Starter files for the GNEP (AFCI) Covariance Library

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BROOKHAVEN NATIONAL LABORATORY

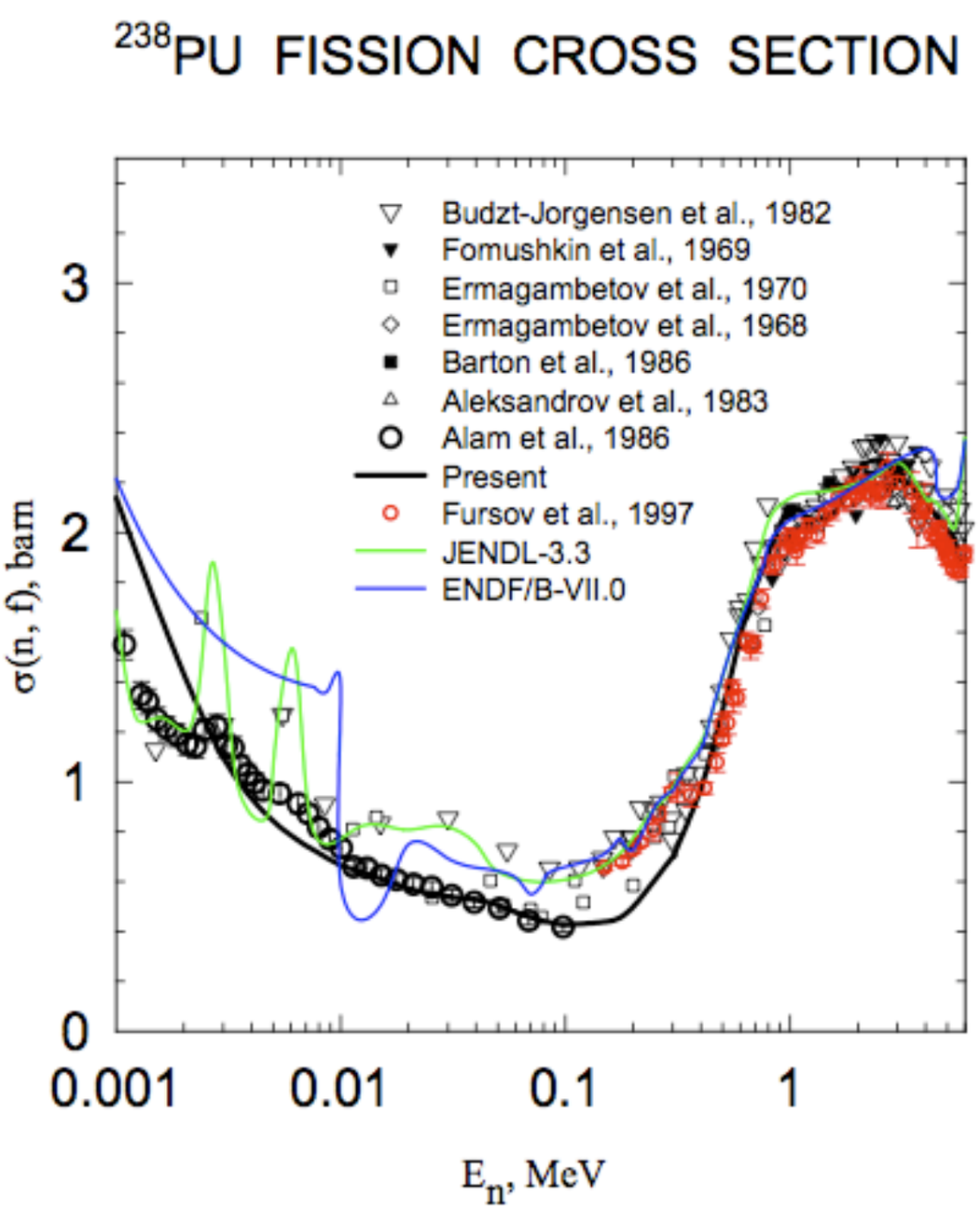
Goals:

- Produce processed 33-multigroup covariances for 108 isotopes of interest (66 high-priority)
- Deliver covariances in user-friendly format
- Plan for further development of the covariance library

