nuclear Moments

- Consultant's Meeting on Evaluation of Nuclear Moments, 27-30 March 2017, IAEA
  - Assessed different measurement techniques and needed corrections (diamagnetism, hyperfine anomaly, half-lives and external-field parameterization for short-lived states, new Electric Field Gradient calculations for Q)
  - Proposed method of implementing all the required corrections
  - Agreed on timeline for producing tables of evaluated μ and Q (2018)
  - IAEA Online Nuclear Moments database to be updated by Mertzimekis
  - Summary report in preparation

Evaluation of Nuclear Moments cont'd

- Magnetic Dipole Moments:
  - Jackowski: Diamagnetism (introdicue corrections to NMR, beta-NMR etc)
  - Persson: Hyperfine Anomaly (flag nuclides where sizeable effect is expected using nuclear models)
  - Stuchbery: update half-lives where relevant; assess uncertainties in B-external field parameterization (transient field); assess accuracy of rel. corrections
  - Updated table of direct measurements of spin/parities to be provided by Kondev
- Quadrupole Moments:
  - Pyykko: perform accurate calculations of EFG and update evaluation of Q for extended nuclides for which data have become available
- General
  - Stone: work together with Jackowski, Persson and Stuchbery to complete evaluation and produce tables
  - Neyens to consult on evaluation of Q

Evaluation of Nuclear Moments cont'd

- Nick Stone
- Karol Jackowski (Univ. Warsaw)
- Pekka Pyykko (Univ. Helsinki)
- Jonas Persson (Univ. Technology Norway)
- Andrew Stuchbery (ANU)
- F. Kondev (ANL)
- Mark Bissell (Univ. Manchester)
- Gerda Neyens (KULeuven)
- Theo Mertzimekis (Univ. Athens)

Coordinated Research Projects (2015-2017)

- Charged-particle Monitor reactions and Medical Isotope production (2012-2016)
  - Ended in 2016: publications in preparation, new online retrieval from Medical Portal
  - Evaluation of production cross sections and decay data finalized
    - *Decay data: A. Nichols, F. Kondev, T. Kibedi, M. Kellett, A.Lucas*
  - Final publications in Nuclear Data Sheets

Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production

CRP: cross-section measurements and evaluations

	Excitation functions
Monitor reactions	$^{27}Al(p,x)^{22,24}Na$, $^{27}Al(d,x)^{22,24}Na$, $^{27}Al(^{3}He,x)^{22,24}Na$, $^{27}Al(\alpha,x)^{22,24}Na$, $^{nat}Ti(p,x)^{46}Sc$ and ^{48}V, $^{nat}Ti(d,x)^{46}Sc$ and ^{48}V, $^{nat}Ti(^{3}He,x)^{48}V$, $^{nat}Ti(\alpha,x)^{51}Cr$, $^{nat}Fe(d,x)^{56}Co$, $^{nat}Ni(p,x)^{57}Ni$, $^{nat}Ni(d,x)^{56,58}Co$ and ^{61}Cu, $^{nat}Cu(p,x)^{56,58}Co$ and $^{62,63,65}Zn$, $^{nat}Cu(d,x)^{62,63,65}Zn$, $^{nat}Cu(^{3}He,x)^{63,65}Zn$ and ^{66}Ga, $^{nat}Cu(\alpha,x)^{65}Zn$ and $^{66,67}Ga$, $^{nat}Mo(p,x)^{96g+m}Tc$
Diagnostic γ emitters	$^{nat}Ti(\alpha.x)^{51}Cr$, $^{nat}V(p,n)^{51}Cr$, $^{nat}V(d,xn)^{51}Cr$, $^{nat}Mn(p,x)^{51}Cr$, $^{nat}Fe(p,x)^{51}Cr$, $^{64}Zn(n,p)^{64}Cu$, $^{68}Zn(\gamma,p)^{67}Cu$, $^{67}Zn(n,p)^{67}Cu$, $^{68}Zn(n,x)^{67}Cu$, $^{90}Zr(n,p)^{90g+m}Y$, $^{100}Mo(n,2n)^{99}Mo$, $^{100}Mo(p,2n)^{99g+m}Tc$, $^{100}Mo(p,pn)^{99}Mo$, $^{100}Mo(d,3n)^{99g+m}Tc$, $^{100}Mo(d,2pn)^{99}Mo$, $^{100}Mo(\gamma,n)^{99}Mo$, $^{238}U(\gamma,f)^{99}Mo$, $^{112}Cd(p,2n)^{111}In$, $^{124}Xe(p,x)^{121}I$, $^{124}Xe(p,2n)^{123}Cs$, $^{124}Xe(p,pn)^{123}Xe$, $^{203}Tl(p,2n)^{202m}Pb$, $^{203}Tl(p,3n)^{201}Pb$, $^{203}Tl(p,4n)^{200}Pb$

Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production

CRP: cross-section measurements and evaluations (continued)

	Excitation functions
Direct β^+ emitters	^{58}Ni(p,α)^{55}Co, ^{54}Fe(d,n)^{55}Co, ^{56}Fe(p,2n)^{55}Co, ^{nat}Fe(p,x)^{55}Co, ^{61}Ni(p,n)^{61}Cu, ^{nat}Ni(d,x)^{61}Cu, ^{64}Zn(p,α)^{61}Cu, ^{66}Zn(p,n)^{66}Ga, ^{63}Cu(α,n)^{66}Ga, ^{68}Zn(p,n)^{68}Ga, ^{65}Cu(α,n)^{68}Ga, ^{nat}Ge(p,xn)^{72}As, ^{75}As(p,3n)^{73}Se, ^{72}Ge(α,3n)^{73}Se, ^{76}Se(p,n)^{76}Br, ^{77}Se(p,2n)^{76}Br, ^{75}As(α,3n)^{76}Br, ^{86}Sr(p,n)^{86}Y, ^{88}Sr(p,3n)^{86}Y, ^{85}Rb(α,3n)^{86}Y, ^{89}Y(p,n)^{89}Zr, ^{89}Y(d,2n)^{89}Zr, ^{93}Nb(p,x)^{90}Nb, ^{89}Y(α,x)^{90}Nb, ^{94}Mo(p,n)^{94}Tc^{m}, ^{92}Mo(α,x)^{94}Tc^{m}, ^{110}Cd(p,n)^{110}In^{m}, ^{110}Cd(d,2n)^{110}In^{m}, ^{107}Ag(α,n)^{110}In^{m}, ^{120}Te(p,n)^{120}I, ^{122}Te(p,3n)^{120}I
Generator β^+ emitters	^{52}Fe/^{52}Mn^{m}: ^{55}Mn(p,4n)^{52}Fe, ^{nat}Ni(p,x)^{52}Fe, ^{50}Cr(α,2n)^{52}Fe ^{62}Zn/^{62}Cu: ^{63}Cu(p,2n)^{62}Zn, ^{63}Cu(d,3n)^{62}Zn ^{68}Ge/^{68}Ga: ^{nat}Ga(p,xn)^{68}Ge, ^{69}Ga(p,2n)^{68}Ge ^{72}Se/^{72}As: ^{75}As(p,4n)^{72}Se, ^{nat}Br(p,x)^{72}Se ^{82}Sr/^{82}Rb: ^{nat}Rb(p,xn)^{82}Sr, ^{85}Rb(p,4n)^{82}Sr ^{44}Ti/^{44}Sc, ^{110}Sn/^{110}In^{m}, ^{118}Te/^{118}Sb, ^{122}Xe/^{122}I, ^{128}Ba/^{128}Cs and ^{140}Nd/^{140}Pr: studies undertaken of all main reactions leading to parent nuclide

Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production

CRP: cross-section measurements and evaluations (continued)

