Covariance Work at LANL

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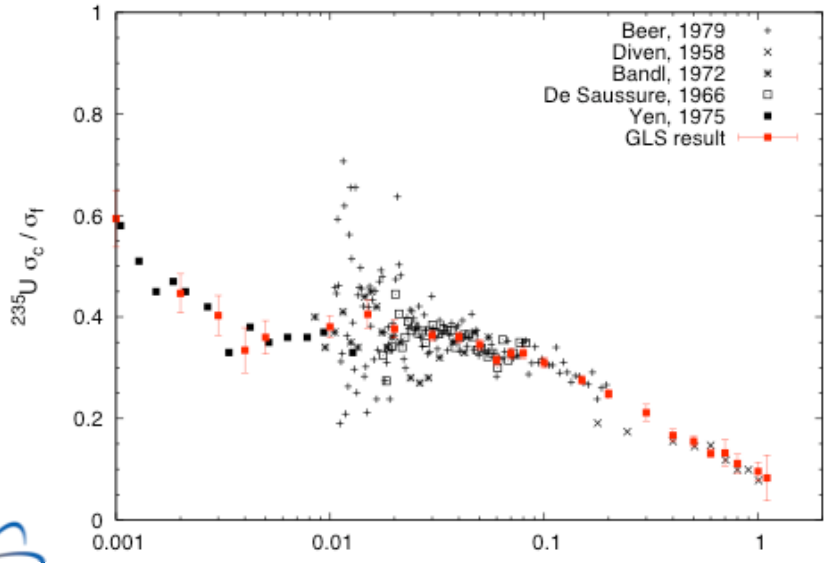
Uncertainty Quantification (UQ) Methodologies

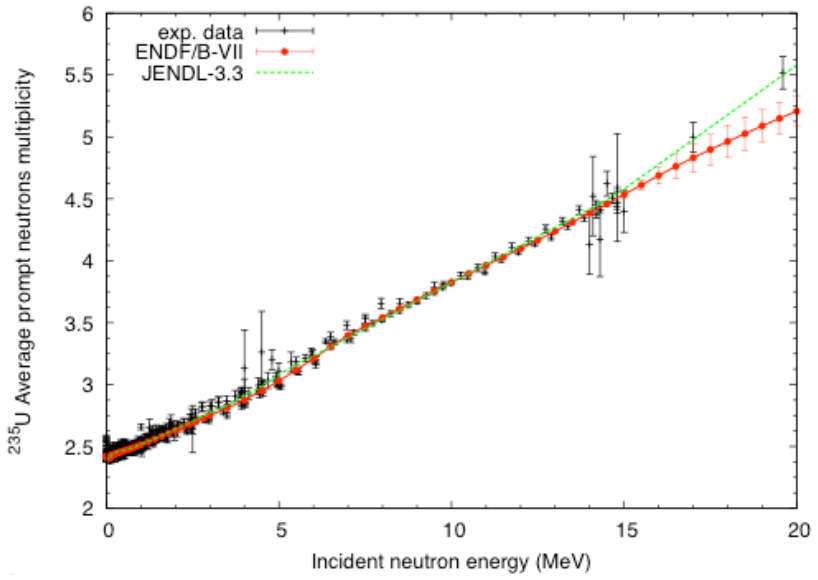
- **"High-fidelity" UQ for Major Actinides**
  - ^{233,235,238}U and ^{239}Pu (LANL/ORNL)
- **"Low-fidelity" UQ for Minor Actinides**
  - From ^{225}Ac to ^{255}Fm
- **Very precise ("High-fidelity"?) R-Matrix analysis for some light elements**
  - ^{1}H, ^{6}Li, ^{10}B
- **"Low-fidelity" UQ for other light elements**
  - From ^{1}H to ^{19}F (except for ^{7}Li)
- **UQ for prompt fission neutrons spectrum**
  - First calculations for ^{235}U+n(0.5 MeV)

"High-Fidelity" UQ for Major Actinides: ^{235,238}U and ^{239}Pu

P.Talou, T.Kawano and P.G.Young, ND2007 Proceedings, p.293

- **Closely follows the ENDF/B-VII.0 evaluation procedure**
- **Uses both model parameters and experimental data uncertainties**
- **Codes: GNASH, CoH, KALMAN, GLUCS, SOK**
- **^{235}U fission cross-section covariance from IAEA Standards Evaluation**

