ORNL Future Plan for Resonance Evaluation

1. Tungsten Resonance Evaluations and Covariance:

   ^{182}W, ^{183}W, ^{184}W, and ^{186}W

Energy Ranges for the ORNL W evaluations:

1. Energy Range for ^{182}W

Resolved (old)	Resolved (new)
10^{-5} eV – 5 keV	10^{-5} eV – 10 keV

2. Energy Range for ^{183}W

Resolved	Resolved
10^{-5} eV – 2.2 keV	10^{-5} eV – 5.0 keV

3. Energy Range for ^{184}W

Resolved	Resolved
10^{-5} eV – 4 keV	10^{-5} eV – 10 keV

4. Energy Range for ^{186}W

Resolved	Resolved
10^{-5} eV – 8.3 keV	10^{-5} eV – 10 keV

2. Cooper Resonance Evaluations and Covariance:

3. Energy Range for ^{63}Cu

Resolved	Resolved
10^{-5} eV – 100 keV	10^{-5} eV – 300 keV

4. Energy Range for ^{65}Cu

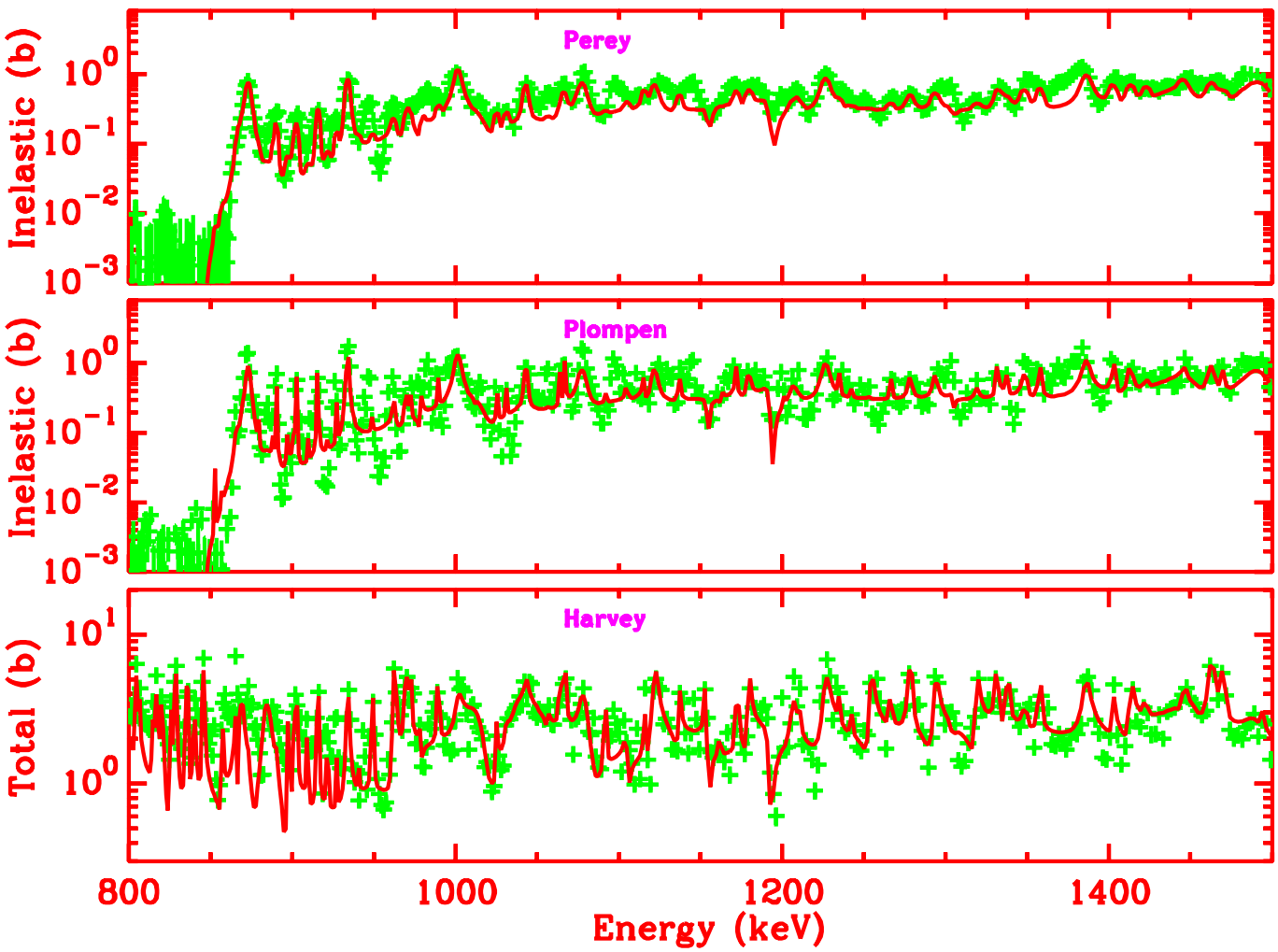
Resolved	Resolved
10^{-5} eV – 100 keV	10^{-5} eV – 300 keV