	Excitation functions
Therapeutic α emitters	^{229}Th(α)^{225}Ra(β$^-$)^{225}Ac(α) decay chain to ^{213}Bi: ^{232}Th(p,x)^{225}Ra and ^{225,227}Ac, ^{226}Ra(p,2n)^{225}Ac ^{230}U(α)^{226}Th(α) decay chain: ^{231}Pa(d,3n)^{230}U, ^{231}Pa(p,2n)^{230}U, ^{232}Th(p,3n)^{230}Pa(β$^-$)^{230}U ^{227}Th(α)^{223}Ra(α) decay chain: ^{232}Th(p,x)^{227}Th
Therapeutic β$^-$, discrete electron and X-ray emitters	^{67}Cu (see Diagnostic γ emitters), $^{90g+m}$Y (see Diagnostic γ emitters) ^{103}Rh(p,n)^{103}Pd, ^{103}Rh(d,2n)^{103}Pd, ^{130}Ba(n,γ)^{131}Ba(EC)^{131}Cs, ^{131}Xe(p,n)^{131}Cs, ^{133}Cs(p,3n)^{131}Ba(EC)^{131}Cs, ^{176}Hf(α,2n)^{178}W(EC)^{178}Ta, ^{nat}Ta(p,xn)^{178}W, ^{nat}Ta(d,5n)^{178}W, ^{nat}Hf(p,x)^{178}Ta

Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production

status of requested decay data, April 2017

Category	Radionuclide	Requested/Comments
monitor reactions	^{61}Cu	Recommended decay data re-assessed – completed
	^{62}Zn	Recommended decay data – no volunteer/no action
	^{63}Zn	Recommended decay data – completed
diagnostic γ emitters	^{67}Cu	Recommended decay data – completed
	^{99}Mo-^{99m}Tc	Recommended ^{99}Mo and pure ^{99m}Tc decay data – completed
	^{111}In	Recommended decay data – completed
β^+ emitters	^{44}Ti	Recommended half-life – completed
	^{52}Fe/^{52}Mn, ^{52m}Mn	Recommended decay data – completed
	^{64}Cu	Recommended decay data re-assessed – completed
	^{66}Ga	Recommended decay data – completed
	^{72}As	Recommended decay data – no volunteer/no action
	^{73}Se	Recommended decay data – completed
	^{76}Br	Recommended decay data – completed
	^{86}Y	Recommended decay data – awaiting measurements
	^{89}Zr	Recommended decay data – completed
	^{94m}Tc	Recommended decay data – completed
	^{120}I	Recommended decay data – completed

Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production

status of requested decay data, April 2017

Category	Radionuclide	Requested/Comments
therapeutic α emitters	^{230}U decay chain:	
	^{230}U	Recommended decay data – completed
	^{226}Th	Recommended decay data – evaluation underway
	^{222}Ra	Recommended decay data – evaluation underway
	^{218}Rn	Recommended decay data – re-assessment underway
	^{214}Po	Recommended decay data – re-assessment underway
	^{210}Pb	Recommended decay data – re-assessment completed
	^{210}Bi	Recommended decay data – completed
	^{210}Po	Recommended decay data – completed

Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production

status of requested decay data, April 2017

Radionuclide	Requested/Comments
	Focus on Auger electrons and X-rays:
$^{99}Tc^{m}$‡	Recommended pure $^{99}Tc^{m}$ decay scheme – completed
^{103}Pd‡	Recommended decay scheme: Auger-electron benchmark? – completed
^{111}In‡	Recommended decay scheme: Auger-electron benchmark – completed
^{125}I‡	Recommended decay scheme: Auger-electron benchmark – completed
^{131}Cs†	Recommended decay scheme – completed
^{178}Ta#	Recommended decay scheme of low-spin (1+) ^{178}Ta
	Recommended decay scheme of high-spin 7- ^{178}Ta – completed

‡Tibor Kibedi (ANU), Filip Kondev (ANL), Alan Nichols (University of Surrey), agreed at discussions on 31 January 2013, ancillary to IAEA meeting of the International Network of Nuclear Structure and Decay Data Evaluators, Kuwait.

† Agreed at 2nd RCM on 11/12 December 2014.

Agreed at 3rd RCM on 1/2 June 2016.

Medical Portal

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Medical Radioisotopes Production

Nuclide
e.g.135XE
Hide Chart

- Use the numeric keypad to zoom and move
- Use the mouse wheel to zoom
- Click on a line to get details

Legend
Target ● Product ●
Charged
Neutral

Color zones by ? value ◉ quantile

main decay mode
- alpha
- EC+ beta+
- beta-
- p
- n
- EC
- SF
- other

Decay data of nuclides denoted by green band were evaluated within IAEA CRPs.

