

AMPX Cross-Section Processing Status

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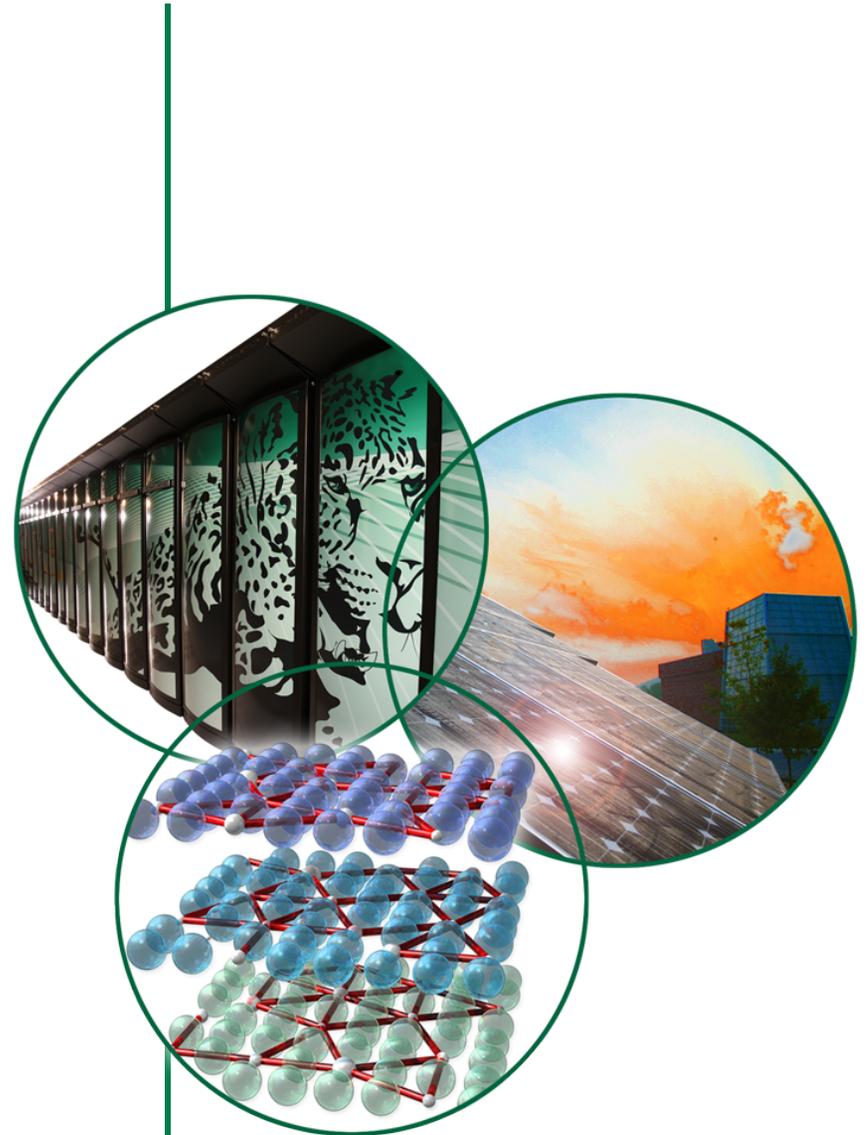
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CSEWG MEETING