3. ^{56}Fe Resonance Evaluations and Covariance:

Energy Range for ^{56}Fe

Resolved	Resolved
10^{-5} eV – 845 keV	10^{-5} eV – 2.0 MeV

Include inelastic level in the SAMMY resonance fitting


Perey
Plompen
Harvey
Inelastic (b)
Inelastic (b)
Total (b)
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{1}
800
1000
1200
1400
Energy (keV)

4. ^{239}Pu issue, ^{240}Pu, and ^{235}U^{239}Pu issue, ^{240}Pu

a) ^{239}Pu (^{240}Pu):

WPEC subgroup 34

b) ^{235}U:

i. Results from WPEC subgroup 28

ii. New capture measurements from LANL and RPI

^{19}F issue

Resonance spin for ^{19}F and inelastic levels:

Resonance spins for inelastic level at 109.9 keV with spin and parity $1/2^-$

l	s=I±1/2		J^π	
0	0		0^-	
0	1		1^-	
1	0		1^+	
1	1	0^+	1^+	2^+
2	0		2^-	
2	1	1^-	2^-	3^-
3	0		3^+	
3	1	2^+	3^+	4^+

Resonance spins for inelastic level at 197.2 keV with spin and parity $5/2^+$

l	s=I ± 1/2		J^π	
0	2		2^+	
0	3		3^+	
1	2	1^-	2^-	3^-
1	3	2^-	3^-	4^-
2	2	0^+	1^+	2^+
2	3	1^+	2^+	3^+
3	2	1^-	2^-	3^-
3	3	0^-	1^-	2^-

Resonance spins for ^{19}F spin and parity 1/2+

l	s=I±1/2	J^{π}		
0	0		0^+	
0	1		1^+	
1	0		1^-	
1	1	0^-	1^-	2^-
2	0		2^+	
2	1	1^+	2^+	3^+
3	0		3^-	
3	1	2^-	3^-	4^-

Conservation of spin and parity

spin of incident channel = $J^{\pi} = J'^{\pi'}$ = spin of exit channel

Typical SAMMY input:

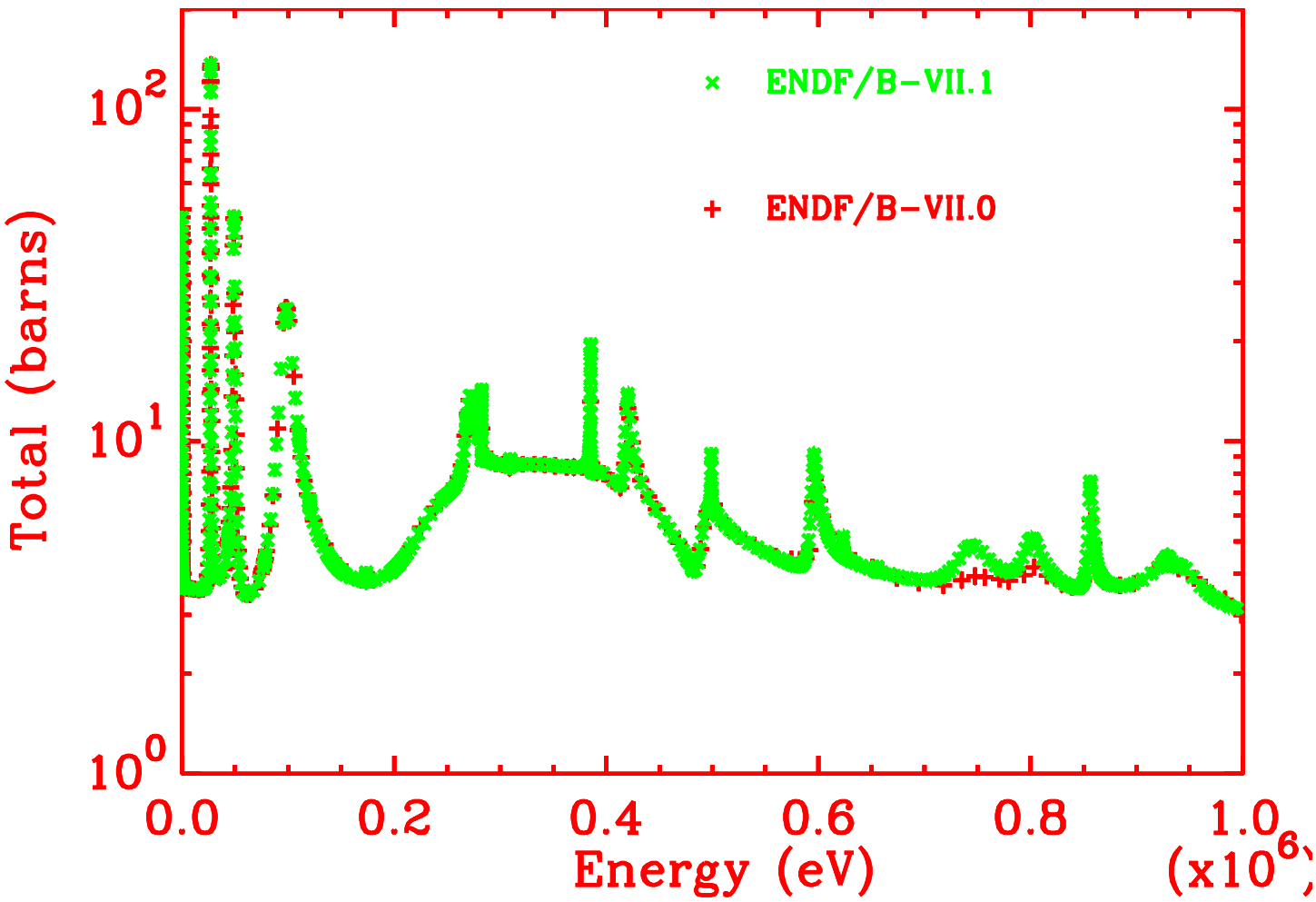
```
Name=PPair1
     Particle a=neutron
     Mb=       18.8350017020     Zb= 9     Sb=  0.5
Name=PPair2
     Particle a=neutron
     Mb=       18.8350017020     Zb= 9     Sb= -0.5
     Q =  -104308.0000000000
Name=PPair3
     Particle a=neutron
     Mb=       18.8350017020     Zb= 9     Sb=  2.5
     Q =  -187122.1000000000

total cross section
  1      1    2  0.0       1.0
    1  PPair1      1       1.0          5.3600000 5.3600000
    2  PPair2      0       0.0          5.3600000 5.3600000
    3  PPair3      3       3.0          5.3600000 5.3600000
  2      1    2  0.0       1.0
    1  PPair1      0       0.0          5.3600000 5.3600000
    2  PPair2      1      -1.0          5.3600000 5.3600000
    3  PPair3      2       2.0          5.3600000 5.3600000
  3      2    5 -1.0       1.0
    1  PPair1      1       0.0          5.3600000 5.3600000
    2  PPair1      1       1.0          5.3600000 5.3600000
    3  PPair2      0      -1.0          5.3600000 5.3600000
    4  PPair2      2      -1.0          5.3600000 5.3600000
    5  PPair3      1       2.0          5.3600000 5.3600000
    6  PPair3      3       2.0          5.3600000 5.3600000
    7  PPair3      3       3.0          5.3600000 5.3600000
  4      2    4  1.0       1.0
    1  PPair1      0       1.0          5.3600000 5.3600000
    2  PPair1      2       1.0          5.3600000 5.3600000
    3  PPair2      1       0.0          5.3600000 5.3600000
    4  PPair2      1      -1.0          5.3600000 5.3600000
    5  PPair3      2       2.0          5.3600000 5.3600000
    6  PPair3      2       3.0          5.3600000 5.3600000
```