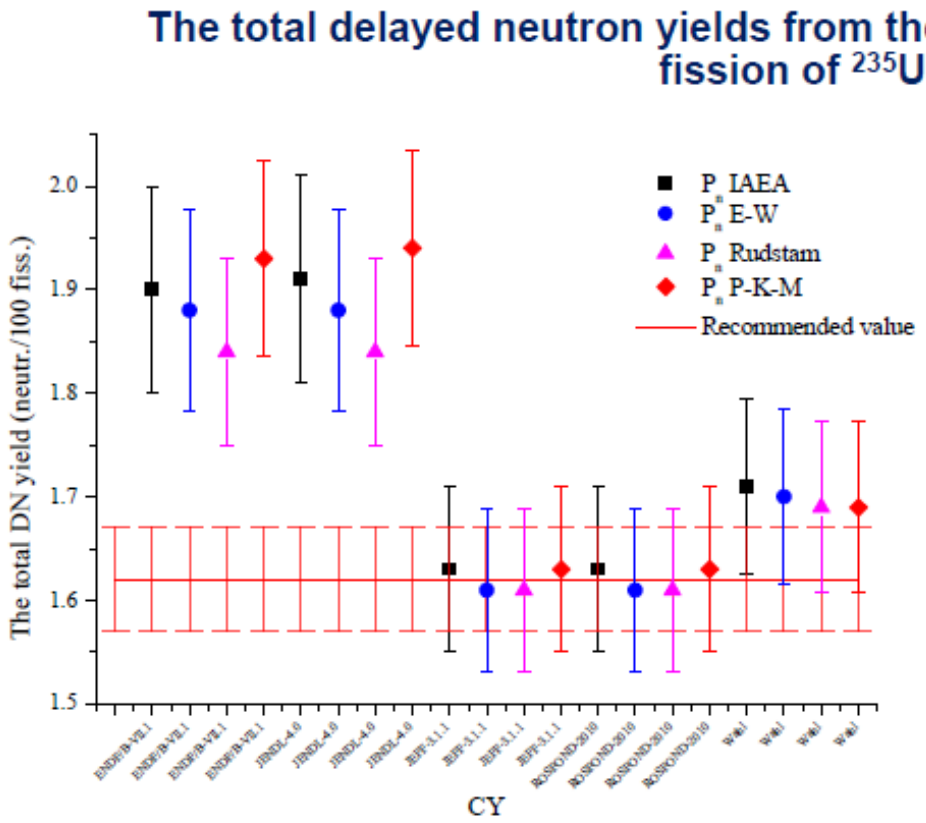
Nuclide	Half-life	Decay %	Emission	Target	Reaction	Product	Mird
$^{11}_{6}C_5$	20.364 min *14*	ec β+ 100 *(β+ ≈ 99.8)*	e^+	$^{14}_{7}N_7$	$^{14}N(p,a)^{11}C$	$^{11}_{6}C_5$	mird
$^{13}_{7}N_6$	9.965 min *4*	ec β+ 100 *(β+ ≈ 99.8)*	e^+	$^{16}_{8}O_8$	$^{16}O(p,a)^{13}N$	$^{13}_{7}N_6$	mird

Coordinated Research Projects cont'd

- Reference database for Beta-delayed neutrons (2013-2018) *(see Balraj's talk)*
  - 2nd RCM: 27-31 March 2015; INDC(NDS)-698
  - Z<29: evaluated T1/2, Pn published in Nuclear Data Sheets (Birch et al, NDS 133 (2015))
  - Z>28: evaluation completed; final checks before submitting for publication; new systematics in progress
  - Benchmarking of existing evaluated/compiled tables completed
  - Benchmarking of new evaluated tables: in progress
  - All available DN spectra digitized and made available: in progress
  - 3rd RCM in 12-16 June 2017

(B. Singh, A. Sonzogni, E. McCutchan, X. Huang, G. Mukherjee)

