Mini CSEWG Meeting, June 22-23, 2010

Port Jefferson, NY

Processing Covariances in ENDF/A and JENDL-4

Ramon Arcilla Jr.
National Nuclear Data Center
Brookhaven National Laboratory

arcilla@bnl.gov

Methodology

Selection of Materials

- **ENDF/A (25 materials: 14 complete, 11 partial)**
  - Cl-35, Cl-37, Cr-52, Cr-53, F-19, K-39, K-41, Mn-55, Ni-58, Ni-60, Pu-239, Pu-240, Pu-241, Ti-46, Ti-47, Ti-49, Ti-50, U-233, U-235, U-238, W-180, W-182, W-183, W-184, W-186
- **JENDL-4 (95 materials: 93 complete, 2 partial)**
  - 79 Actinides, 5 Light Nuclides,11 Structural Materials,

Processing Codes

- **NJOY-99.336**
- **PUFF-IV 10_02_2009**

Test Criteria

- **Processability with NJOY-99.336 and/or PUFF-IV 10_02_2009**
- **If processable by both, differences between NJOY & PUFF results**

Summary of Results

Internal Websites Constructed

http://ndclx1.nndc.bnl.gov/gnep/ENDFA/endfa.jsp

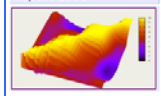
National Nuclear Data Center

BROOKHAVEN NATIONAL LABORATORY

NNDC Databases: ENDF | CSISRS | Sigma | NuDat | NSR | XUNDL | ENSDF | MIRD

Search the NNDC: Go

- NNDC Site Index
- AFCI Covariance Library
- ENDF/A covariances
- Sigma
- ENDF/B-VII.0 covariances
- ENDF/A neutron files
- 33-energy group structure
- Empire methodology
- Report 2008



ENDF/A Covariances

The library contains 9 materials with complete covariances. The latest versions of NJOY and PUFF, NJOY-99.305 and PUFF-IV 10_02_2009, were used to process their covariances using 1/E flux and AFCI's 33-energy group structure. Click on any of the columns marked 'Yes' under 'Processability' to view the plots of uncertainties and correlation matrices for a specific material.

Material	Covariance data	Processability		NJOY/PUFF Agree?	Comments on Processing
		NJOY	PUFF		
W-180	MF33, MF34	Yes	Yes	Yes	
W-182	MF32, MF33, MF34	Yes	Yes	Yes	
W-183	MF32, MF33, MF34	Yes	Yes	Yes	
W-184	MF32, MF33, MF34	Yes	Yes	No	Discrepancies: total, elastic, capture
W-186	MF32, MF33, MF34	Yes	Yes	Yes	
U-233	MF31, MF33 (MF32 converted to MF33)	Yes	Yes	Yes	
U-235	MF31, MF33 (MF32 converted to MF33)	Yes	Yes	Yes	
U-238	MF31, MF33 (MF32 converted to MF33)	Yes	Yes	Yes	
Pu-239	MF31, MF33 (MF32 converted to MF33), MF35	Yes	Yes	Yes	

The library also contains 7 materials with partial covariances. These covariances were also processed by NJOY-99.305 and PUFF-IV 10_02_2009 using 1/E flux and AFCI's 33-energy group structure. Click on any of the columns marked 'Yes' under 'Processability' to view the plots of uncertainties and correlation matrices for a specific material.

Material	Covariance data	Processability		NJOY/PUFF Agree?	Comments on Processing
		NJOY	PUFF		

BROOKHAVEN NATIONAL LABORATORY

ISRS | Sigma | NuDat | NSR | XUNDL | ENSDF | MIRD

JENDL-4 Covariances

ins 93 materials with complete covariances: 79 actinides and 14 structural materials. The latest versions of NJOY -99.336 and PUFF-IV 10_02_2009, were used to process their covariances using 1/E flux and AFCI's 33-energy Click on any of the columns marked 'Yes' under 'Processability' to view the plots of uncertainties and correlation ecific material.

	Covariance data	Processability		NJOY/PUFF Agree?	Comments on Processing
		NJOY	PUFF		
	MF31, MF33, MF34, MF35	Yes	Yes	No	Discrepancy: delayed nubar
	MF31, MF33, MF34, MF35	Yes	Yes	Yes	
	MF31, MF33, MF34, MF35	Yes	Yes	Yes	
	MF31, MF33, MF34, MF35	Yes	Yes	Yes	
	MF31, MF32, MF33, .F34, MF35	Yes	Yes	No	Discrepancy: fission
	MF31, MF33, MF34, MF35	Yes	Yes	Yes	
	MF31, MF32, MF33, MF34, MF35	Yes	Yes	No	Discrepancy: capture
	MF31, MF32, MF33, MF34, MF35	Yes	Yes	No	Discrepancy: fission
	MF31, MF33, MF34, MF35	Yes	Yes	Yes	
	MF31, MF33, MF34, MF35	Yes	Yes	Yes	
	MF33	Yes	Yes	Yes	
B-11	MF33	Yes	Yes	Yes	
Bi-209	MF33	Yes	Yes	Yes	
Bk-245	MF31, MF33, MF34, MF35	Yes	Yes	Yes	
Bk-246	MF31, MF33, MF34, MF35	Yes	Yes	Yes	

http://ndclx1.nndc.bnl.gov/gnep/JENDL4/jendl4.jsp

Summary of Results

Discrepancies in ENDF/A

Complete Covariances					
Material	**Covariance Data**	**Processability**		**NJOY/PUFF Agree?**	**Comments on Processing**
		NJOY	**PUFF**		
Ti-46	MF32, MF33	Yes	Yes	No	Discrepancies: total, elastic
Ti-47	MF32, MF33	Yes	Yes	No	Discrepancies: total, elastic
Ti-49	MF32, MF33	Yes	Yes	No	Discrepancies: total, elastic
Ti-50	MF32, MF33	No	Yes	N/A	Missing MT17 in MF33
W-184	MF32, MF33,MF34	Yes	Yes	No	Discrepancies: total, elastic, capture

Summary of Results

Discrepancies in ENDF/A

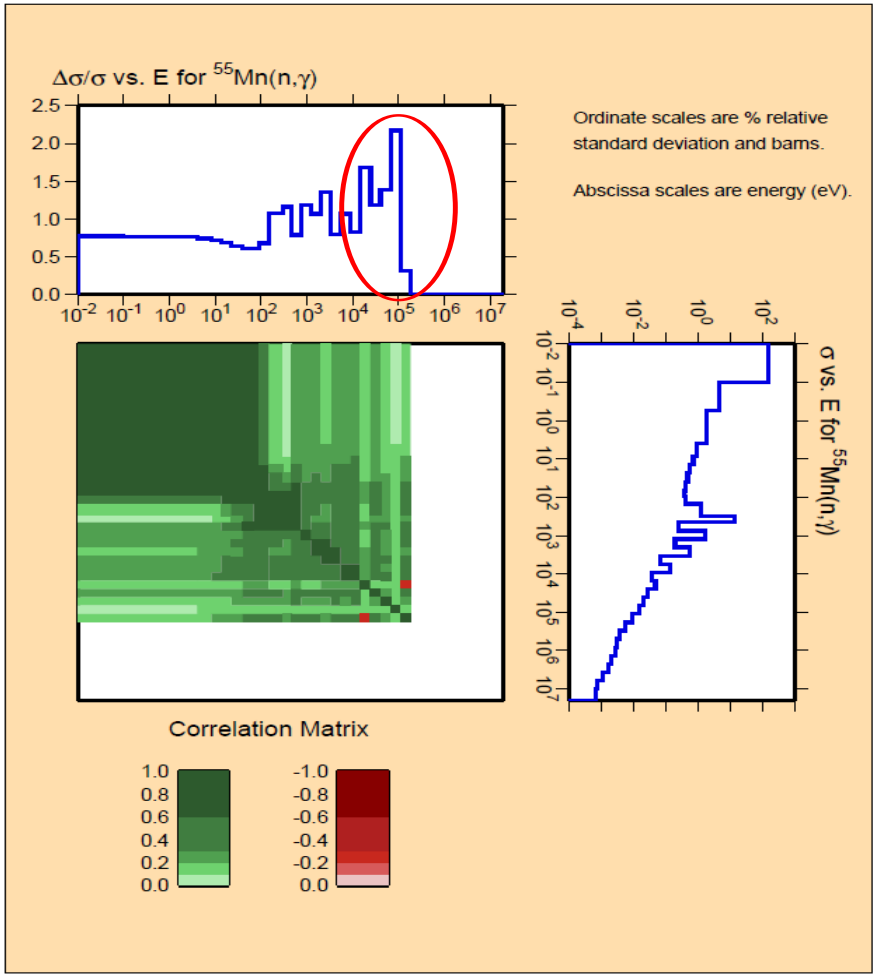
Partial Covariances					
Material	**Covariance Data**	**Processability**		**NJOY/PUFF Agree?**	**Comments on Processing**
		NJOY	**PUFF**		
Cl-35	MF32	No	Yes*	N/A	
F-19	MF32, MF33	No	No**	N/A	
Cr-53	MF32	Yes	Yes	No	Discrepancy: capture
Ni-58	MF32, MF33	Yes	Yes	No	Discrepancy: capture

* Processed using ORNL-supplied PENDF.