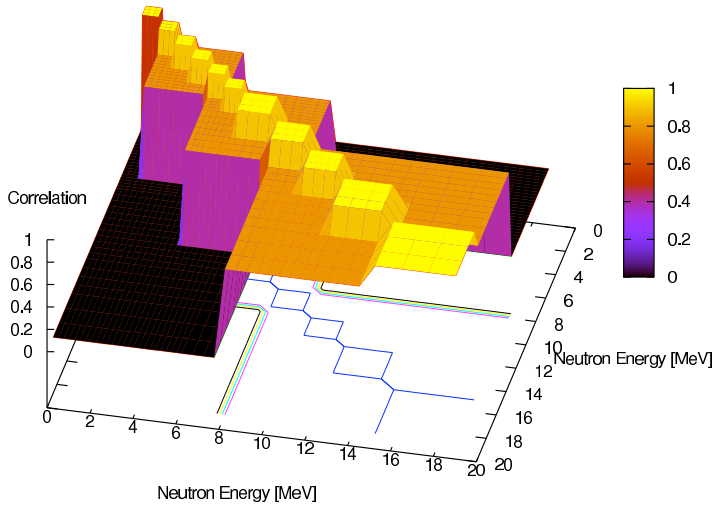




"Low-Fidelity" for Minor Actinides
(DOE Criticality-Safety Program)

T.Kawano, "Covariance Workshop", Port Jefferson, June 2008

- Minor Actinides from ^{225}Ac to ^{255}Fm
- KALMAN calculations using CoH and GNASH reaction codes
- Default global optical model potential Koning-Delaroche
- Sensitivity to the model parameters
- Simplified UQ on fission cross-sections

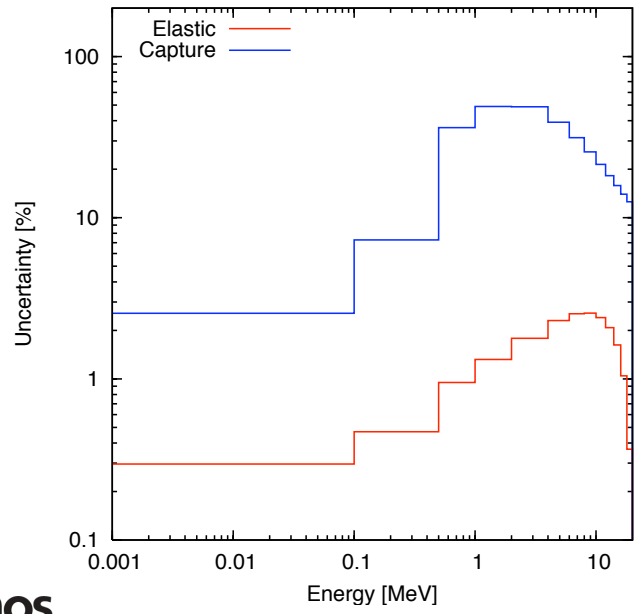


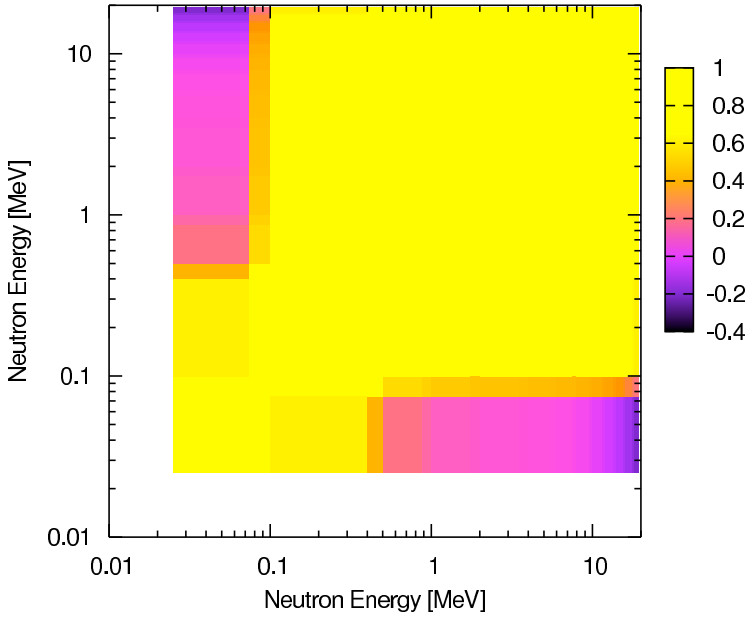
The common structure of correlation matrix for fission cross-sections of MA

