CSEWG Meeting, BNL, November 3-5, 2009

Covariance Review of ENDF/B-VII.0 and ENDF/A

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Review of Covariances: Procedure

Produce covariance plots

- Unprocessed files (MF33), plots by Sigma
- Processed files (NJOY or PUFF), plots by NJOY, see previous talk by R. Arcilla

Analyze uncertainties

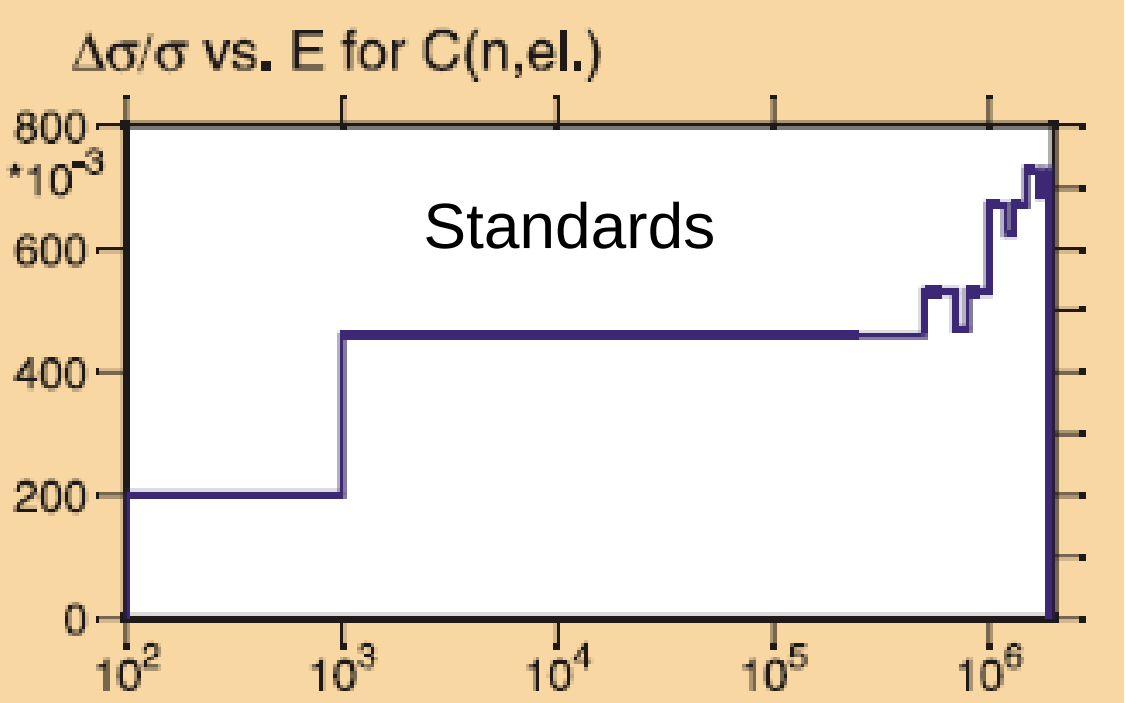
- Use experience from several reviews of AFCI covariance library, including feedback from users
- Use experience of covariance developer in producing covariances in both the resonance and fast regions
- Pay specific attention to low uncertainties

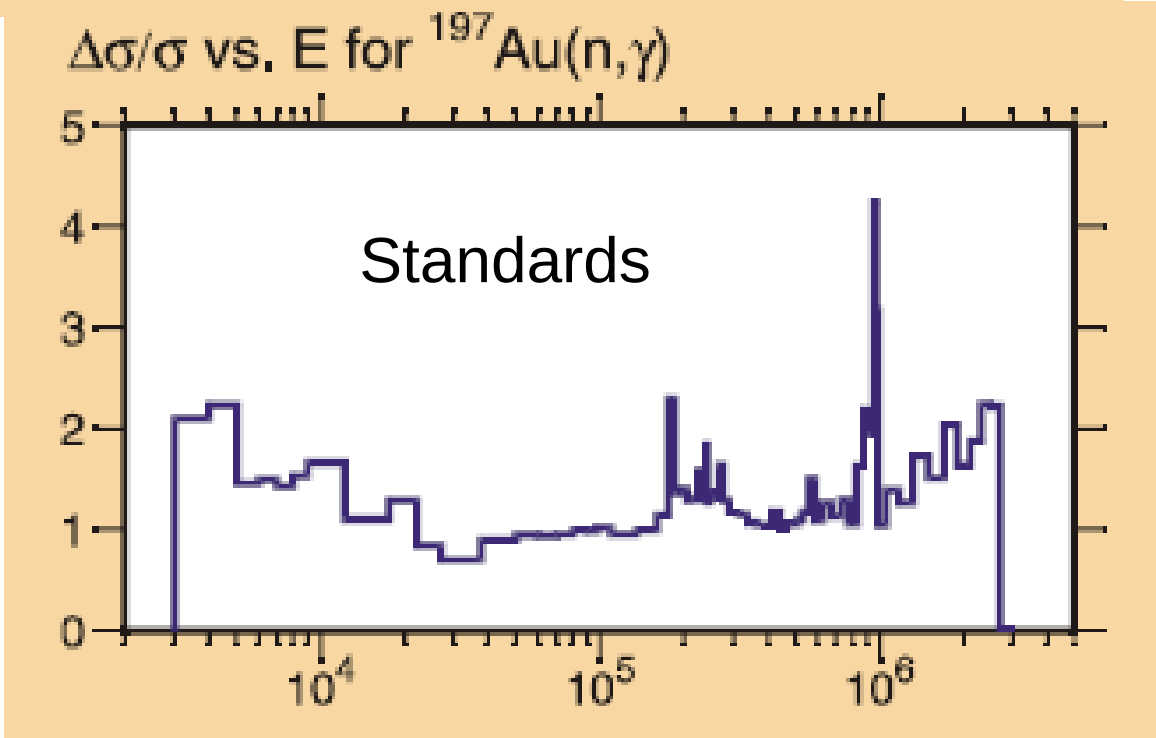
What are low uncertainties?

Estimated from comparison with standards:

Elastic
- standards ~ .5 - .8%
- low < 1 - 1.5%

Capture
- standards ~ 1 – 2 %
- low < 2 – 4 %





Covariances in ENDF/B-VII.0

14 materials

14 materials with complete covariances

- ^{7}Li taken from ENDF/B-VI.8
- ^{89}Y, ^{99}Tc, ^{191,193}Ir new, all data in MF33
- $^{152\text{-}155,156\text{-}158,160}$Gd new, MF32,33
- ^{232}Th new, MF31,32,33

12 materials with partial covariances

Evaluations should be done from scratch for VII.1

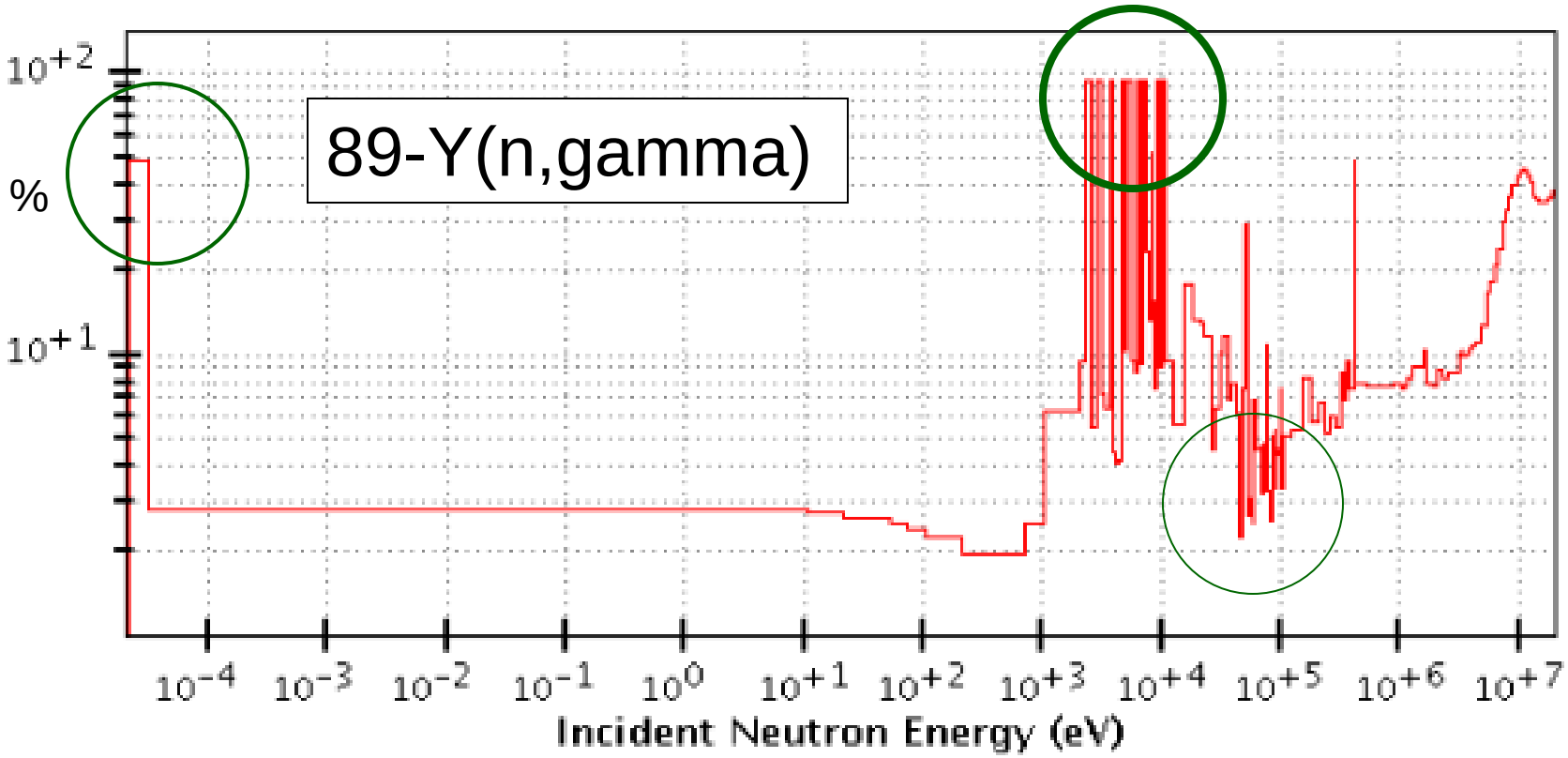
Covariance nomenclature

MF31 = nubars
MF32 = resonance parameters
MF33 = cross sections
MF34 = angular distributions

Covariances in ENDF/B-VII.0

Probably the worst case: 89-Y

All data in MF33, directly viewed by Sigma, RRR < 410 keV
Biggest issue: huge RRR uncertainty peaks - generated artificially