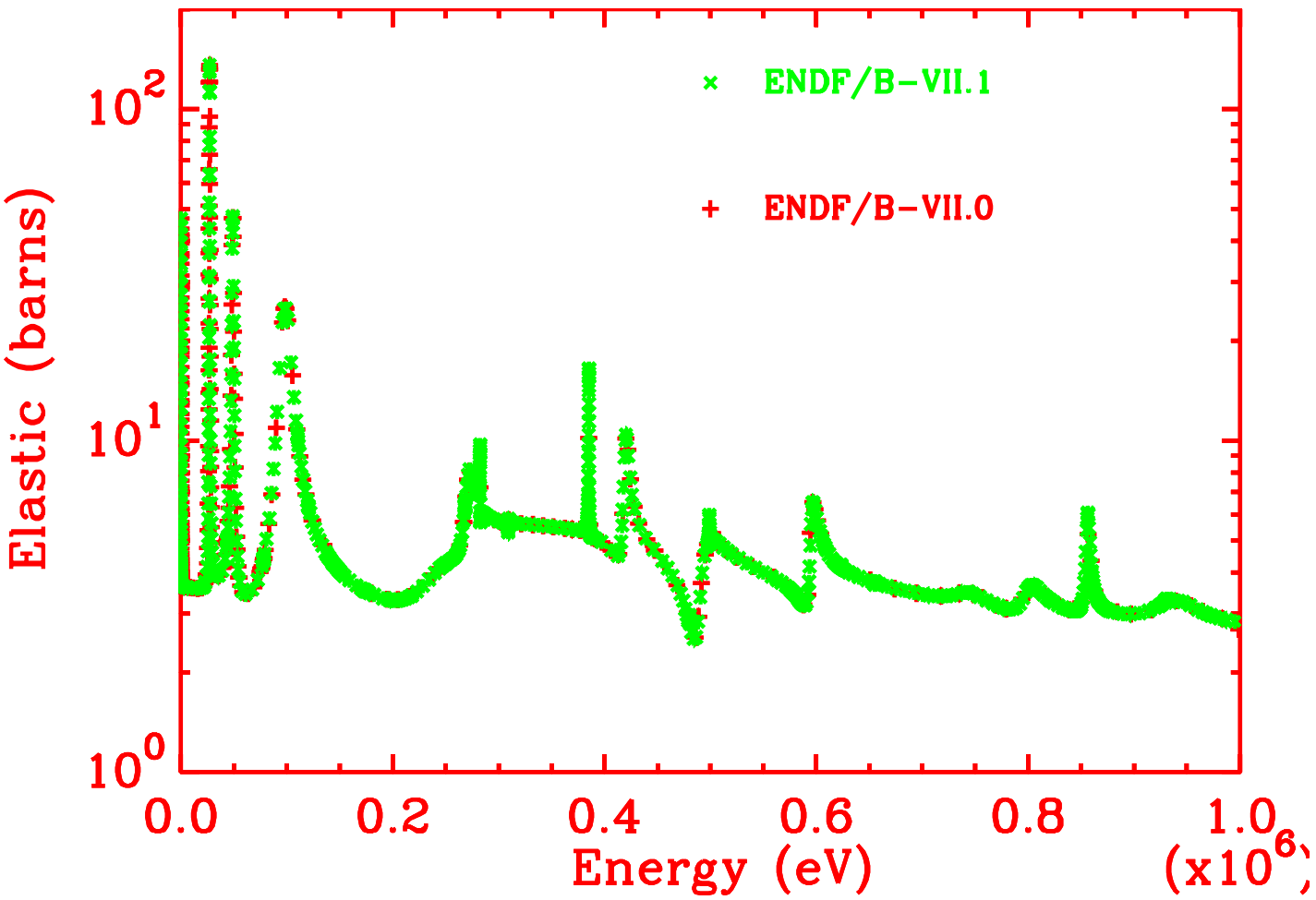
Issue with F-19 BVII.1 evaluation:

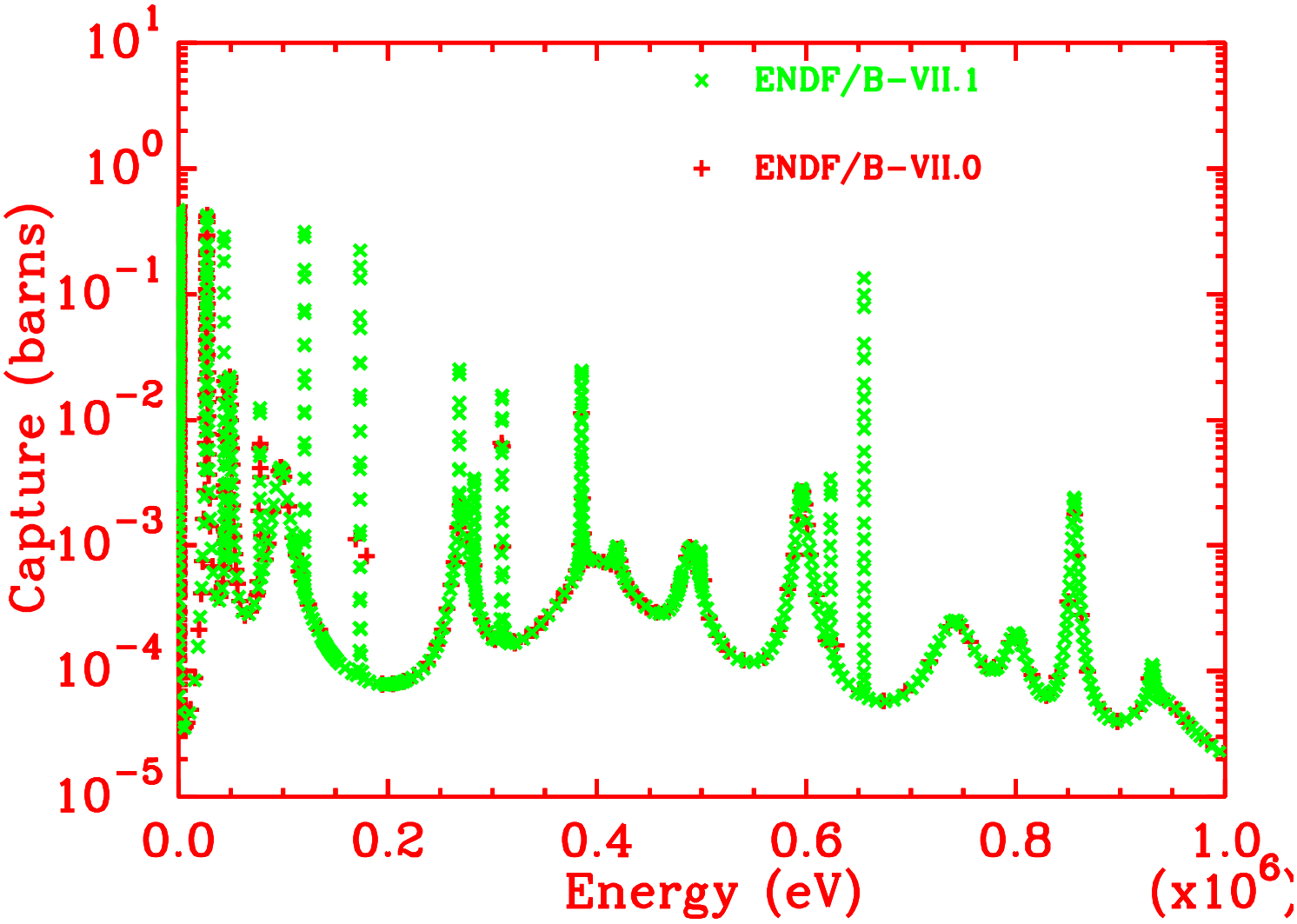
a) Conversion from SAMMY to ENDF parameter using LRF=7 did not go right!!