R-Matrix Analysis of Light Elements

G.Hale, "Covariance Workshop", Port Jefferson, June 2008

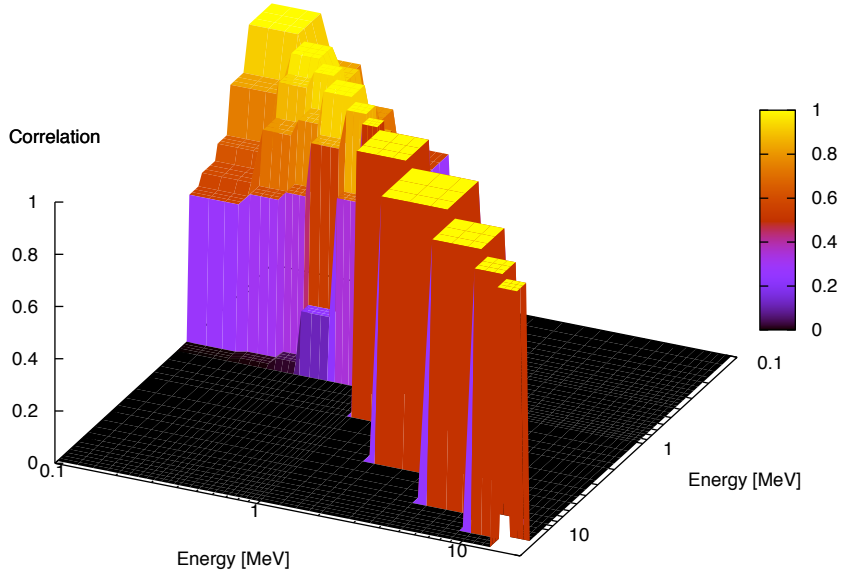
- **Very precise analysis with EDA code**
  - Elastic and capture on ^{1}H evaluated in the entire energy range
  - Standards evaluation: small uncertainties and strong correlation
  - Ideal case for covariance evaluation





“Low-Fidelity” UQ for other Light Elements

- **Different evaluation procedures depending on the elements**
  - R-matrix, least-squares fitting, simple interpolation, guess, …
  - Resonance parameter covariance matrices not available
  - Many “derived” cross-sections: $(n,\alpha)=(n,\alpha_0)+(n,\alpha_1)+\ldots$
- **LANL covariance data for elements ^{1}H to ^{19}F**