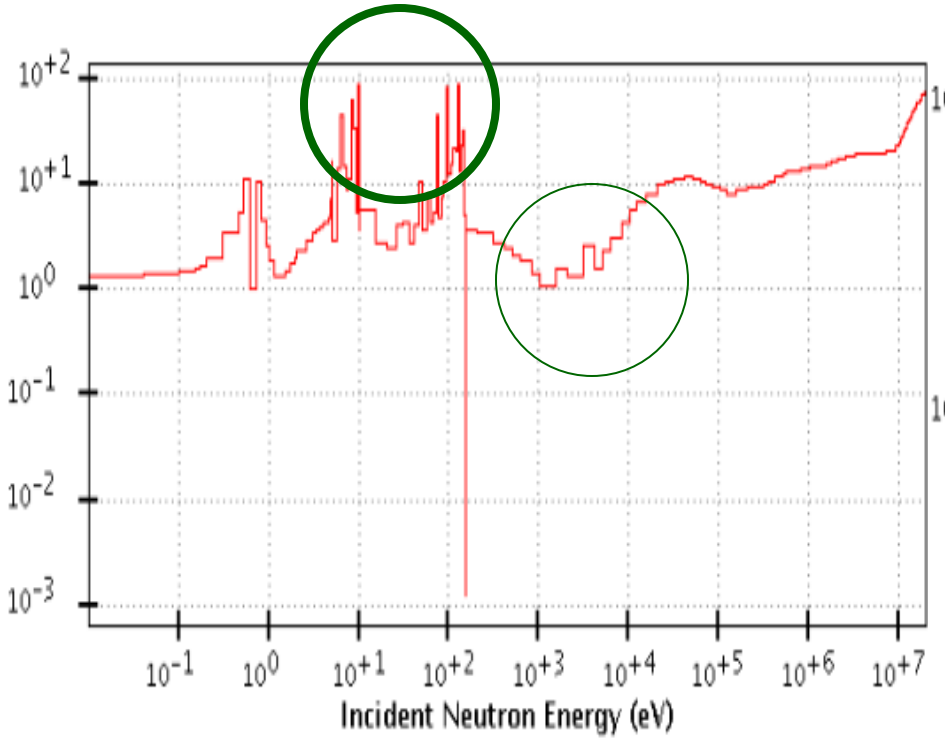


Covariances in ENDF/B-VII.0

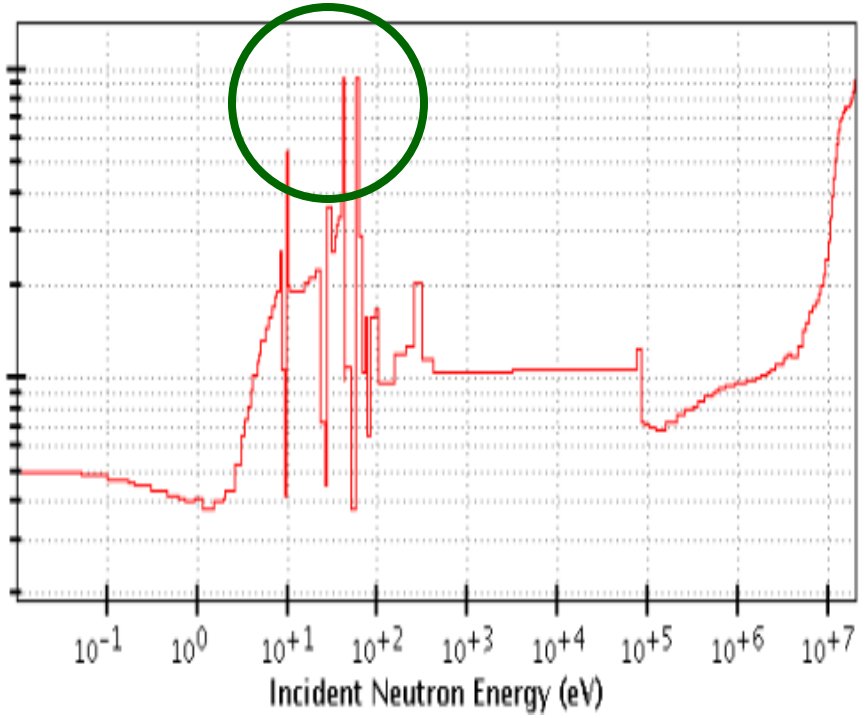
Similar problems also in 191,193-Ir

All data in MF33, unprocessed, directly viewed by Sigma
Biggest issue: huge RRR uncertainty peaks - generated artificially

191-Ir(n,gamma)



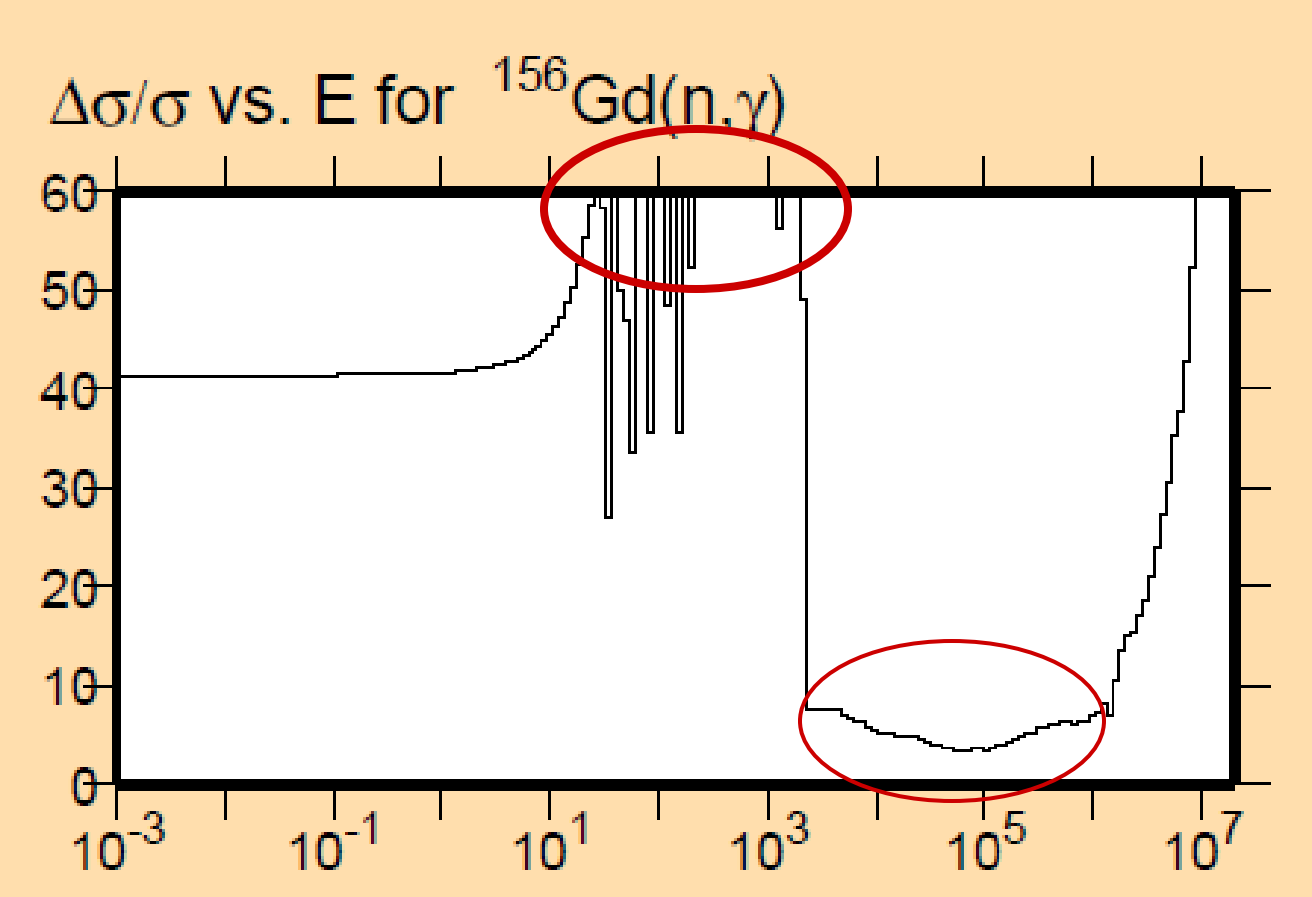
193-Ir(n,gamma)



Covariances in ENDF/B-VII.0

156-Gd

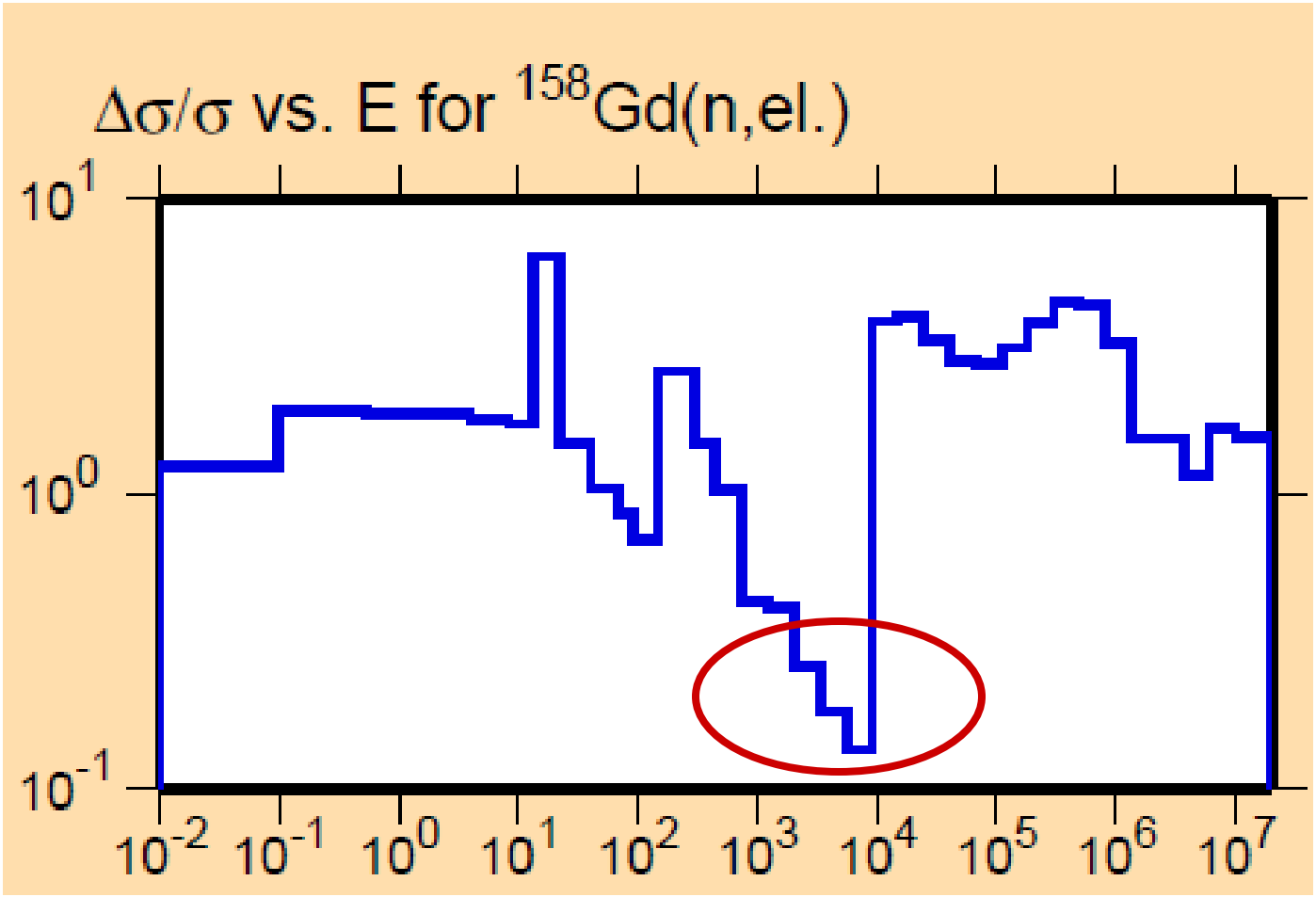
156-Gd capture: Huge uncertainties in RRR, dramatic drop between RRR and fast region