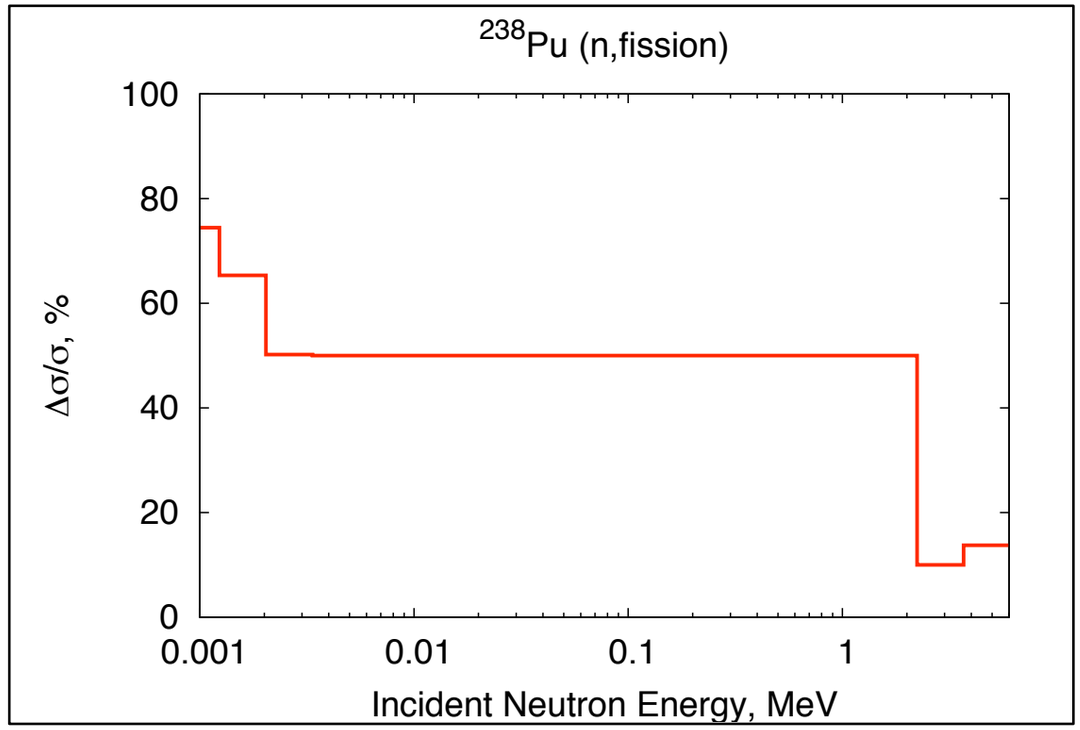
Contents of the Library

- Covariance data for the 108 isotopes taken from multiple sources:
  - ENDF/B-VII, 8 isotopes including ^{232}Th, $^{155\text{-}160}$Gd, ^{99}Tc
  - JENDL-3.3 (^{23}Na and ^{56}Fe)
  - ENDF/A (LANL evaluations for 4 major actinides)
  - BNL evaluations of ^{55}Mn and ^{90}Zr (M.Pigni presentation)
  - V. Maslov (14 minor actinides)
  - "Low-fidelity" estimates from BNL/ORNL/LANL used for most structural materials, fission products, and light nuclei: 75 total.
  - For some materials, revised estimates for (n,γ) thermal and RR uncertainties were provided by Norm Holden (BNL).

Minor Actinides:

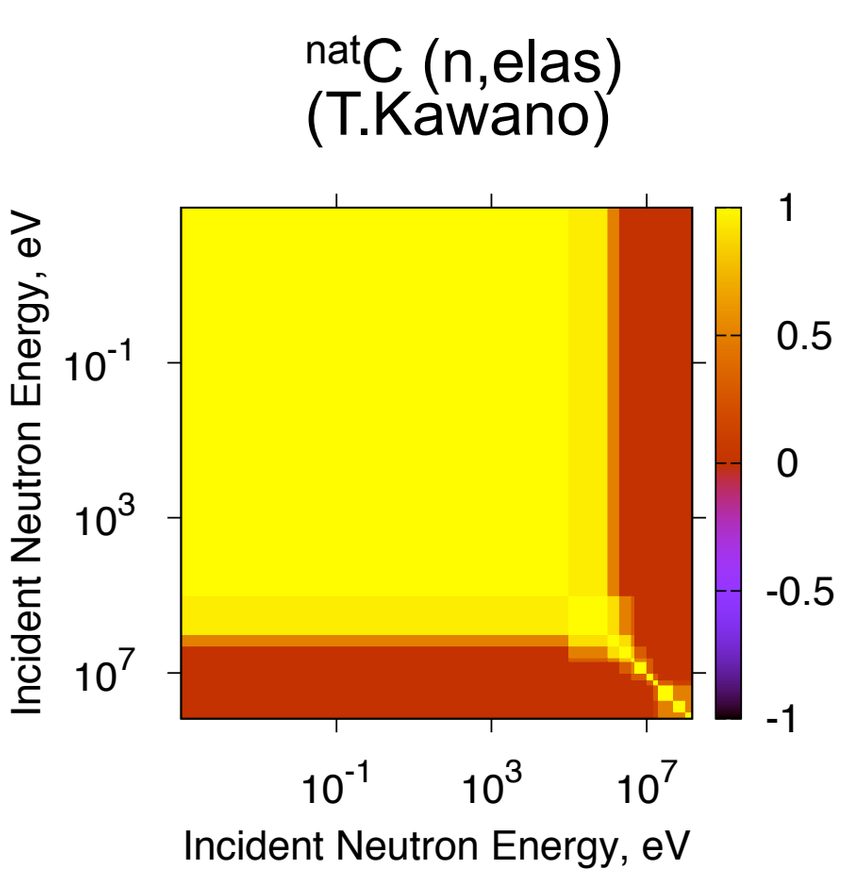


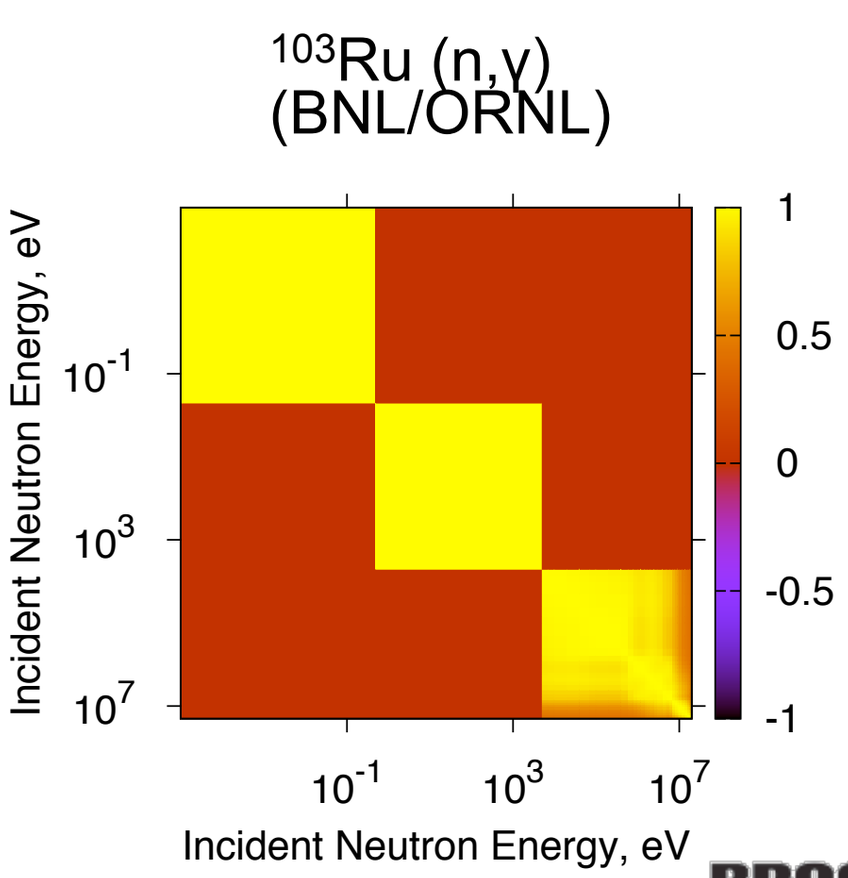
- Experimental data was considered, uncertainties adjusted
- Off-diagonal elements of covariance matrix *not* adjusted
- Example courtesy of V.Maslov, from Port Jefferson workshop



Low-fidelity:

- Intended as a simple covariance analysis for *all* isotopes in ENDF/B-VII
- In general does not account for experimental results
- See also Little *et al,* current edition *NDS*