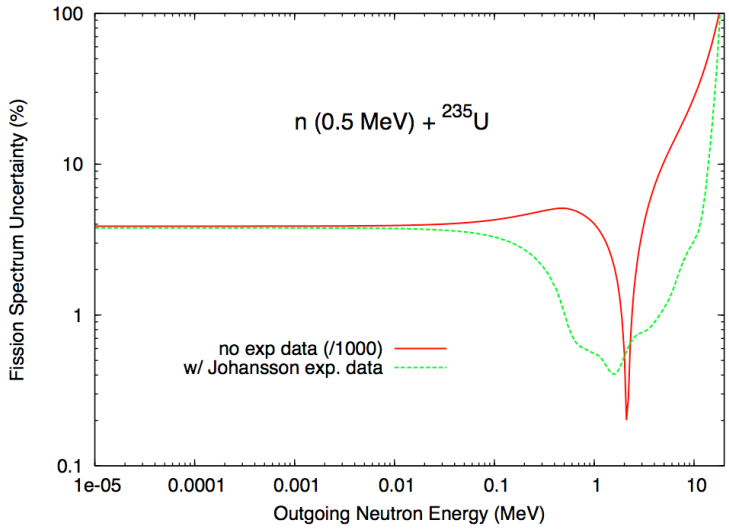


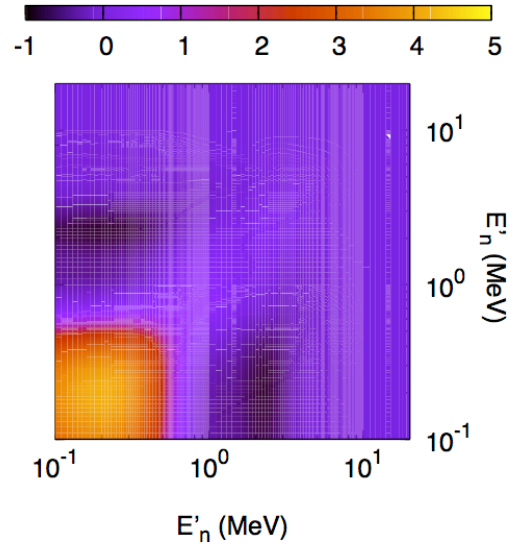
T.Kawano, “Covariance Workshop”, Port Jefferson, June 2008

UQ for Prompt Fission Neutrons Spectrum PFNS

- Follows "high-fidelity" UQ for major actinides
- Los Alamos model for PFNS calculations
- Combines model sensitivity calculations with experimental data with the KALMAN code
- First test case: n(0.5 MeV)+^{235}U

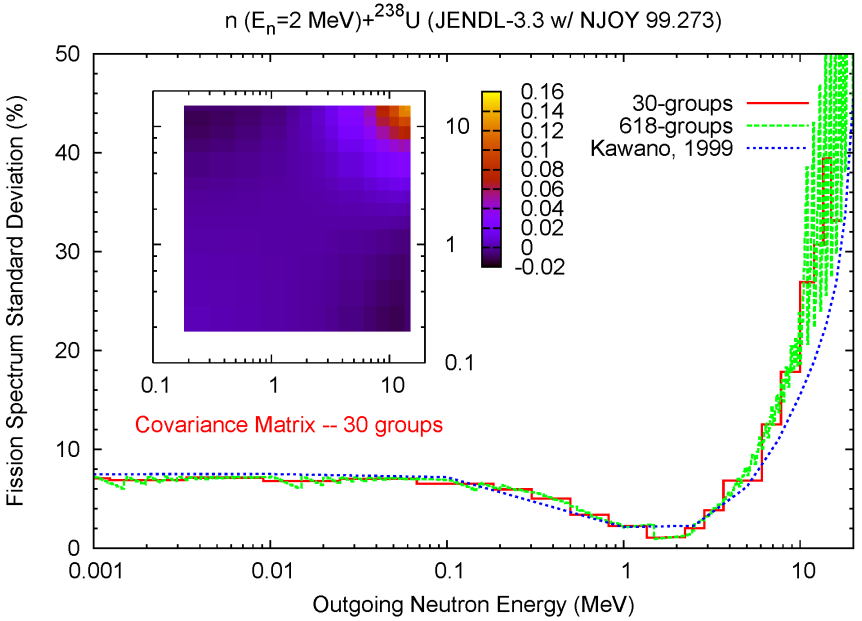
P.Talou, D.G.Madland, T.Kawano,
"Covariance Workshop", Port Jefferson, June 2008





