

Release of the ENDF/B-VII.1 Evaluated Nuclear Data File

David Brown

BROOKHAVEN
NATIONAL LABORATORY

a passion for discovery



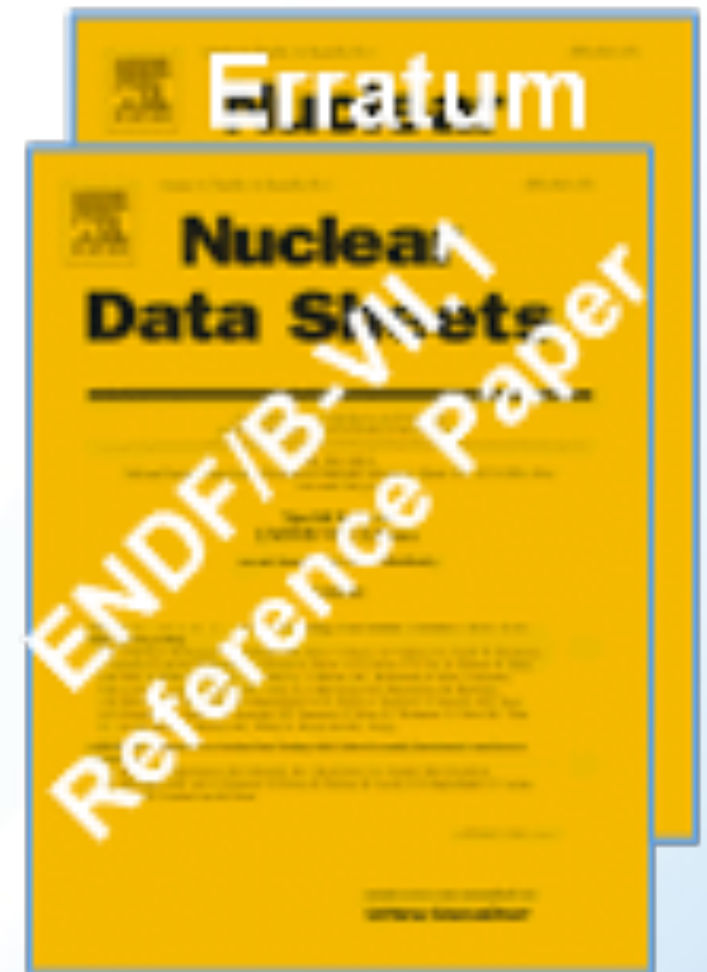
U.S. DEPARTMENT OF
ENERGY

Office of
Science

ENDF/B-VII.1 was released on Dec. 22, 2011

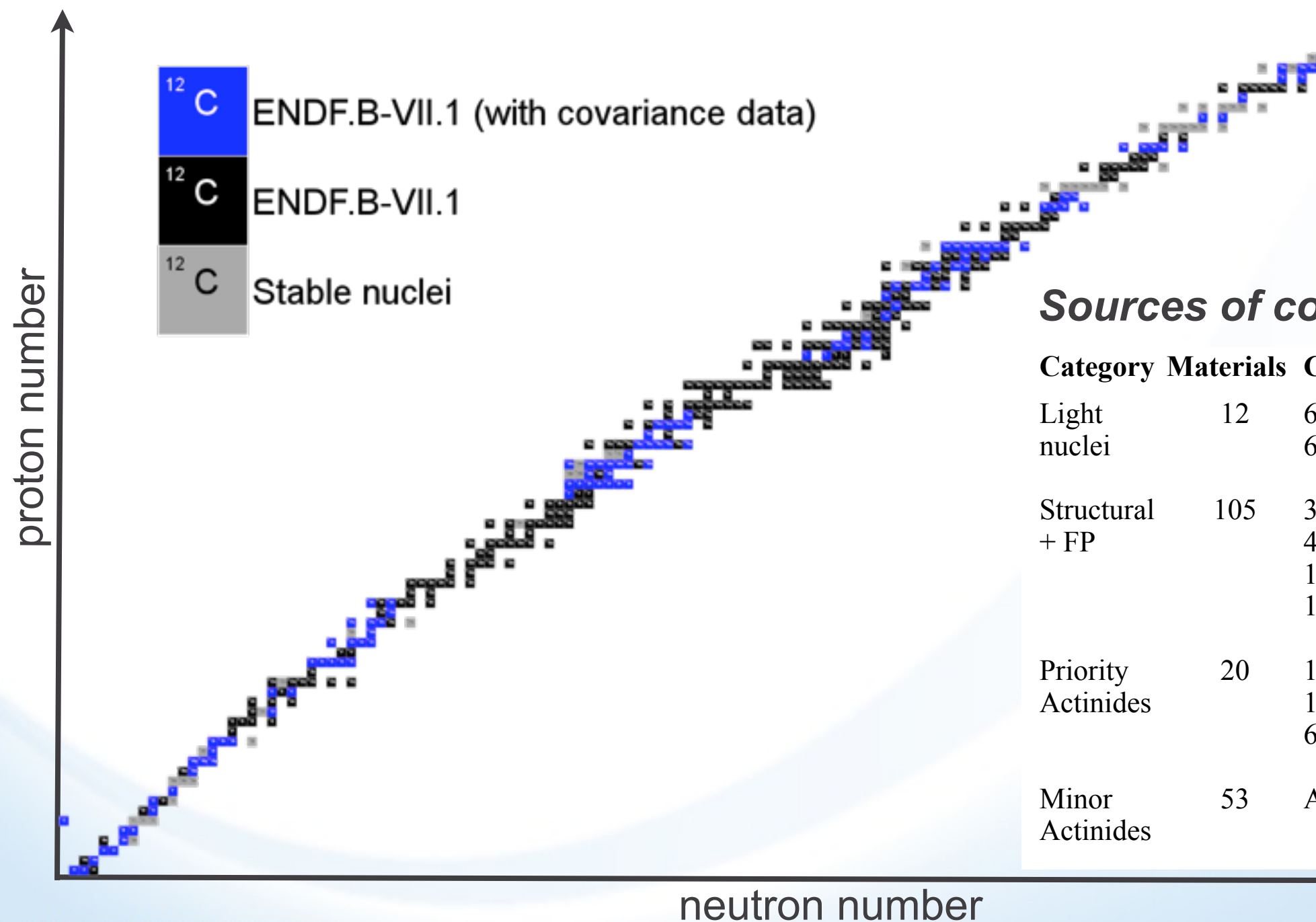


- ENDF/B is arguably most important nuclear data library for all nuclear applications
- Many more full evaluations in neutron sublibrary than in any other release
 - ENDF/B-VII.0 contains 393 evaluations
 - ENDF/B-VII.1 contains 423 evaluations
- Extensive collection of covariance data (190 evaluations)
- Library summarized in Dec. 2011 issue of Nuclear Data Sheets
- See also <http://www.nndc.bnl.gov/endl/b7.1/index.html>



An overview of the library

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B-VII.1

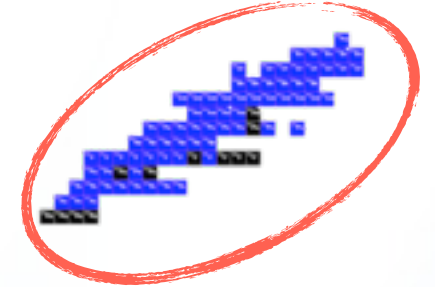


Sources of covariance data

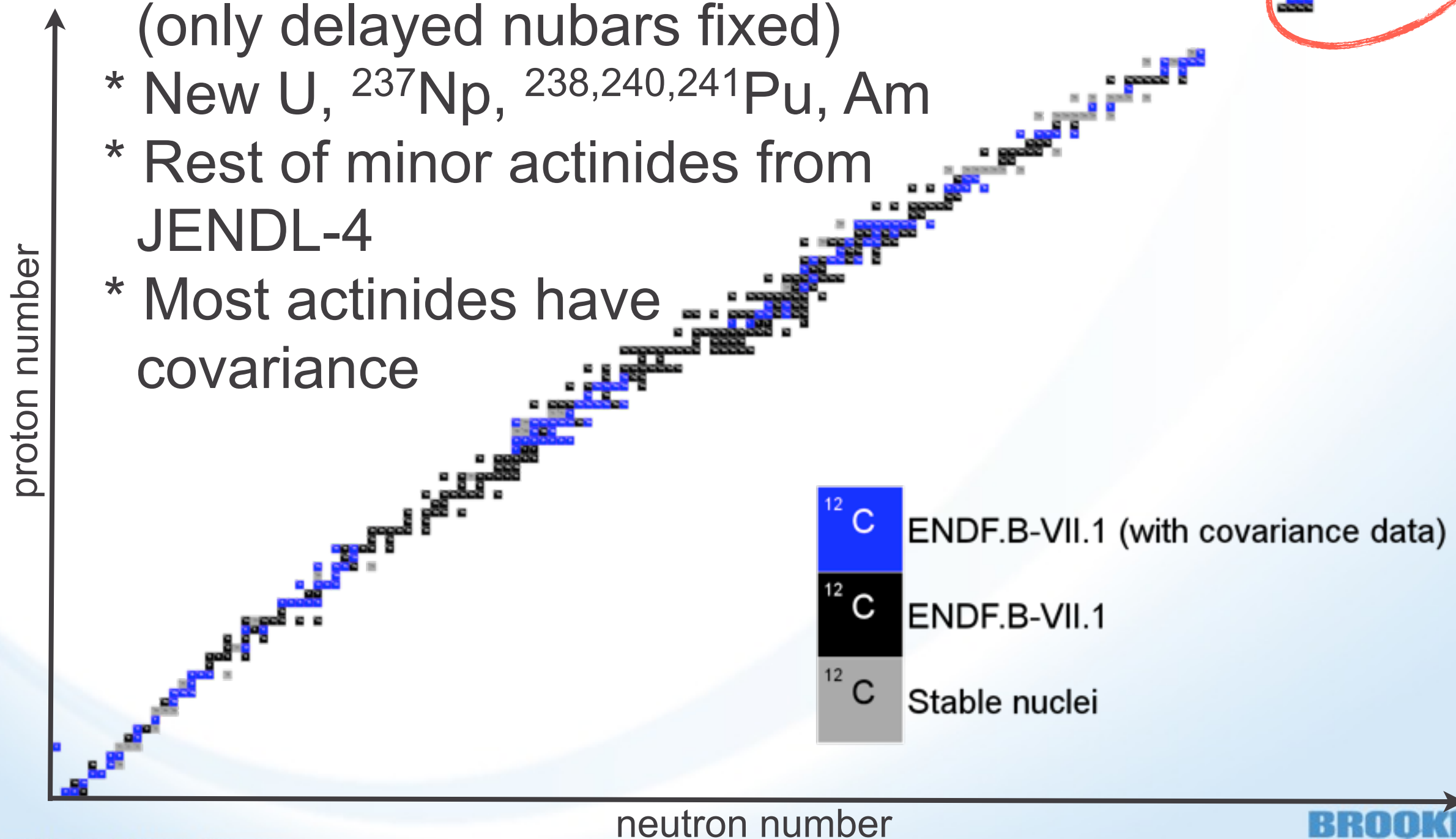
Category	Materials	Comment
Light nuclei	12	6 evaluated by R-matrix; 6 low fidelity estimates
Structural + FP	105	38 evaluated for COMMARA-2.0; 40 updated low fidelity estimates; 15 for criticality safety programs; 12 for other purposes
Priority Actinides	20	13 evaluated for COMMARA-2.0; 1 from ENDF/B-VII.0; 6 from JENDL-4.0
Minor Actinides	53	All from JENDL-4.0

