Using INEL TAGS data in the ENSDF/B-VII Decay Data Library

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Actions

- Contact INEL to obtain raw TAGS data

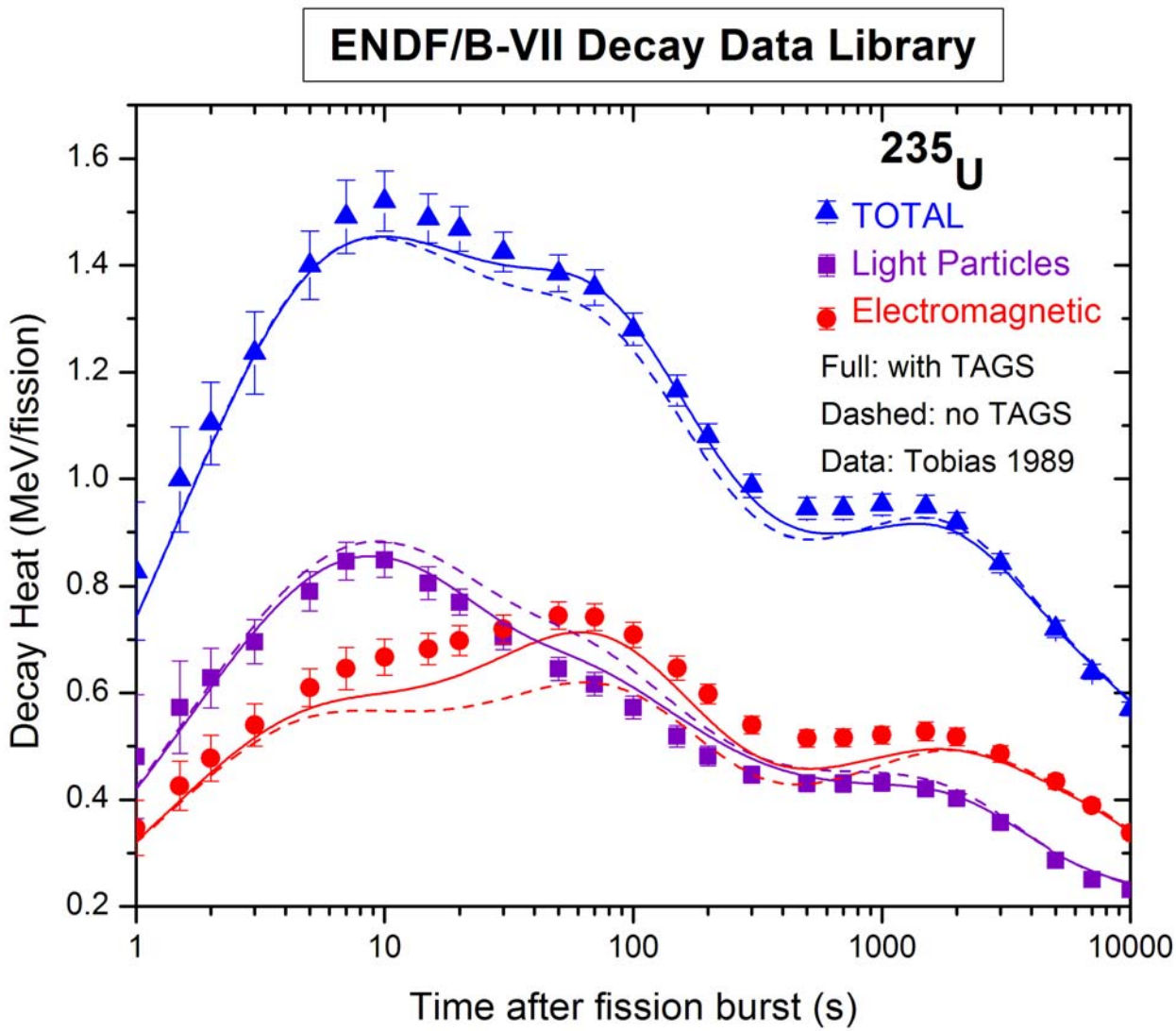
Raw data is not available

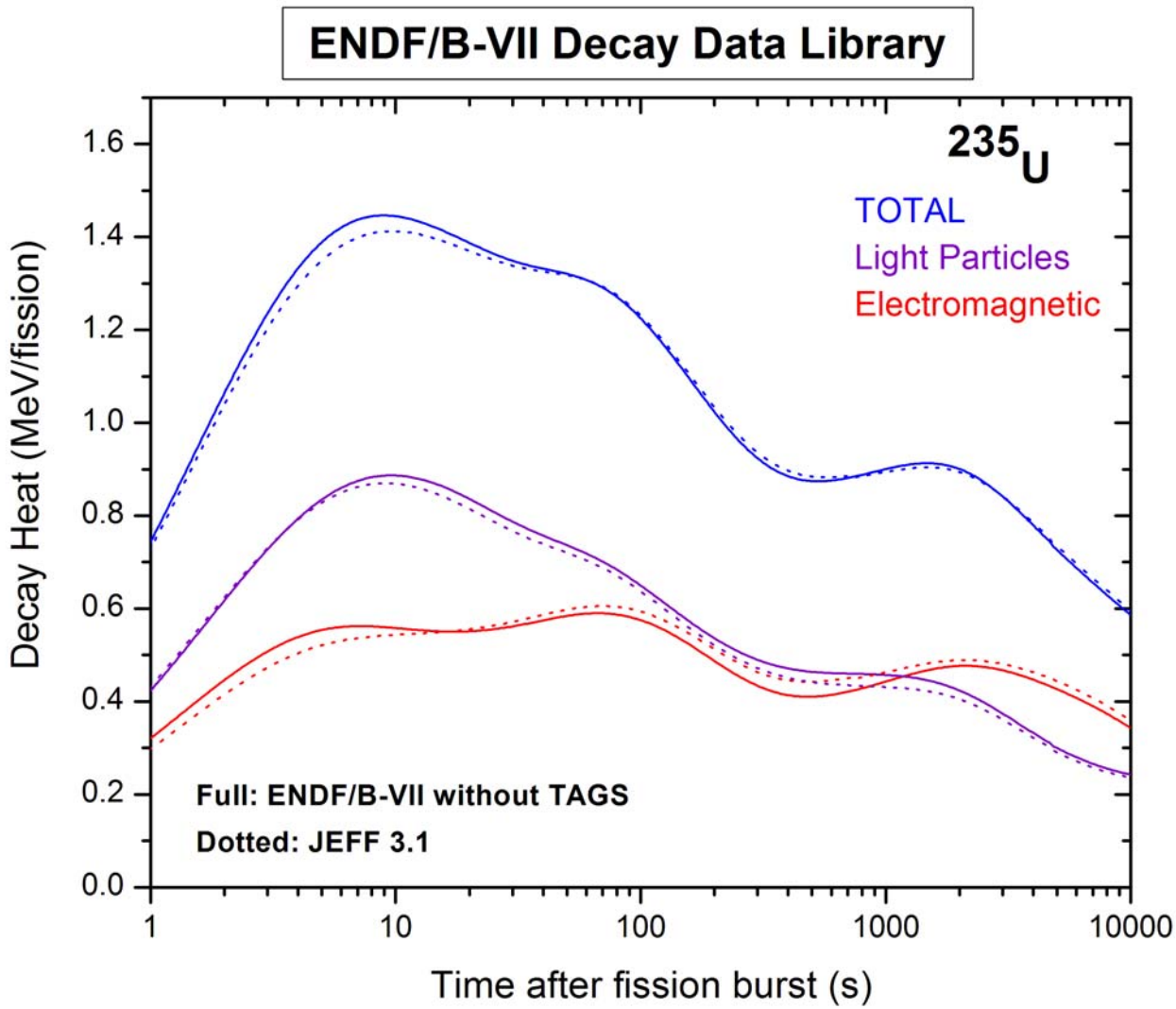
- Put INEL TAGS data into ENSDF format and obtain mean energies