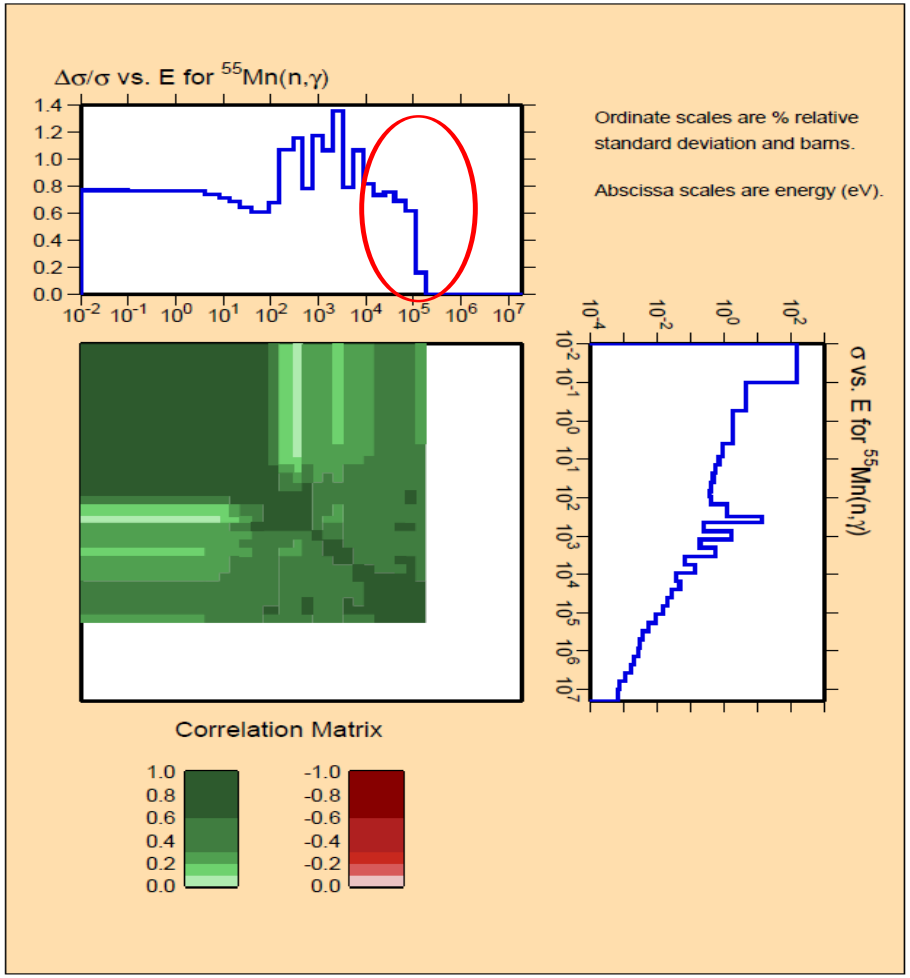
** Processable using an AMPX-generated PENDF as reported by ORNL.

Mn-55 (MF32 only) Discrepancies: capture 1/E Flux, 33-group (AFCI)