An overview of the library

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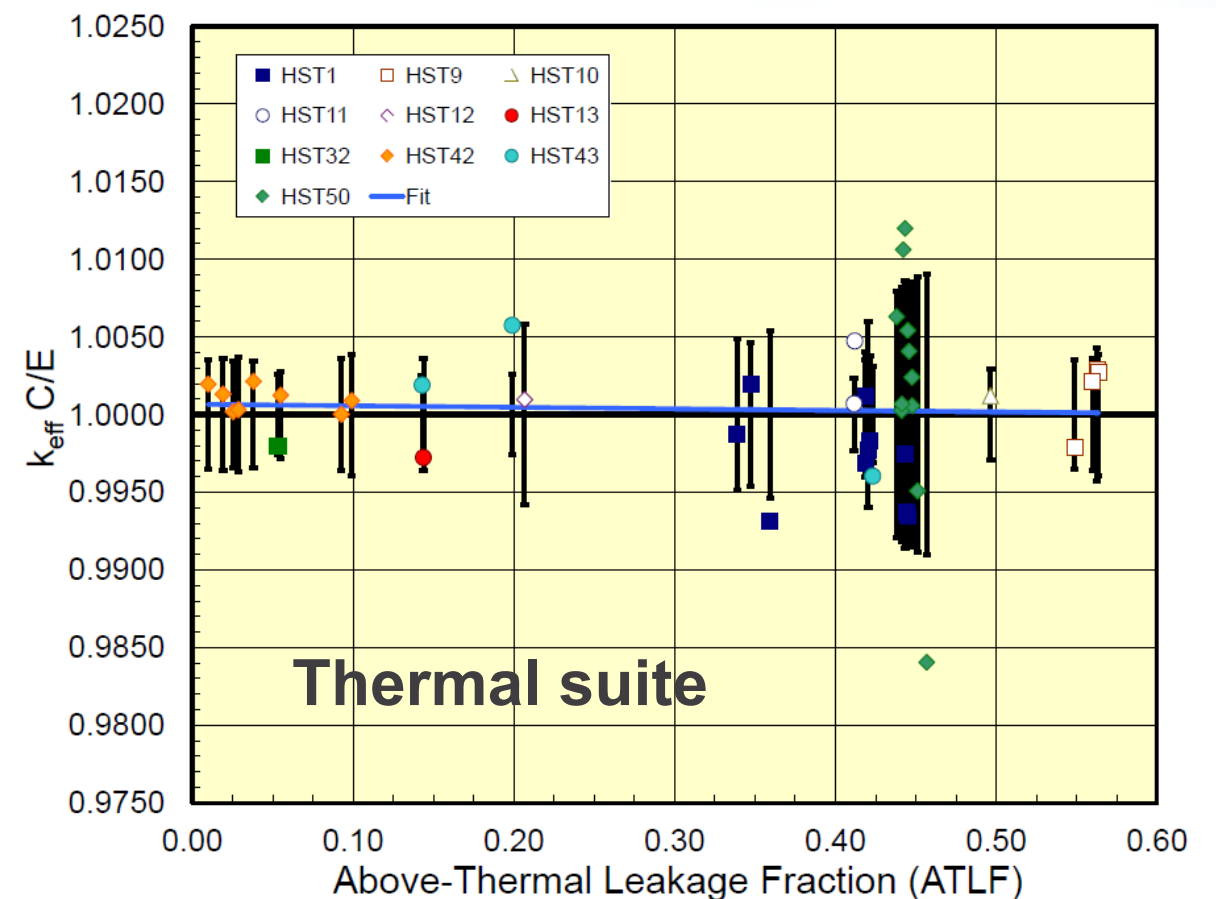
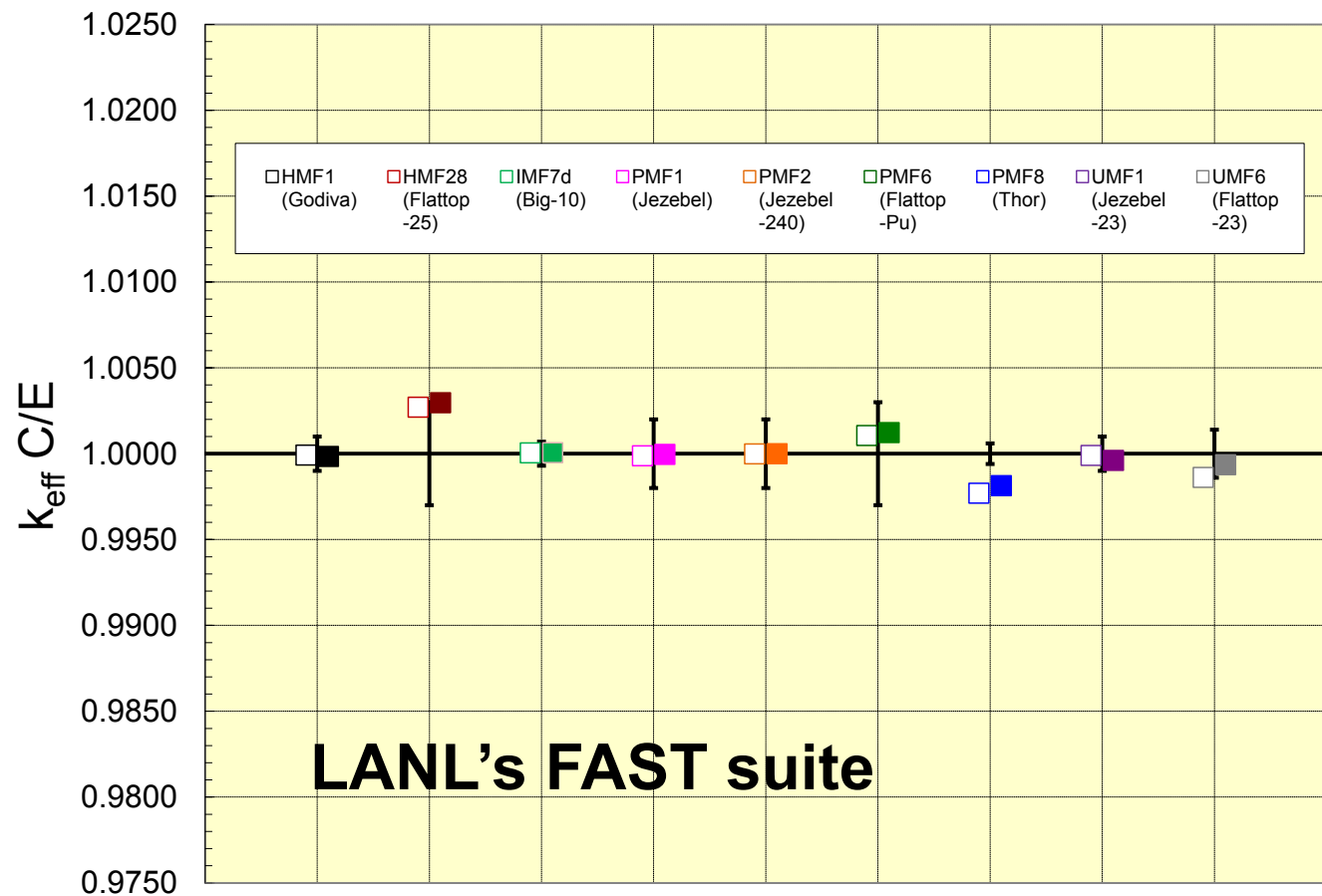


- * Major actinides essentially unchanged, (only delayed nubar fixed)
- * New U, ^{237}Np , $^{238,240,241}\text{Pu}$, Am
- * Rest of minor actinides from JENDL-4
- * Most actinides have covariance



