Adjustment Methodology Issues

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Summary

- Parameters that help select or eliminate experiments, and assessing adjustment.
- Cross section central values after adjustment: do we accept them?
- The problem of compensations:
  - An example: ^{239}Pu σ_{fis}
  - Missing Reactions
- Validation of Covariance Matrix:
  - Standard deviations too small
  - Correlations (among experiments, nuclear data) before and after adjustment. How can we exploit them?
- Problems with negative eigenvalues in covariance matrix.
- A pledge for unified formalism in adjustment equations.

Parameters for Assessing Adjustments

- **Adjustment Margin**
- **Experiment Merit**
- **Theoretical Adjustment Margin**
- **IS (Ishikawa factor).**
- **ISC_i (Ishikawa factor modified for taking into account correlations).**
- **Initial χ^2 and χ_i^2 experiment contribution to χ^2.**
- **Individual χ_i measured in sigmas (before and after adj.)**
- **Diagonal χ_i measured in sigmas (before and after adj.)**
- **$\Delta\,\chi_{i\,E}'^2$ contribution to $[\chi'^2 - \chi^2]$ after adjustment due to change of (E-C)/E .**
- **$\Delta\,\chi_{i\,E}'^2$ contribution to $[\chi'^2 - \chi^2]$ after adjustment due to $\Delta\sigma_i$. The sum over all cross section and experiments is Cook's distance.**

SG33 adjustment experiment starting values

#		NUCL. DATA UNC.	MEAS.+CALC. UNC.	ABS[(E-C)/C]	ADJ. MARGIN	EXP. MERIT	THEO. ADJ. MARG.
1	JEZ_PU9 KEFF	7.24413E-03	2.00808E-03	1.40020E-04	9.11220E-03	1.86806E-03	7.10411E-03
2	JEZ_PU9 F28/F25	3.74506E-02	1.42127E-02	2.35415E-02	2.81218E-02	-9.32878E-03	1.39091E-02
3	JEZ_PU9 F37/F25	2.38210E-02	1.43178E-02	1.31712E-02	2.49676E-02	1.14660E-03	1.06498E-02
4	JEZ_PU9 F49/F25	8.20421E-03	9.48683E-03	2.53255E-02	-7.63450E-03	-1.58387E-02	-1.71213E-02
5	JEZ_PU0 KEFF	7.19275E-03	2.00808E-03	1.90036E-04	9.01080E-03	1.81805E-03	7.00271E-03
6	FLATTOP KEFF	7.84415E-03	3.02152E-03	9.69060E-04	9.89661E-03	2.05246E-03	6.87509E-03
7	FLATTOP F28/F25	3.11071E-02	1.86011E-02	1.81226E-02	3.15856E-02	4.78493E-04	1.29845E-02
8	FLATTOP F37/F25	2.04288E-02	1.43178E-02	4.41945E-03	3.03271E-02	9.89838E-03	1.60093E-02
9	ZPR6/7 KEFF	9.70254E-03	2.30426E-03	4.29815E-04	1.15770E-02	1.87444E-03	9.27272E-03
10	ZPR6/7 F28/F25	6.39405E-02	3.49857E-02	4.47984E-03	9.44463E-02	3.05059E-02	5.94606E-02
11	ZPR6/7 F49/F25	8.34445E-03	2.52389E-02	3.75597E-02	-3.97635E-03	-1.23208E-02	-2.92152E-02
12	ZPR6/7 C28/F25	1.51049E-02	2.68328E-02	9.70489E-03	3.22328E-02	1.71279E-02	5.40003E-03
13	ZPR6/7 PU40 KEFF	9.72626E-03	2.21097E-03	6.30397E-04	1.13068E-02	1.58058E-03	9.09586E-03
14	ZPPR9 KEFF	1.19240E-02	1.17154E-03	7.80609E-04	1.23149E-02	3.90929E-04	1.11433E-02
15	ZPPR9 F28/F25	7.89544E-02	2.91548E-02	2.98661E-02	7.82431E-02	-7.11358E-04	4.90883E-02
16	ZPPR9 F49/F25	8.68286E-03	2.11896E-02	1.95759E-02	1.02966E-02	1.61376E-03	-1.08930E-02
17	ZPPR9 C28/F25	1.54422E-02	1.99249E-02	9.21431E-03	2.61528E-02	1.07106E-02	6.22790E-03
18	ZPPR9 STEP3	7.56730E-02	7.73692E-02	1.88383E-02	1.34204E-01	5.85309E-02	5.68347E-02
19	ZPPR9 STEP5	9.74114E-02	7.54321E-02	2.75380E-02	1.45305E-01	4.78941E-02	6.98734E-02
20	JOYO KEFF	8.83953E-03	1.80898E-03	2.54647E-03	8.10204E-03	-7.37490E-04	6.29306E-03

Individual χ_i before SG33 adjustement

$$\chi_i = \frac{\left| R_{e,i} - R_{c,i}(\mathbf{T_0}) \right|}{\sqrt{\mathbf{G}_i \mathbf{M} \mathbf{G}_i^t + V_{e,i} + V_{m,i}}}$$

$$\chi^2_{\mathrm{dia},i} \equiv \left(k_i - m_i\right)^2 C^{-1}_{dd}(i,i) \quad .$$