NJOY Processing Code Upgrades

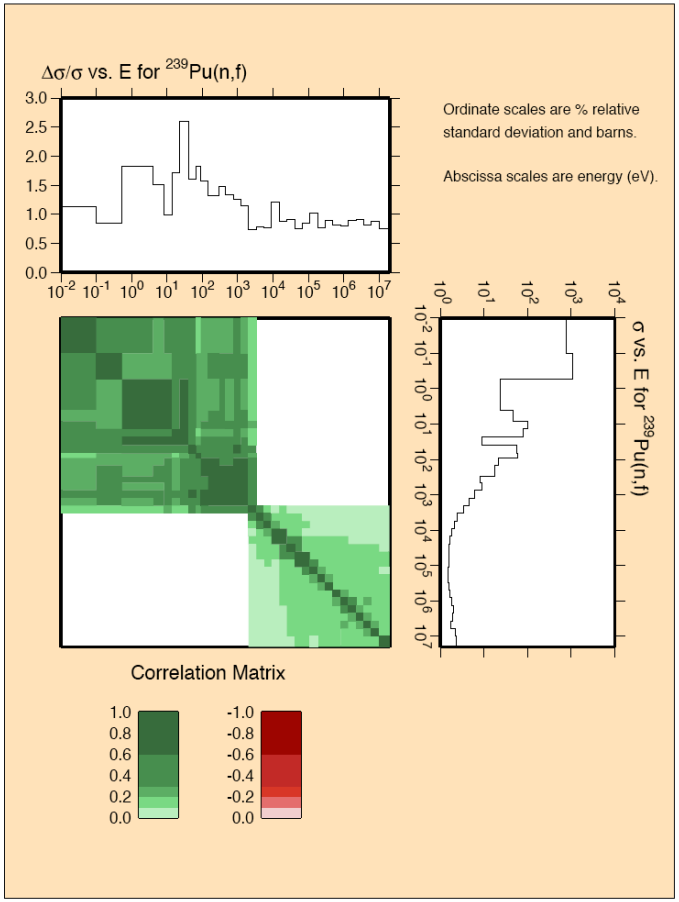
- **New NJOY version 99.275**
  - Includes version ERRORJ v.2.3
  - Successful runs of test cases from Go Chiba (JAEA)
  - Additional testing:
    - Prompt fission neutrons spectra (MF35)
    - Very fine energy-group structure (618 energy groups)
- **Successful processing of latest ORNL/LANL covariance files for ENDF/B-VII.1**

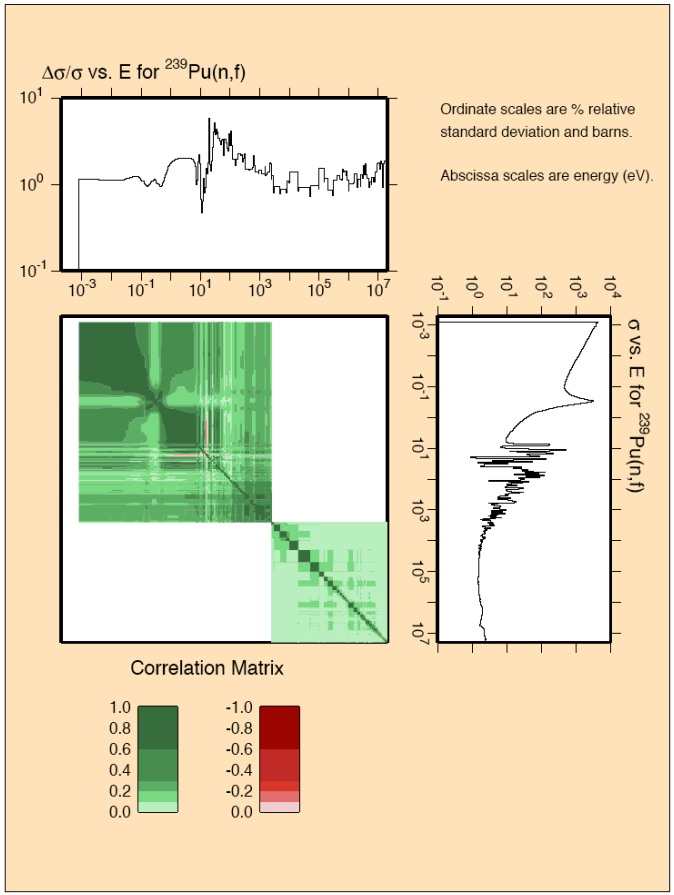


A.C.Kahler, "Covariance Workshop", Port Jefferson, June 2008

NJOY 99.275 Processing of ^{233,235,238}U and ^{239}Pu files

Example: ^{239}Pu in 33 and 618 groups





Future work

- **UQ of evaluated nuclear data is an ongoing process**
- **Improvements for *specific* LoFi covariance evaluations**
  - Elements and reactions of importance to be specified
- **UQ on PFNS to be completed for ^{235,238}U and ^{239}Pu**
- **Continuous testing and upgrading of the NJOY processing code**
- **Testing of Covariance Matrices**