NJOY-99.305

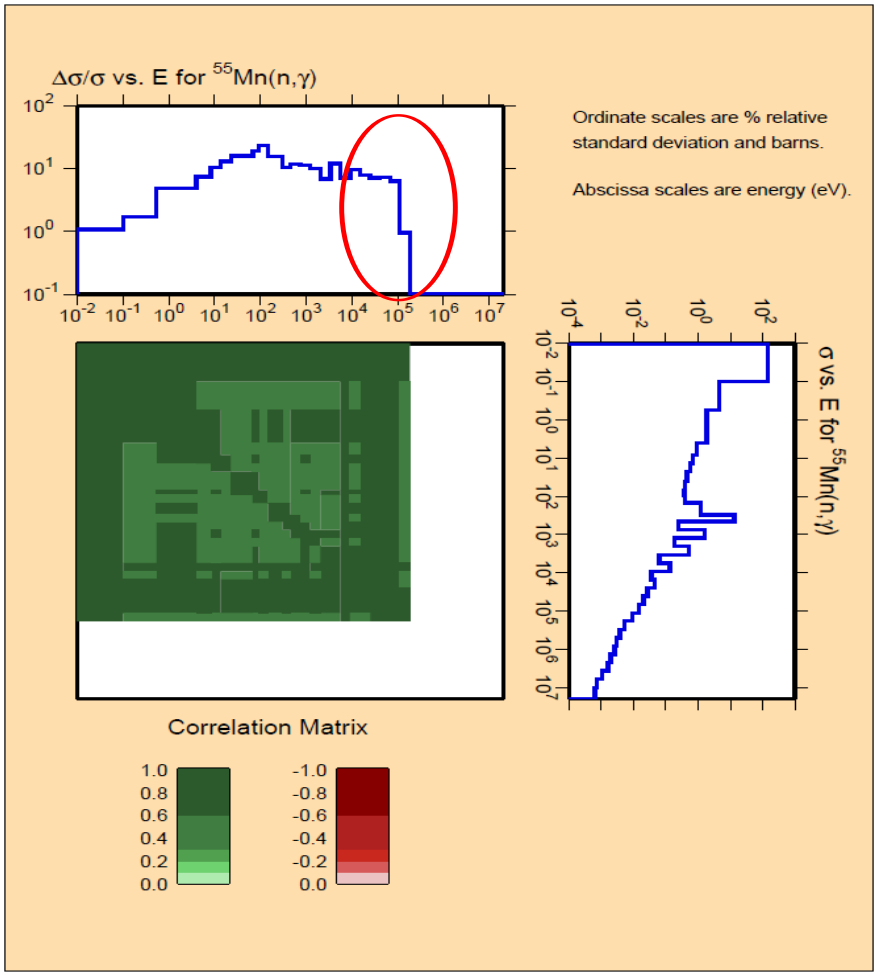


PUFF-IV 10_02_2009

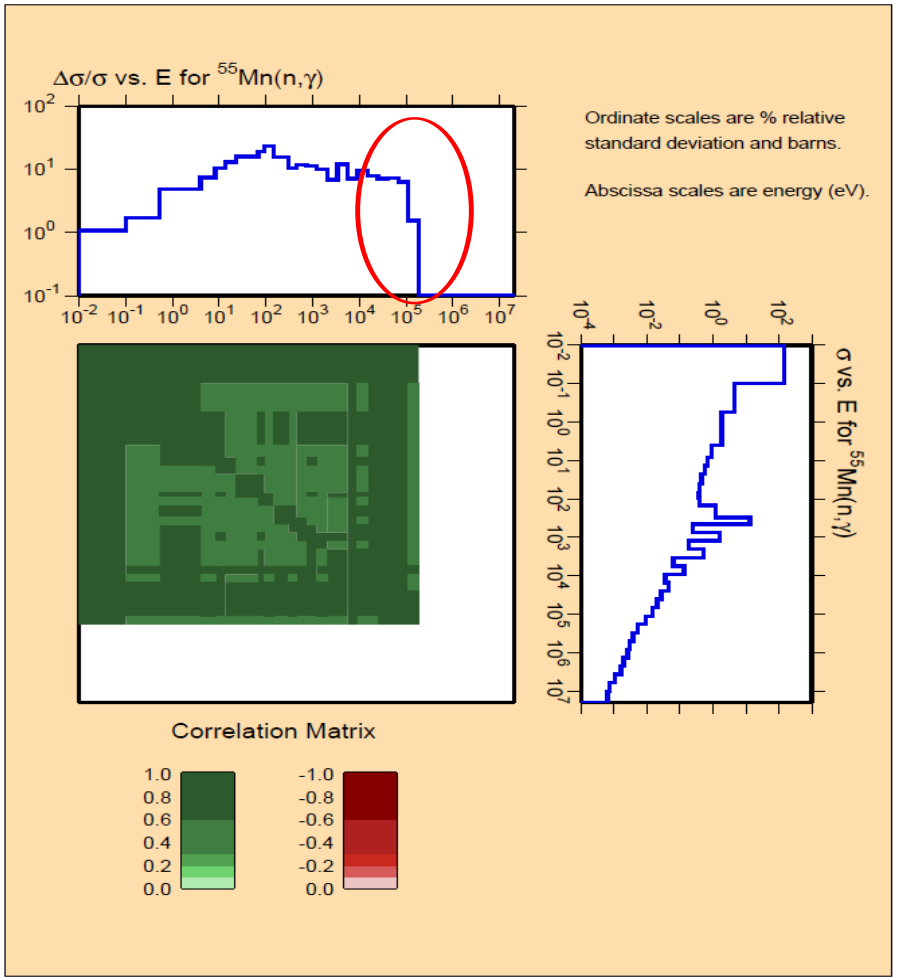


New Mn-55 (MF32/MF33) Evaluation: capture 1/E Flux, 33-group (AFCI)

NJOY-99.336



PUFF-IV 10_02_2009



F-19 Discrepancies: total
1/E Flux, 33-group (AFCI)

NJOY-99.336

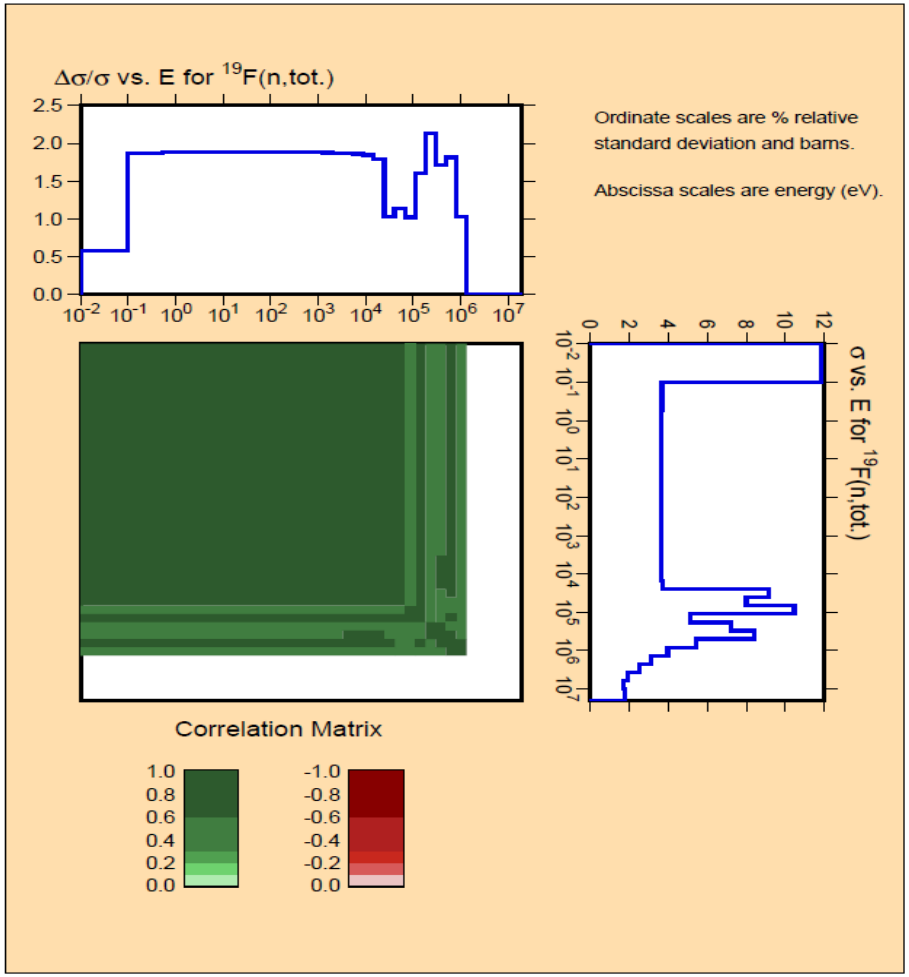
reconr...

error in rdfil2illegal resonance mode

error in rdfil2illegal resonance mode

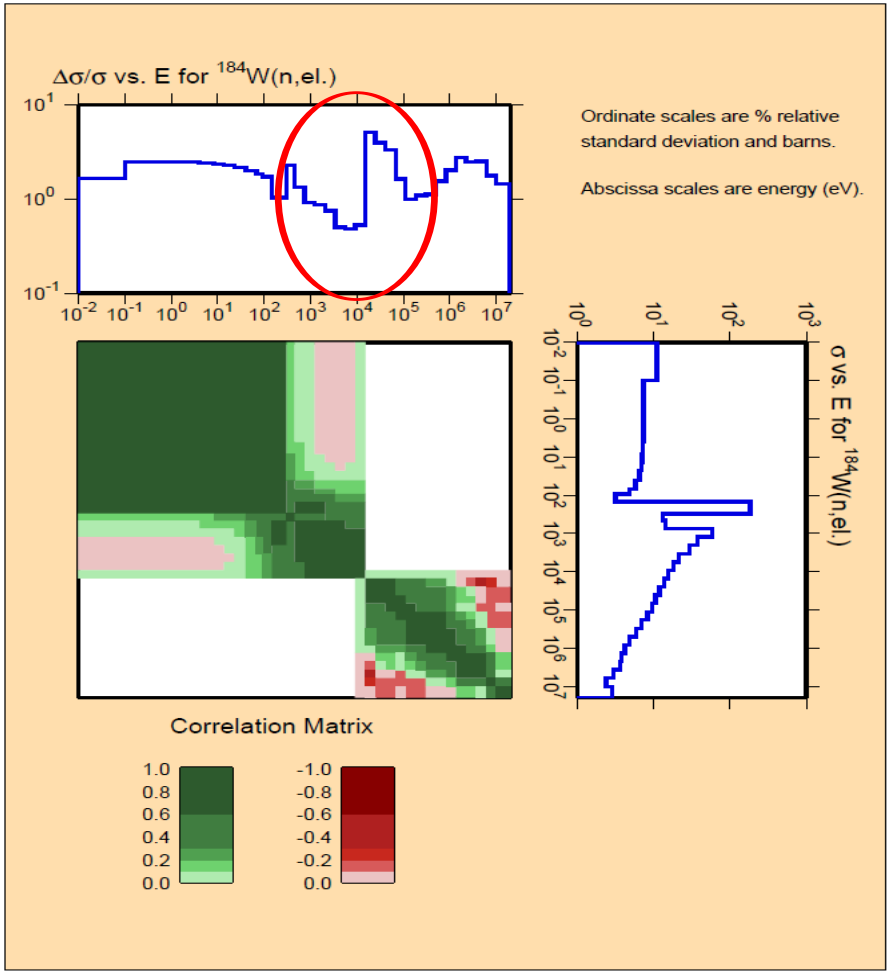
NOTE: Cl-35 processing also generated same error.