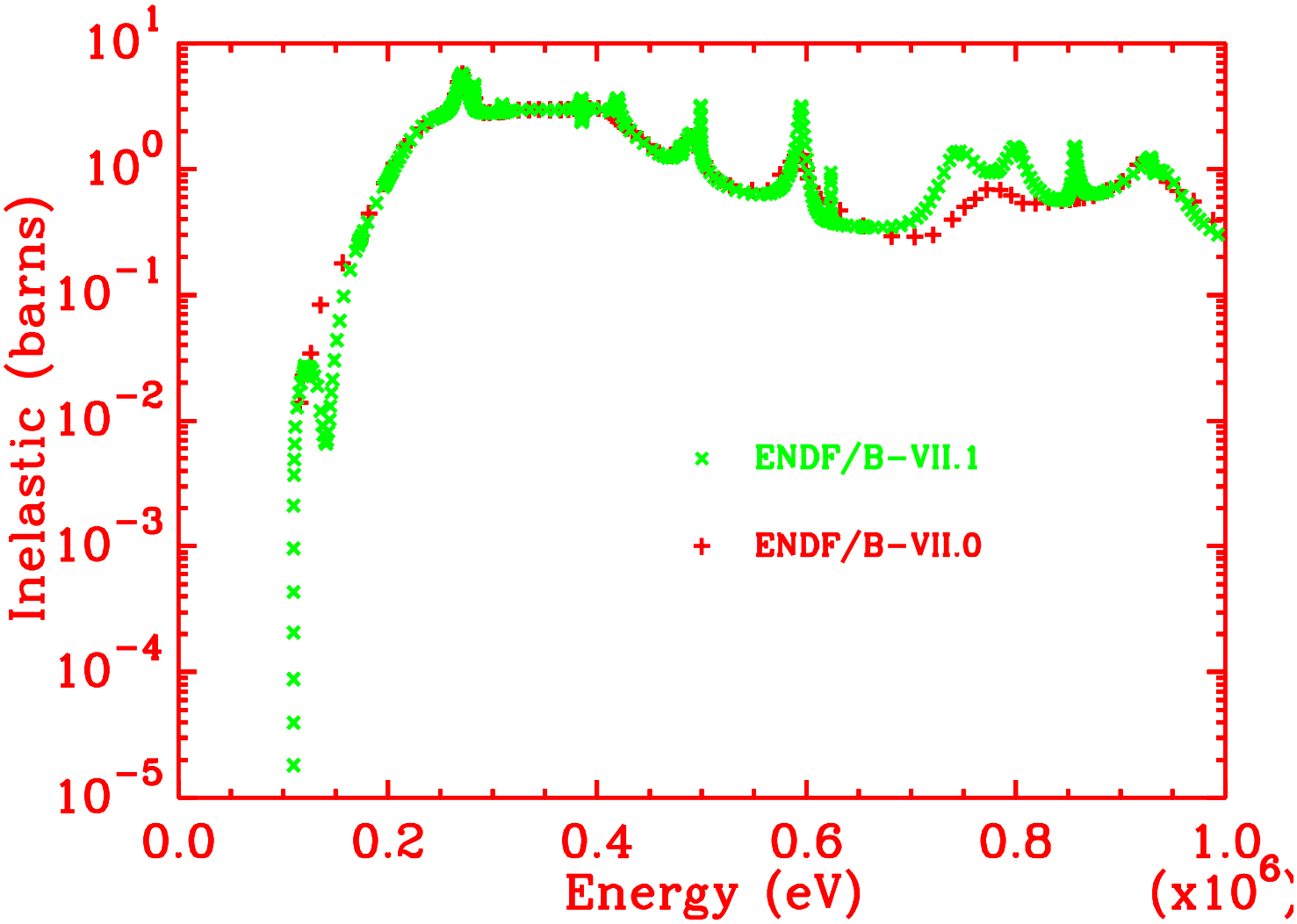
b) Conversion for more than one effective radius not done properly!!