CRP on beta-delayed neutrons: Benchmarking Pn and CFY



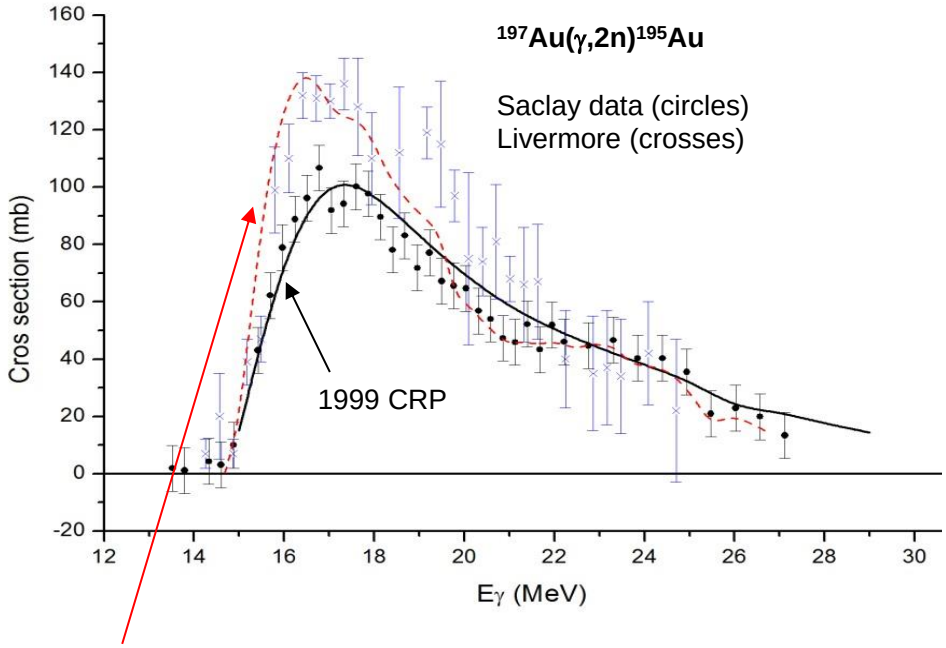
Set P_n	ν_d, neutr./100 fiss					Data from literature		
	ENDF/B-VII.1	JENDL-4.0	JEFF-3.1.1	Wahl	ROSFOND-2010	Recommended data	Blachot[**] CY-JEF2.2, Pn-JEF2.2	Wilson[***] CY-ENDF/B6, Pn-E-W
E-W	1.88	1.88	1.61	1.70	1.61	1.62±0.05	1.71±0.11	1.67
P-K-M	1.93	1.94	1.63	1.72	1.63			-
Rudstam	1.84	1.84	1.61	1.69	1.61			-
IAEA	1.90±0.10	1.91±0.10	1.63±0.08	1.71	1.63±0.08			-