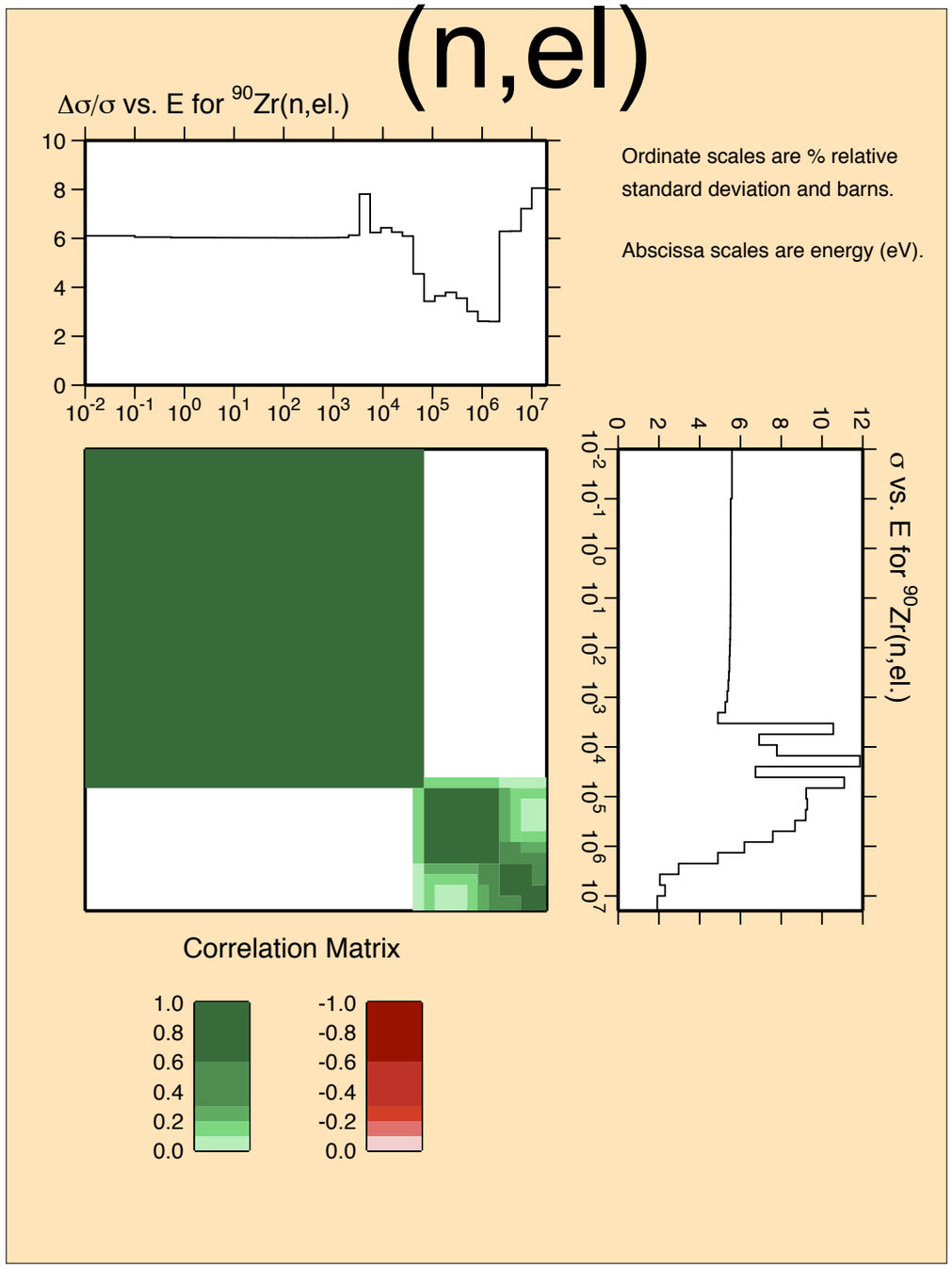


To 33-multigroup format:

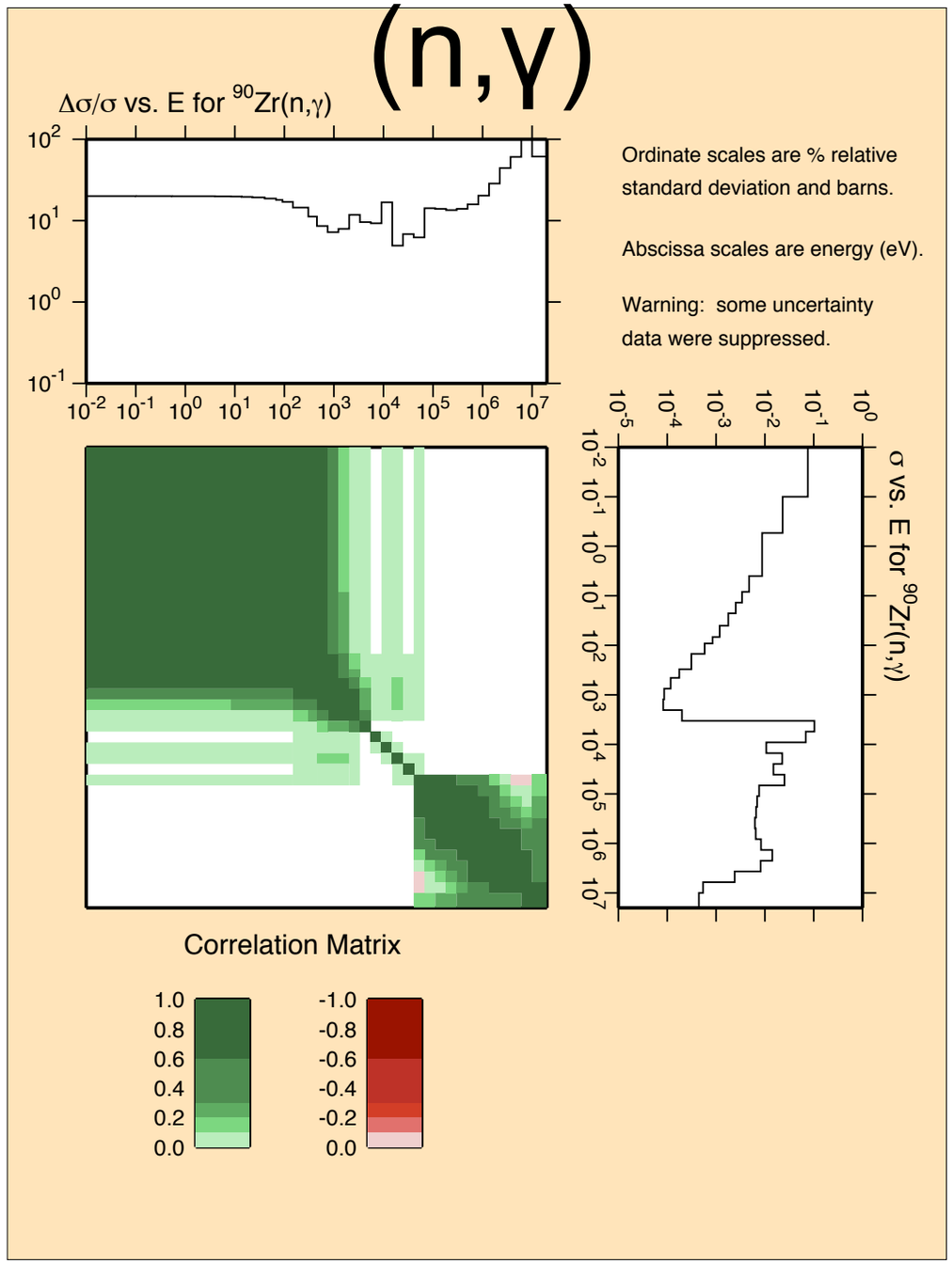
- The isotopes (excluding minor actinides) were processed with NJOY-99.279 (testing version). Details in earlier talk by R. Arcilla
- <u>Results have been inspected individually. A few issues appear:</u>
  - no (n,elastic) thermal uncertainty estimate for 22 isotopes in low-fidelity (probably not a big issue for GNEP library)
  - In some cases, uncertainties in fast region are outside the range expected based on optical model; these deserve closer look
  - Off-diagonal elements for the minor actinides should be treated with caution

33-group results for ^{90}Zr:

(n,el)



(n,γ)



Formatting:

- Ascii output from NJOY:
  - only 3 significant digits
  - may be difficult to parse

```
<<< correlation matrix >>>
column material mat-mt=(9437,  2)  vs  row material
   row   1    2    3    4    5    6    7    8    9
column-----------------------------------------------
   1  1000  623  172  179  184  105  102  147  137
   2   623 1000  613  357  275  145   95   83   58
   3   172  613 1000  792  641  402  287  198  155
   4   179  357  792 1000  929  658  524  404  343
   5   184  275  641  929 1000  879  785  686  629
   6   105  145  402  658  879 1000  980  933  896
   7   102   95  287  524  785  980 1000  980  956
   8   147   83  198  404  686  933  980 1000  992
   9   137   58  155  343  629  896  956  992 1000
```

- Higher precision option:
  - NJOY writes the covariance matrix in ‘BOXER’ format, with optional binary flag. Higher precision found here
- NJOY outputs not suitable for reactor engineers, a new format was proposed (G.Palmiotti) to contain results for all isotopes in single file. Format is under discussion