✓If $GMG^t \ll Ve+Vm$, $T' \fallingdotseq T_0$ and $GM'G^t \fallingdotseq GMG^t$

✓If $GMG^t \gg Ve+Vm$, $GM'G^t \fallingdotseq Ve+Vm$

✓If $GMG^t \fallingdotseq Ve+Vm$, $GM'G^t \fallingdotseq 1/2 \times GMG^t$

#	EXPERIMENT	INDIVIDUAL KHI	DIAGONAL KHI	IS FACTOR	ISC FACTOR
1	JEZ_PU9 KEFF	0.019	0.070	3.607	3.607
2	JEZ_PU9 F28/F25	0.588	1.781	2.635	2.550
3	JEZ_PU9 F37/F25	0.474	0.983	1.664	1.327
4	JEZ_PU9 F49/F25	2.019	2.817	0.865	0.542
5	JEZ_PU0 KEFF	0.025	0.095	3.582	3.582
6	FLATTOP KEFF	0.115	0.321	2.596	2.596
7	FLATTOP F28/F25	0.500	0.998	1.672	1.569
8	FLATTOP F37/F25	0.177	0.316	1.427	1.290
9	ZPR6/7 KEFF	0.043	0.196	4.211	2.211
10	ZPR6/7 F28/F25	0.061	0.137	1.828	1.947
11	ZPR6/7 F49/F25	1.413	1.639	0.331	0.162
12	ZPR6/7 C28/F25	0.315	0.396	0.563	0.647
13	ZPR6/7 PU40 KEFF	0.063	0.299	4.399	2.562
14	ZPPR9 KEFF	0.065	0.728	10.178	9.799
15	ZPPR9 F28/F25	0.355	1.081	2.708	2.846
16	ZPPR9 F49/F25	0.855	1.000	0.410	0.160
17	ZPPR9 C28/F25	0.366	0.500	0.775	0.886
18	ZPPR9 STEP3	0.174	0.280	0.978	0.671
19	ZPPR9 STEP5	0.224	0.420	1.291	1.179
20	JOYO KEFF	0.282	1.408	4.886	4.886

χ^2 and its components before and after SG33 adjustment

STARTING KHI SQUARE BY COMPONENT			FINAL KHI SQUARE BY COMPONENT		
#	EXPERIMENT	KHI SQUARE	#	EXPERIMENT	KHI SQUARE
1	JEZ_PU9 F49/F25	0.320	1	JEZ_PU9 F49/F25	0.241
2	ZPR6/7 F49/F25	0.147	2	ZPR6/7 F49/F25	0.129
3	JOYO KEFF	0.099	3	ZPPR9 F49/F25	0.034
4	JEZ_PU9 F28/F25	0.083	4	ZPPR9 F28/F25	0.031
5	ZPPR9 F28/F25	0.053	5	ZPPR9 C28/F25	0.018
6	ZPPR9 F49/F25	0.047	6	JEZ_PU9 F37/F25	-0.018
7	FLATTOP F28/F25	0.046	7	FLATTOP F28/F25	0.015
8	ZPPR9 KEFF	0.026	8	ZPR6/7 C28/F25	0.012
9	ZPPR9 C28/F25	0.025	9	JEZ_PU9 F28/F25	0.012
10	ZPR6/7 C28/F25	0.017	10	JOYO KEFF	0.010
11	ZPPR9 STEP5	0.012	11	ZPPR9 STEP5	0.009
12	ZPPR9 STEP3	0.007	12	FLATTOP F37/F25	-0.008
13	FLATTOP KEFF	0.005	13	ZPPR9 STEP3	0.007
14	ZPR6/7 KEFF	0.004	14	ZPR6/7 F28/F25	0.005
15	ZPR6/7 F28/F25	0.003	15	ZPPR9 KEFF	-0.004
16	ZPR6/7 PU40 KEFF	0.002	16	FLATTOP KEFF	0.004
17	FLATTOP F37/F25	0.002	17	ZPR6/7 KEFF	0.003
18	JEZ_PU9 F37/F25	0.001	18	ZPR6/7 PU40 KEFF	0.003
19	JEZ_PU0 KEFF	0.000	19	JEZ_PU9 KEFF	0.000
20	JEZ_PU9 KEFF	0.000	20	JEZ_PU0 KEFF	-0.000
	TOTAL	0.898		TOTAL	0.505

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Diagonal χ before and after SG33 adjustment

#	EXPERIMENT	BEFORE	AFTER	CHANGE
1	JOYO KEFF	1.408	0.315	-1.093
2	JEZ_PU9 F28/F25	1.781	1.238	-0.543
3	JEZ_PU9 F49/F25	2.817	2.445	-0.371
4	ZPPR9 KEFF	0.728	0.410	-0.319
5	ZPPR9 F28/F25	1.081	0.845	-0.237
6	FLATTOP F28/F25	0.998	0.884	-0.114
7	FLATTOP KEFF	0.321	0.209	-0.111
8	JEZ_PU9 F37/F25	0.983	0.879	-0.104
9	ZPPR9 C28/F25	0.500	0.447	-0.053
10	JEZ_PU0 KEFF	0.095	0.042	-0.053
11	ZPPR9 STEP5	0.420	0.369	-0.051
12	ZPR6/7 F49/F25	1.639	1.591	-0.047
13	FLATTOP F37/F25	0.316	0.276	-0.040
14	ZPPR9 F49/F25	1.000	0.960	-0.040
15	JEZ_PU9 KEFF	0.070	0.037	-0.033
16	ZPR6/7 C28/F25	0.396	0.372	-0.024
17	ZPR6/7 PU40 KEFF	0.299	0.275	-0.024
18	ZPR6/7 F28/F25	0.137	0.122	-0.016
19	ZPR6/7 KEFF	0.196	0.184	-0.013
20	ZPPR9 STEP3	0.280	0.271	-0.010

