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Fission yields and cross sections: correlated or not?

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Summary

- Motivation/examples
- Considered system and results
- Conclusion

BFMC + integral data

- Motivation 1: integral data are already used during adjustment
- Motivation 2: This should be done at the evaluation level
- Motivation 3: It leads to uncertainty reduction and cross-isotope correlations
- Motivation 4: nothing new: already done with GLLS by SG… at the OECD

- BFMC:
  - Generate n=5000 random FY and XS libraries based on ENDF/B-VIII.0 covariance
  - Calculate n times the benchmark
  - Assign weights to all realizations *i* with a chi2 and update the parameter distributions

For a random file i and a set of p benchmarks:

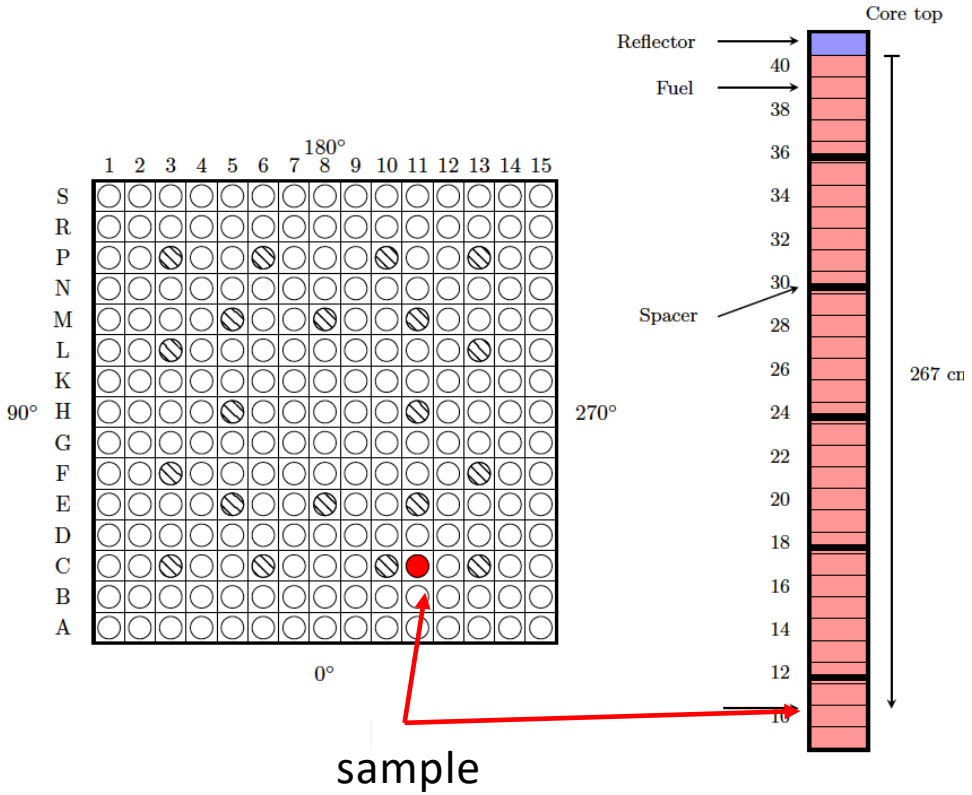
$$\chi_i = \sum_j^p \left(\frac{k_{eff,i}^{(j)} - k_{exp}^{(j)}}{\Delta k^{(j)}} \right)^2 \quad (1)$$