Done, excel file with mean energies sent to the list

Also

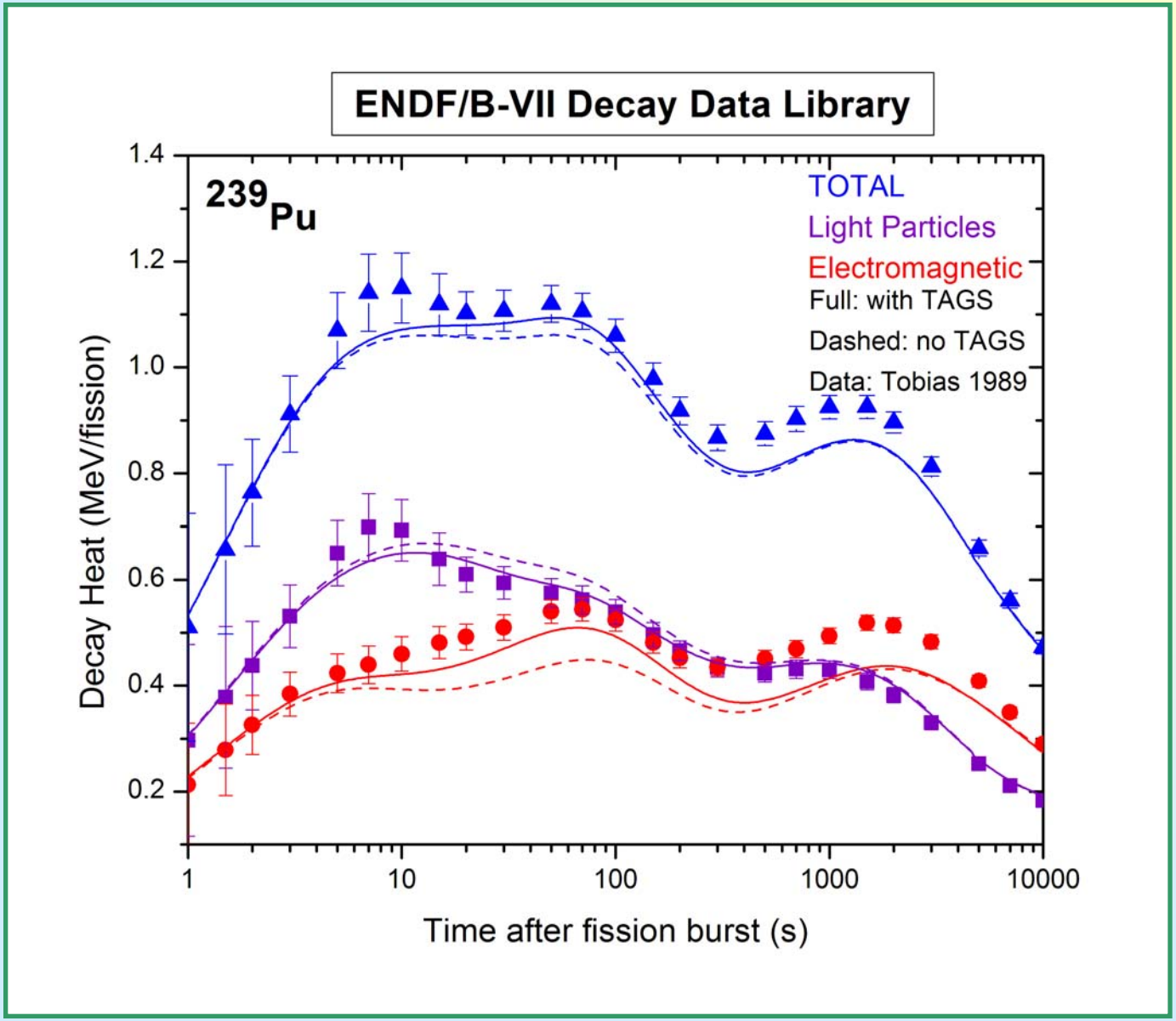
- Compare ENDF/B-VII mean energies with discrepant JEFF 3.1 and JENDL values
- Compare decay heat calculations from ENDF/B-VII with and without TAGS
- Compare decay heat calculations using ENDF/B-VII (without TAGS) and JEFF 3.1
- Performed sensitivity studies to identify nuclides for TAGS experiments


ENDF/B-VII Decay Data Library
235U
TOTAL
Light Particles
Electromagnetic
Full: with TAGS
Dashed: no TAGS
Data: Tobias 1989
Decay Heat (MeV/fission)
Time after fission burst (s)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
1
10
100
1000
10000