χ^2 variation for SG33 adj. (total -0.393)

$$\chi^2_{GSL} = \left(\vec{x}-\vec{x}_m\right)^T M_x^{-1}\left(\vec{x}-\vec{x}_m\right)+\left(\vec{y}-\vec{t}\right)^T M_y^{-1}\left(\vec{y}-\vec{t}\right)$$

KHI SQUARE VARIATION DUE TO (E-C)/C CHANGE

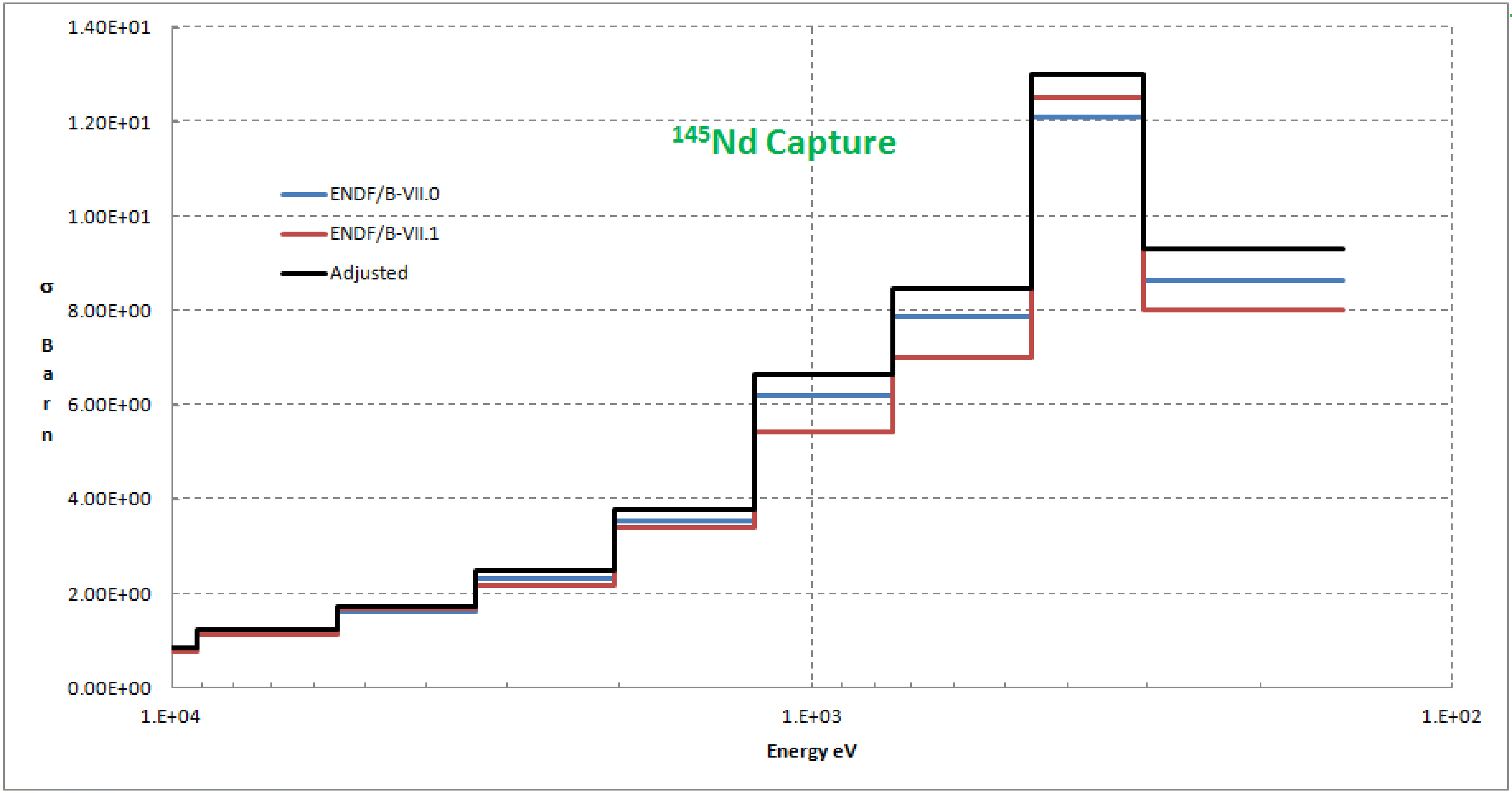
#	EXPERIMENT	CONTRIBUTION
1	JOYO KEFF	-0.081
2	JEZ_PU9 F28/F25	-0.050
3	ZPPR9 KEFF	-0.038
4	JEZ_PU9 F49/F25	-0.027
5	FLATTOP F28/F25	-0.025
6	FLATTOP F37/F25	-0.024
7	JEZ_PU9 F37/F25	-0.017
8	ZPPR9 F28/F25	-0.009
9	ZPR6/7 F28/F25	-0.005
10	ZPPR9 F49/F25	-0.004
11	ZPR6/7 F49/F25	-0.003
12	ZPPR9 C28/F25	-0.001
13	ZPR6/7 C28/F25	-0.001
14	ZPPR9 STEP5	-0.001
15	ZPR6/7 KEFF	0.001
16	ZPR6/7 PU40 KEFF	0.001
17	JEZ_PU0 KEFF	-0.000
18	ZPPR9 STEP3	-0.000
19	FLATTOP KEFF	-0.000
20	JEZ_PU9 KEFF	-0.000
	TOTAL	-0.285