Key fast and thermal benchmarks are unchanged

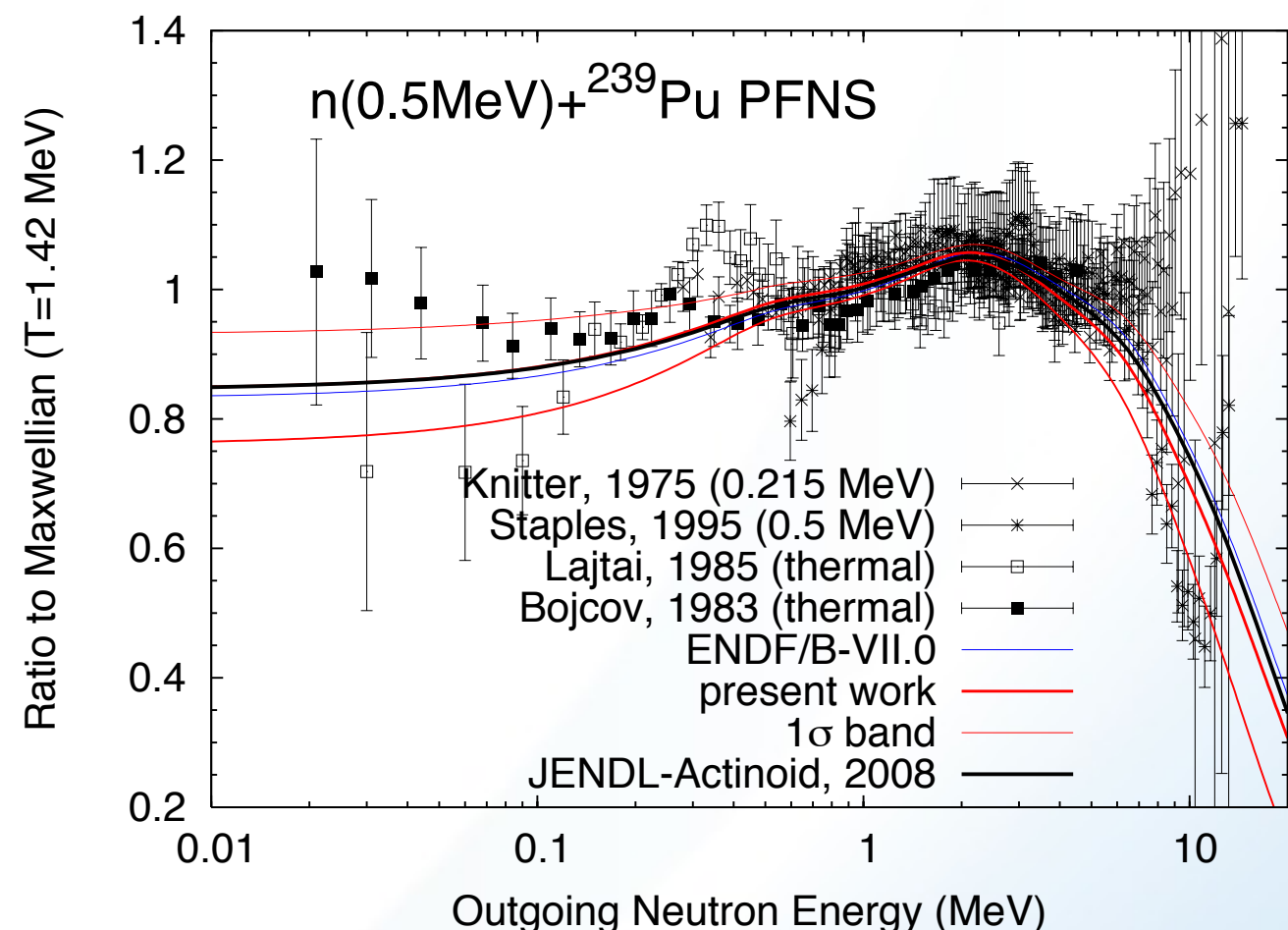
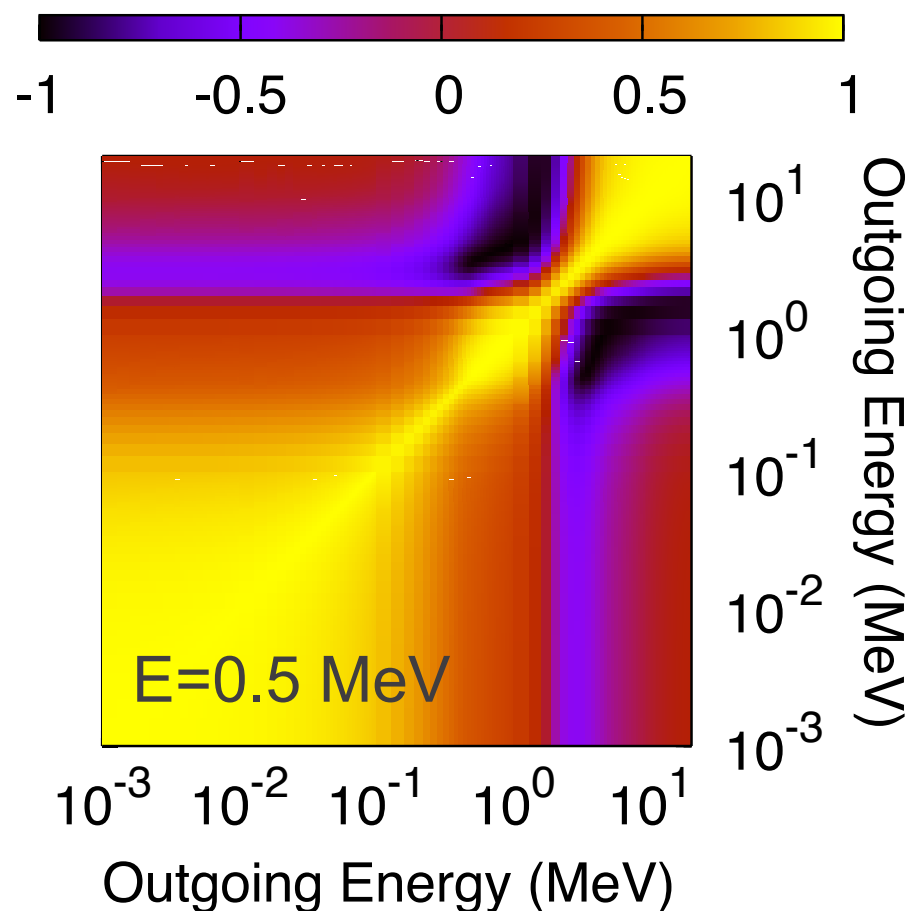
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- These tests are taken from the ICSBEP benchmark book
- Data processed with NJOY into ACE format
- Tests run with MCNP by A. Kahler, et al.
- See Skip's talk next for more details...

Only change to ^{239}Pu : addition of prompt fission neutron spectrum covariance

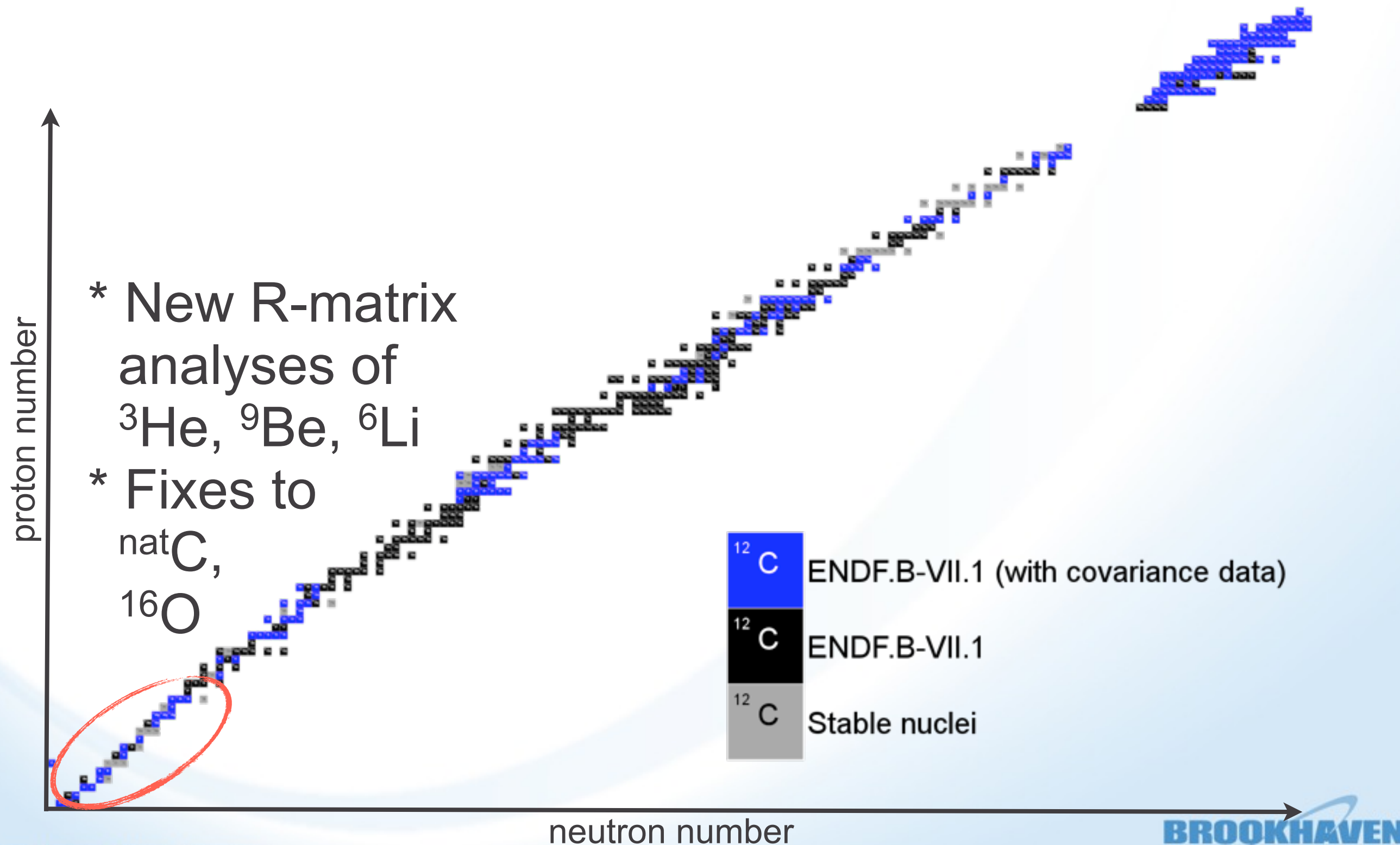
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- Talou et al (LANL) retrofitted using Madland-Nix model
- Valuable contribution enabling full QMU studies in Pu systems (previously only nubar and cross section covariance available)