ENDF/B-VII

- Internal conversion coefficients from BRICC
- Mean beta energies from SPEBETA for a few 2nd forbidden non-unique transitions (not relevant here)
- $T_{1/2}$ values from Moller 1997 for some fragments only $T_{1/2}$ limits (important below 1 second)
- Need to improve X-Rays and Auger coverage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239Pu
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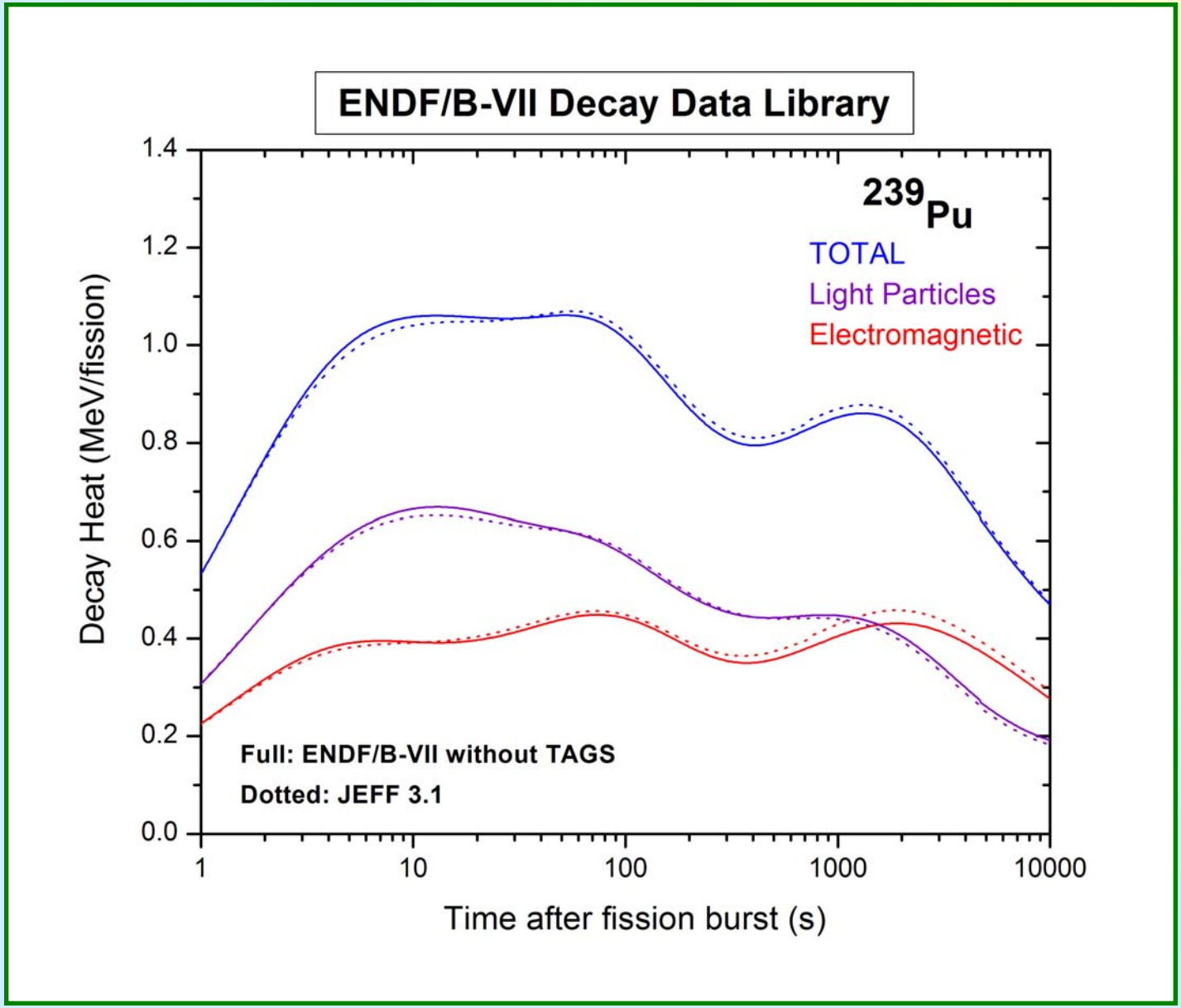
1.4
1.2
1.0
0.8
0.6
0.4
0.2
1
10
100
1000
10000