PUFF-IV 10_02_2009

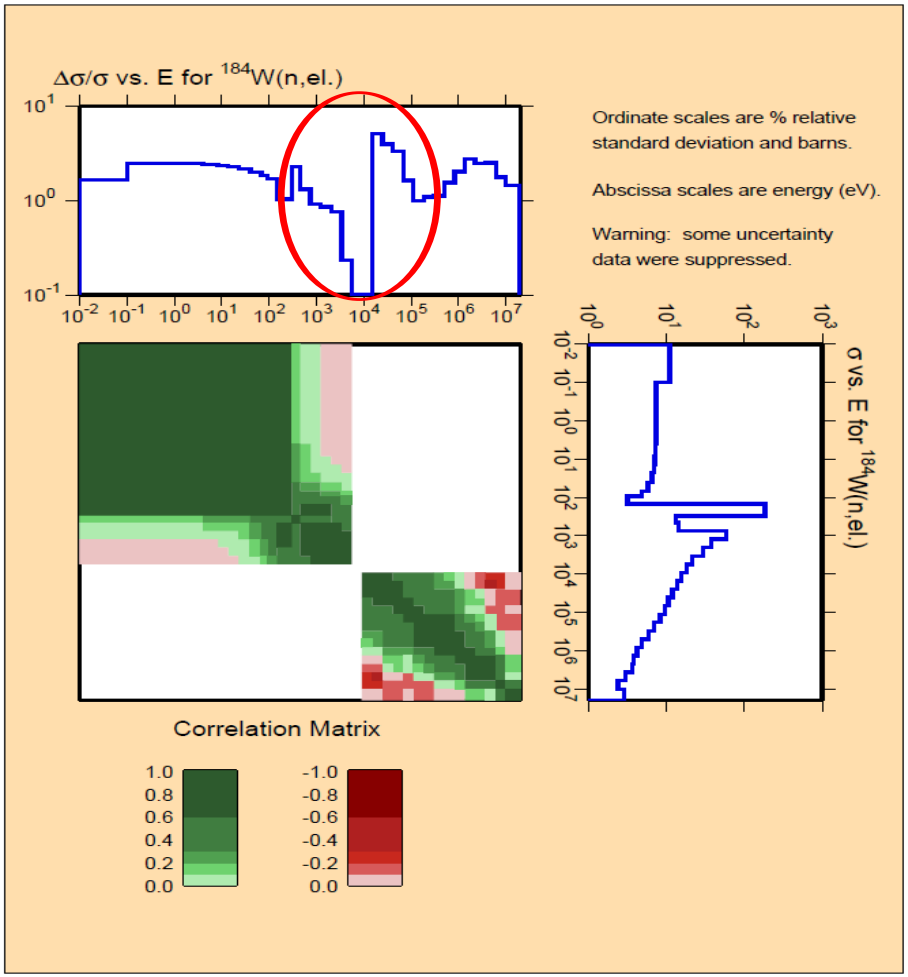


W-184 Discrepancy: elastic
1/E Flux, 33-group (AFCI)

NJOY-99.336

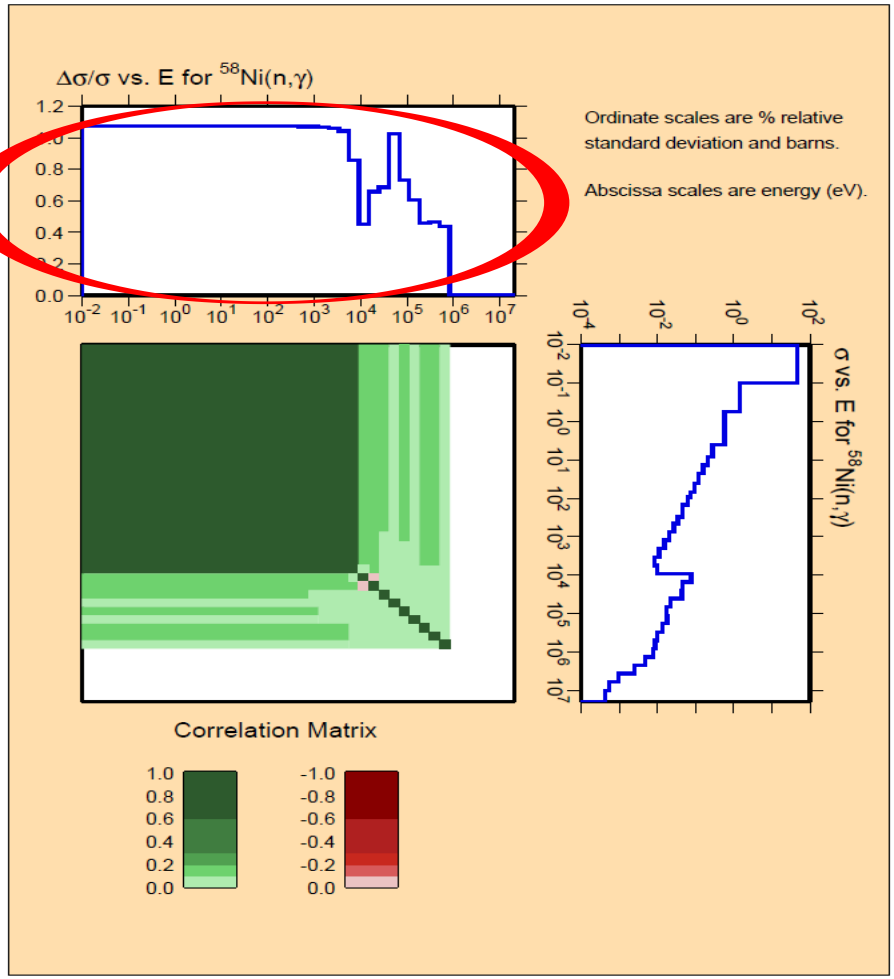


PUFF-IV 10_02_2009

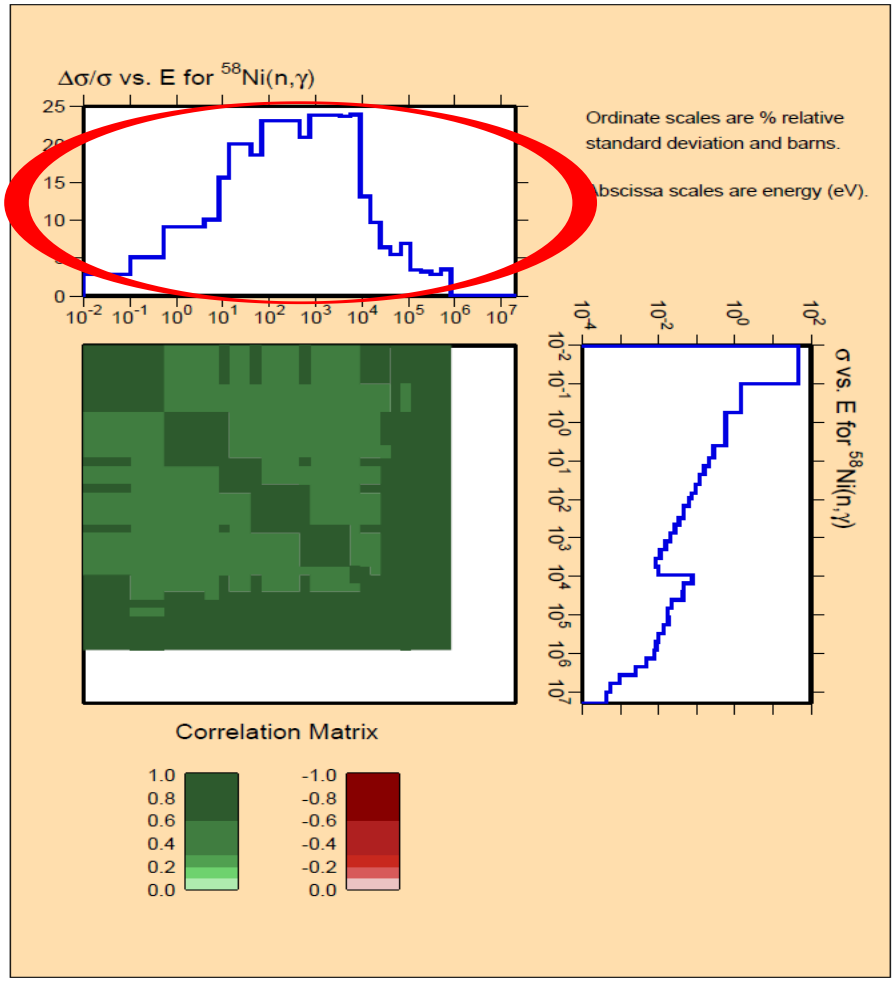


Ni-58 Discrepancy: capture
1/E Flux, 33-group (AFCI)