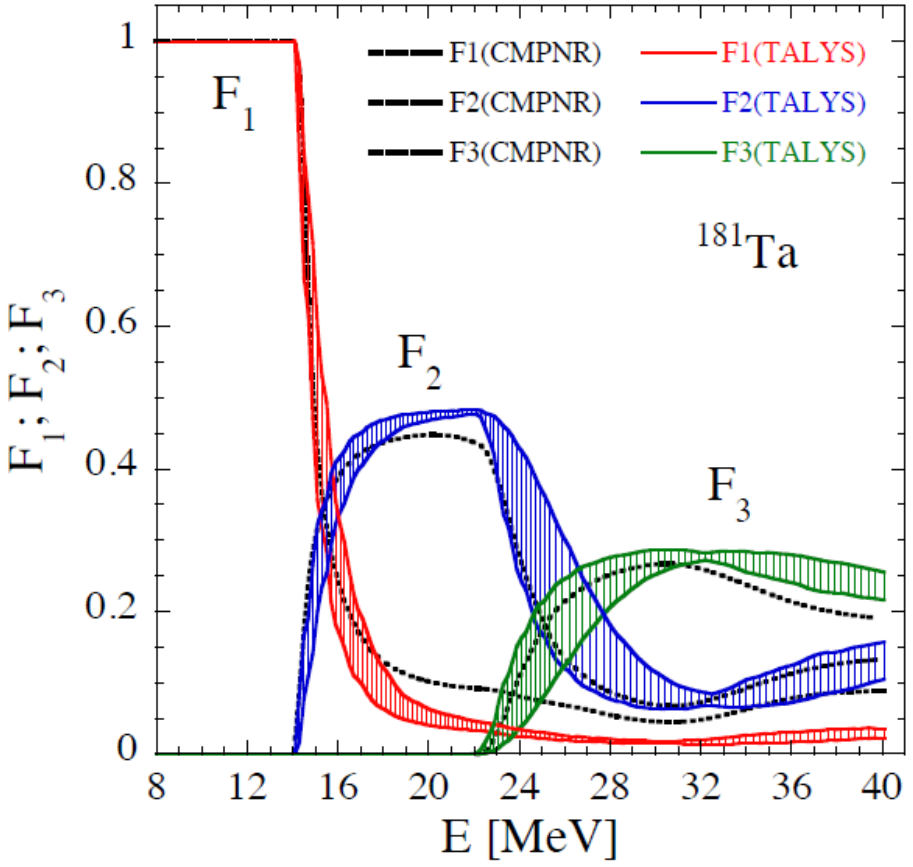
Coordinated Research Projects cont'd

- Photonuclear Data and Photon Strength Functions (2016-2020)
  - 1st RCM: 4-8 April 2016; INDC(NDS)-712
  - New evaluations of photonuclear cross sections
  - New measurements of photoneutron cross sections using direct multiplicity sorting
  - Correction factors for partial photoneutron cross sections above the GDR
  - Compilation and assessment of all existing Photon Strength Function data
  - Global models (QRPA, SLO/MLO), TLO (for e-e)
  - Empirical M1 formula (enhanced scissors mode)
  - User-friendly web interface linked to RIPL
  - 2nd RCM in 16-20 October 2017

(R. Firestone, L. Bernstein)