c) Luiz Messed things up here by not checking SAMMY output results with ENDF results


ENDF/B-VII.1
ENDF/B-VII.0
Total (barns)
10^2
10^1
10^0
0.0
0.2
0.4
0.6
0.8
1.0
Energy (eV)
(x10^6)


ENDF/B-VII.1
ENDF/B-VII.0
Elastic (barns)
10^2
10^1
10^0
0.0
0.2
0.4
0.6
0.8
1.0
Energy (eV)
(x10^6)


ENDF/B-VII.1
ENDF/B-VII.0
Capture (barns)
Energy (eV)
(x10^6)
10^1
10^0
10^-1
10^-2
10^-3
10^-4
10^-5
0.0
0.2
0.4
0.6
0.8
1.0

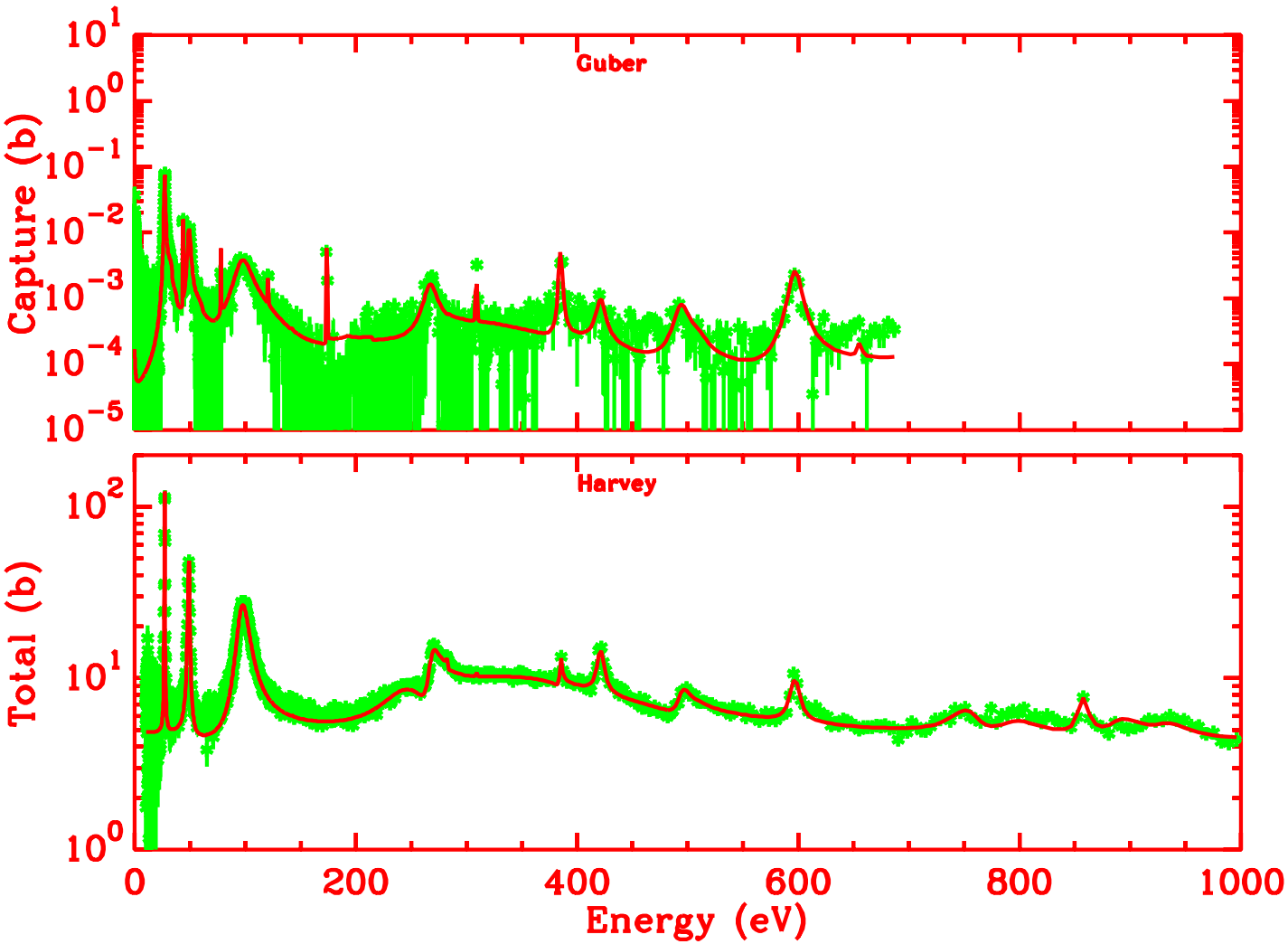

Inelastic (barns)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
0.0
0.2
0.4
0.6
0.8
1.0
Energy (eV)
(x10^{6})
ENDF/B-VII.1
ENDF/B-VII.0