NJOY-99.336



PUFF-IV 10_02_2009



Summary of Results

Discrepancies in JENDL-4

Complete Covariances					
Material	**Covariance Data**	**Processability**		**NJOY/PUFF Agree?**	**Comments on Processing**
		NJOY	**PUFF**		
Ac-225	MF31,33,34, 35	Yes	Yes	No	Discrepancy: delayed nubar
Am-241	MF31,32,33, 34, 35	Yes	Yes	No	Discrepancy: fission
Am-242m	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: capture
Am-243	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: fission
Bk-249	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: fission
Cf-249	MF31,32,33, 34,35	Yes	Yes	No	Discrepancies: total, fission
Cf-250	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: fission

Summary of Results

Discrepancies in JENDL-4, continued

Complete Covariances					
Material	**Covariance Data**	**Processability**		**NJOY/PUFF Agree?**	**Comments on Processing**
		NJOY	**PUFF**		
Cf-252	MF31,32,33, 34, 35	Yes	Yes	No	Discrepancies: total, fission
Cm-242	MF31,32,33, 34, 35	Yes	Yes	No	Discrepancies: elastic, fission
Cm-243	MF31,32,33, 34,35	Yes	Yes	No	Discrepancies: total,fission
Cm-245	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: fission
Cm-247	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: fission
Cm-248	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: fission
Np-236	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: total, fission

Summary of Results

Discrepancies in JENDL-4, continued

Complete Covariances					
Material	**Covariance Data**	**Processability**		**NJOY/PUFF Agree?**	**Comments on Processing**
		NJOY	**PUFF**		
Np-237	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: total, fission, capture
Np-238	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: total
Pa-232	MF31,32,33, 34,35	Yes	Yes	No	Discrepancies: capture
Pa-236	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: fission
Pu-238	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: total, elastic, fission, capture
Pu-240	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: total, elastic, fission, capture
Pu-242	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: total, elastic, fission, capture

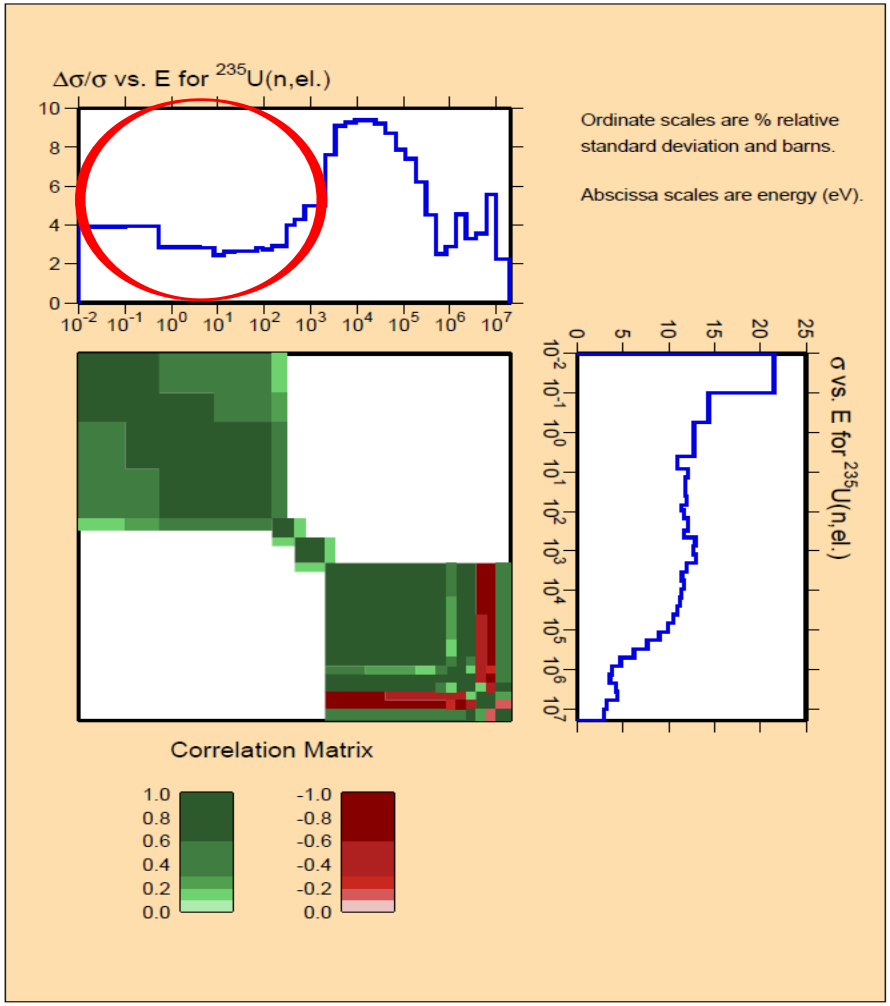
Summary of Results

Discrepancies in JENDL-4, continued

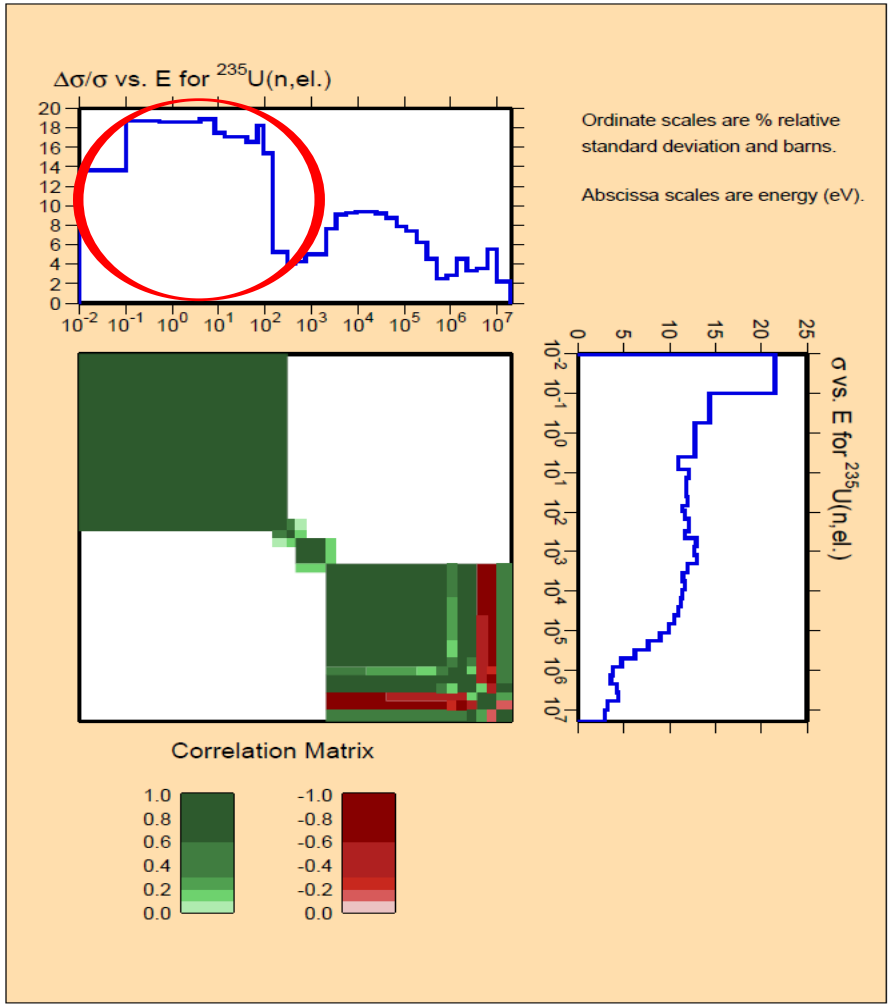
Complete Covariances					
Material	**Covariance Data**	**Processability**		**NJOY/PUFF Agree?**	**Comments on Processing**
		NJOY	**PUFF**		
Pu-244	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: fission
U-232	MF31,32,33, 34,35	Yes	Yes	No	Discrepancies: total, fission
U-233	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: total, elastic, fission, capture
U-235	MF31,32,33, 34,35	Yes	Yes	No	Discrepancy: total, elastic, fission, capture