Photoneutron cross sections: multiplicity puzzle

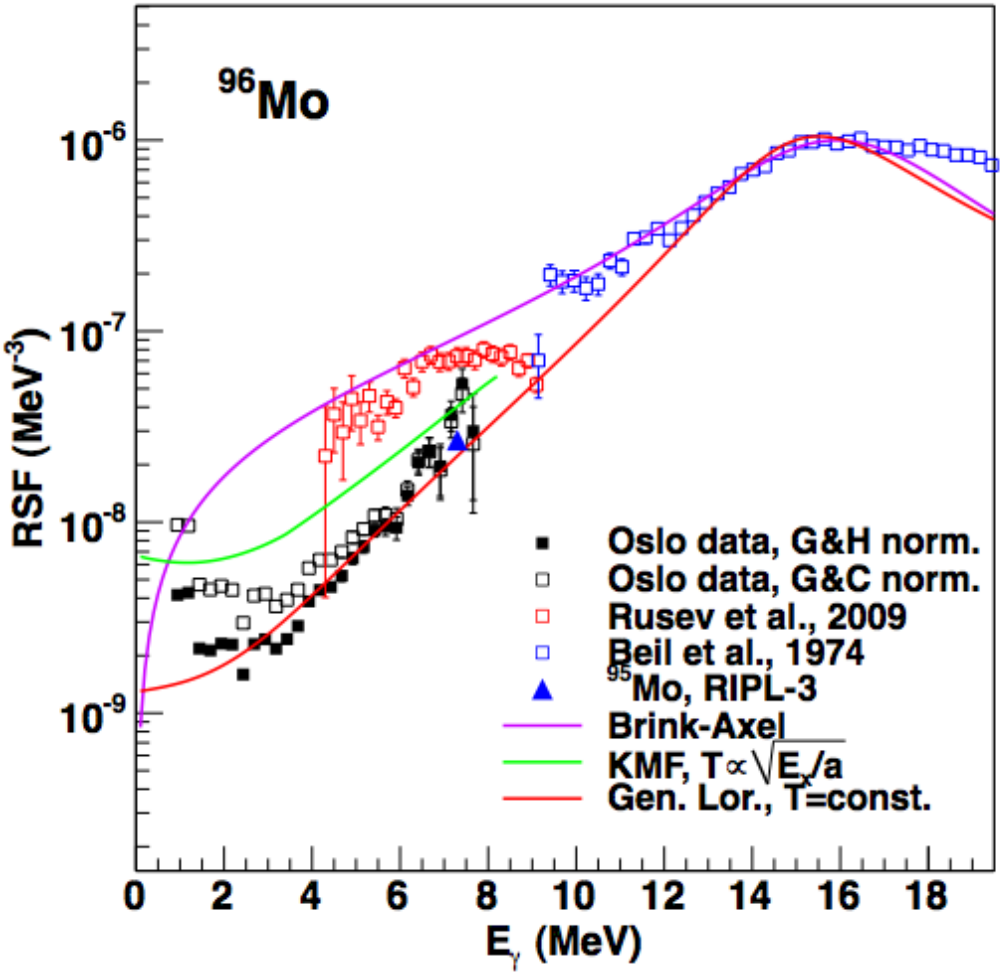




new evaluation criteria by Varlamov:
F_1, F_2, F_3 corrections for (γ,1n), (γ,2n), (γ,3n)

Ultimately: new data from new multiplicity sorting technique (Utsunomiya)

Photon Strength Function puzzle



Meetings 2015-2017

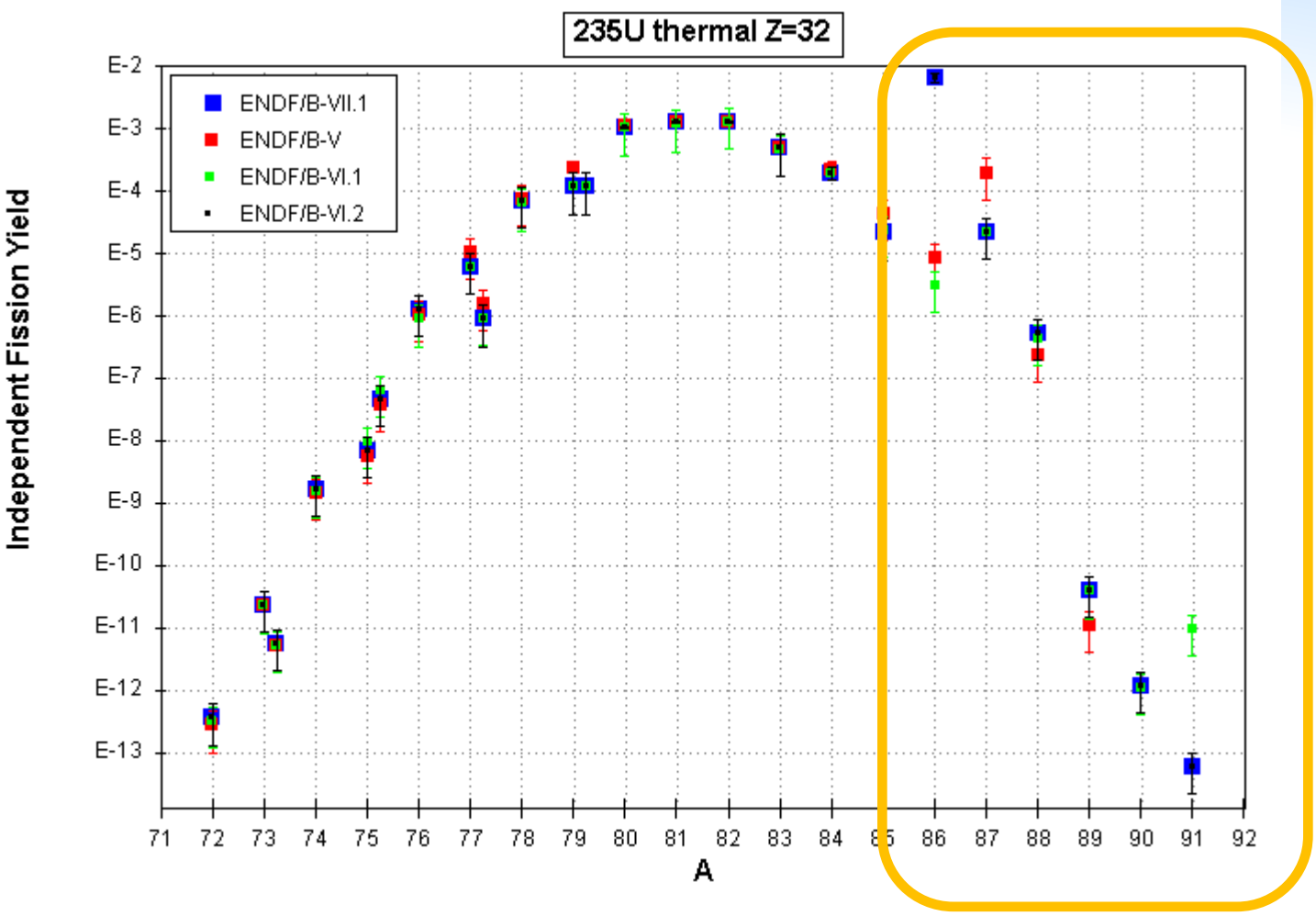
- Technical Meeting on Fission Product Yields: current status and perspectives, 23-25 May 2016, IAEA
  - Assessed measurements, theories and current status of evaluated FYP libraries
  - Recommended a CRP to update evaluated libraries for 235,238U, 239,241Pu and 252Cf
  - Summary Report INDC(NDS)-0713