ENDF/B-VII Decay Data Library
239Pu
TOTAL
Light Particles
Electromagnetic
Full: ENDF/B-VII without TAGS
Dotted: JEFF 3.1
Decay Heat (MeV/fission)
Time after fission burst (s)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1
10
100
1000
10000

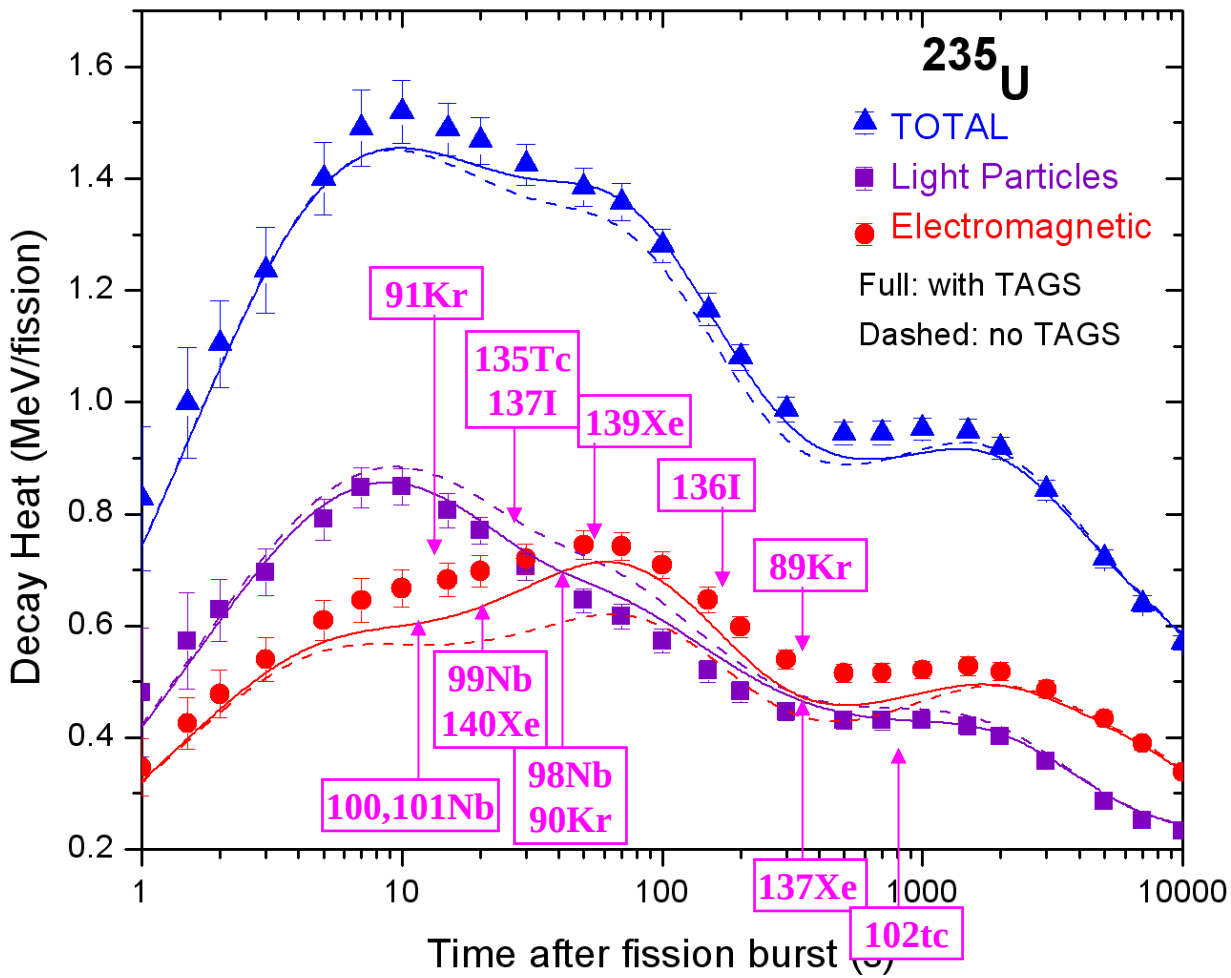
Sensitivity Study

For each nuclei involved in the decay process:

- Increase EEM by 50% of ELP, i.e. EEM=EEM+0.5* ELP.
- Decrease ELP by 50%, i.e. ELP=0.5*ELP.
- Calculate EM decay heat, get ratio of perturbed total EM decay heat to the unperturbed one, get maximum ratio and time of the maximum.
- Make a list ordered by EM decay heat ratio, check if it was measured by INEL, if not get decay Q-value, look at decay scheme, get highest level, infer presence of pandemonium effect.
- Used JEFF3.1 library to achieve common ground

^{235}U sensitivity study

nucleus	z	a	liso	max ratio	tmax(s)	T1/2(s)	TAGS?	Q-value	highest level	Pandemonium?
41-Nb-100	41	100	0	5.78%	11	1.5		6245	3130	yes
55-Cs-139	55	139	0	4.47%	741	556.2	INEL TAGS			
54-Xe-137	54	137	0	4.39%	369	229.08		4173	3976	fragmented DS
37-Rb- 90	37	90	0	4.23%	285	158	INEL TAGS			
55-Cs-140	55	140	0	4.23%	108	63.7	INEL TAGS			
41-Nb- 98	41	98	0	3.93%	40	2.86		4586	2608	yes
39-Y - 95	39	95	0	3.86%	803	618	INEL TAGS			
41-Nb-101	41	101	0	3.84%	12	7.1		4569	1099	yes
38-Sr- 95	38	95	0	3.71%	31	23.9	INEL TAGS			
43-Tc-102	43	102	0	3.36%	870	5.28		4526	2909	yes
37-Rb- 91	37	91	0	3.05%	92	58.4	INEL TAGS			
52-Te-135	52	135	0	3.04%	25	19		5960	4773	yes
55-Cs-141	55	141	0	3.03%	33	24.94	INEL TAGS			
57-La-144	57	144	0	2.86%	67	40.8	INEL TAGS			
56-Ba-143	56	143	0	2.72%	20	14.5	INEL TAGS			
54-Xe-139	54	139	0	2.64%	54	39.68		5057	4227	yes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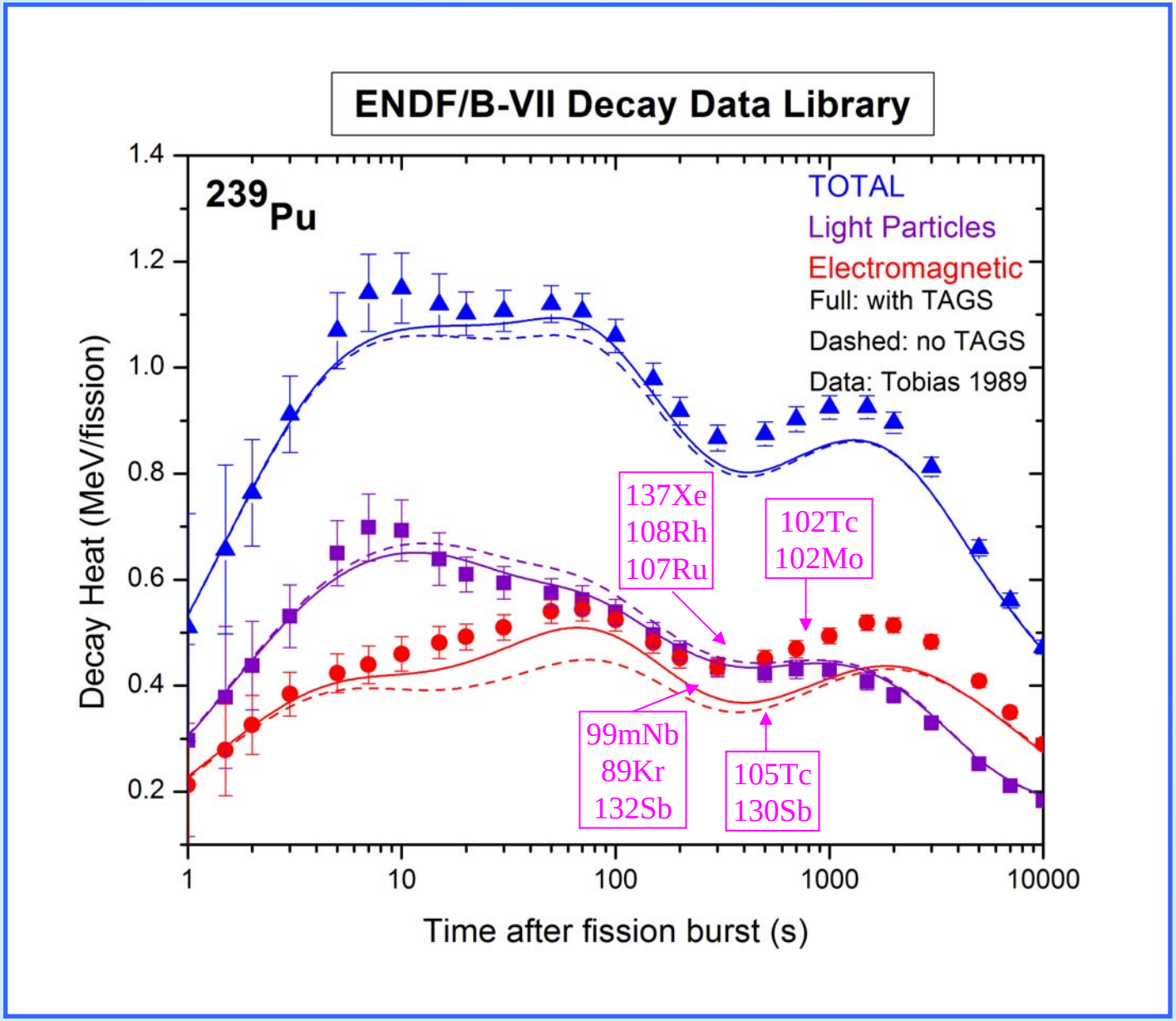
Time after fission burst (s)
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
1
10
100
1000
10000
91Kr
135Tc
137I
139Xe
136I
89Kr
99Nb
140Xe
98Nb
90Kr
100,101Nb
137Xe
102tc