U-235 Discrepancy: elastic
1/E Flux, 33-group (AFCI)

NJOY-99.336

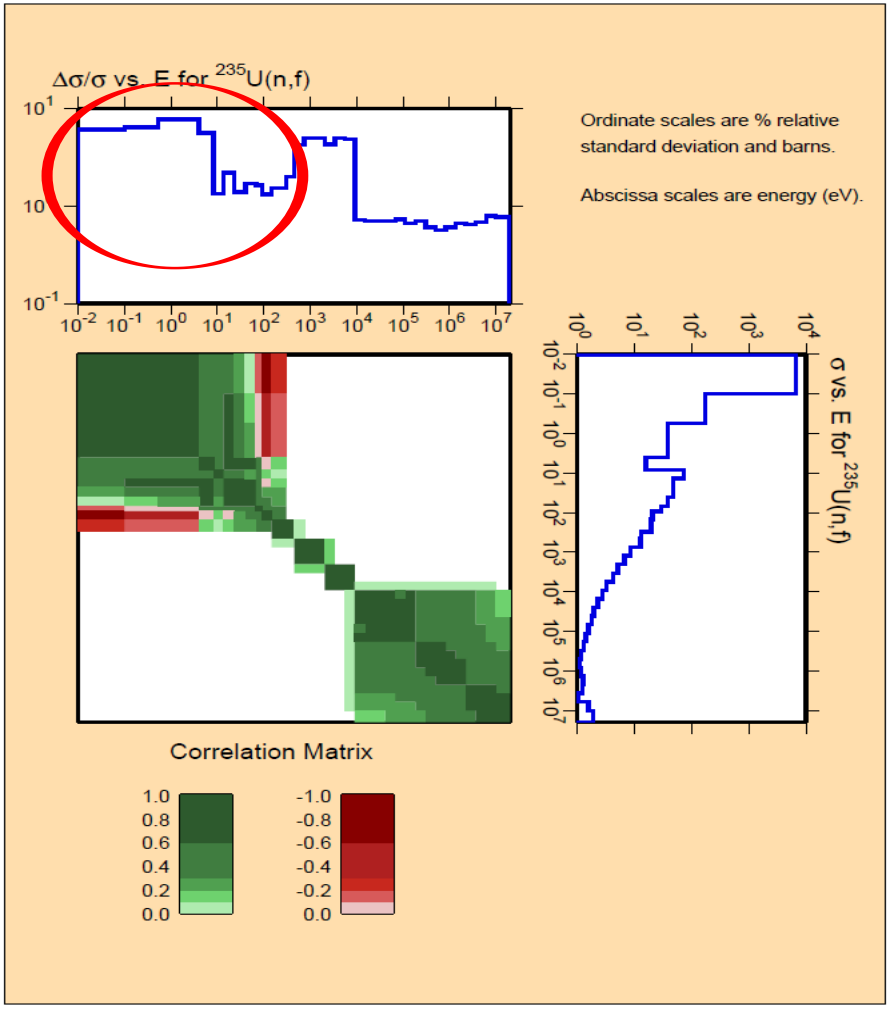


PUFF-IV 10_02_2009

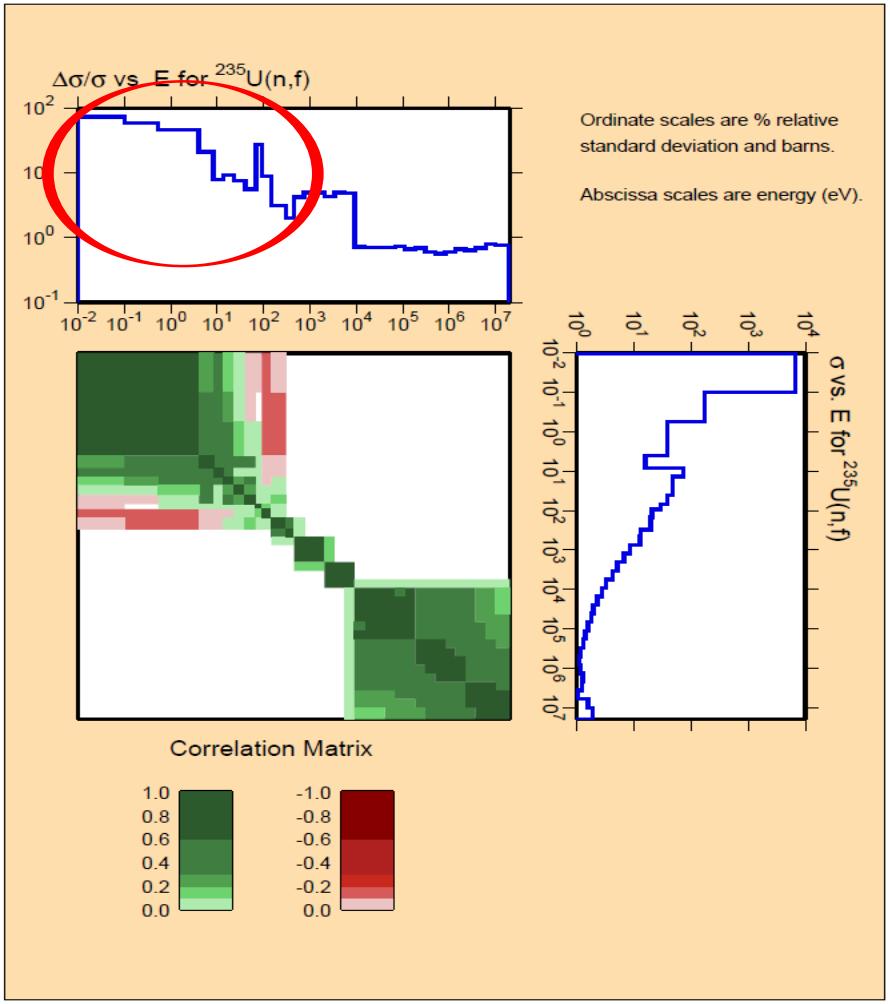


U-235 Discrepancy: fission
1/E Flux, 33-group (AFCI)