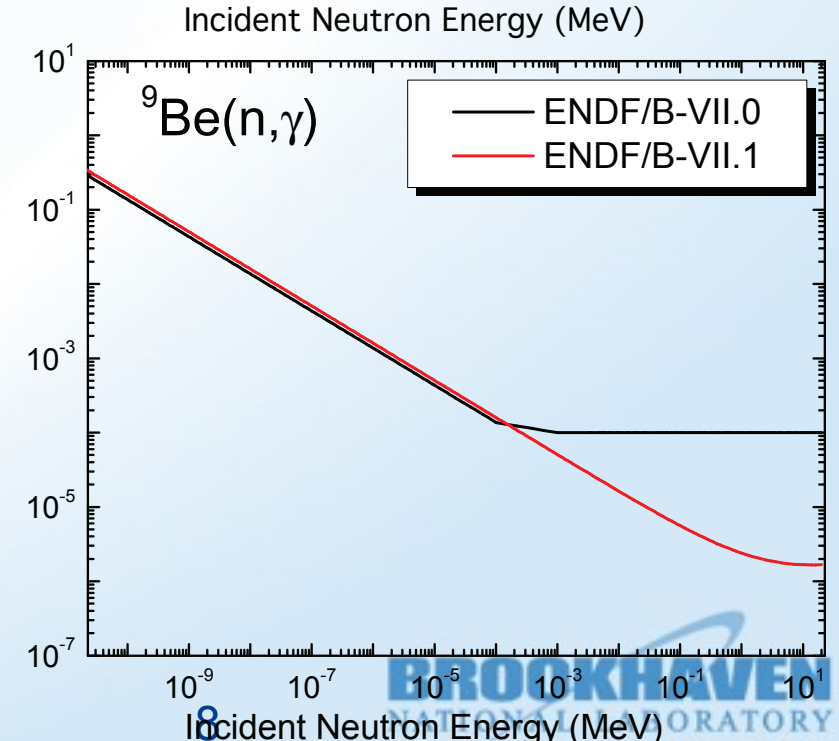
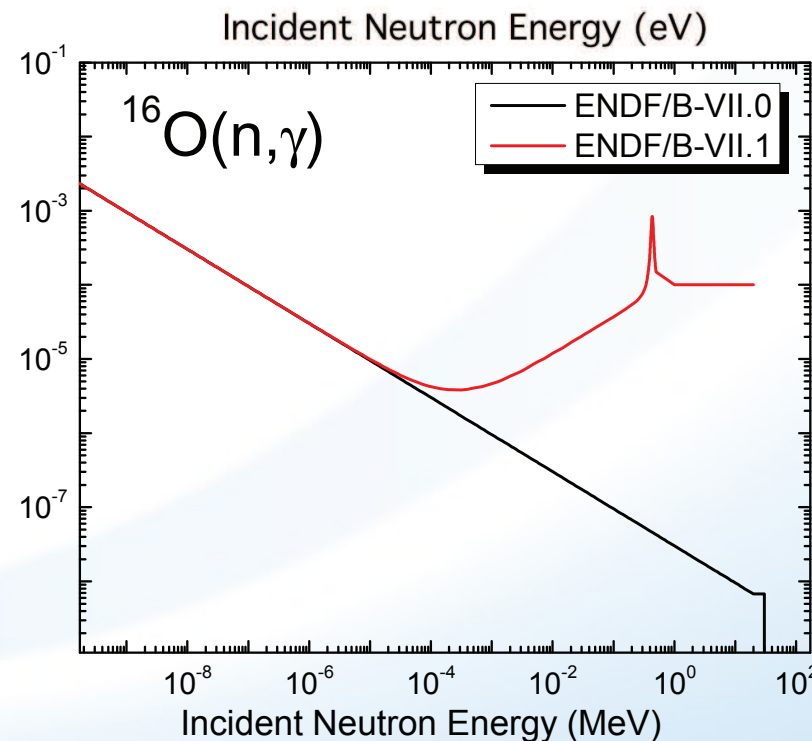
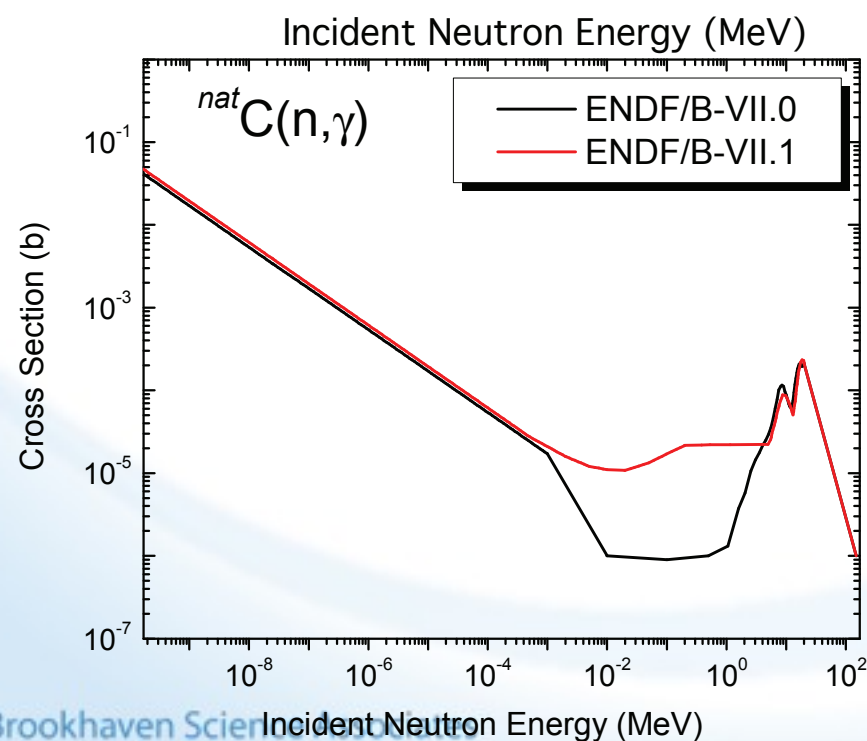
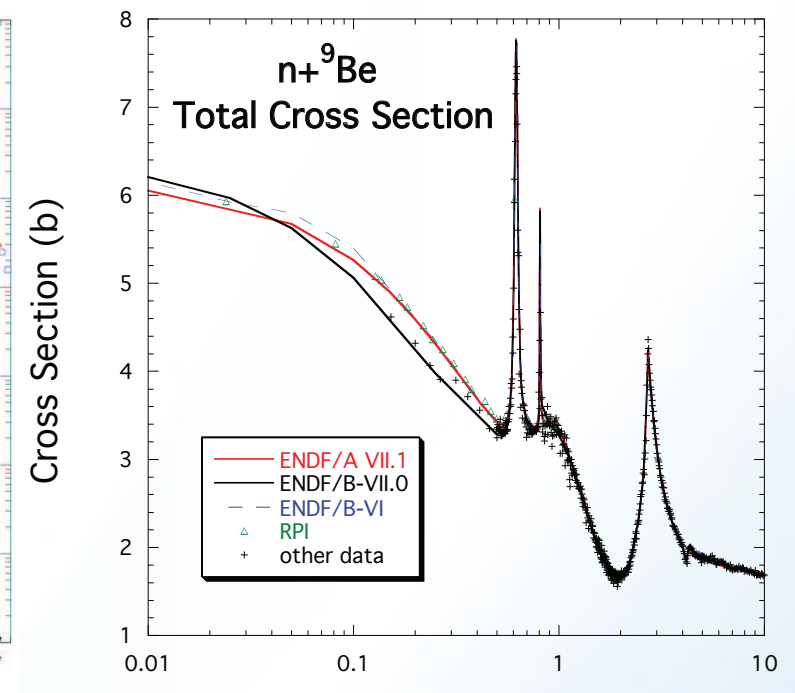
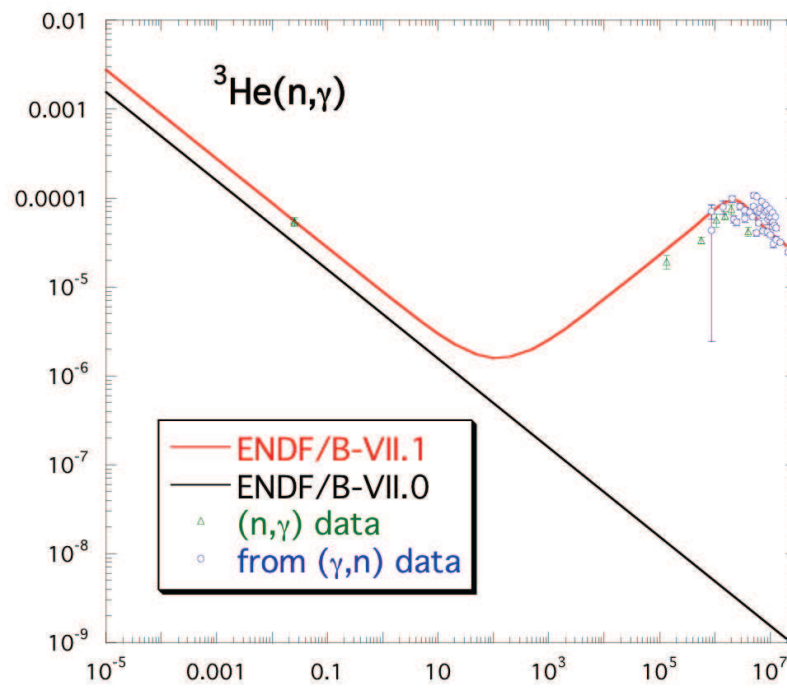
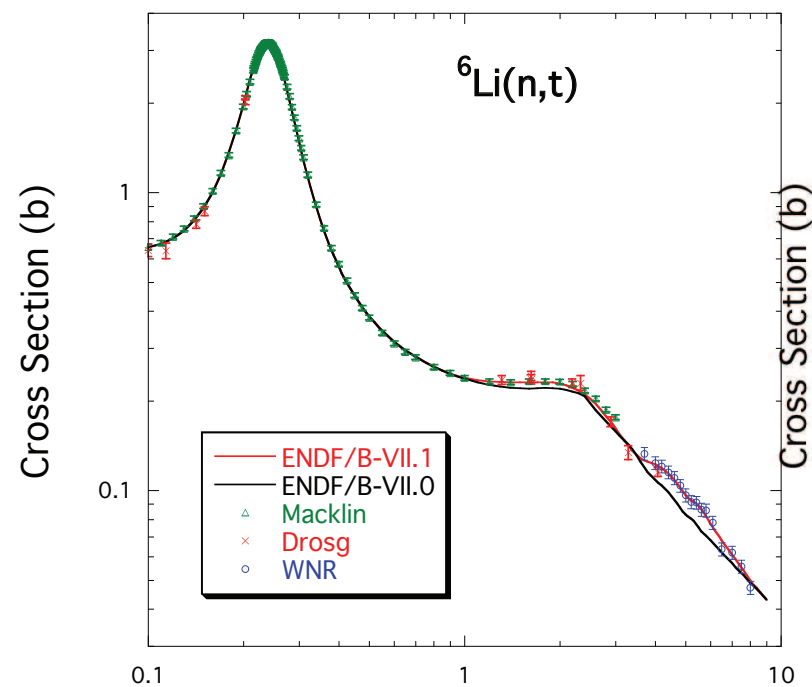
An overview of the library