^{239}Pu sensitivity study

nucleus	z	a	liso	change	tm	T1/2	
41-Nb-100	41	100	0	7.15%	11	1.5	
41-Nb-101	41	101	0	5.61%	11	7.1	
54-Xe-137	54	137	0	5.43%	339	229.08	
43-Tc-102	43	102	0	5.30%	783	5.28	
41-Nb- 98	41	98	0	5.22%	39	2.86	
39-Y - 96	39	96	0	5.03%	8	5.34	
43-Tc-103	43	103	0	4.52%	194	54.2	
55-Cs-139	55	139	0	4.51%	654	556.2	INEL TAGS
40-Zr- 99	40	99	0	4.38%	3	2.2	
55-Cs-140	55	140	0	3.88%	106	63.7	INEL TAGS
43-Tc-105	43	105	0	3.76%	552	456	
42-Mo-103	42	103	0	3.67%	113	67.9	
43-Tc-106	43	106	0	3.48%	51	36	


ENDF/B-VII Decay Data Library
239Pu
TOTAL
Light Particles
Electromagnetic
Full: with TAGS
Dashed: no TAGS
Data: Tobias 1989
137Xe
108Rh
107Ru
102Tc
102Mo
99mNb
89Kr
132Sb
105Tc
130Sb
Decay Heat (MeV/fission)
Time after fission burst (s)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
1
10
100
1000
10000

Summary

- ENDF/B-VII decay data library (without TAGS) was released in late April (part of beta 2 release)
- Plan to improve X-ray and Auger coverage
- As Yoshida pointed out, including TAGS data helps considerably, more so for ^{235}U than for ^{239}Pu, however.
- Sensitivity studies were carried out to identify nuclides with a need of a TAGS experiment
- I used Tobias compilation, we need to come up with an official one.