Covariances in ENDF/B-VII.0

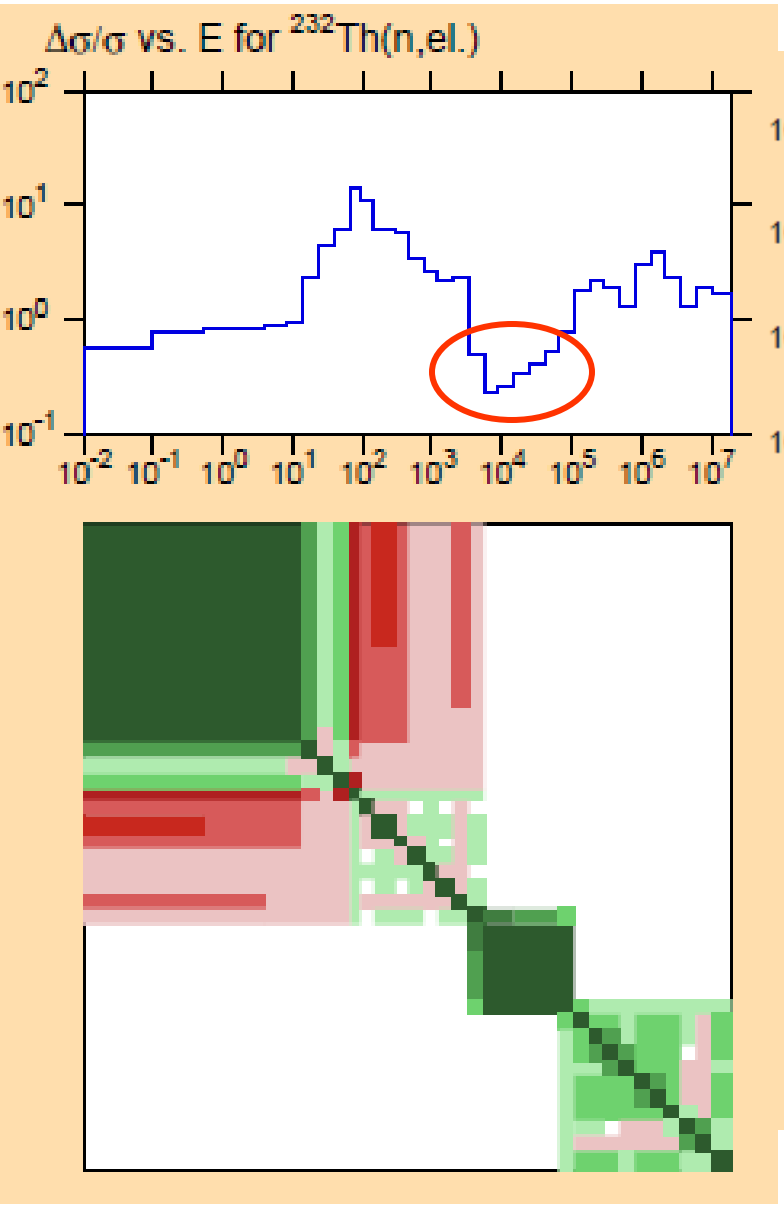
158-Gd

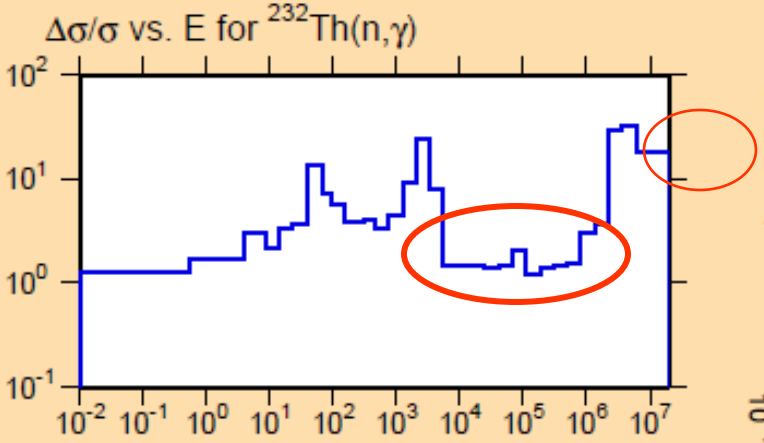
158-Gd(n,el): Uncertainties at RRR high-end are unrealistically low



Covariances in ENDF/B-VII.0

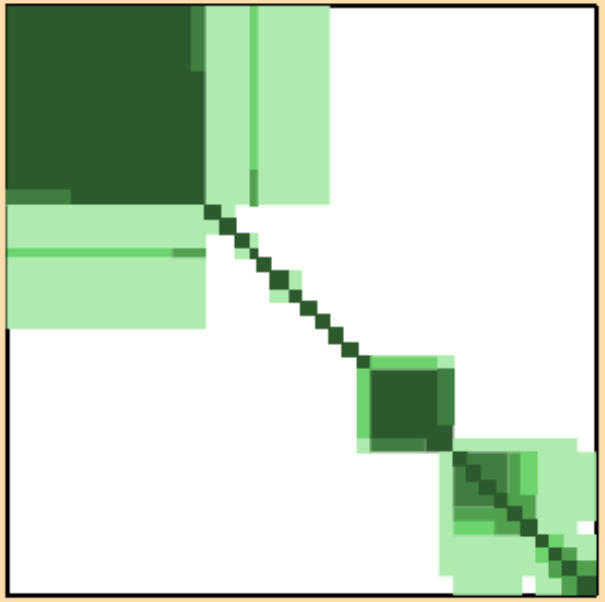
232-Th: three teams contributed => mismatch in el, …

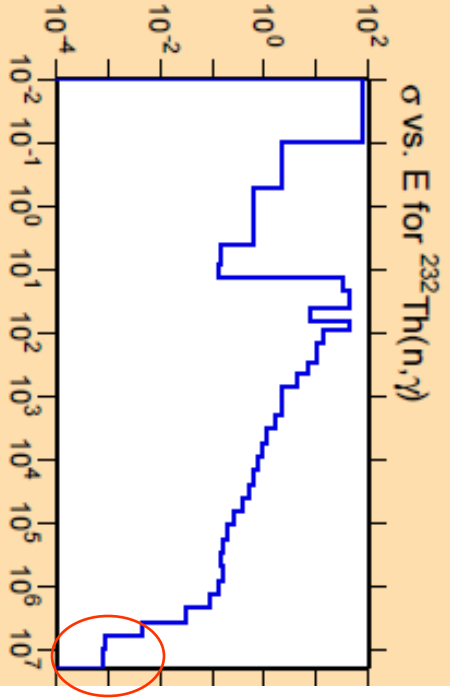




Ordinate scales are % relative standard deviation and barns.

Abscissa scales are energy (eV).





Covariances in ENDF/B-VII.0
Summary

We reviewed 14 covariance files and found considerable deficiencies in 6 files:

- ^{89}Y, ^{191,193}Ir - issues mostly in RRR (BNL)
- ^{156,158}Gd - issues in RRR (ORNL)
- ^{232}Th - issues in URR and fast (IAEA)

Covariances in ENDF/A

16 materials

9 materials with complete covariances

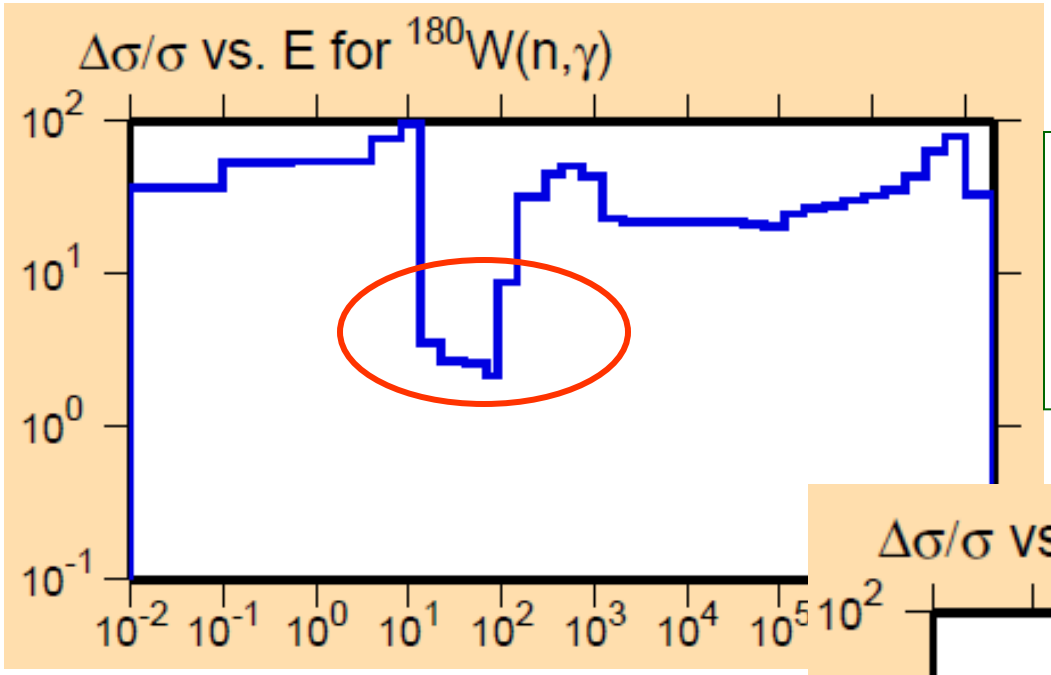
- $^{180,182\text{-}184,186}$W MF32,33,34 (^{180}W MF33 only)
- ^{233,235,238}U MF31,32,33 (MF32 converted to MF33)
- ^{239}Pu MF31,32,33 (MF32 converted to MF33)