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Many of the changes to the light nuclei were quite dramatic

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An overview of the library

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Fission Products and Other Evaluations

1. ^{95}Mo
2. ^{92}Mo
3. ^{99}Tc
4. ^{103}Rh
5. ^{109}Ag
6. ^{133}Cs
7. ^{143}Nd
8. ^{145}Nd
9. ^{147}Nd
10. ^{147}Sm
11. ^{149}Sm
12. ^{152}Sm
13. ^{153}Eu
14. ^{58}Co
15. ^{62}Ni
16. Zr
17. ^{113}Cd
18. ^{157}Gd

Structural Material Evaluations

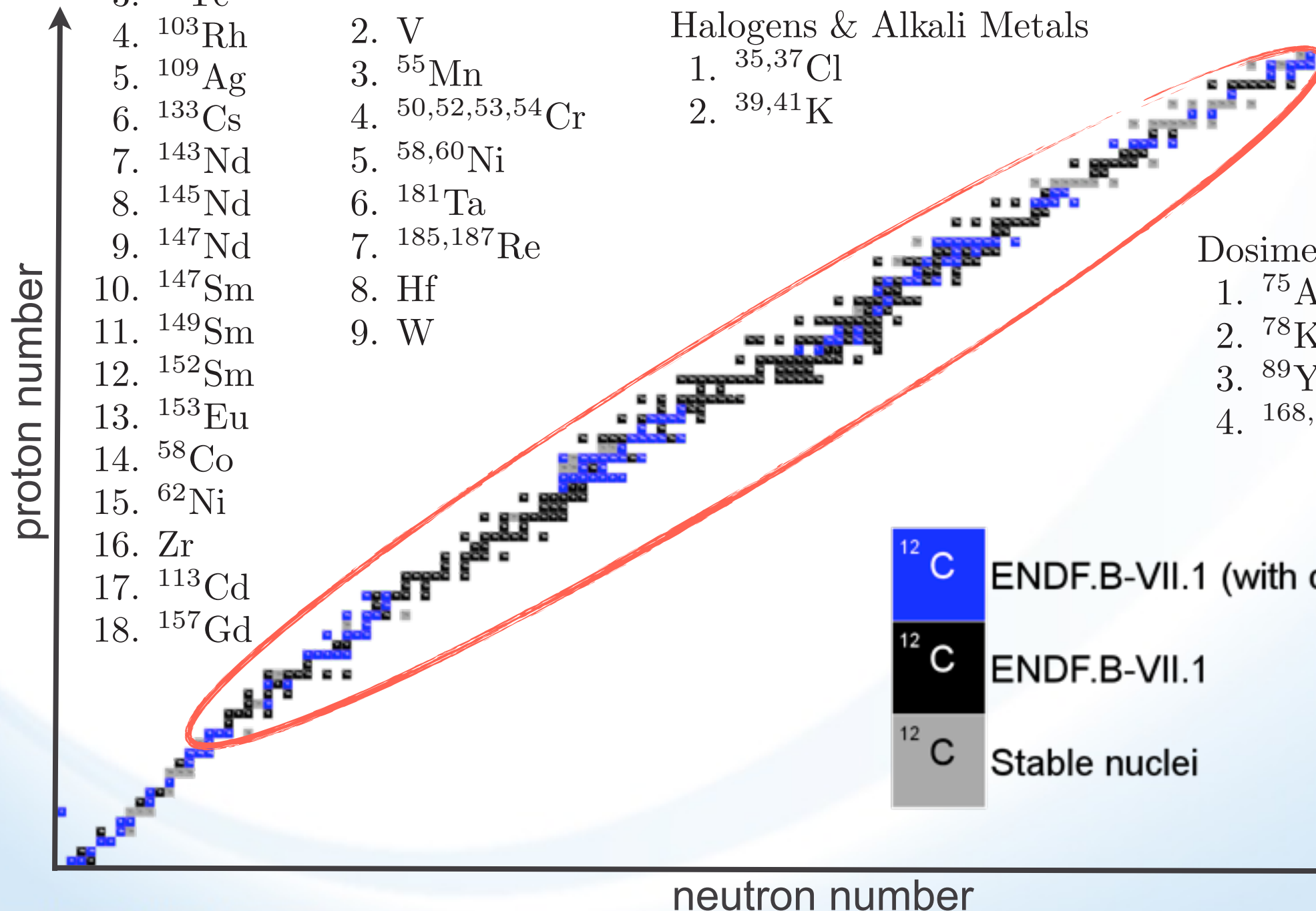
1. Ti
2. V
3. ^{55}Mn
4. $^{50,52,53,54}\text{Cr}$
5. $^{58,60}\text{Ni}$
6. ^{181}Ta
7. $^{185,187}\text{Re}$
8. Hf
9. W

Halogens & Alkali Metals

1. $^{35,37}\text{Cl}$
2. $^{39,41}\text{K}$

Dosimetry cross sections

1. ^{75}As
2. ^{78}Kr
3. ^{89}Y
4. $^{168,169,170}\text{Tm}$ and $^{203,205}\text{Tl}$



An overview of the library

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16. **Zr**
17. ^{113}Cd
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Structural Material Evaluations

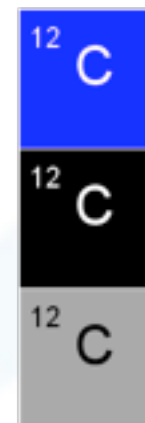
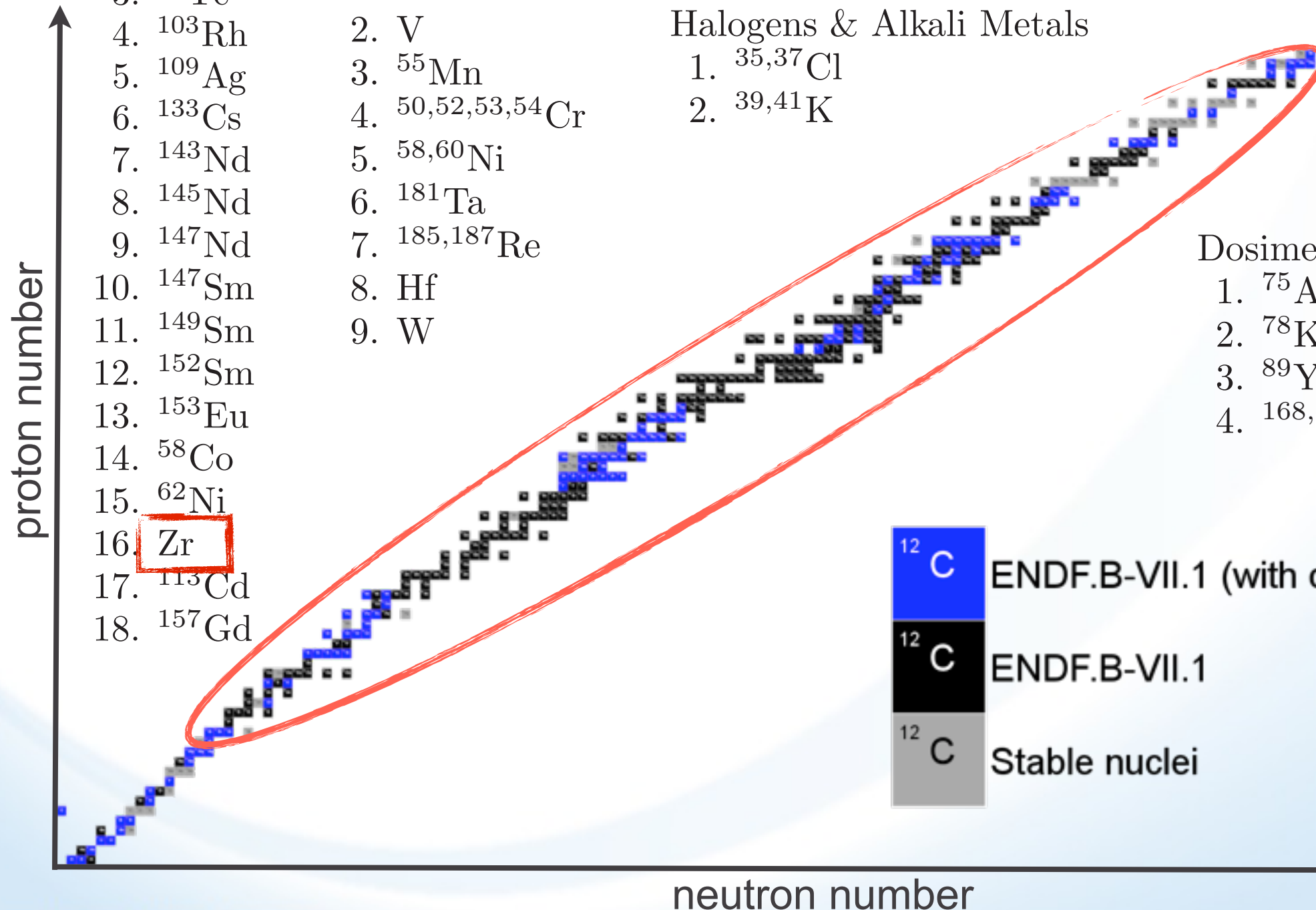
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ENDF.B-VII.1 (with covariance data)