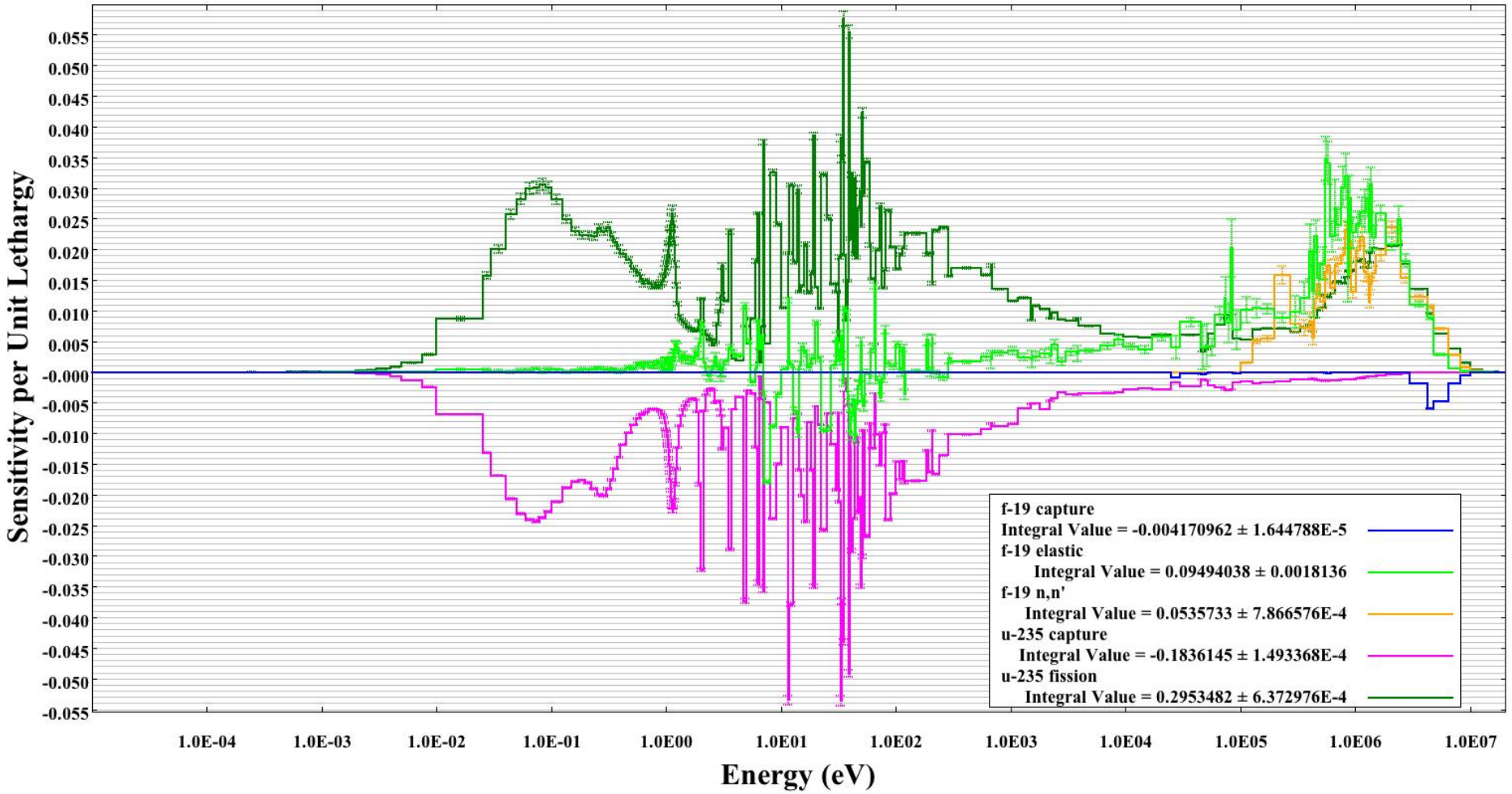
ANL results (Dick McKnight)