KHI SQUARE VARIATION DUE TO NUCLEAR DATA CHANGE

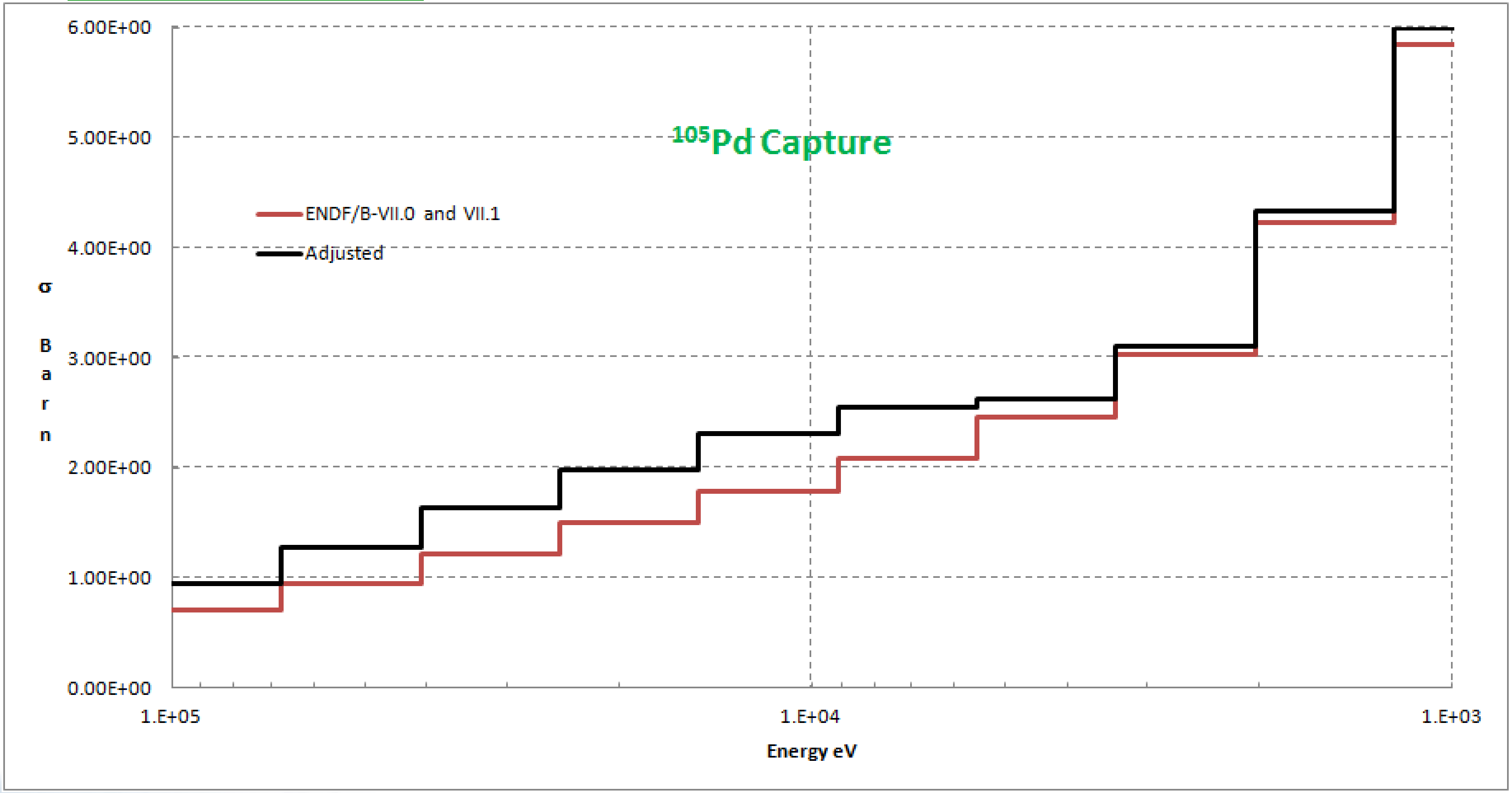
#	NUCLEAR DATA				CONTRIBUTION
1	PU239	FISSION	GROUP	5	-0.010
2	PU239	FISSION	GROUP	4	-0.007
3	PU239	FISSION	GROUP	6	-0.006
4	U235	FISSION	GROUP	5	-0.004
5	PU239	FISSION	GROUP	7	-0.004
6	U235	FISSION	GROUP	6	-0.004
7	U235	FISSION	GROUP	4	-0.003
8	PU239	CAPTURE	GROUP	16	-0.003
9	PU239	INELASTIC	GROUP	5	-0.003
10	PU239	CAPTURE	GROUP	17	-0.003
11	PU239	INELASTIC	GROUP	4	-0.003
12	U235	FISSION	GROUP	7	-0.003
13	PU239	FISSION	GROUP	3	-0.002
14	PU239	CAPTURE	GROUP	15	-0.002
15	PU239	FISSION	GROUP	8	-0.002
16	U235	FISSION	GROUP	8	-0.002
17	PU239	CAPTURE	GROUP	14	-0.002
18	PU239	INELASTIC	GROUP	3	-0.002
19	U235	FISSION	GROUP	3	-0.002
20	U235	CAPTURE	GROUP	11	-0.002
	TOTAL				-0.108