7 materials with partial covariances

- ^{19}F MF32, MF33 partial from VII.0
- ^{35,37}Cl MF32 only
- ^{39,41}K MF32 only
- ^{55}Mn MF32 only
- ^{240}Pu MF33, fast region only

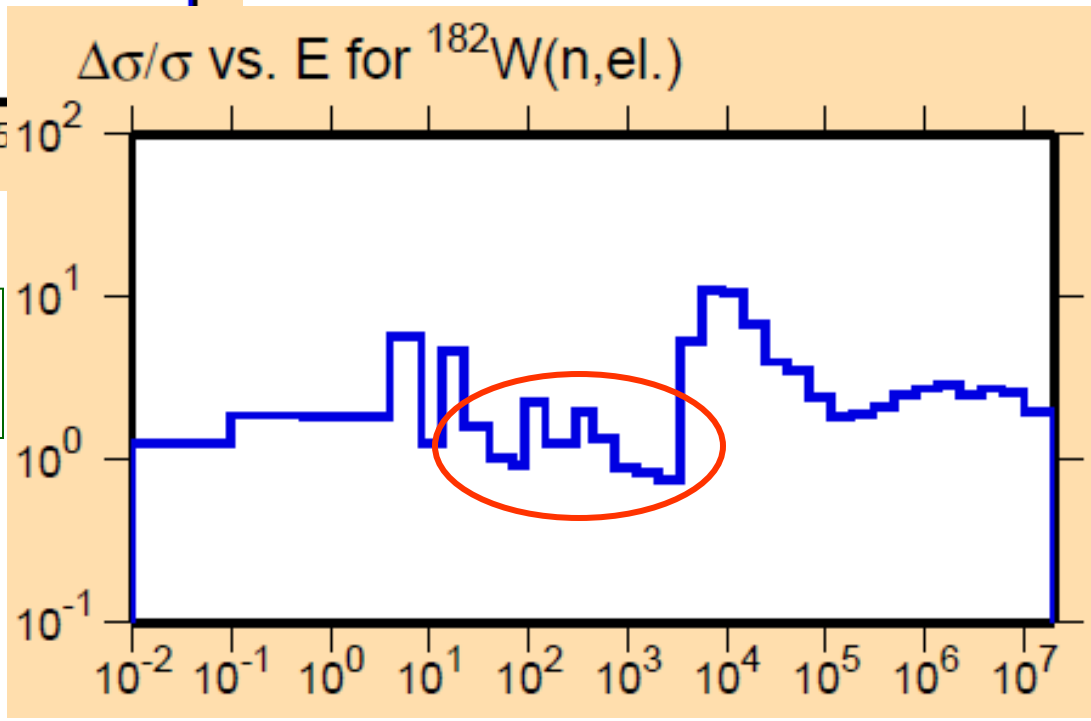
Covariances in ENDF/A

180,182-W



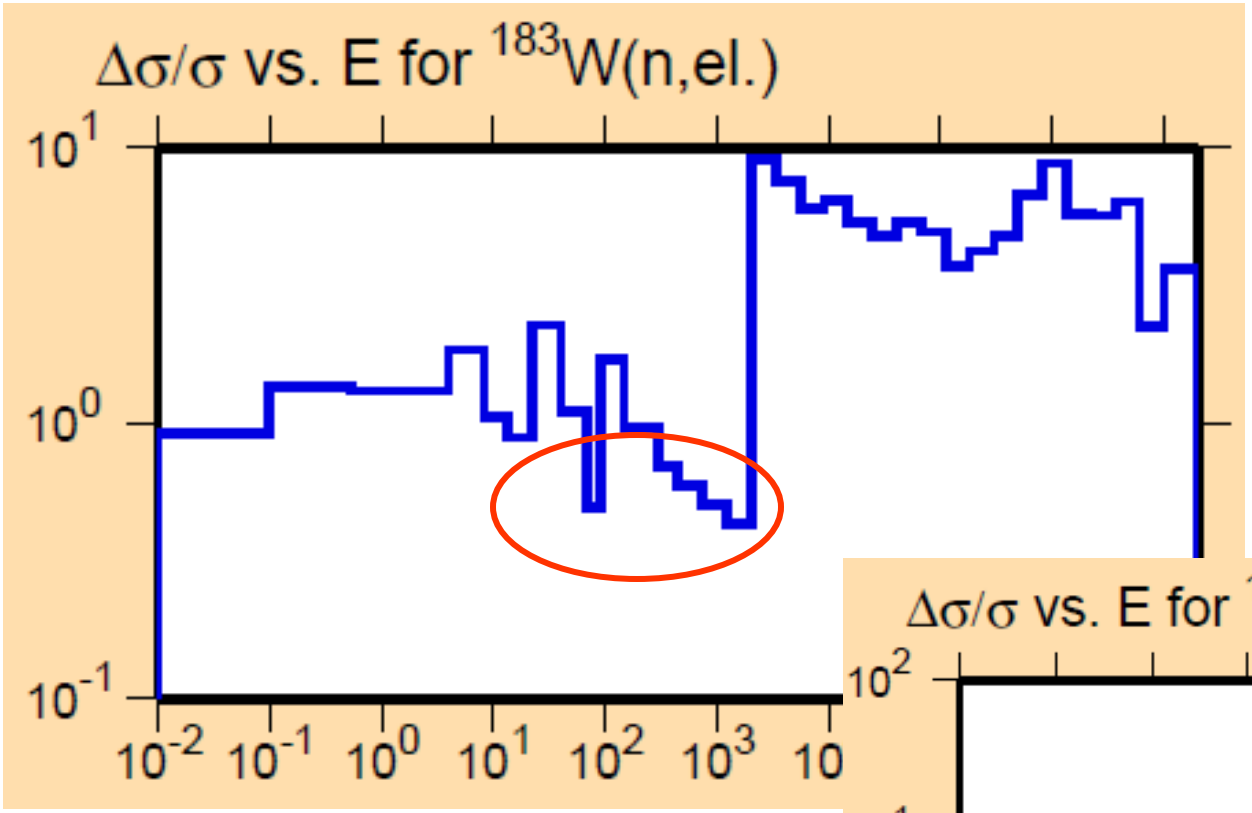
No covariance description, v. low abundance (0.1%), capture uncertainties at ~10-100 eV are unrealistic

Elastic uncertainties at ~30eV-3keV are too low

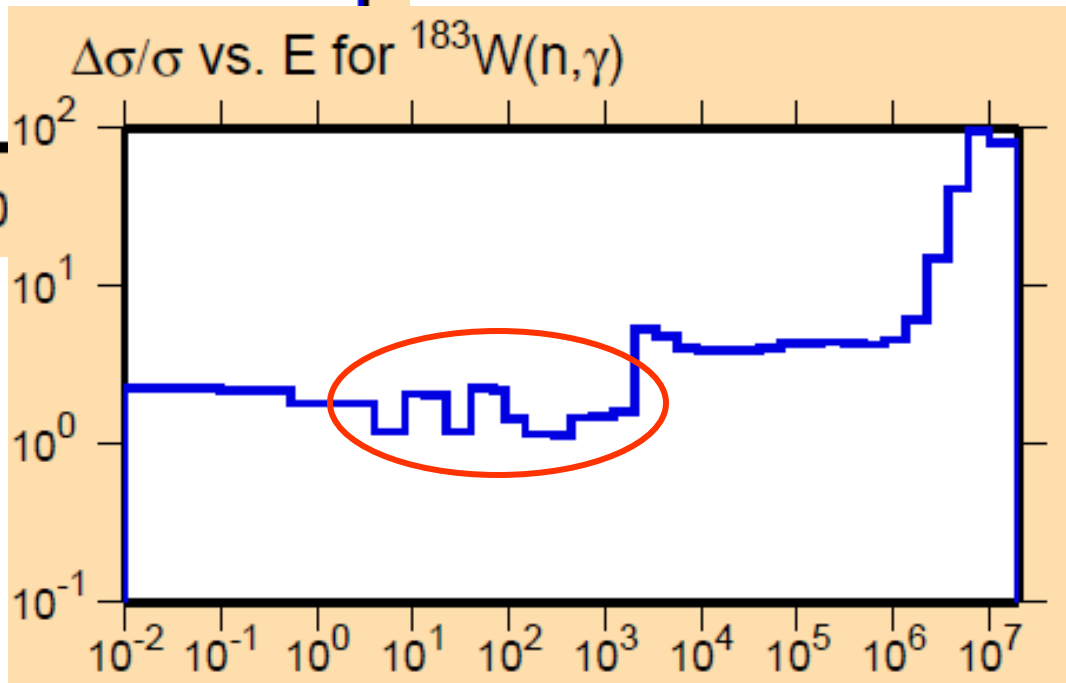


Covariances in ENDF/A

183-W



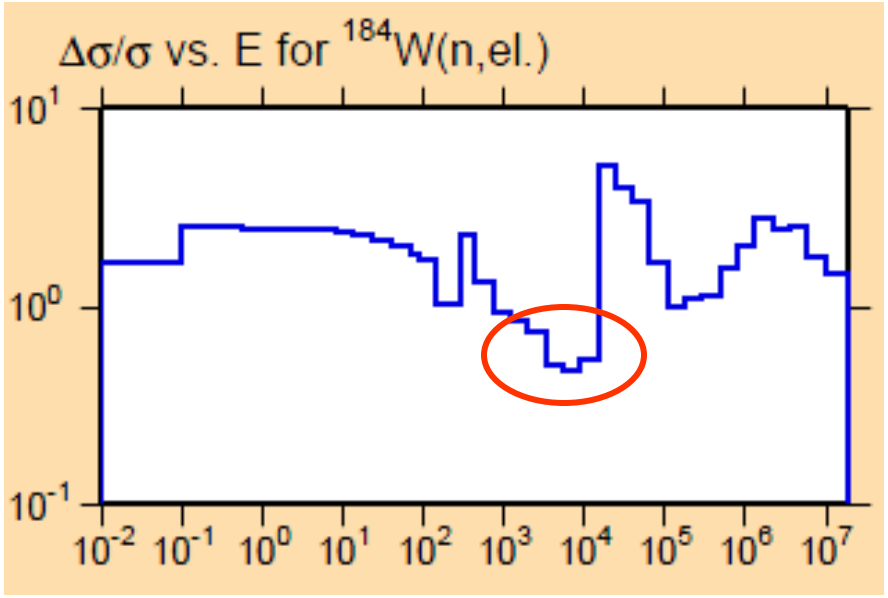
Elastic uncertainties in RRR are well below 1%, unrealistically low.