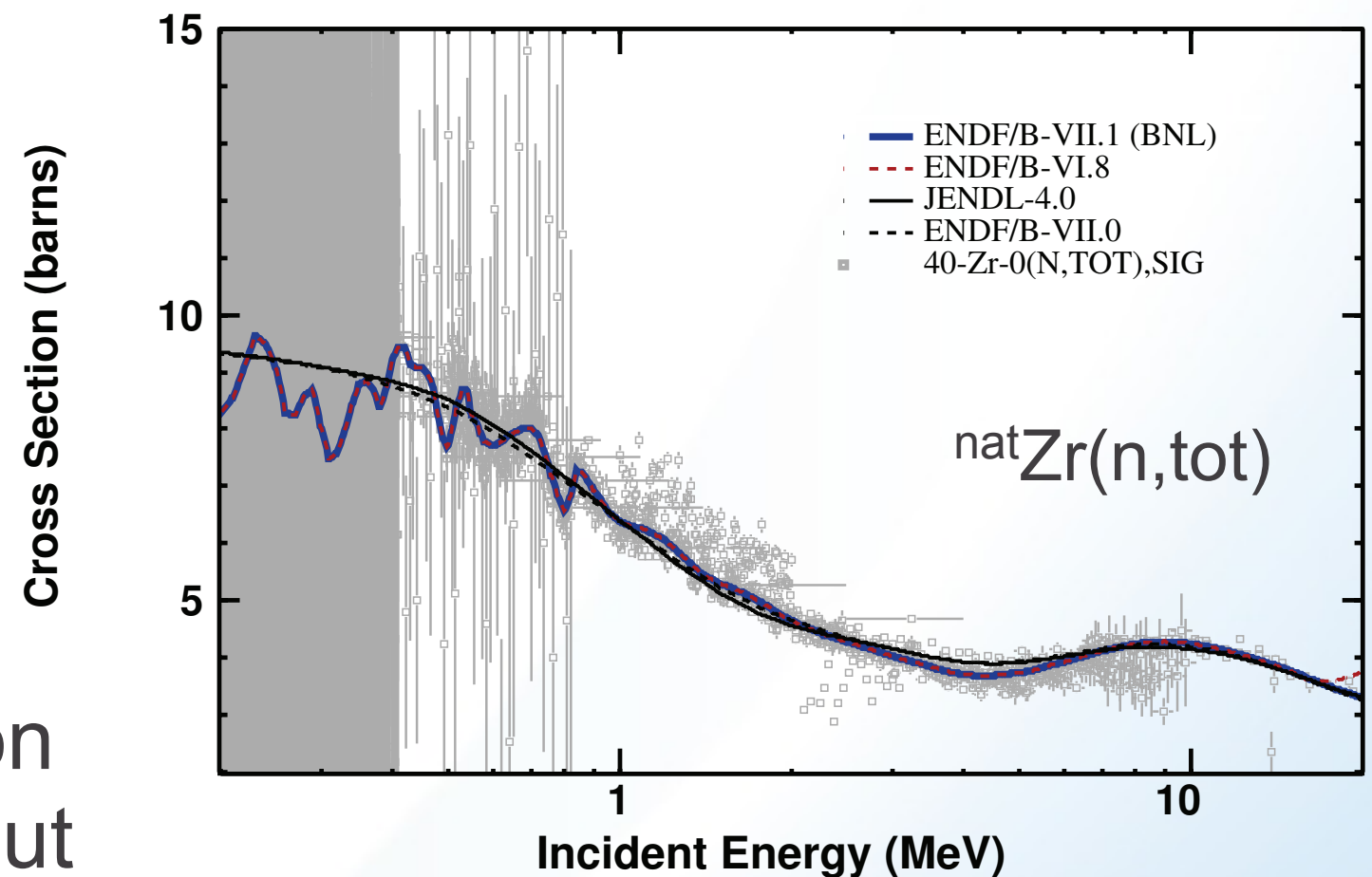
ENDF.B-VII.1

Stable nuclei

Zr needed to be reworked for ENDF/B-VII.1



- ENDF/B-VI.8 fitted $^{nat}\text{Zr}(n,\text{tot})$, but missed outgoing dists.
- ENDF/B-VII.0 is EMPIRE evaluation, but not fitted
- Attempted re-evaluation for ENDF/B-VII beta, but that version tested poorly
 - Leakage problems (not leaky enough!)
 - Suspected problem (n,el) angular distributions
 - Lead evaluator had health issues that prevented him from fixing evaluation



We took over the evaluation and made a few key changes

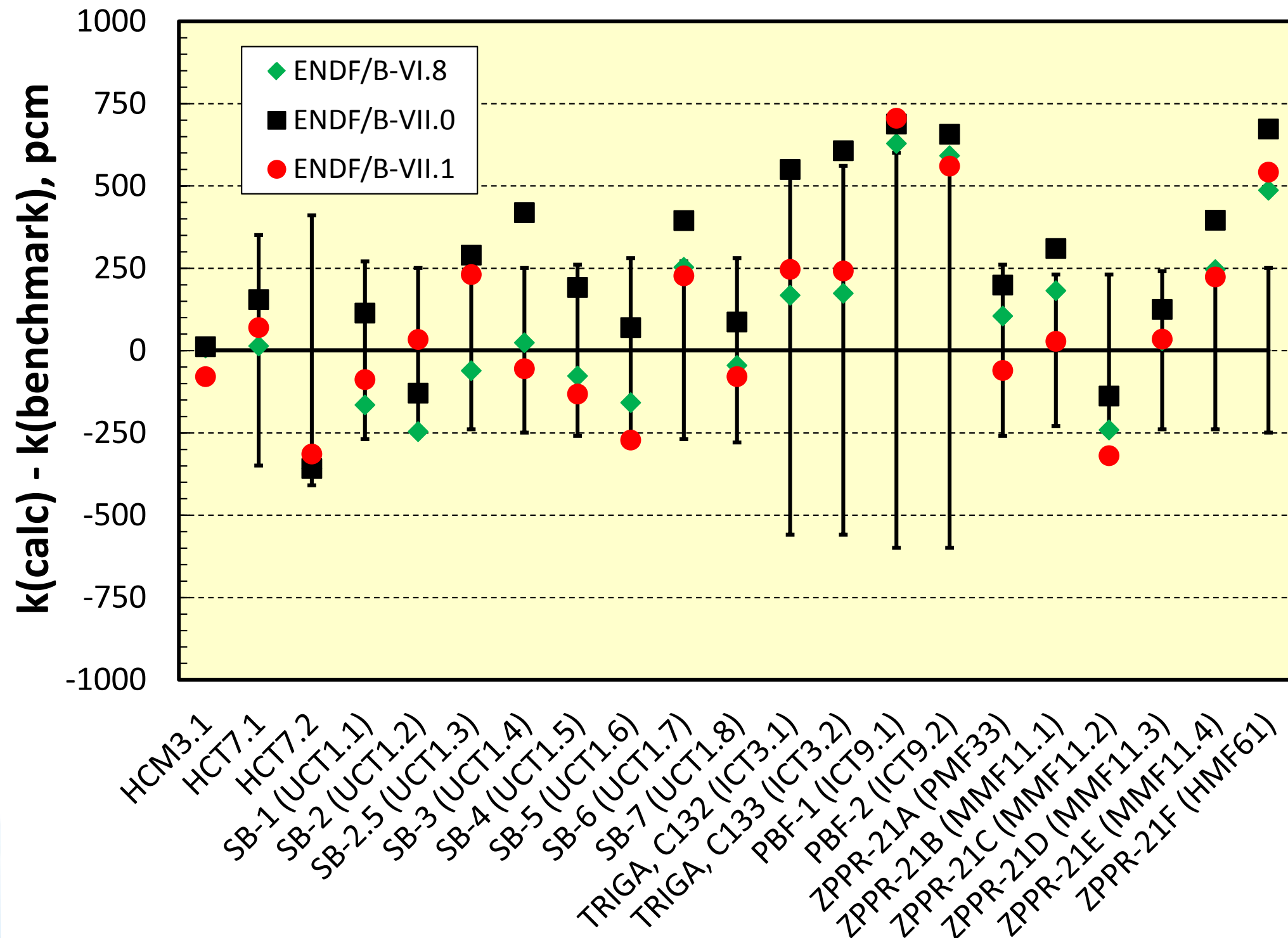


- Found backward peaked low energy neutron dists. - now patched using JENDL-4
- S. Mughabghab reevaluated the RRR:
 - ^{90}Zr all new
 - ^{91}Zr first pass at fixes

Reaction	^{90}Zr		^{91}Zr	
	σ_T (barn)	I_γ (barn)	σ_T (barn)	I_γ (barn)
Total	5.50762	-	11.0729	-
Elastic	5.49765	-	9.85728	-
Capture	9.97256×10^{-3}	0.132506	1.21566	6.0062