Cross section central values after adjustment: do we accept them?

- This problem appear often when there are large variations with respect to initial values
- Claim made after performing the ENDF/B-VII.0 adjustment: "Central values of (n,γ) for ^{242}Cm and ^{244}Cm, and for ^{105}Pd, ^{133}Cs, ^{151}Sm, and ^{153}Eu needed most adjustment."
- One can check consistency with other evaluated files
- Another check is against the associated standard deviation: How many sigmas we should allow?
- Problem can arise in energy ranges that were not the target of the adjustment, just because there is a large standard deviation associated to the cross section (and low sensitivity).
- Sometimes variations from nominal values go against trends observed in differential measurements
- Other criteria we should adopt?



^{145}Nd Capture
ENDF/B-VII.0
ENDF/B-VII.1
Adjusted
σ Barn
1.40E+01
1.20E+01
1.00E+01
8.00E+00
6.00E+00
4.00E+00
2.00E+00
0.00E+00
1.E+04
1.E+03
1.E+02
Energy eV


105Pd Capture
ENDF/B-VII.0 and VII.1
Adjusted
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
σ Barn
1.E+05
1.E+04
1.E+03
Energy eV

The Problem of Compensations, an Example: ^{239}Pu σ_{fis}

- **In COMMARA 2.0: average uncertainty ~0.5%**
  - Common believe among users is that it is too low
  - Result: other cross sections are adjusted for compensating the lack of room in the ^{239}Pu σ_{fis} uncertainty
- **In COMAC: average uncertainty ~3%**
  - Common believe among users is that it is too high
  - Result: the ^{239}Pu σ_{fis} uncertainty absorbs adjustments that should be made on other cross sections
- **We need a goldilocks approach**
  - How can we have a solid argument to support the user feeling with the evaluators?
  - Is there a formal methodology that can be applied?

The Problem of Compensations: The Missing Reactions

- In COMMARA 2.0 there are several holes in terms of missing reactions for certain isotopes:
  - Fission spectra covariance matrices are present only for few isotopes: $^{238, 239, 240}Pu$,
  - Anisotropic scattering (P_1 component) of σ_{elas} covariance matrices present only for two isotopes: ^{23}Na, ^{56}Fe
  - The secondary energy distribution for σ_{elas} and σ_{inelas} (multigroup transfer matrix) covariance is not present
- Result: the adjustment is compensating for the missing reactions
- We need to stimulate evaluators for providing the missing data in order to improve the adjustment results

The Problem of Validating Covariance Matrix

ENDF/B-VII.0 Adjustment: Major Contributors to χ^2. (χ^2=1.6315)

#	Experiment	(E-C)/C (%)	Contrib. to χ^2
1	PROFIL1 PU239 IN PU238 SAMPLE	-27.38	0.480
2	COSMO F51/F25	-8.19	0.107
3	PROFIL1 PD106 IN PD105 SAMPLE	17.92	0.093
4	GODIVA F28/F25	4.71	0.072
5	COSMO F48/F25	-6.76	0.063
6	ZPPR-10 CENTER ROD	-6.28	0.061
7	BIGTEN F49/F25	2.67	0.057
8	TRAPU2 CM243 BUILD UP	107.04	0.057
9	JEZ_PU239 PU239/U235	2.53	0.054
10	PROFIL1 PU240 IN PU239 SAMPLE	10.38	0.051
11	PROFIL1 AM243 IN PU242 SAMPLE	-5.66	0.048
12	BIGTEN F28/F25	5.60	0.046
13	PROFIL1 RU102 IN RU101 SAMPLE	-9.42	0.041
14	PROFIL1 PU238 IN PU239 SAMPLE	32.80	0.038
15	ZPR6/7 F9/F5	3.76	0.032
16	TRAPU2 PU238 BUILD UP	1.01	-0.031
17	PROFIL1 CS134 IN CS133 SAMPLE	13.77	0.029
18	PROFIL1 PU239 IN U238 SAMPLE	2.88	0.028
19	PROFIL1 PU238 IN AM241 SAMPLE	5.37	0.023
20	ZPPR-10 STEP2	-13.72	0.020