Capture uncertainties in RRR of ~1% seem far too low.

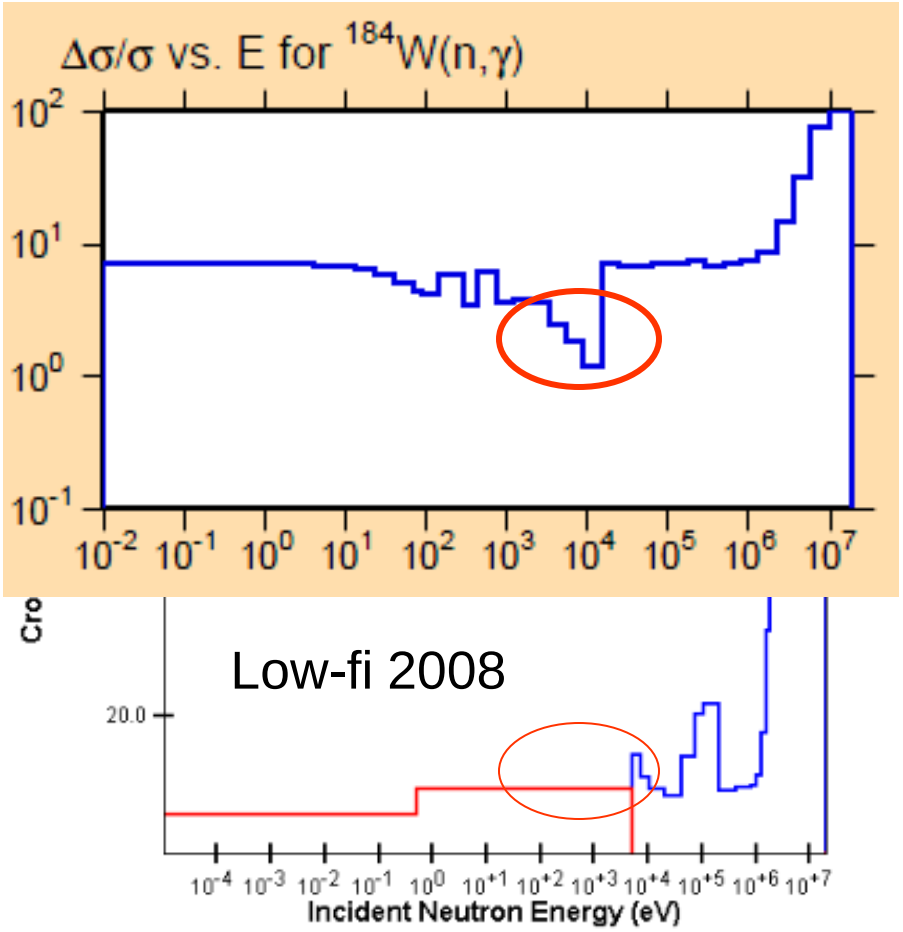
Covariances in ENDF/A

184-W



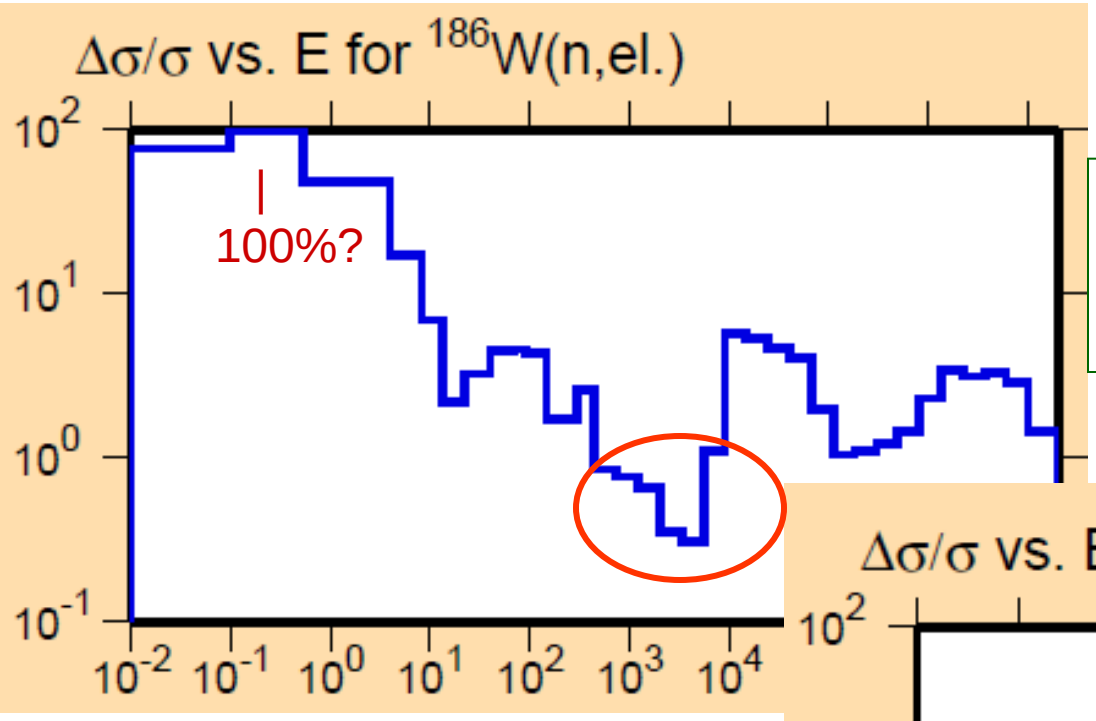
Elastic is far too low (well below 1%) at the high-end of RRR. Decline of uncertainties at the high-end of RRR is typical drawback of many evaluations.

Capture is far too optimistic (~1%) at the high-end of RRR. Low-fi estimate (~10%) based on RI looks more realistic.

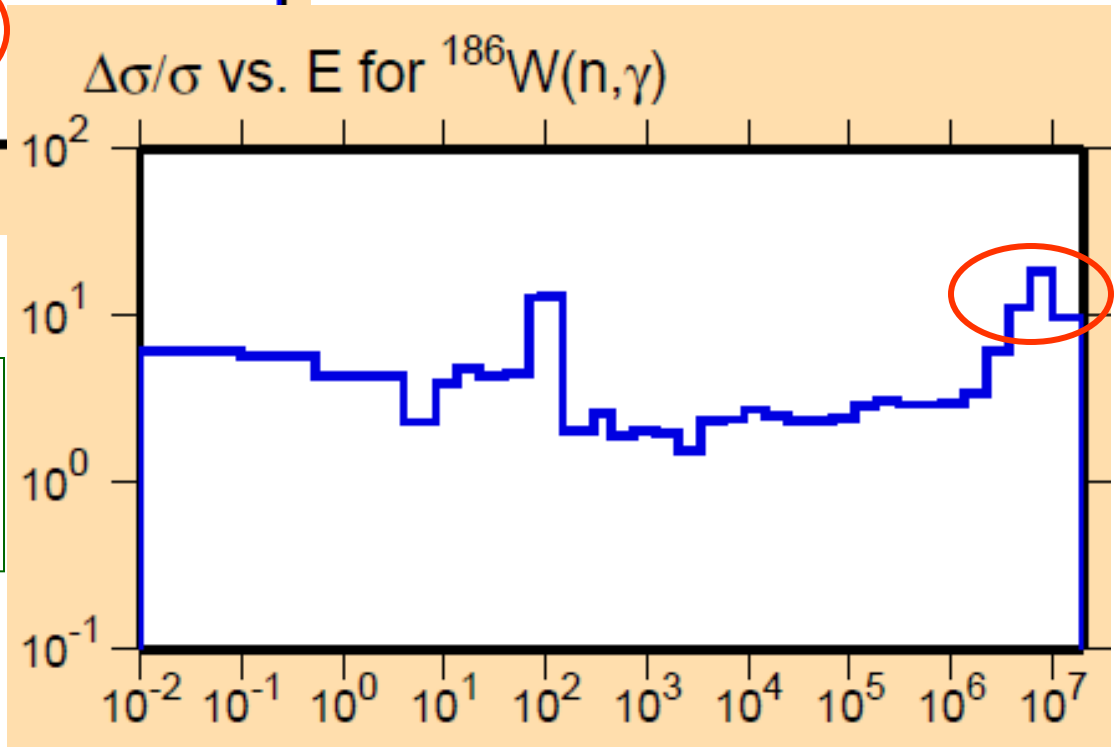


Covariances in ENDF/A

186-W



Elastic uncertainties in RRR are well below 1%, unrealistically low.