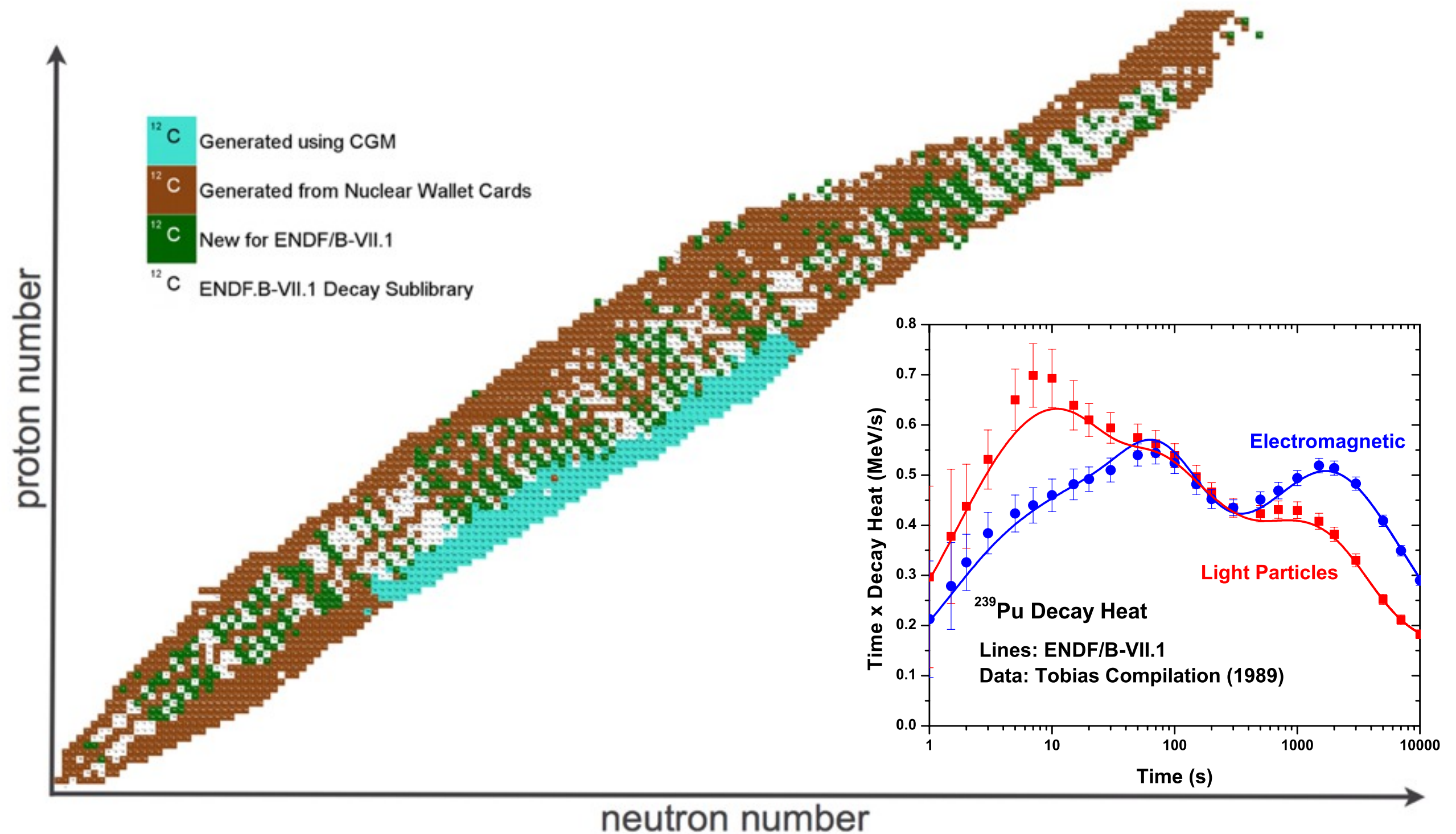
New Zr evaluations perform well in TRIGA and ZPR assemblies

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New decay sublibrary enables more accurate decay heat calculations

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- # ADVANCE: Online Data Verification System (Automated *Data Verification* and Assurance for *Nuclear Calculations Enhancement*)

Visit <http://www.nndc.bnl.gov/endl/b7.dev/qa/>



www.nndc.bnl.gov/endl/b7... index.html

ENDF/B-VII.1 Evaluated Nuclides Information System

National Nuclear Data Center

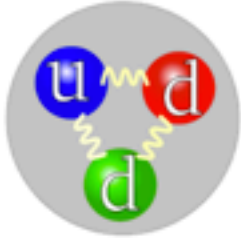
ADVANCE: The ENDF Continuous Integration System

MAIN LIBRARY PERIODIC TABLE LIST VIEW ABOUT ADVANCE

Neutrons Sublibrary

ENDF/B Development Library

- General Information:
 - ENDF sublib designator: 10
- Revision Number: 592
- Last Modified Revision: 532:592
- Build Status:
 - Build status: **FAILURE**
 - Build time: 2012-10-24 13:52:00.314153
 - Listfile: [neutrons.list](#)
 - Release Notes: [neutrons-releaseNotes.pdf](#)
- GForge Links:
 - Browse [SVN](#)
 - Browse sublibrary [tracker](#)



1	H	2	He
3	Li	4	Be
11	Na	12	Mg
19	K	20	Ca
21	Sc	22	Ti
23	V	24	Cr
25	Mn	26	Fe
27	Co	28	Ni
29	Cu	30	Zn
31	Ga	32	Ge
33	As	34	Se
35	Br	36	Kr
37	Rb	38	Sr
39	Y	40	Zr
41	Nb	42	Mo
43	Tc	44	Ru
45	Rh	46	Pd
47	Ag	48	Cd
49	In	50	Sn
51	Sb	52	Te
53	I	54	Xe
55	Cs	56	Ba
57	La	58	Ce
59	Pr	60	Nd
61	Pm	62	Sm
63	Eu	64	Gd
65	Tb	66	Dy
67	Ho	68	Er
69	Tm	70	Yb
71	Lu	72	Hf
73	Ta	74	W
75	Re	76	Os
77	Ir	78	Pt
79	Au	80	Hg
81	Tl	82	Pb
83	Bi	84	Po
85	At	86	Rn
87	Fr	88	Ra
89	Ac	90	Th
91	Pa	92	U
93	Np	94	Pu
95	Am	96	Cm
97	Bk	98	Cf
99	Es	100	Fm
101	Md	102	No
103	Lr	104	Rf
105	Db	106	Sg
107	Bh	108	Hs
109	Mt	110	Ds
111	Rg	112	Cn
113	Uut	114	Fl
115	Uup	116	Lv
117	Uus	118	Uuo

Symbol Legend

- FAILURE: At least one evaluation in the element/sublibrary was so badly done that it coredumped a checker code or the checking code has a serious bug
- ERROR: The evaluation/sublibrary DOES NOT pass all checks
- WARNING: The evaluation/sublibrary passed all checks, but there were warnings

www.nndc.bnl.gov/endl/b7... index.html

ENDF/B-VII.1 Evaluated Nuclides Information System

National Nuclear Data Center

ADVANCE: The ENDF Continuous Integration System

MAIN LIBRARY PERIODIC TABLE LIST VIEW ABOUT ADVANCE

³He

Neutrons Sublibrary

- General Information:
 - ENDF MAT designator: 225
 - Evaluated date: MAY90
 - Evaluation lab: LANL
 - Evaluation authors: G.Hale, D.Dodder, P.Young
 - Natural abundance: 0.000137 +/- 3e-06 %
 - Check out Wikipedia's entry for [helium](#)
- Revision Number: 592
- Last Modified Revision: 532:592
- Build Status:
 - Build status: **ERROR** ([Submit tracker item](#))
 - Build time: 2012-10-24 13:50:20.874937
- GForge Links:
 - Browse [SVN](#)
 - View current [revision](#)
 - Download current [revision](#)




Image of helium from <http://images-of-elements.com/>

Status	Code	# Tests	# Failures	# Errors	Run time (sec)	Files
	STAN	0	0	0	0.033	STN File
	STANEF	0	0	0	0.026	
	CHECKR	8	0	0	0.012	
	FIZCON	8	0	0	0.012	
	PSYCHE	16	0	0	0.013	
	PREPRO	2	0	0	0.041	prepro File
	INTER	1	0	0	0.018	inter File
	FUDGE-2.9	4	0	4	0.614	Log_gnd.xml File
	NJOY99	3	0	0	6.786	ace File , acer.ps File , heatr.ps File , heatr.chk File , gendt File , xsdir File , -armor.cov File