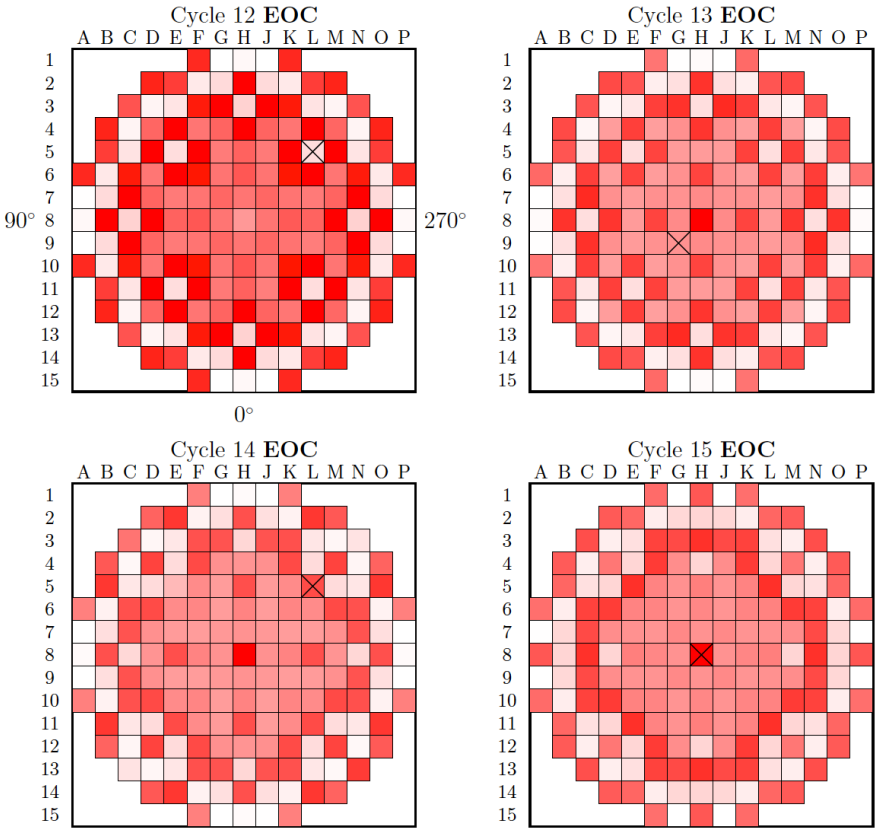
$$w_i = \exp(-\frac{\chi_i}{2}) \quad (2)$$

  - Update the cross sections with the weights.
- System: PIE sample called GU1, simulated with CASMO (18 actinides, 32 fission products measured)

PIE data: GU1 sample

- PIE data: isotopic concentrations from irradiated samples in a specific reactor
- Measured actinides and fission products (e.g. in mg/gU)
- Used for transport and depletion code validation





Results

- Production of some measured fission products depends on both FY and XS

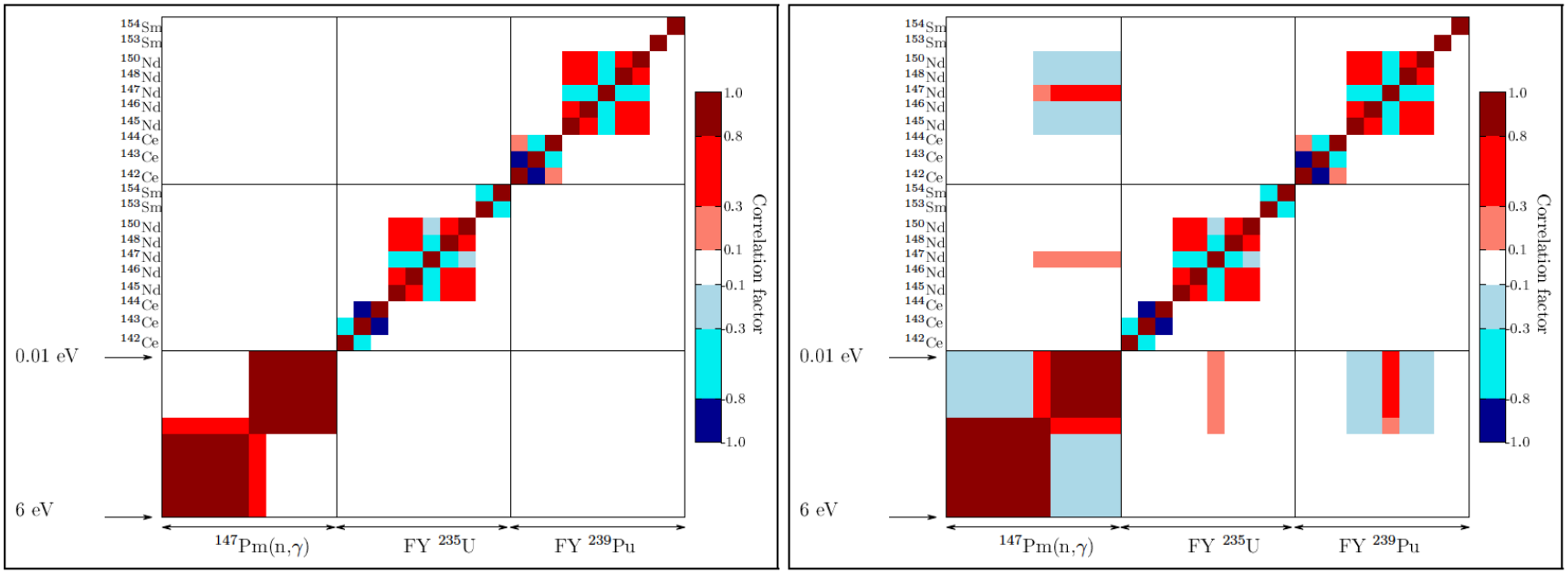


Fig. 4. Case of correlations between ^{147}Pm(n,γ) and fission yields from ^{235}U and ^{239}Pu. Left: prior correlation matrix without PIE data; Right: posterior correlation matrix using the PIE measurement from ^{147}Sm.

