Status of WPEC Subgroup 26 Work on Covariances

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Uncertainty and Target Accuracy Assessment for Innovative Systems Using Recent Covariance Data Evaluations

WPEC Subgroup 26: chair Salvatores, established in 2005

- Identify nuclear data needs using well justified technical procedures
- Perform sensitivity analysis for Na, gas and Pb cooled fast reactors
- Considerable amount of covariance data needed

Requested covariance data

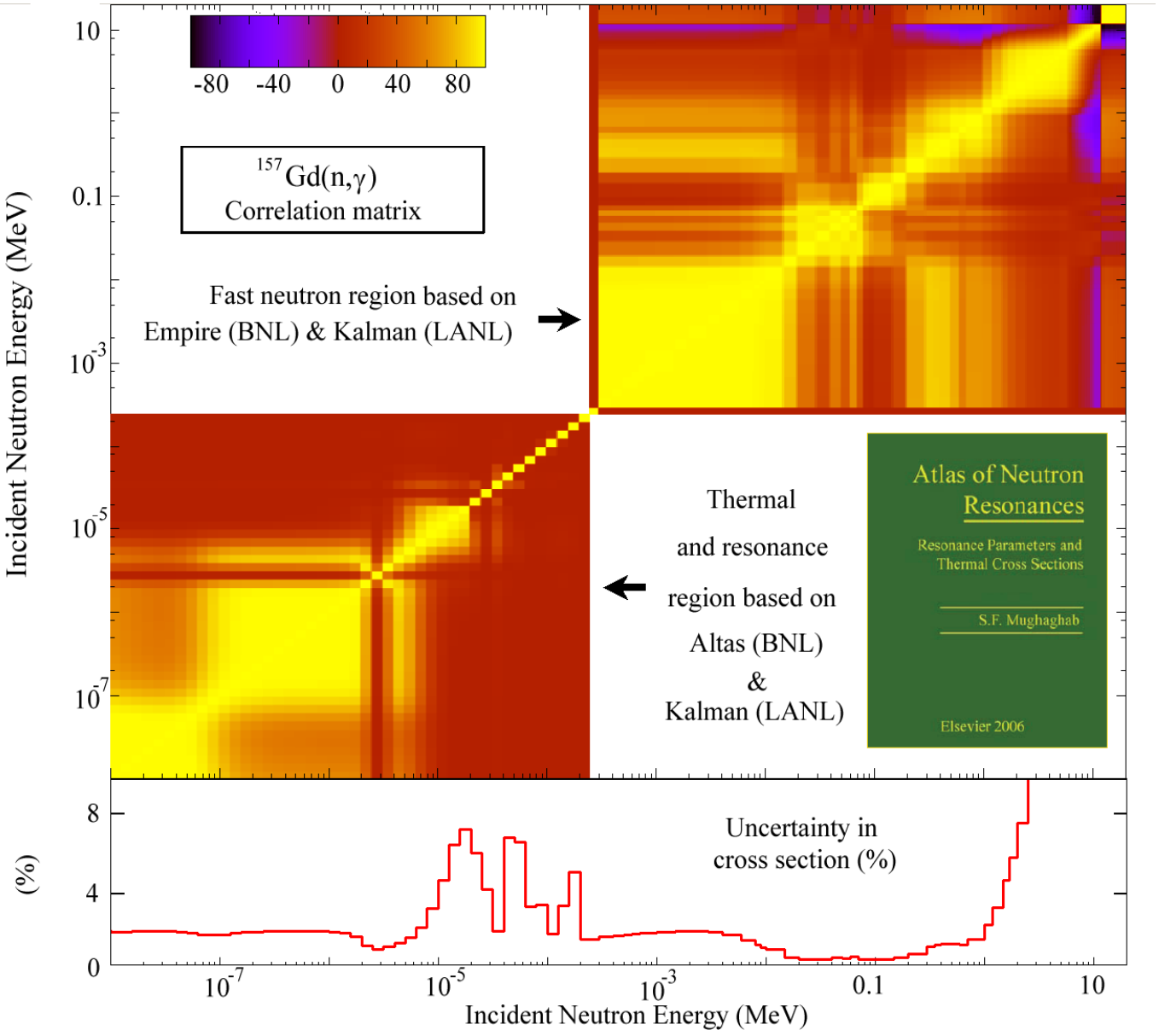
- 19 actinides, 26 structural, 8 light nuclei = 53 materials in total
- (n,el), (n,inl), (n,2n), capture, (n,f), nu-bar
- 15-energy groups