The Problem of Validating Covariance Matrix

***** WARNING: SOME UNPHYSICAL CHANGE IN NUCLEAR DATA AFTER ADJUSTMENT HAVE BEEN DETECTED *****

NUCL. DATA WITH UNPHYSICAL CHANGE

#	NUCLEAR DATA				RELAT. CHANGE %
1	PU238	CAPTURE	GROUP	3	-155.492
2	PU238	CAPTURE	GROUP	10	-108.038
3	PU238	CAPTURE	GROUP	16	-126.273
4	PU238	CAPTURE	GROUP	17	-111.524

The Problem of Validating Covariance Matrix

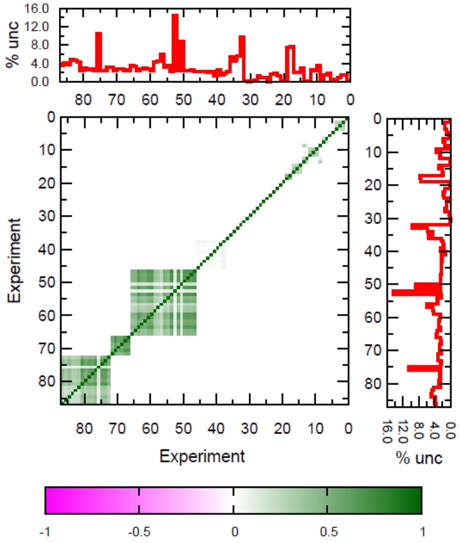
- Claim made after performing the ENDF/B-VII.0 adjustment:

  Overall the adjustment is quite satisfactory, but some standard deviations are underestimated:

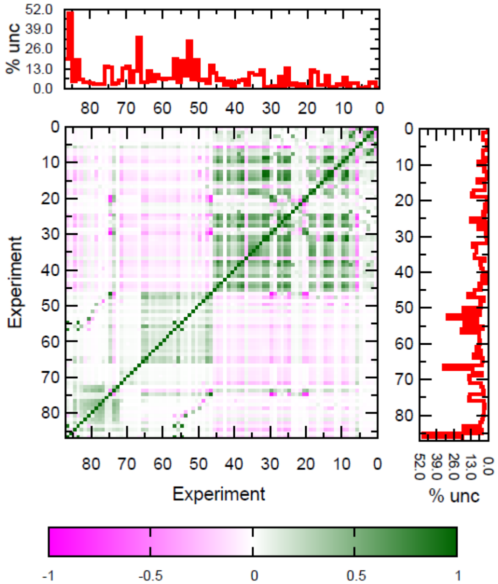
  - ^{238}Pu, ^{241}Am, and ^{242}Cm,
  - ^{238}U (fission, capture, and inelastic),
  - ^{239}Pu (fission, capture, and (n,2n)),
  - ^{56}Fe and ^{23}Na (elastic, inelastic, capture)
- Besides some clear case as for ^{238}Pu (discussed previously) this claim was based on observations (combination of sensitivity coefficients and starting uncertainties), common believes, and user feelings
- We need a formal methodology in order to make credible statements about validity of covariance matrix values

Correlations: ENDF/B-VII.0 Adjustment (87 Experiments)

EXP. CORR. BASED ON INITIAL DATA (MEAS. + CALC.)



EXP. CORR. BASED ON G MATRIX COVAR.



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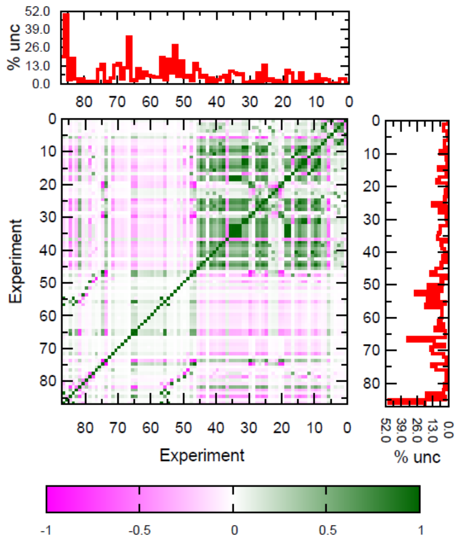
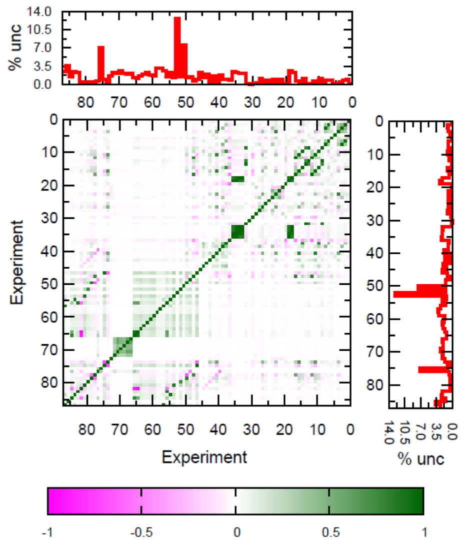
Correlations: ENDF/B-VII.0 Adjustment (87 Experiments)

EXP. CORR. BASED ON INITIAL NUCL. DATA COVAR.



EXP. CORR. BASED ON ADJUST. NUCL. DATA COVAR.