Results

- Production of some measured fission products depends on FY from a few actinides

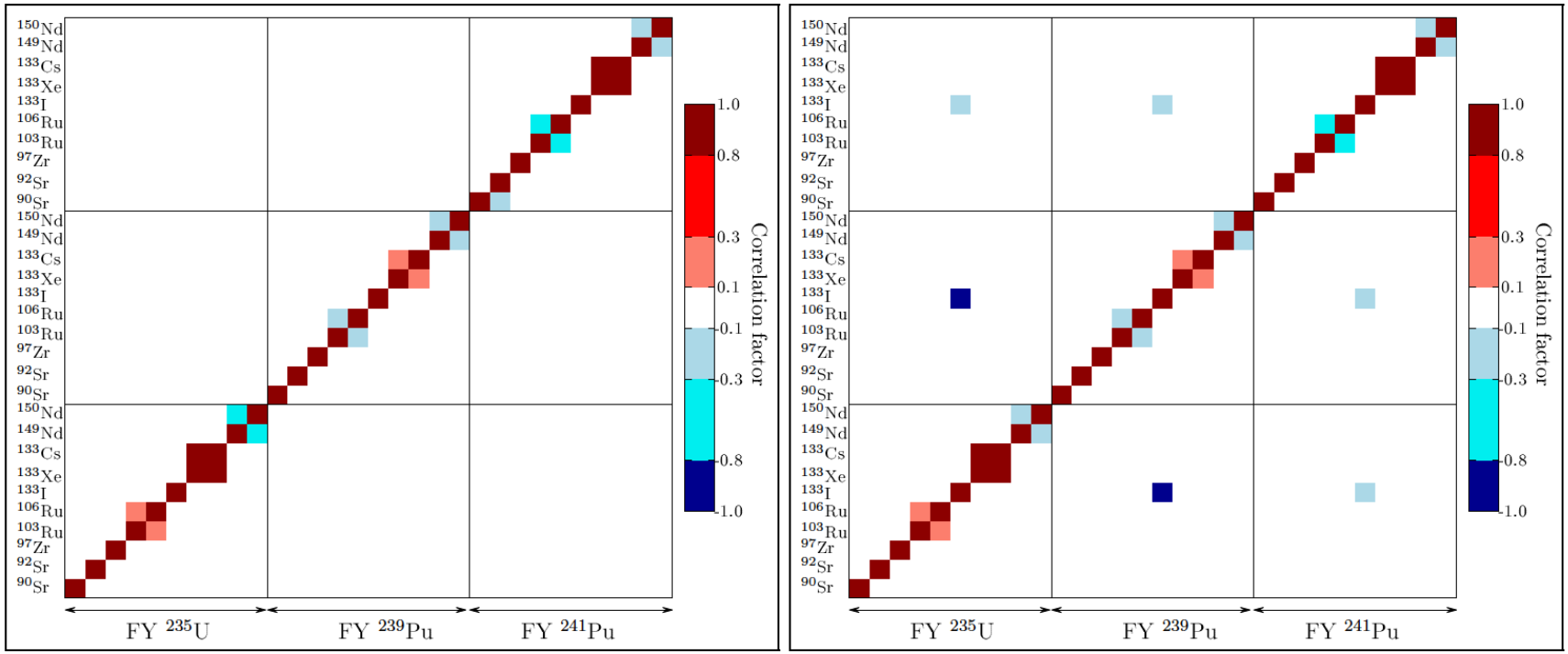


Fig. 3. Case of correlations between fission yields from ^{235}U, ^{239}Pu and ^{241}Pu. Left: prior correlation matrix without PIE data; Right: posterior correlation matrix using the PIE measurement from ^{133}Cs.

Conclusions

- Last example of correlations between nuclear data, after XS-XS, XS-nu, XS-nu-PFNS,
- Such correlations can improve calculations of integral quantities and answer requests from a number of users
- Because such correlations are constructed with specific measurements, and are case dependent, it is advocated that such correlations (and adjusted nuclear data) find their place in dedicated adjusted libraries
- This possibility can improve the user's satisfaction, but also emphasizes the fact that current nuclear data evaluations do not lead to a unique set of cross sections, nubar or fission yields.

References on correlations

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