Covariance data contributed by BOLNA labs

- **B**NL: 36 materials (Atlas-Empire-Kalman estimates)
- **O**RNL/**L**ANL: ^{235,238}U and ^{239}Pu (evaluations for VII.1)
- **N**RG Petten: Pb isotopes (Monte Carlo estimates)
- **A**NL: Light nuclei (educated guess)

Covariance methodology used by BNL

Atlas-EMPIRE-KALMAN



Nubars:

- v-bar energy dependence approximated by a linear function.
- Thermal & higher energy data considered, propagated with KALMAN.

BNL covariances

Should be treated as preliminary, review is underway

Low energies

- Thermal capture and fission: Comparison with $\Delta\sigma_{thermal}$ in Atlas done
- Resonance integrals: Comparison with ΔRI in Atlas done
- In quite a few cases considerable differences → Review is underway

Fast neutron region

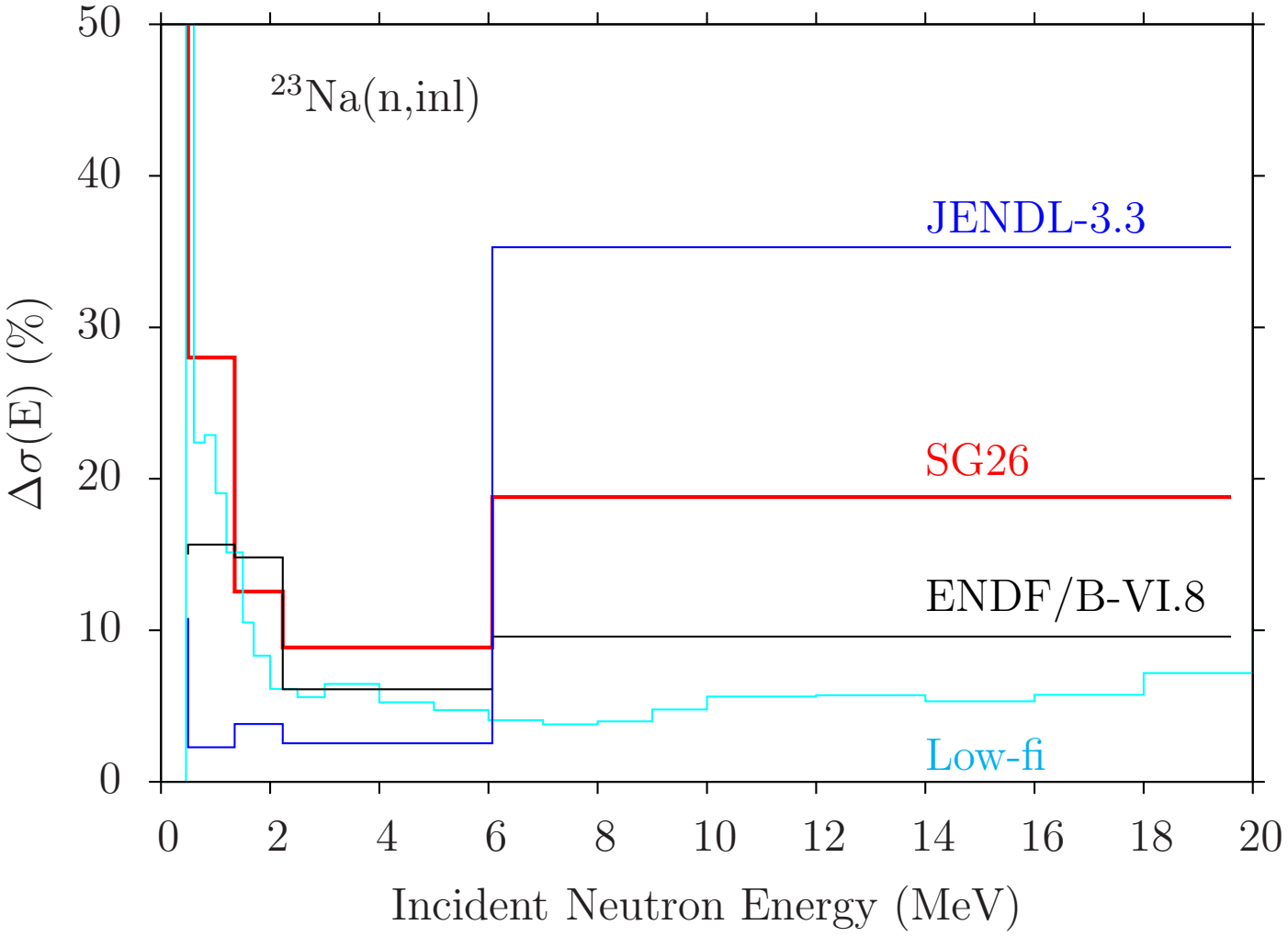
- (n,el), (n,2n) and (n,γ) looks reasonable
- (n,n') for ^{56}Fe too high, probably also ^{28}Si, ^{23}Na → Review is underway
- (n,f) higher Pu to be checked, Cm may be too high → Review underway