			Adjusted Experiment		Calculated beta4 w/ beta4 ^{19}F			Calculated beta4 w/ VII.0 ^{19}F			Δ (k_{eff}) beta4 - VII.0 ^{19}F	
IEU-COMP-MIXED-002	^{235}U Enr	H/X	k_{eff}	σ	k_{eff}	σ	C/E-1, %	k_{eff}	σ	C/E-1, %	Δk	σ
Case 1	30	14.00	0.9980	0.0030	1.04180	0.00013	4.39	1.03251	0.00013	3.46	0.00929	0.00018
Case 2	25	13.58	0.9980	0.0028	1.04270	0.00013	4.48	1.03350	0.00013	3.56	0.00920	0.00018
Case 3	18.8	13.70	0.9980	0.0025	1.04578	0.00012	4.79	1.03658	0.00012	3.87	0.00920	0.00017
Case 4	18.8	14.57	0.9974	0.0024	1.03421	0.00012	3.69	1.02492	0.00012	2.76	0.00929	0.00017
Case 5	18.8	9.22	0.9976	0.0024	1.03678	0.00011	3.93	1.02730	0.00012	2.98	0.00948	0.00016
Case 6	18.8	2.45	0.9984	0.0025	1.02290	0.00010	2.45	1.01571	0.00010	1.73	0.00719	0.00014
Case 7	12.5	13.86	0.9982	0.0020	1.03168	0.00011	3.35	1.02377	0.00011	2.56	0.00791	0.00016
Case 8	12.5	13.97	0.9978	0.0021	1.03589	0.00011	3.82	1.02814	0.00011	3.04	0.00775	0.00016
Case 9	12.5	7.11	0.9983	0.0022	1.01523	0.00010	1.70	1.00902	0.00010	1.07	0.00621	0.00014

ORNL results with resonance parameters

Benchmark			Adjusted Experiment		Calculated B-VII.0 (pointwise)			Calculated B-VII.0 + ^{19}F Res Par			Δ (k_{eff}) Res Par - VII.0 ^{19}F	
IEU-COMP-MIXED-002	^{235}U Enr	H/X	k_{eff}	σ	k_{eff}	σ	C/E-1, %	k_{eff}	σ	C/E-1, %	Δk	σ
Case 1	30	14.00	0.9980	0.0030	1.03264	0.00010	3.47	1.03322	0.00010	3.53	0.00058	0.00014
Case 2	25	13.58	0.9980	0.0028	1.03314	0.00009	3.52	1.03002	0.00009	3.21	-0.00312	0.00013
Case 3	18.8	13.70	0.9980	0.0025	1.03652	0.00009	3.86	1.03715	0.00009	3.92	0.00063	0.00013
Case 4	18.8	14.57	0.9974	0.0024	1.02496	0.00009	2.76	1.02559	0.00009	2.83	0.00063	0.00013
Case 5	18.8	9.22	0.9976	0.0024	1.02757	0.00009	3.00	1.02828	0.00009	3.07	0.00071	0.00013
Case 6	18.8	2.45	0.9984	0.0025	1.01589	0.00007	1.75	1.01652	0.00007	1.81	0.00063	0.00010
Case 7	12.5	13.86	0.9982	0.0020	1.02437	0.00008	2.62	1.02480	0.00008	2.66	0.00043	0.00011
Case 8	12.5	13.97	0.9978	0.0021	1.02863	0.00008	3.09	1.02926	0.00008	3.15	0.00063	0.00011
Case 9	12.5	7.11	0.9983	0.0022	1.00917	0.00007	1.14	1.00980	0.00007	1.15	0.00063	0.00010ß


Guber
Capture (b)
10^{1}
10^{0}
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
Harvey
Total (b)
10^{2}
10^{1}
10^{0}
0
200
400
600
800
1000
Energy (eV)


Sensitivity per Unit Lethargy
0.055
0.050
0.045
0.040
0.035
0.030
0.025
0.020
0.015
0.010
0.005
-0.000
-0.005
-0.010
-0.015
-0.020
-0.025
-0.030
-0.035
-0.040
-0.045
-0.050
-0.055
1.0E-04
1.0E-03
1.0E-02
1.0E-01
1.0E00
1.0E01
1.0E02
1.0E03
1.0E04
1.0E05
1.0E06
1.0E07
Energy (eV)
f-19 capture
Integral Value = -0.004170962 ± 1.644788E-5
f-19 elastic
Integral Value = 0.09494038 ± 0.0018136
f-19 n,n'
Integral Value = 0.0535733 ± 7.866576E-4
u-235 capture
Integral Value = -0.1836145 ± 1.493368E-4
u-235 fission
Integral Value = 0.2953482 ± 6.372976E-4

Encouraging E-mail messages:

1. Following disconcerting reports about performance of the new F-19 evaluation in integral testing by Steven van der Marck, Said and I looked into the F-19 in a bit more details. We really appreciate your advancement in the evaluation methodology that allows to extend the resonance region above the inelastic threshold - feature that should lead the way to much better representation of fluctuations in the cross sections for many A<100 nuclei. …..

2. The source of the problem is the (n,n') of the second excited state of F-19 at 197 keV. The SAMMY calculation below 1 MEV, adopted in ENDF/B.VII.1Beta4, over-predicts the inelastic cross section by a factor of about two when compared with the ENDF/BVII.0 evaluation as well as the measurements!. No wonder the performance of ENDF/B.VII.0 for F19 is better than that of ENDF/B.VII.1.