Presentations - Discussions

- New improved experimental techniques producing more precise and reliable experimental data: Lohengrin-ILL, SOFIA-GSI, IGISOL-Jyvaskyla, TUNL-HIGγs, IRMM (2E-2ν), SPIDER-LANL (2E-2ν)
- Improved models: microscopic HFB (Gogny force), micro/macro+ random walk, GEF empirical model
- Evaluated data/libraries: dated, inconsistent (CFY vs decay data), discrepant
- Covariances: methods under development (OECD/WPEC-SG37 concluded), ENDF-6 format not available
- Validation procedures and results

Example 2

^{86,87,88}Ge yields in the historical releases of ENDF/B yields



Discovery reported after 1992

c/o: A. Sonzogni (presented at TM, 23 May 2016)

Recommendation for CRP

- Objective: improve existing evaluated Fission Product Yields (FPY)
- Scope:
  - Compilation of all new FFY and FPY experimental data
  - Improve systematics and models
  - Incorporate new knowledge in FPY evaluations: correct errors and inconsistencies, update evaluations, provide reliable estimate of uncertainties
  - Agree on treatment of covariances, provide FPY covariance data and propose suitable format for inclusion in ENDF-6
  - Validation of new evaluations
- Participant countries: Belgium, China, Finland, France, Germany, India, Japan, Russia, Sweden, UK, USA

Technical Meeting on FPY cont'd

- TM recommendations endorsed by International Nuclear Data Committee (INDC) at meeting on 6-9 June 2016

- Future CRP could start after the completion of the CRP on beta-delayed neutron (2019)

Future Meetings

- 3rd RCM of CRP on beta-delayed neutrons: 12-16 June 2017
- 4rd CM on R-matrix codes for charged-particle reactions in the RRR: 28-30 June 2017
- 2nd RCM of CRP on Photonuclear Data and Photon Strength Functions: 16-20 October 2017

Future Meetings cont'd

- CM on Total Absorption Gamma-ray Spectrometry, Dec. 2017, IAEA:
  - Update tables of high-priority nuclides for TAGS measurements based on recent comprehensive inventory calculations on a variety of fuel cycles and energies and irradiation times
  - Assess impact of new TAGS measurements on decay heat calculations, anti-neutrino spectra and beta-delayed neutrons

Future Meetings cont'd

- TM on Improvement of Analysis Codes for NSDD evaluations, early spring 2018, IAEA
  - Follow-up on the work of the Codes/formats committee based on recommendationsactions from NSDD 2017 and USNDP 2017

- ICTP-IAEA NSDD workshop: 2018

- Specialized/advanced Workshop for NSDD evaluators adjacent to NSDD 2019 (IAEA)

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Thank you!