NJOY-99.336

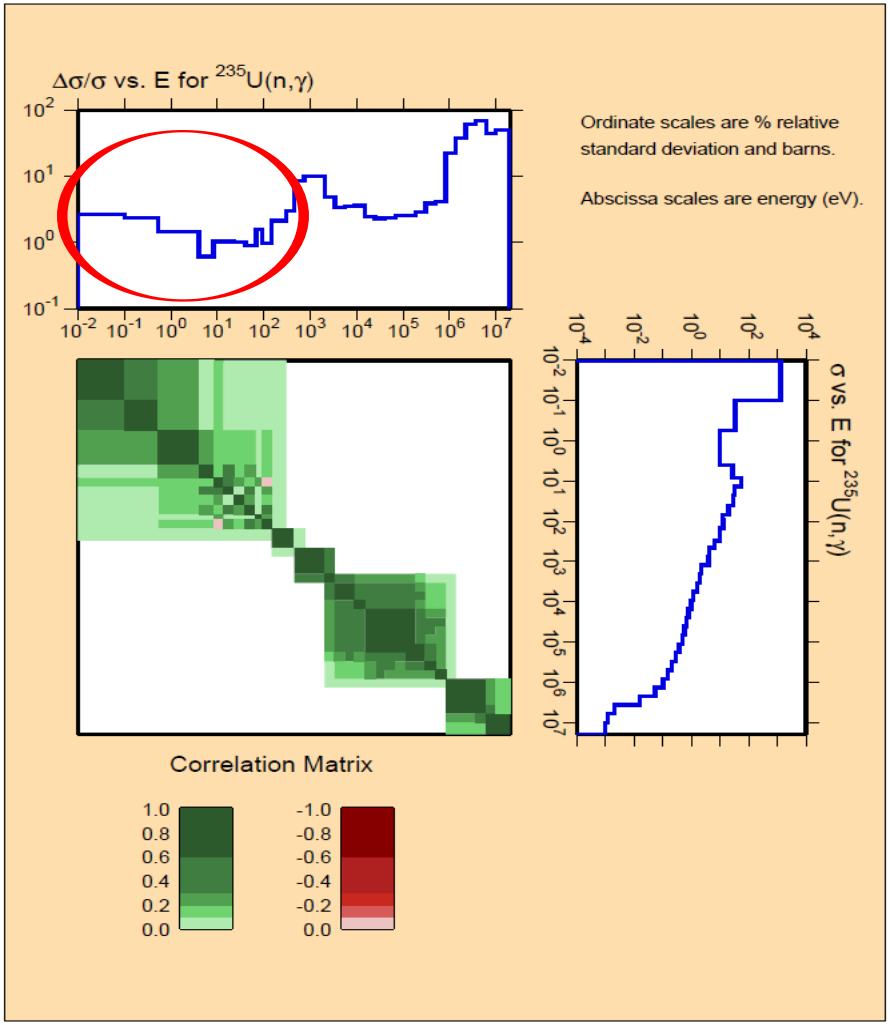


PUFF-IV 10_02_2009

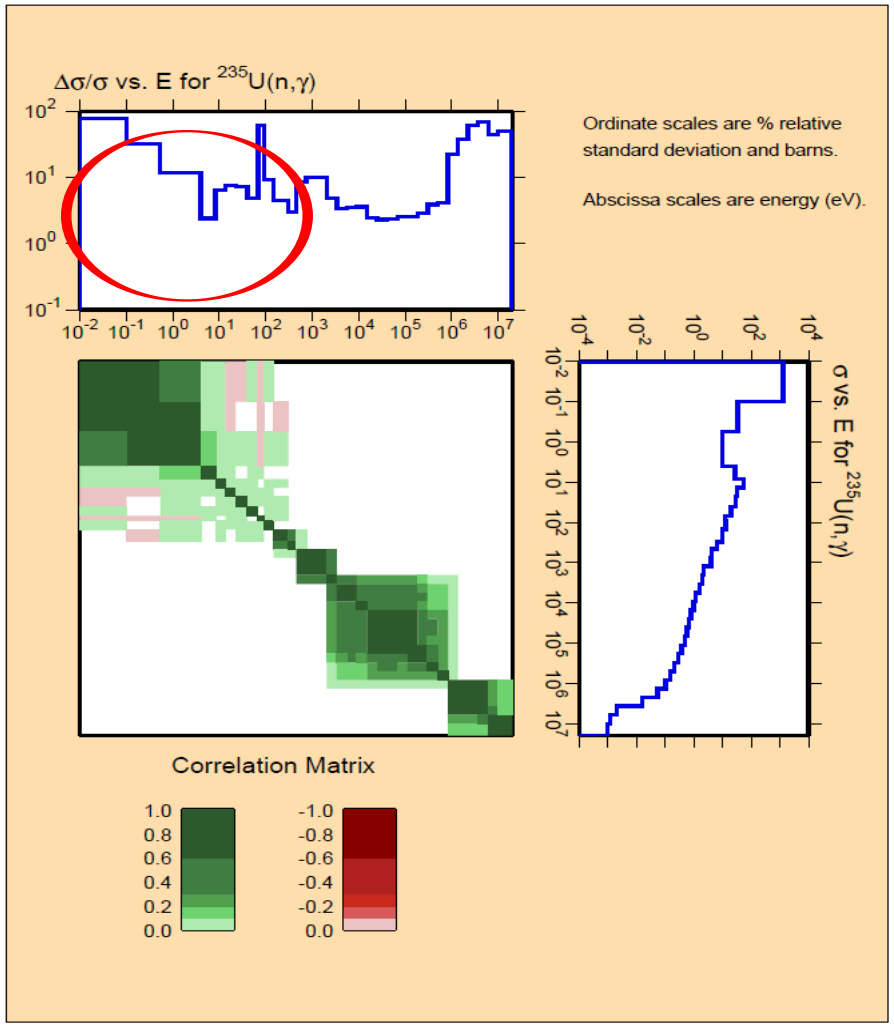


U-235 Discrepancy: capture
1/E Flux, 33-group (AFCI)