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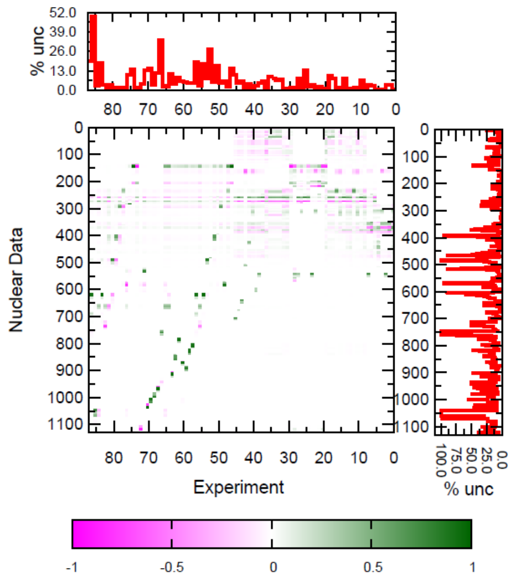
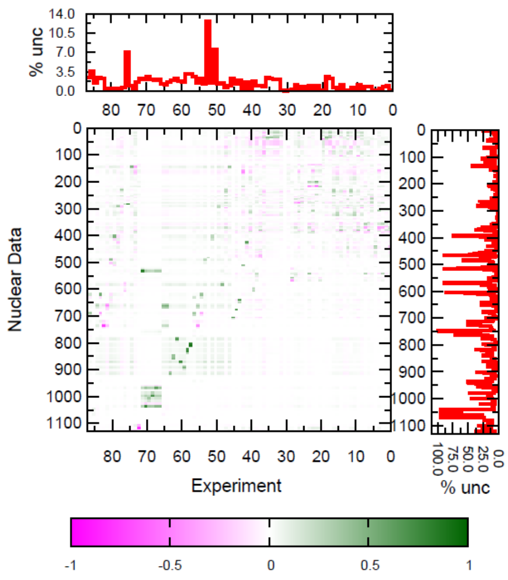
Correlations: ENDF/B-VII.0 Adjustment (87 Experiments)

EXPERIMENTS AND NUCL. DATA CORREL. BEFORE

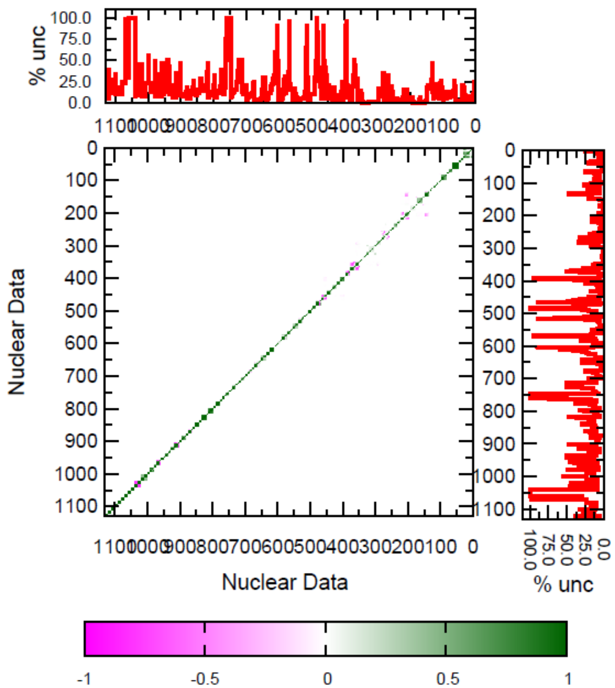


EXPERIMENTS AND NUCL. DATA CORREL. AFTER

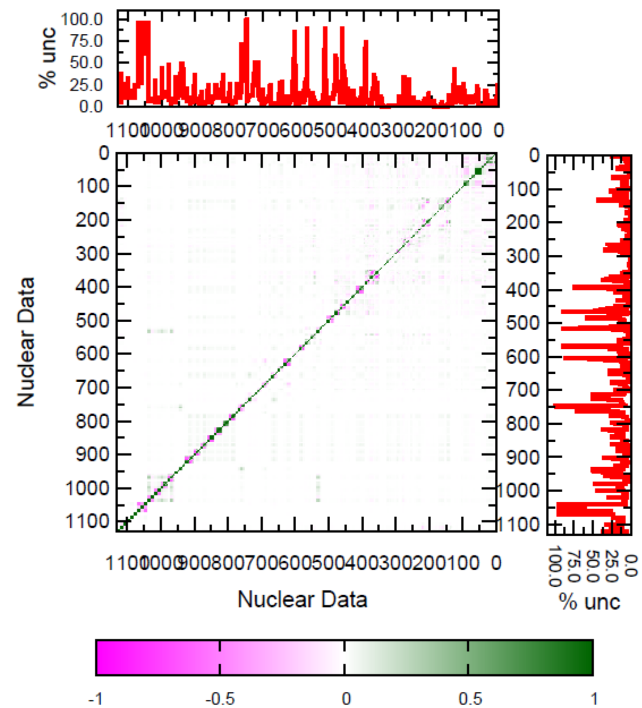


Correlations: ENDF/B-VII.0 Adjustment (87 Experiments)

Nuclear Data Correlation Before Adjustment



Nuclear Data Correlation After Adjustment



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ABR Ox. K_{eff} Uncertainty (pcm)

COMMARA 2.0

Isotope	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}	χ	P_1^{el}	Total
U238	278	29	112	105	547	0	0	633
PU239	308	223	71	30	79	161	0	428
FE56	170	0	0	172	147	0	44	287
PU240	61	45	82	5	17	24	0	116
NA23	4	0	0	20	80	0	69	107
CR52	21	0	0	38	18	0	0	47
O16	5	0	0	45	2	0	0	46
PU241	10	7	3	0	2	0	0	13
Total	453	229	156	213	578	163	82	834

ADJUSTED No New Correl.