Nubars

- ν-bar energy dependence approximated by a linear function
- Thermal and higher energy data considered, propagated with KALMAN
- Review is underway

BNL covariances: Example

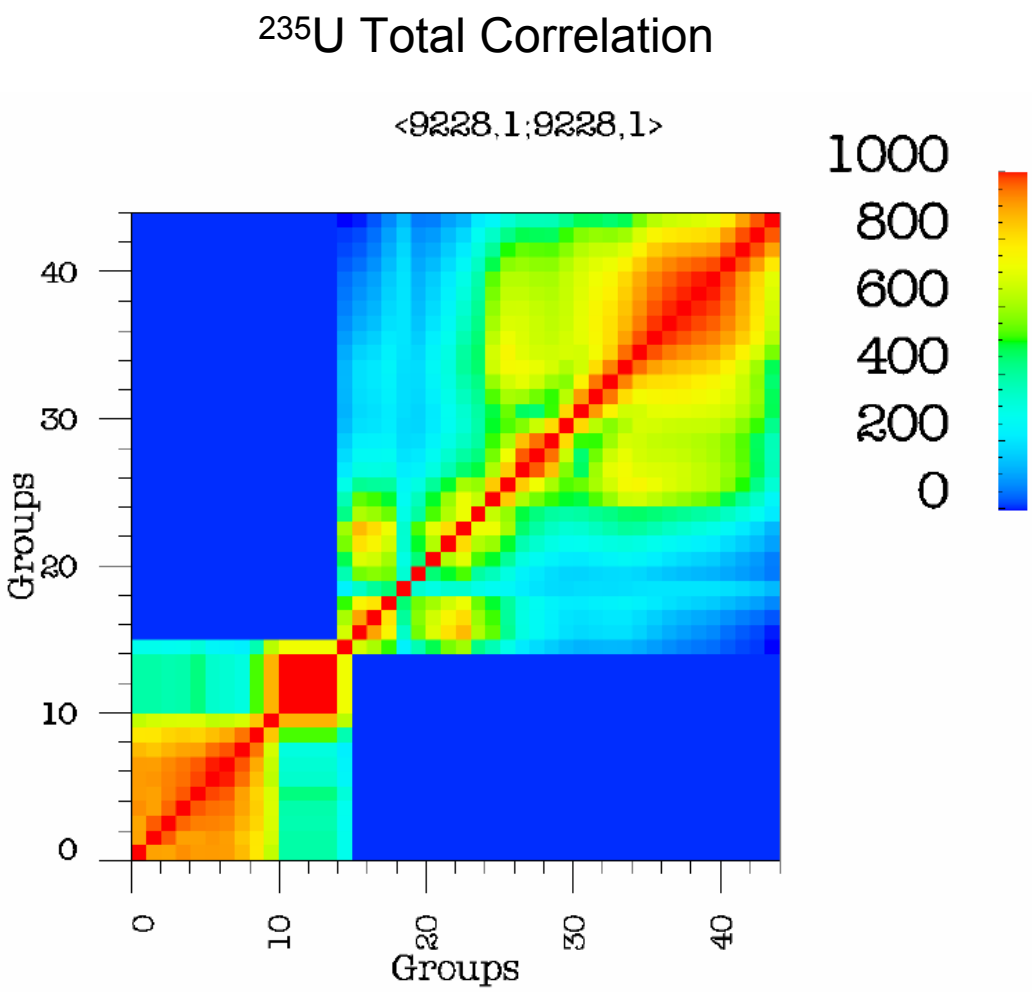
(n,n') for ^{56}Fe and ^{23}Na particularly important