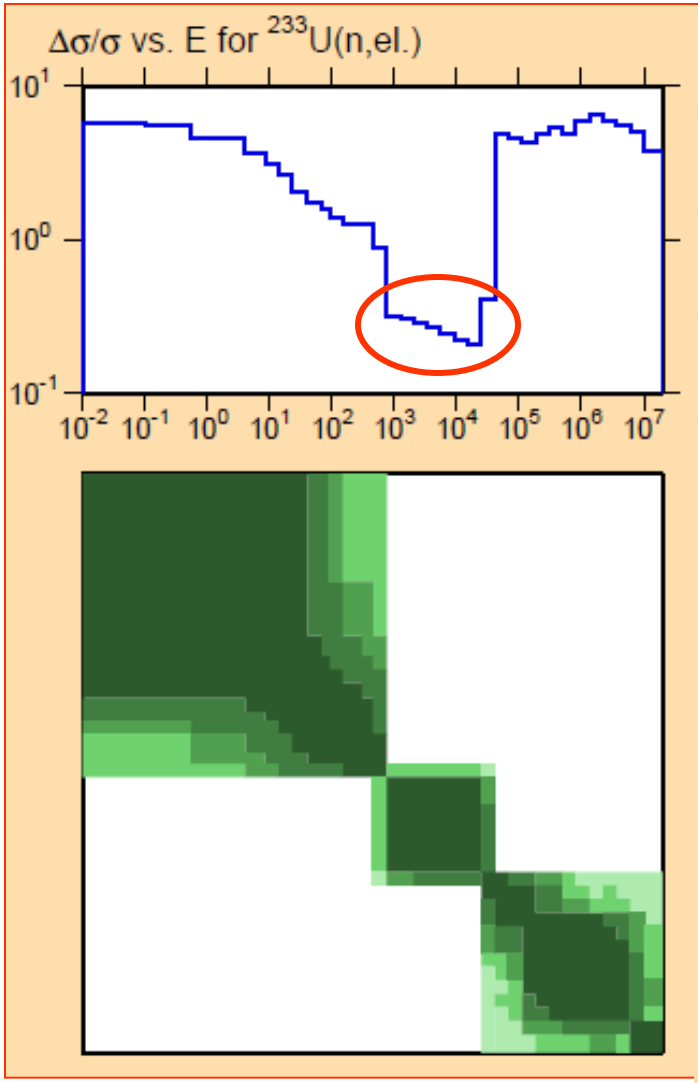


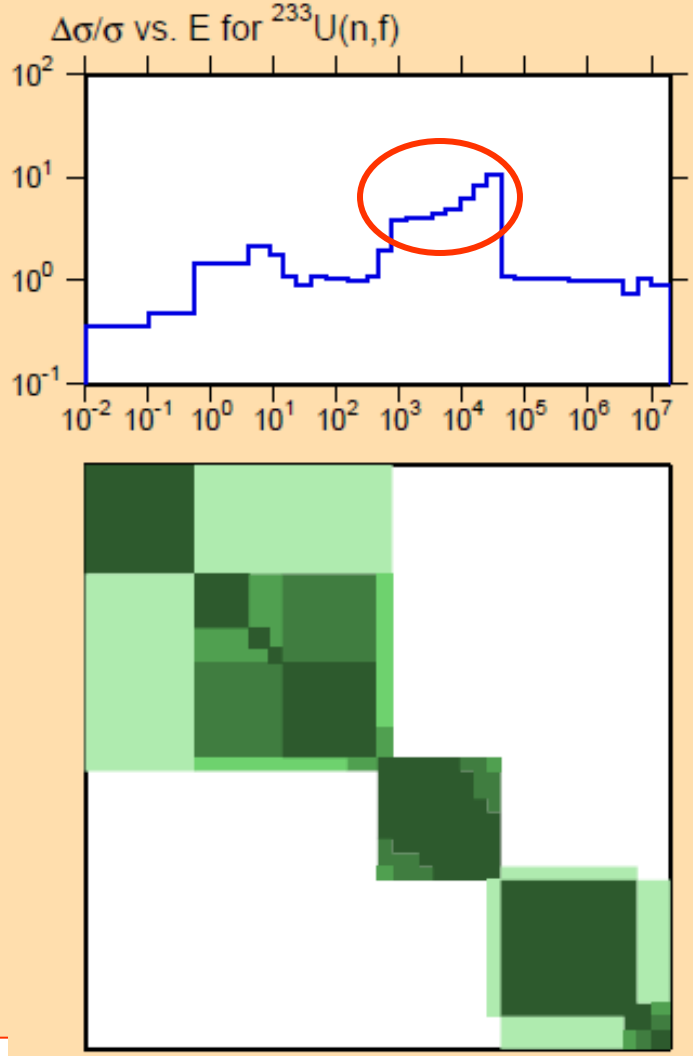
Capture uncertainties of 10% above 10 MeV seem unrealistic.

Covariances in ENDF/A

233-U: problems with elastic and fission

233-U: URR region 0.6-40 keV, (n,el) and (n,f) uncertainties?





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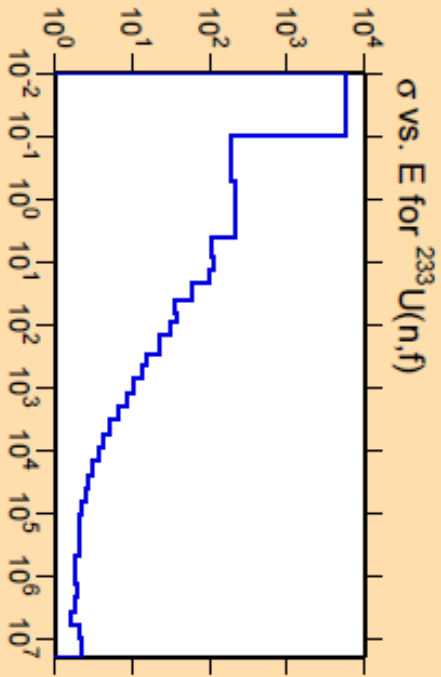
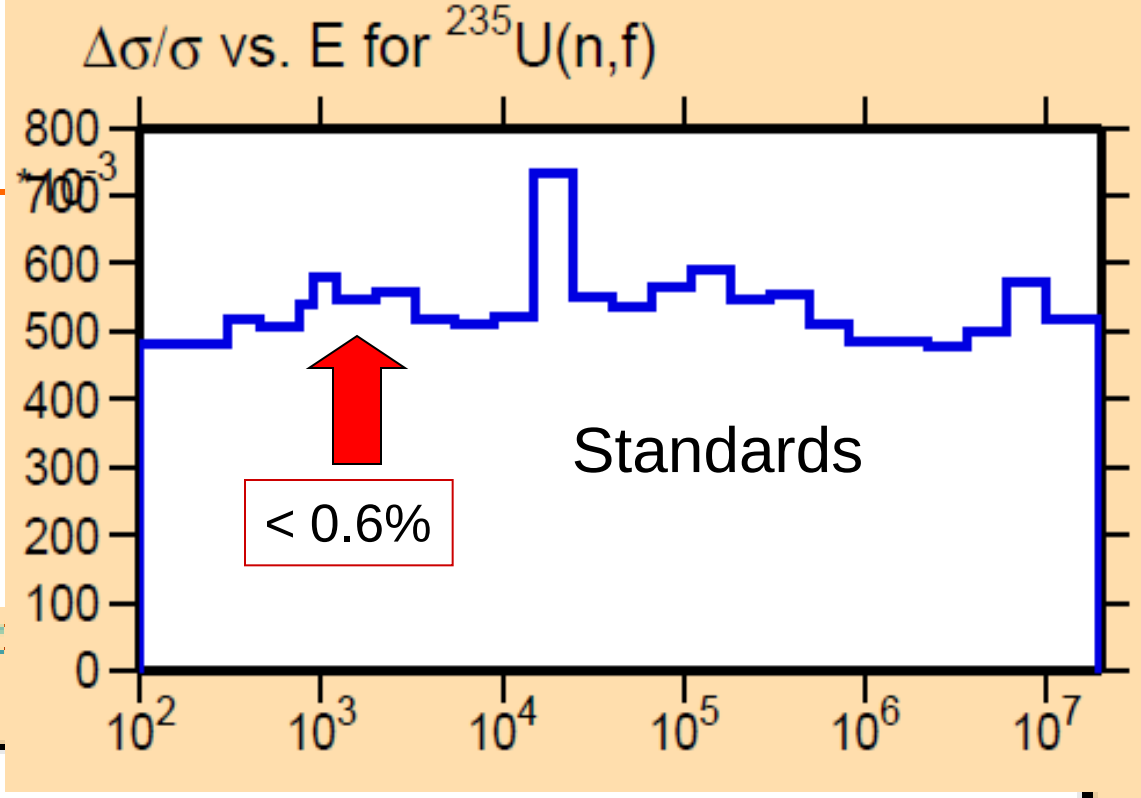
Abscissa scales are energy (eV).

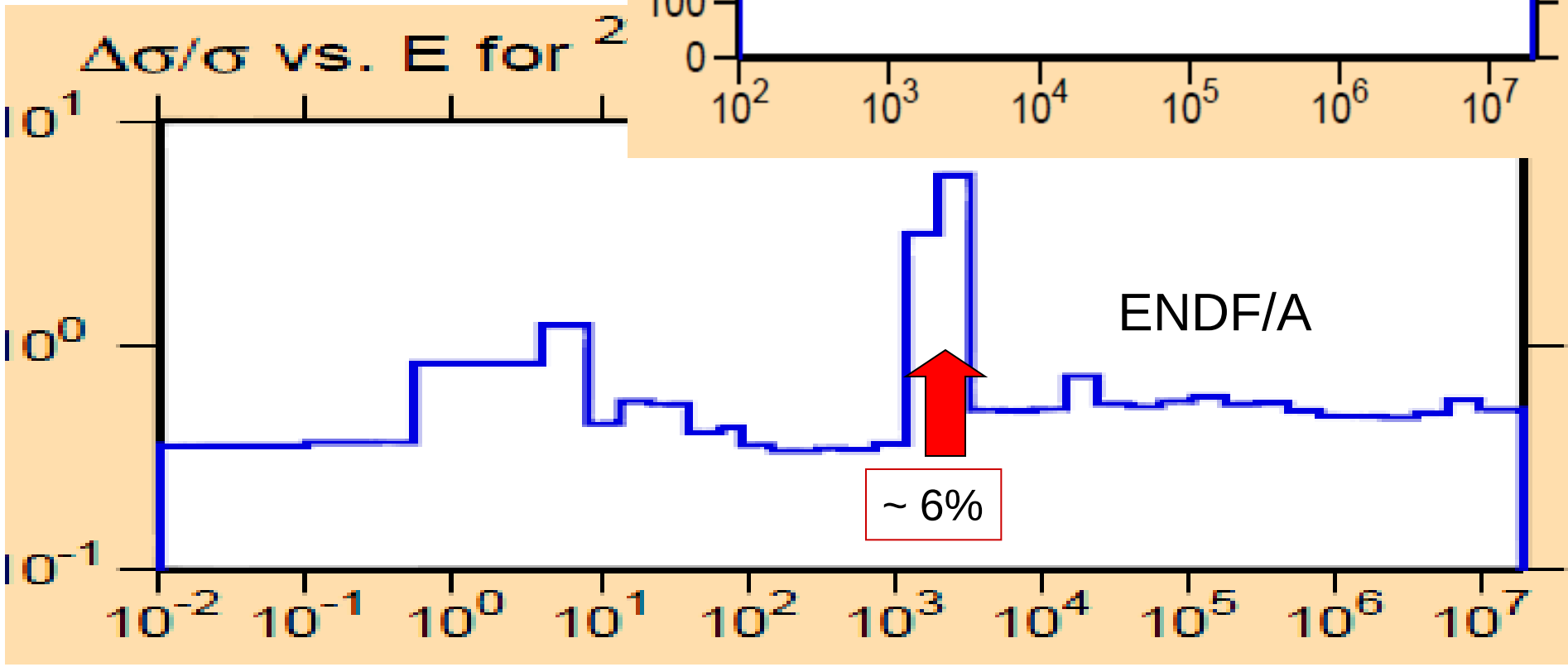


ENDF/A

235-U(n,f)