Isotope	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}	χ	P_1^{el}	Total
U238	128	29	91	23	62	0	0	173
PU239	71	149	70	16	37	93	0	206
FE56	141	0	0	138	97	0	44	224
PU240	19	32	62	4	16	23	0	78
NA23	4	0	0	19	59	0	59	86
CR52	21	0	0	38	18	0	0	46
O16	5	0	0	40	2	0	0	41
PU241	2	7	4	0	2	0	0	8
Total	205	156	130	153	136	96	74	374

ADJUSTED Full Correl.

Isotope	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}	χ	P_1^{el}	Total
U238	-56	-12	-17	-20	-43	0	0	-76
PU239	37	43	17	4	7	-30	0	52
FE56	92	0	0	100	41	0	33	146
PU240	11	14	23	3	11	11	0	33
NA23	5	0	0	-9	-12	0	-34	-37
CR52	7	0	0	15	-11	0	0	12
O16	5	0	0	49	2	0	0	49
PU241	-1	6	4	0	2	0	0	7
Total	84	44	22	111	-15	-28	-10	143

ABR Ox. Recycled K_{eff} Uncertainty (pcm)

COMMARA 2.0

Isotope	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}	χ	P_1^{el}	Total
U238	219	28	104	105	707	0	0	756
PU240	180	162	292	19	77	121	0	406
FE56	155	0	0	153	211	0	46	307
CM245	5	282	37	0	1	0	0	285
PU239	200	168	52	22	79	151	0	317
CM244	107	76	60	1	3	0	0	145
PU242	119	50	42	3	9	0	0	136
NA23	5	0	0	30	121	0	66	142
PU238	62	74	64	3	13	3	0	117
PU241	63	44	25	1	18	0	0	83
Total	422	388	332	191	756	194	81	1045

ADJUSTED No New Correl.

Isotope	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}	χ	P_1^{el}	Total
U238	102	27	85	20	75	0	0	156
PU240	53	115	220	18	74	114	0	288
FE56	120	0	0	121	150	0	45	232
CM245	5	276	37	0	1	0	0	278
PU239	43	113	51	12	36	89	0	163
CM244	24	76	60	1	3	0	0	100
PU242	16	26	42	3	9	0	0	52
NA23	6	0	0	25	90	0	57	110
PU238	16	53	64	3	13	3	0	86
PU241	12	44	25	1	18	0	0	55
Total	175	338	264	127	209	145	73	548

ADJUSTED Full Correl.

Isotope	σ_{cap}	σ_{fiss}	ν	σ_{el}	σ_{inel}	χ	P_1^{el}	Total
U238	-47	-12	20	-18	-45	0	0	-66
PU240	45	74	182	20	83	80	0	233
FE56	75	0	0	84	105	0	34	158
CM245	6	264	37	0	1	0	0	267
PU239	27	-67	-24	-5	-13	-70	0	-97
CM244	-74	74	60	1	3	0	0	61
PU242	15	21	42	3	9	0	0	50
NA23	5	0	0	16	40	0	-47	-18
PU238	18	54	64	3	13	3	0	86
PU241	13	42	25	1	22	0	0	56
Total	37	285	210	86	134	39	-33	391

Problems with negative eigenvalues in covariance matrix

- If covariance matrix has zero and/or negative eigenvalues (mostly due to truncations) there are problems:
  - Difficulty in inverting matrices (both original and adjustment one)
  - Many multiplications leads to unphysical values (imaginary values of cross section standard deviations)
- Problem found in big adjustment where 75 zero or negative eigenvalues found (1126 cross sections):
  - Impossible to invert the initial covariance matrix
  - Imaginary values for standard deviations of 7 cross sections (elastic and inelastic ^{235}U)
- Possible remedies:
  - Multiply by a factor all correlations. We had to use 0.8 factor that affects significantly results.
  - Recalculate matrix by replacing with positive eigenvalues:

    $B=VT'V^{-1}$. Slight impact on results.
  - Under study: identification of responsible of negative values through kernel of eigenvalues, then apply factor only to identified cross sections.

A pledge for unified formalism in adjustment equations

- Cross Sections: x, T, σ ->
- The Measured and Calculated Values of Experiments: E and C, R_e and R_c, y and t ->
- The Sensitivity Array: S, G ->
- The Experiment Covariance Matrix (from measurement and calculation): V (V_e, V_m), P (P_e, P_c), M_y, D_y ->
- The Nuclear Data Covariance Matrix: B, C, D, M ->
- Chi square: R, χ^2, J ->