ORNL-LANL covariances

^{235,238}U and ^{239}Pu

- ORNL resonance analyses with SAMMY R-matrix code to produce new RPCM for ^{235}U, ^{238}U and ^{239}Pu
  - Retroactive resonance analysis for ^{235}U and ^{238}U—no change to existing ENDF/B File 2 parameters
  - New resonance evaluation for ^{239}Pu
- LANL high-energy GNASH-KALMAN analyses
  - Experimental errors (statistical and systematic) are from EXFOR and literature
  - Correlation from systematic errors



ORNL-LANL covariances

^{235,238}U and ^{239}Pu, some examples

ORNL, low energy region

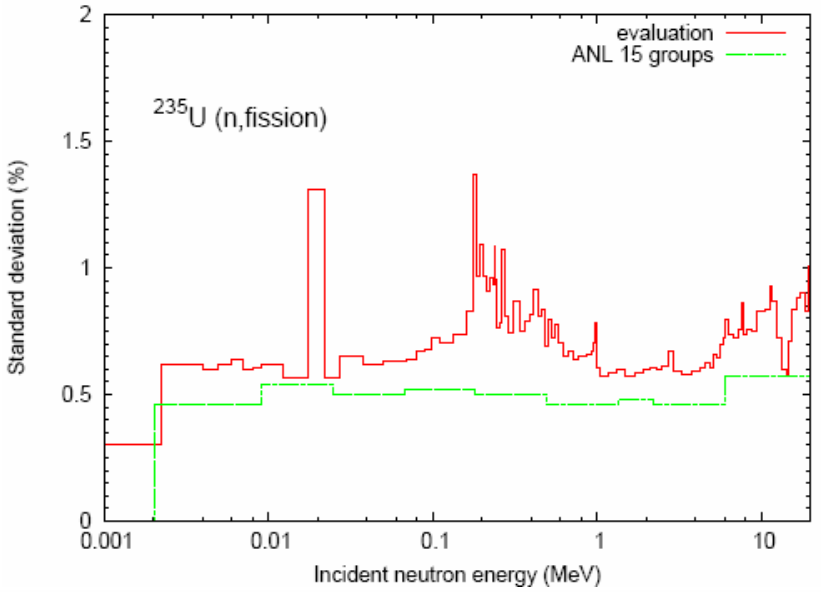
^{235}U RRR+URR, retroactive SAMMY

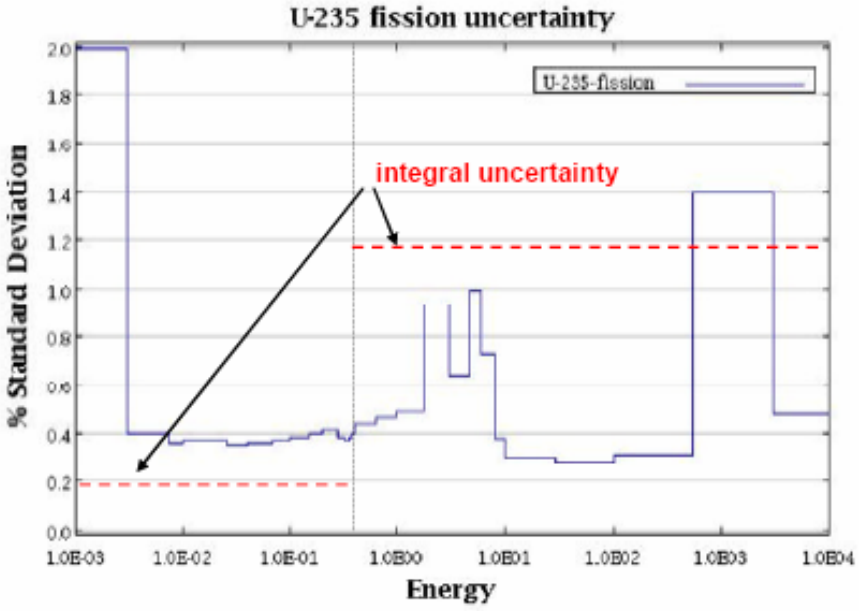
^{238}U RRR, retroactive SAMMY

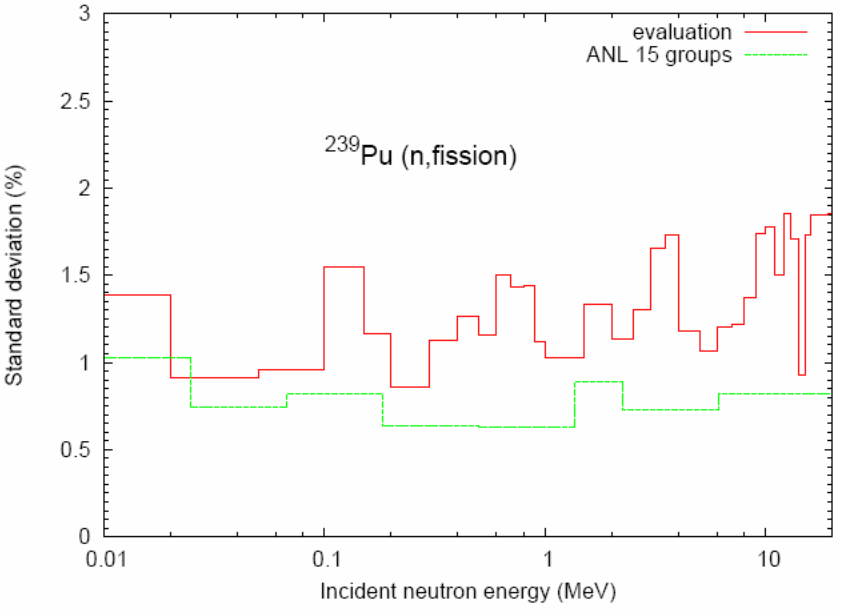