NJOY-99.336

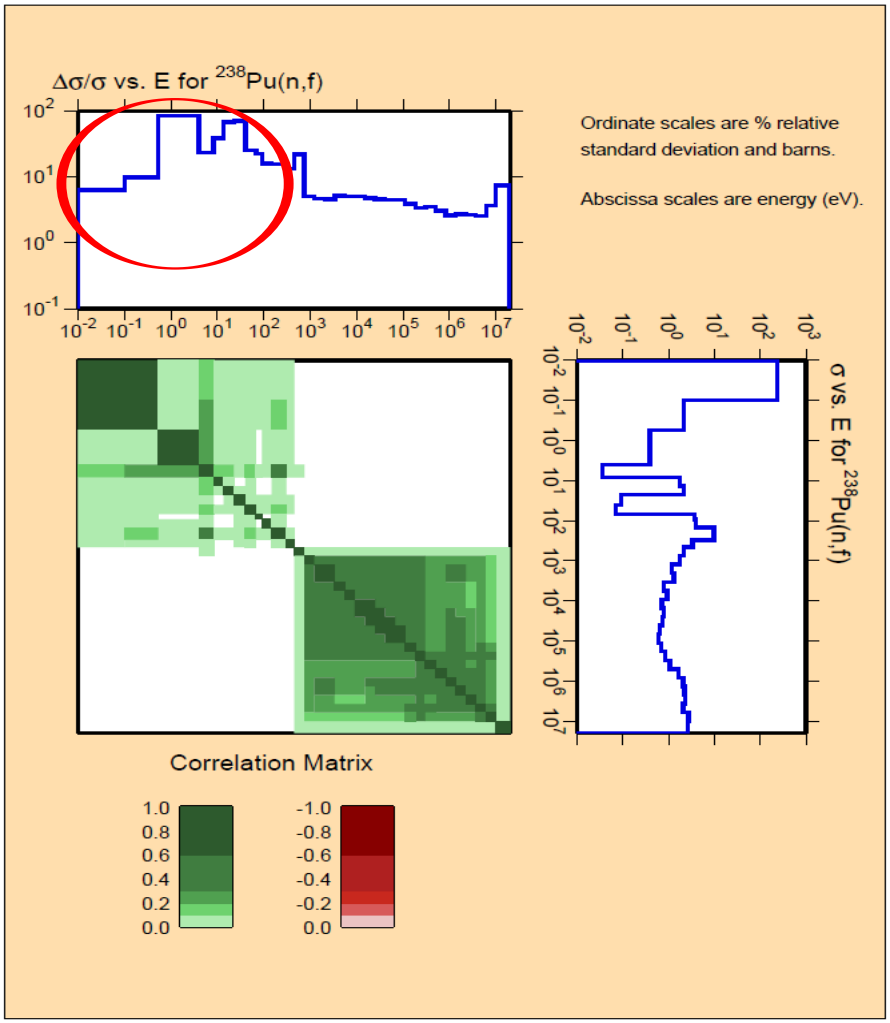


PUFF-IV 10_02_2009

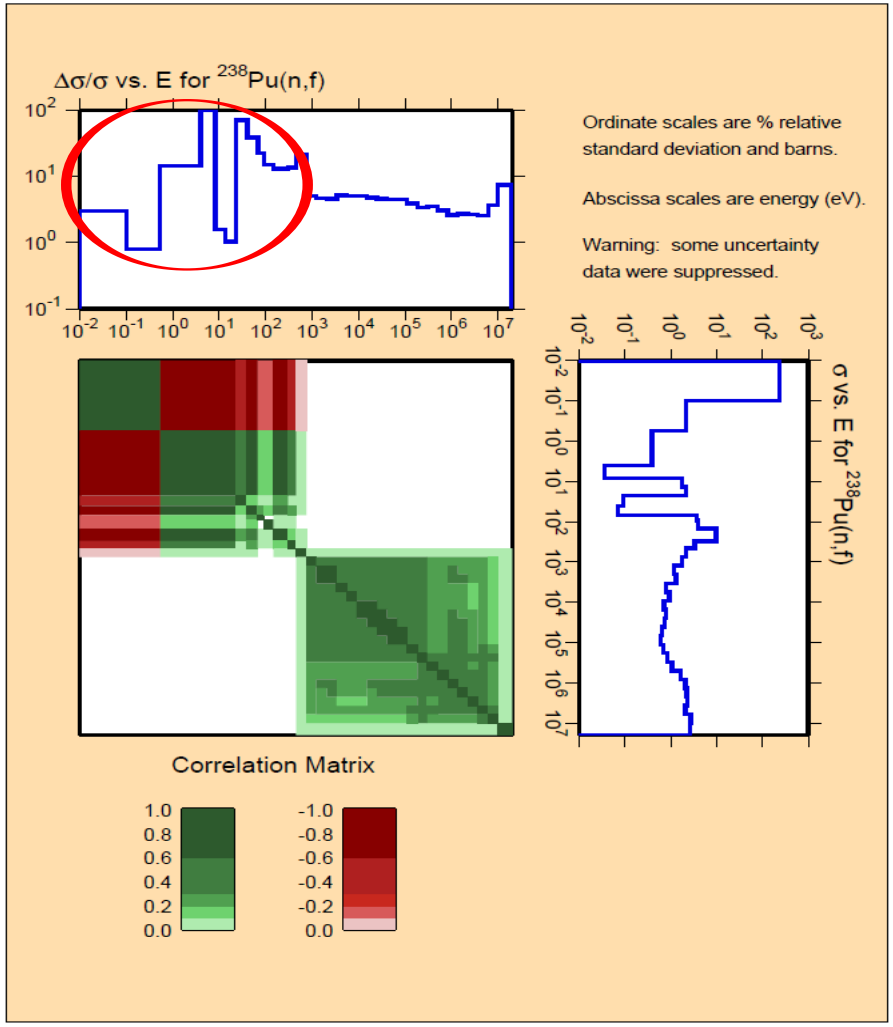


Pu-238 Discrepancy: fission
1/E Flux, 33-group (AFCI)

NJOY-99.336

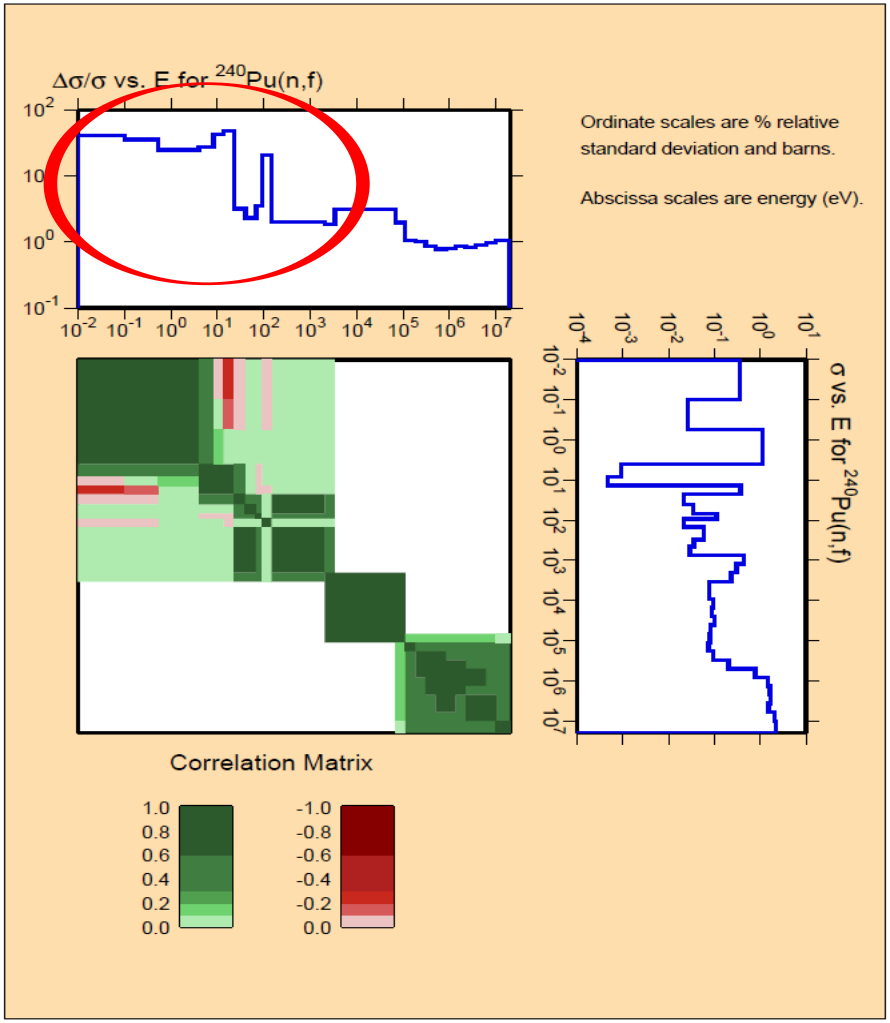


PUFF-IV 10_02_2009

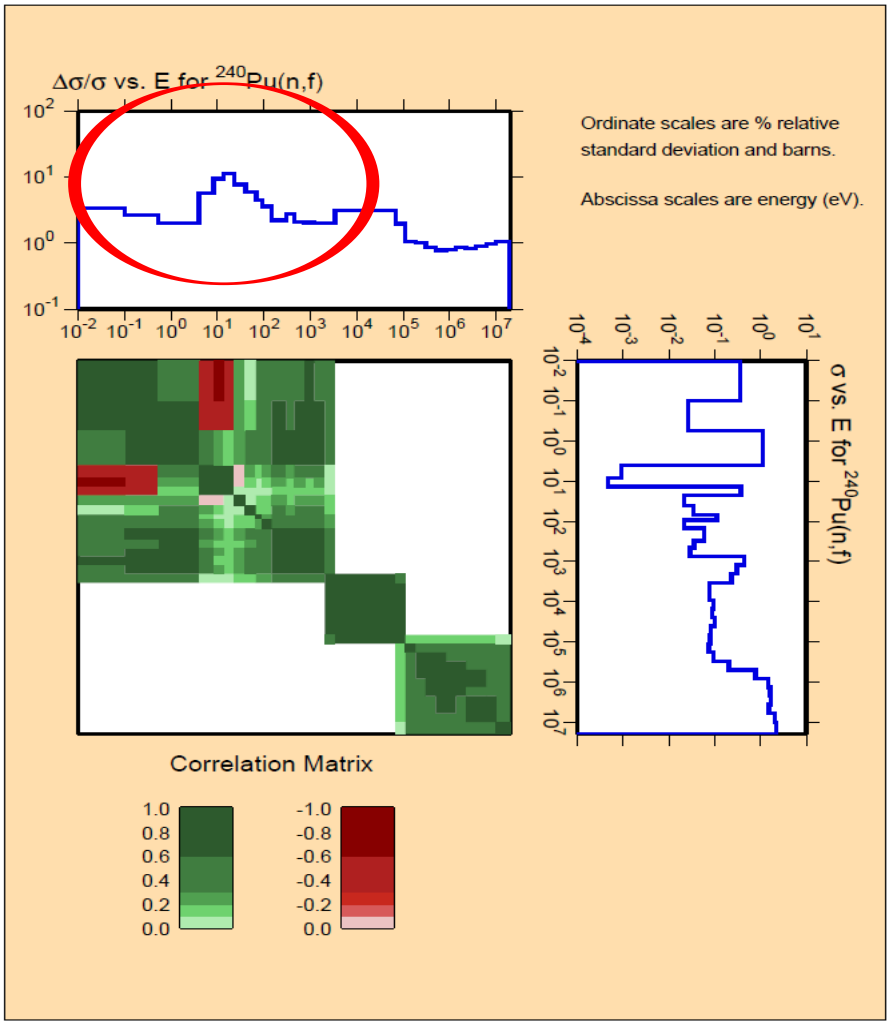


Pu-240 Discrepancy: fission
1/E Flux, 33-group (AFCI)

NJOY-99.336



PUFF-IV 10_02_2009



Conclusion

- **AFCI Users: Need for NJOY to process materials with new *R-Matrix Limited* (LRF=7) format, e.g. F-19**

- **Need to investigate and resolve discrepancies between NJOY and PUFF for covariances in ENDF/A and JENDL-4 materials before adopting them for ENDF/B-VII.1. Possible sources:**

  - **Evaluated file**

  - **Processing codes**