Serious discrepancy in uncertainties with Standards at 1-3 keV

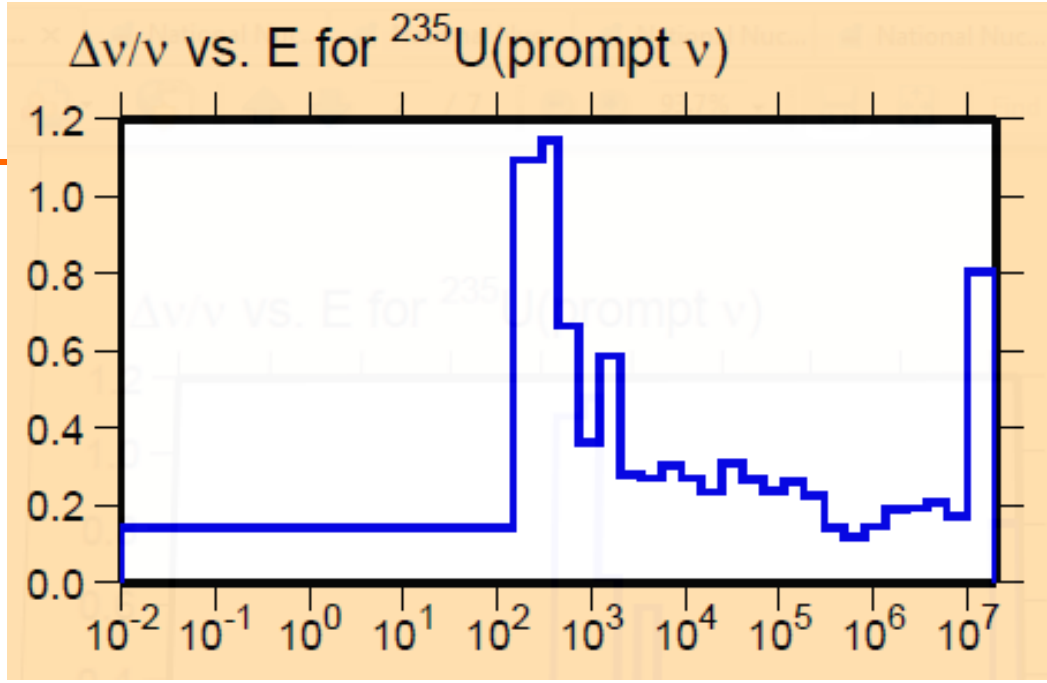


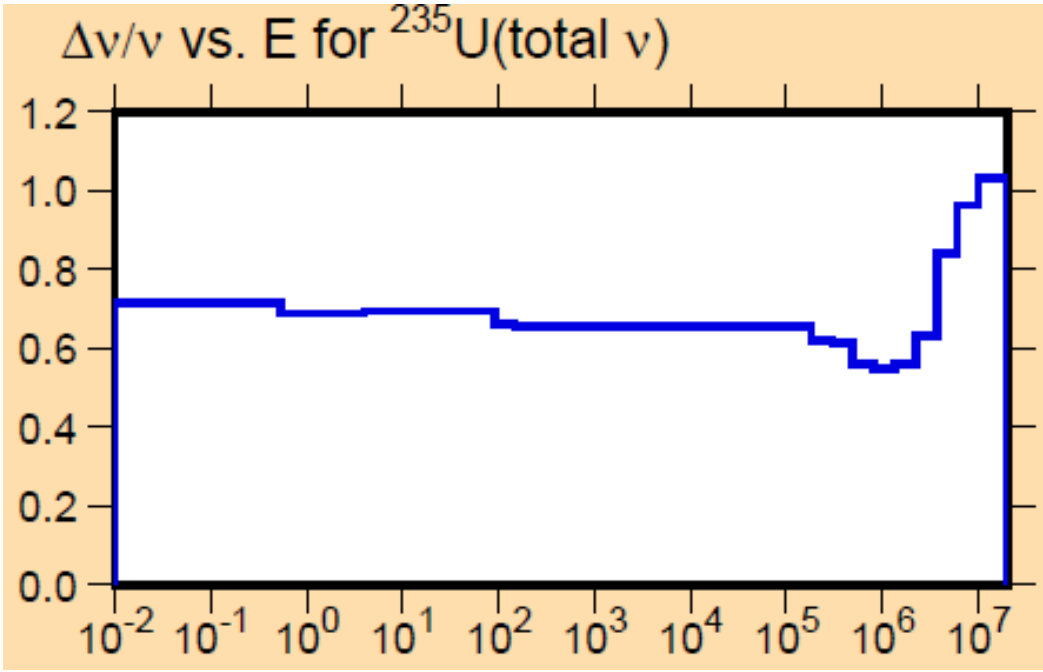


ENDF/A

235-U nubars

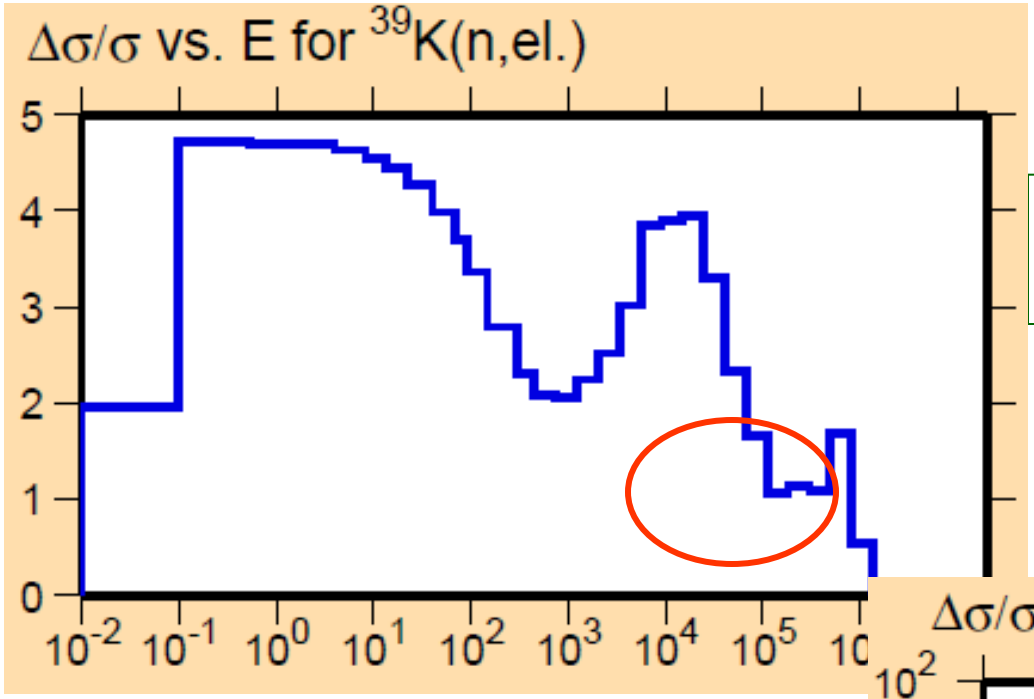
Prompt nubar uncertainty differs considerably from total nubar uncertainty, this should be checked.





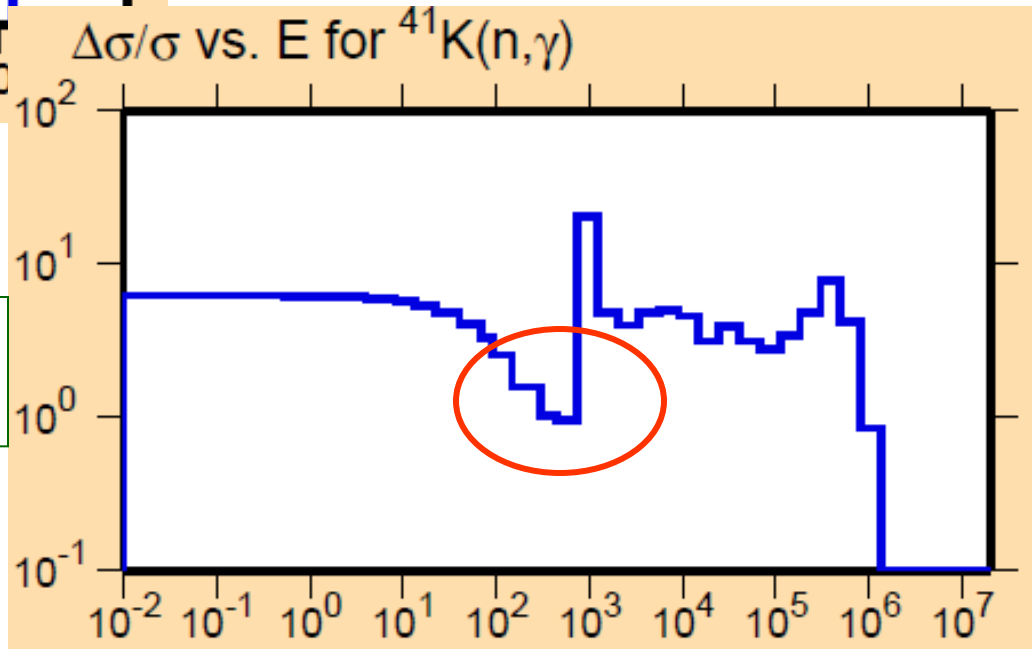
Covariances in ENDF/A

39,41-K (partial, MF32 only)