^{239}Pu RRR, direct SAMMY method

LANL, fast neutron region

GNASH-KALMAN method

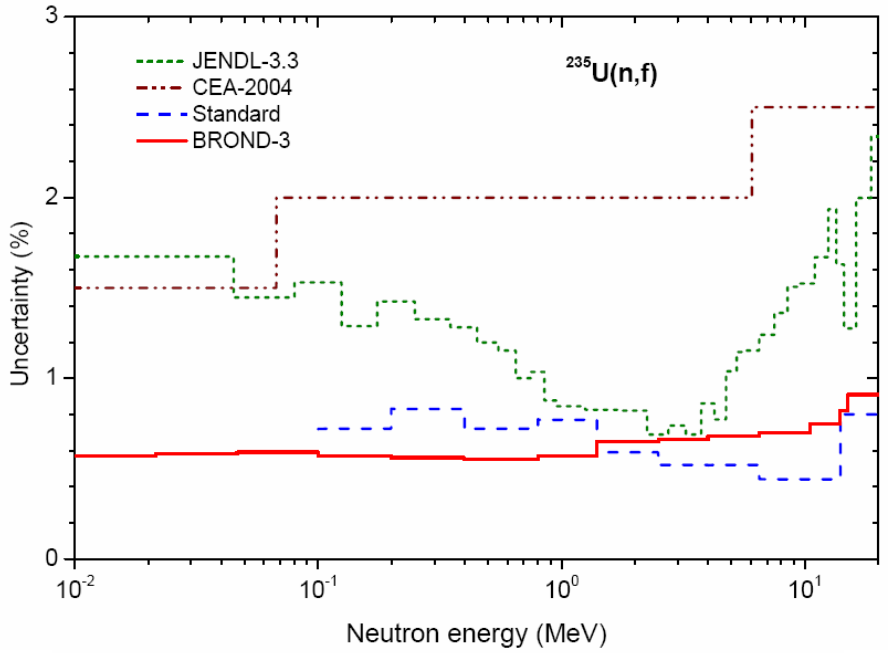




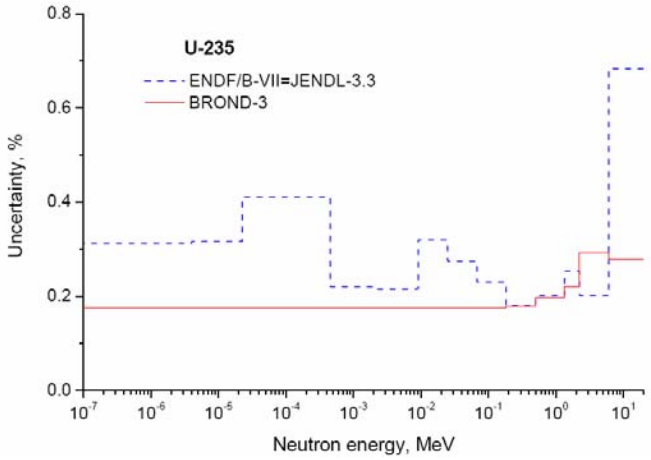


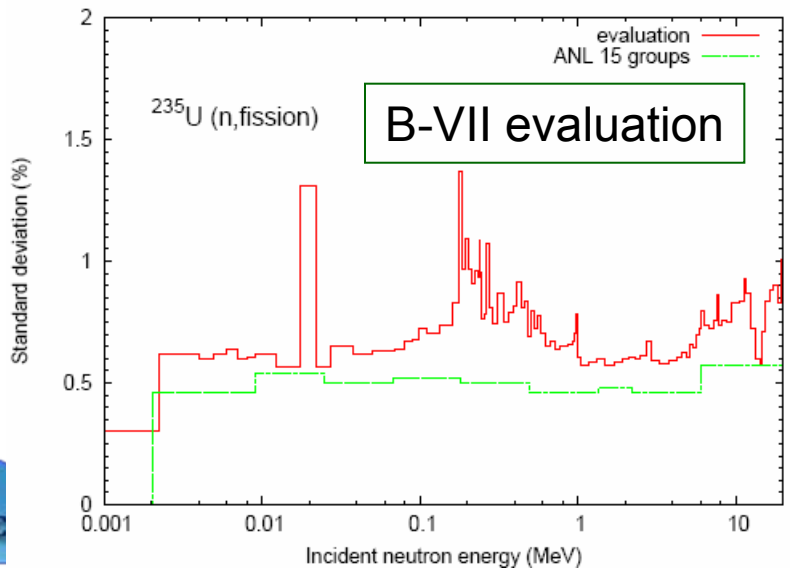
Ignatyuk: Covariances for actinides

Comparison with BROND-3



Uncertainties of the fission-neutron multiplicities for U-235





Multiplicities averaged over the Cf-252 fission-neutron spectrum

	U-235	U-238	Pu-239
ENDF/B-VII	2.647	2.619	3.166
uncertainty	0.163%	0.888%	0.155
BROND-3	2.718	2.668	3.230
uncertainty	0.224%	0.428%	0.223%

SG26 Concluding Meeting

Prague, October 19, 2007

Covariance/uncertainty data needs and issues

- (n,n'): ^{238}U (2-3% !!), ^{56}Fe (3-6%), ^{23}Na (4-10%), also Pb isotopes
- Pu: mostly ^{240,241}Pu, fission, nubar, capture (often < 2-3% needed)
- ^{238}U and ^{239}Pu capture (~1-500 keV), uncertainties to be reduced by factor of 2
- MA: ^{242m,243} Am, ^{243}Cm fission (3-7%, for burner), also (n,n') for ^{243}Am
- Low values for major actinides should be resolved (e.g. ^{239}Pu(n,f) is well below 1%) → already addressed in Oct 2007 report by LANL
- Other …

Additional requirements for covariance data

- Fission energy spectra
- mu-bar (scattering average cosine) for ^{16}O, ^{23}Na and ^{56}Fe
- Cross correlations

SG26 report and future work

- Draft already available, final version in spring 2008
- Follow-up SG proposed: Methods and issues for the combined use of integral experiments and covariance data