Symbol Legend

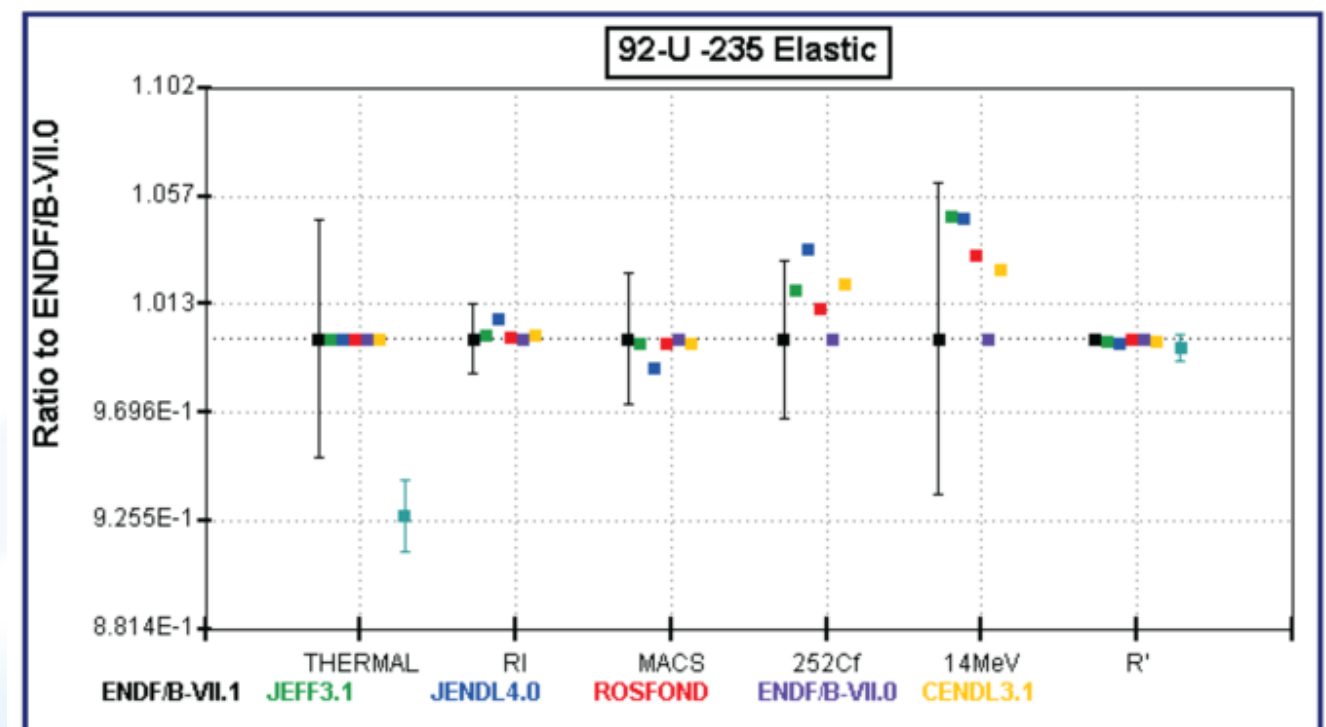
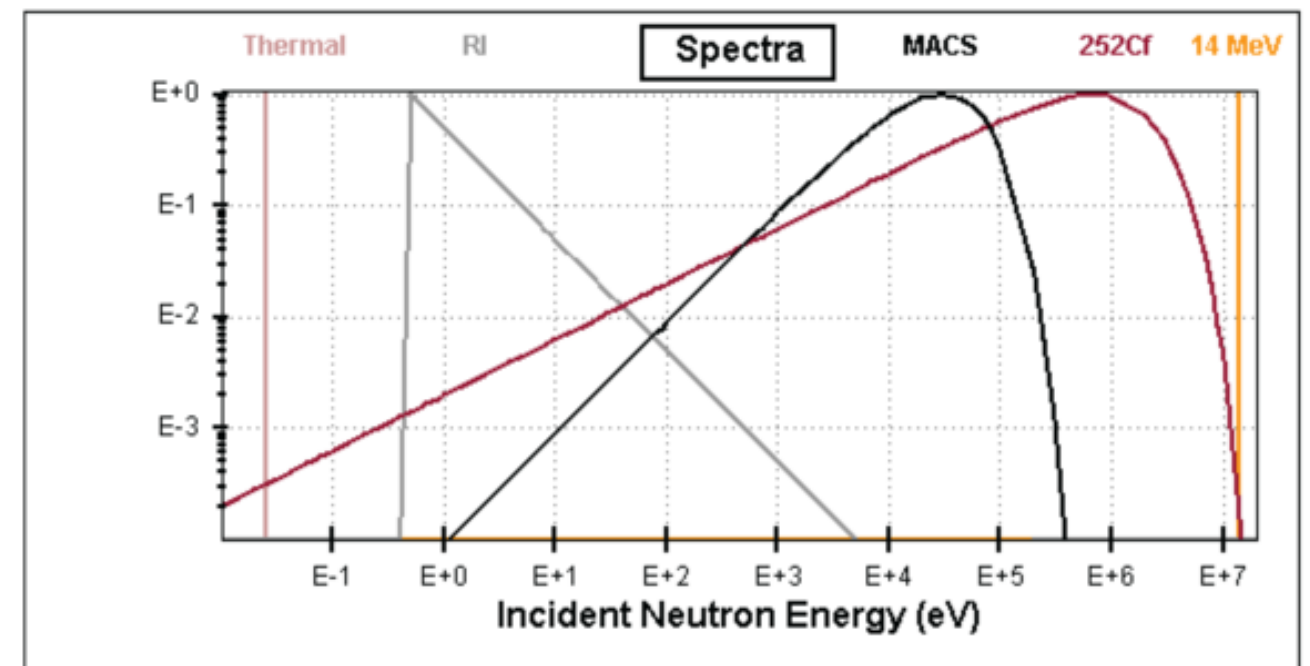
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Updated every hour!

ADVANCE will be expanded and is ready for general use

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- Use ControlTier for test management
- ACE quality control /w ACELST
- Other processing codes
 - AMPX, CALENDF
- Integrate covariance QA system
 - MACS, other spectrum average plots
 - plots of cross sections
- Ground work for general evaluation review system



Other longer term changes are in the works



■ New data:

- Expanded charged particle library (porting ENDL2011 charged particle sublibrary)
- Filling holes in reaction networks
- Eliminate last elemental evaluation from transport library: ^{nat}C

■ New format:

- Most likely based on Generalized Nuclear Data format
- USNDP/CSEWG actively participating
- WPEC hopefully to form to collect international input

■ Investigating possibility of international, unified evaluated nuclear data library

ENDF/B-VII.1 was the combined effort of collaborators from across the US...

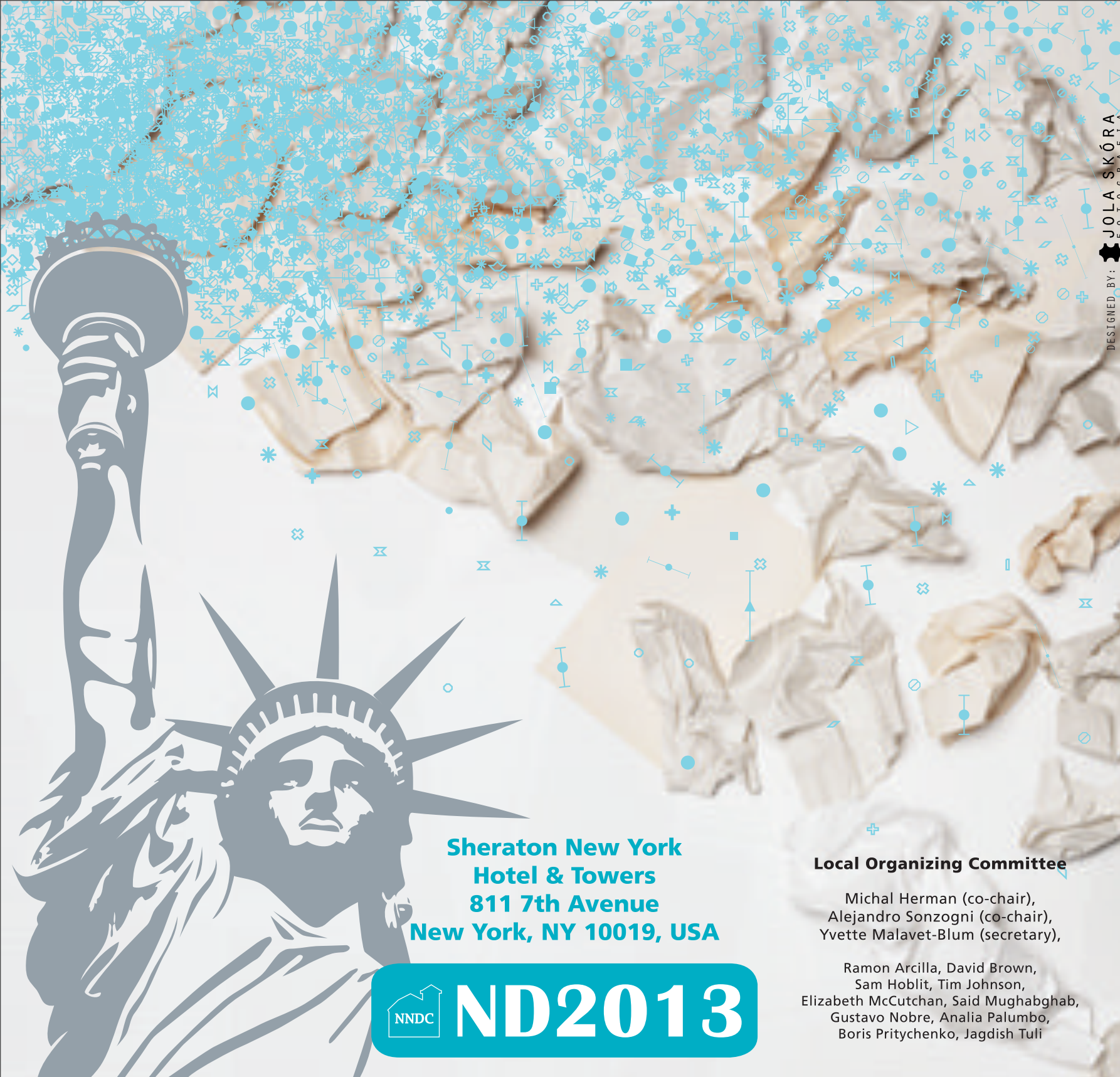
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... and the world.

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ND2013

Local Organizing Committee

Michal Herman (co-chair),
Alejandro Sonzogni (co-chair),
Yvette Malavet-Blum (secretary),

Ramon Arcilla, David Brown,
Sam Hoblit, Tim Johnson,
Elizabeth McCutchan, Said Mughabghab,
Gustavo Nobre, Analia Palumbo,
Boris Pritychenko, Jagdish Tuli

**INTERNATIONAL CONFERENCE ON NUCLEAR DATA
FOR SCIENCE & TECHNOLOGY**
March 4-8, 2013
www.bnl.gov/nd2013

Important Dates

Aug. 1, 2012	Abstracts for oral/poster presentations due.
Sept. 1, 2012	Program is announced.
Feb. 10, 2013	Deadline to reserve rooms at the Sheraton at conference rates.
Mar. 4, 2013	Conference begins.
Mar. 8, 2013	Deadline for article submission.

Topics

- Nuclear reaction data
- Nuclear structure and decay data
- Delayed neutrons
- Fission yields
- Atomic masses
- Experimental facilities and detection techniques
- Nuclear data measurements and analysis
- Nuclear theories, models and data evaluation
- Uncertainty quantification and covariances
- Evaluated nuclear data libraries
- Nuclear data processing
- Nuclear data adjustment
- Validation of evaluated data
- Integral experiments
- Cross section and decay standards,
- Data dissemination and international collaboration
- Nuclear Fission (75th anniversary)
- Nuclear data for reactors
- Nuclear decay heat
- Dosimetry and shielding
- Safeguards and security
- Criticality safety
- Homeland security and safety
- Accelerator related applications
- Fusion technology
- Space, cosmic-rays, radiation effects on electronics
- Astrophysics and cosmology
- Medical and environmental applications
- Nuclear physics education

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