39-K elastic at ~200 keV
is ~1%, this seems too low

41-K capture at ~0.3-0.6 keV
is ~1% and this seems too low

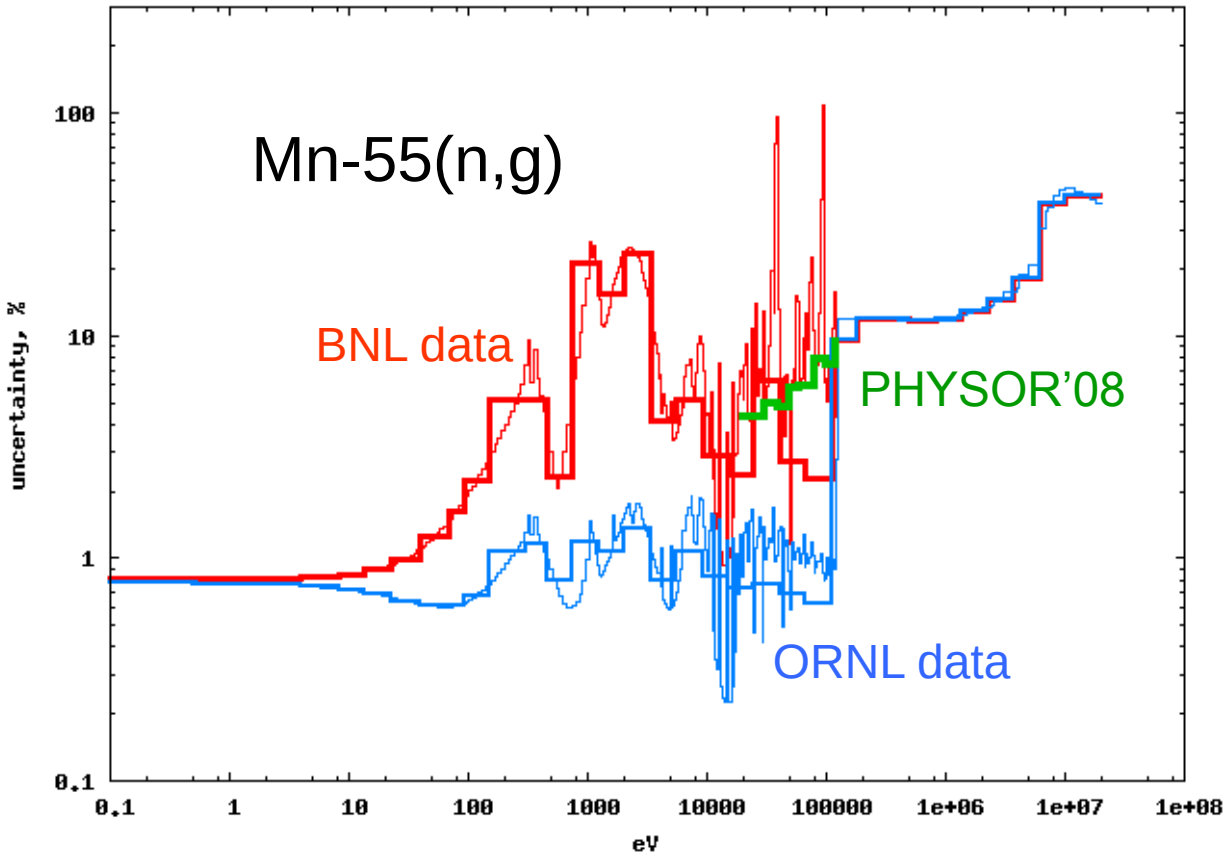


Covariances in ENDF/A

55-Mn (partial, MF32 only; fast MF33 preliminary BNL)

MF32 issues discussed already in Port Jeff, June 2009

- ORNL stated that they are working on it
- would fix the problems by adding MF33



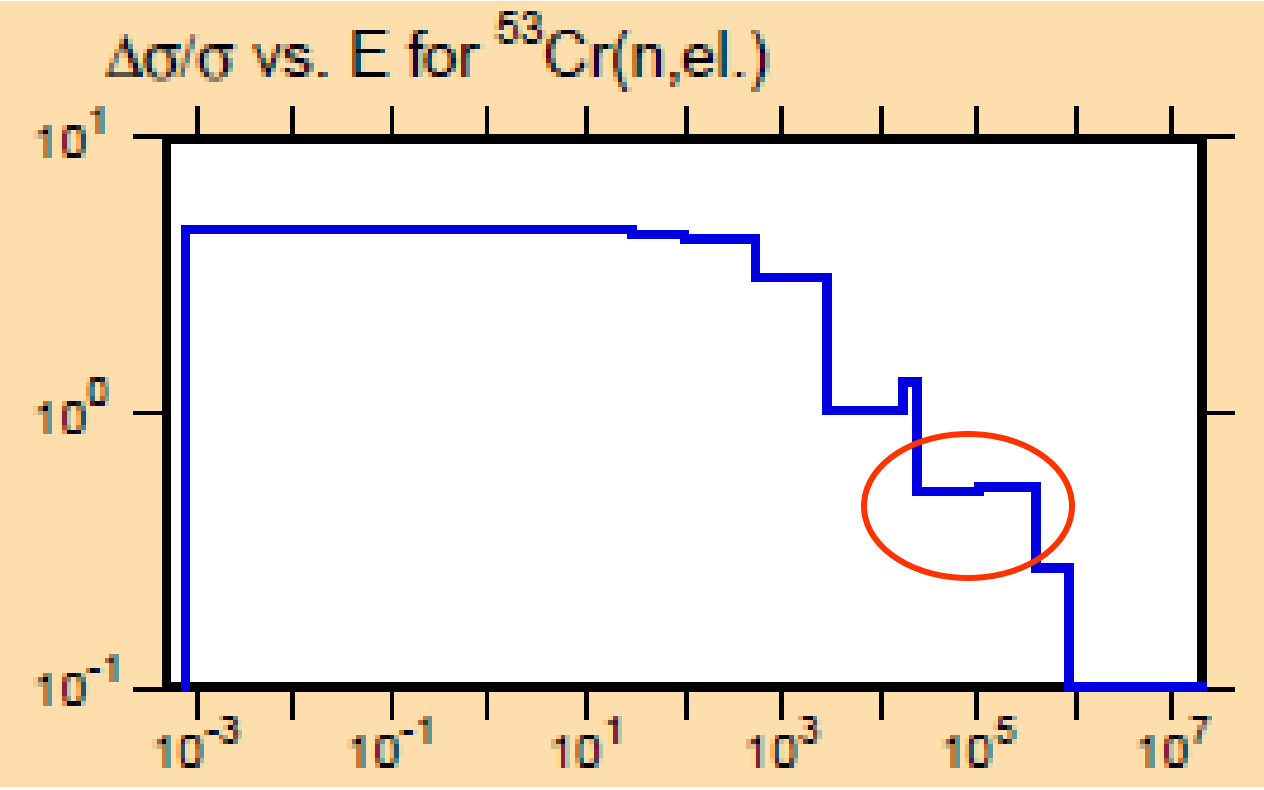
Most recent additions to ENDF/A

8 materials submitted by ORNL (Oct 28, 2009)

^{52,53}Cr, ^{58,60}Ni, ^{46,47,49,50}Ti, mostly complete covariances

Well documented, submitted with plots!

Only quick review, seems to be in fairly good shape

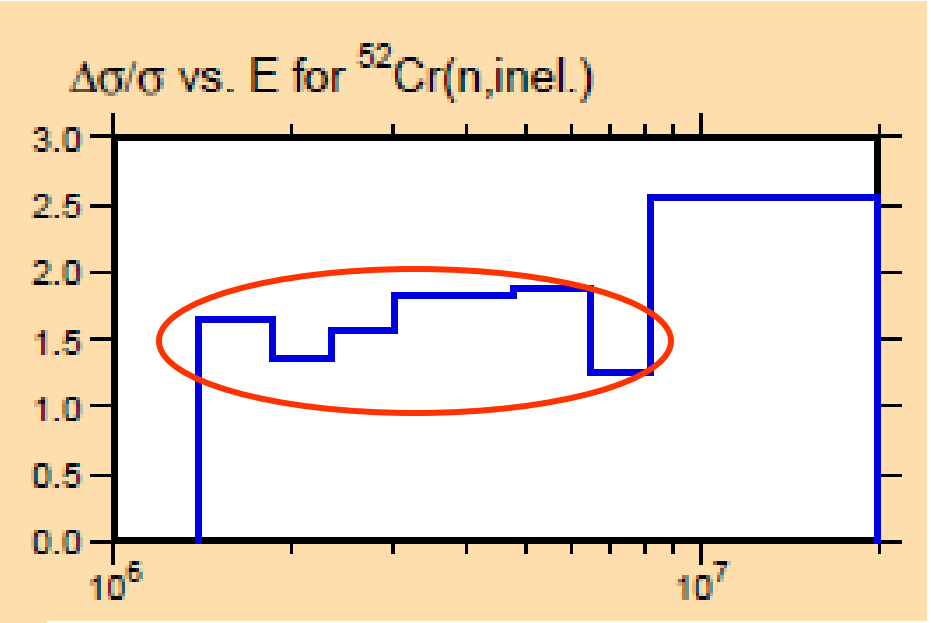


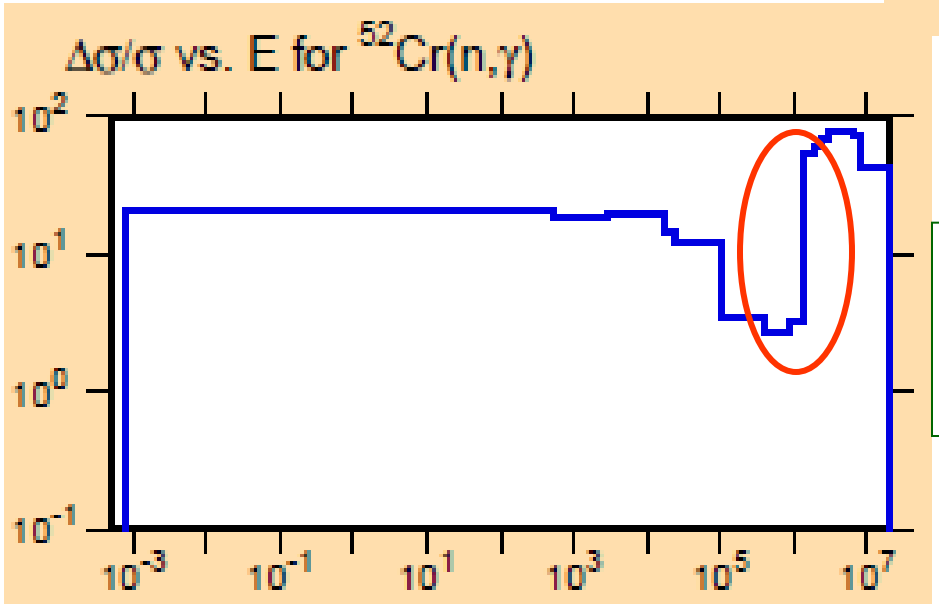
Elastic uncertainty at RRR high end looks far too low.

Most recent additions to ENDF/A

Inelastic ~1.5% needs very strong justification!

Compare with ~16% difference between JEFF and JENDL cs in the lowest energy group.





Capture: sudden jump (~20x) in uncertainty does not look plausible.

Covariances in ENDF/A
Summary

We reviewed 16 materials and found deficiencies in 10 materials

- ^{39,41}K, ^{55}Mn - RRR (ORNL)
- $^{180,182\text{-}184,186}$W - mostly RRR, partly fast (IAEA)
- ^{233}U - RRR and URR (ORNL)
- ^{235}U - fission(?), nubar (LANL)

8 additional materials will be reviewed later

- ^{52,53}Cr, ^{58,60}Ni, ^{46,47,49,50}Ti – quick review: fairly good

Conclusions

Systematic review of covariances in ENDF/B-VII.0 and ENDF/A (30 materials)

- VII.0: Deficiencies in 6 materials
- ENDF/A: Deficiencies in 10 materials

Typical deficiencies

- Unrealistically low uncertainties (< 1%)
- Uncertainty decline in RRR high-end
- Mismatch between RRR and fast region

Actions needed to fix deficiencies

Parties involved: BNL, LANL, ORNL, IAEA