U.S. DEPARTMENT OF
ENERGY

 **OAK RIDGE NATIONAL LABORATORY**
MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

Process ENDF/A Files containing covariance matrices

Comparison is done two different ways, always using a flux of $1/E$

Use the new PUFF-IV option

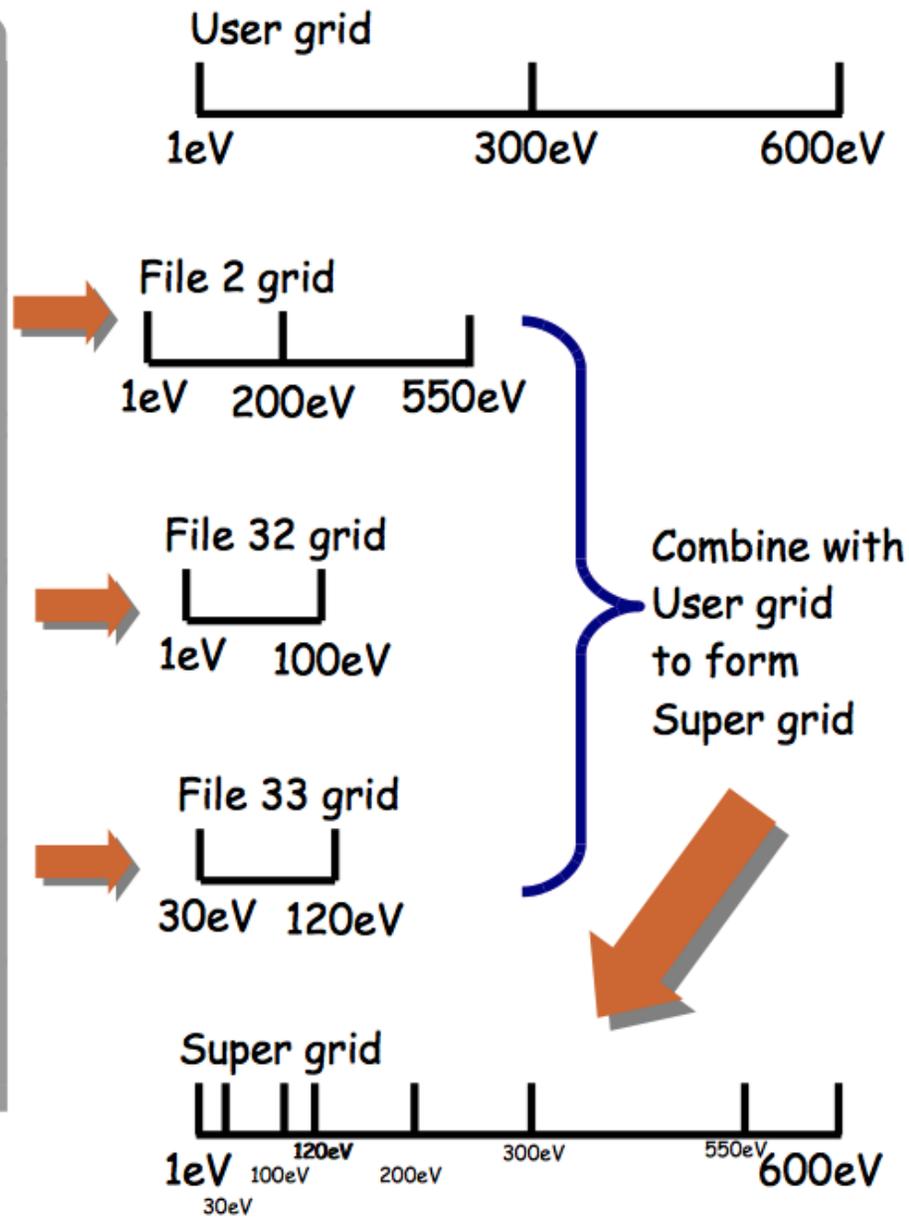
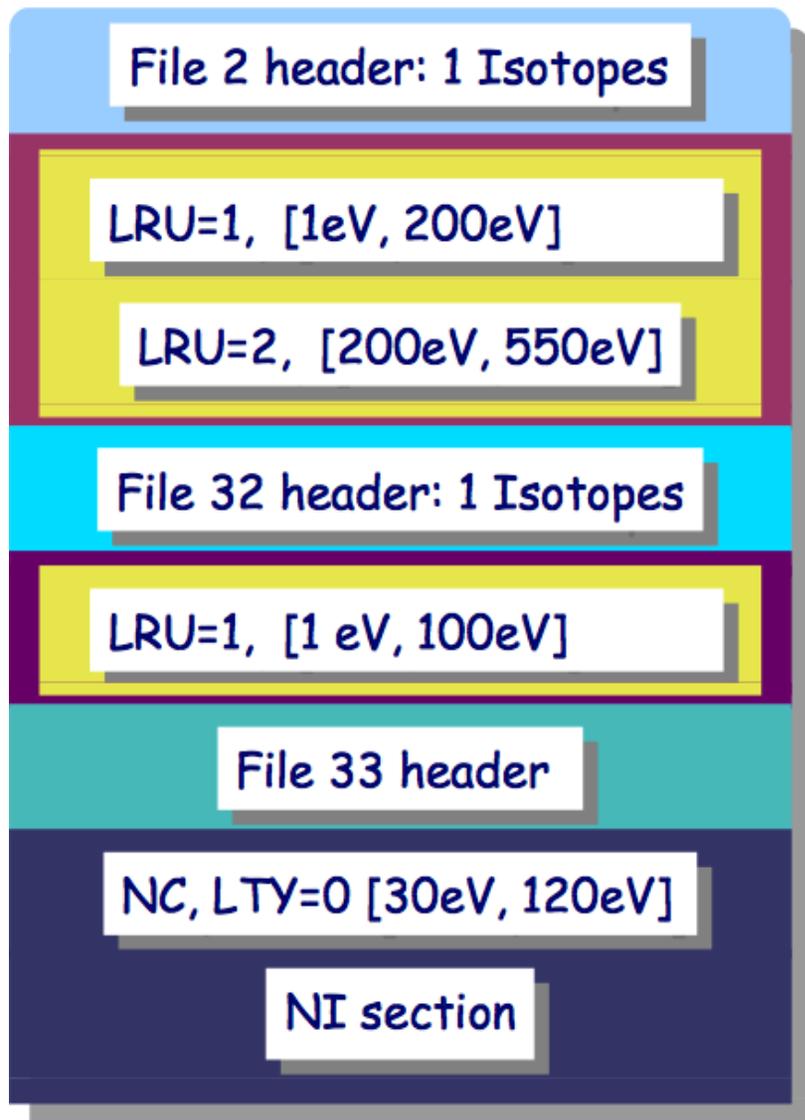
- Point-wise cross section at 300K are generated using AMPX
- Run PUFF-IV
- Use AMPX to generate a PENDF file to use with ERRORR
- Run ERRORR

Use an existing MG library

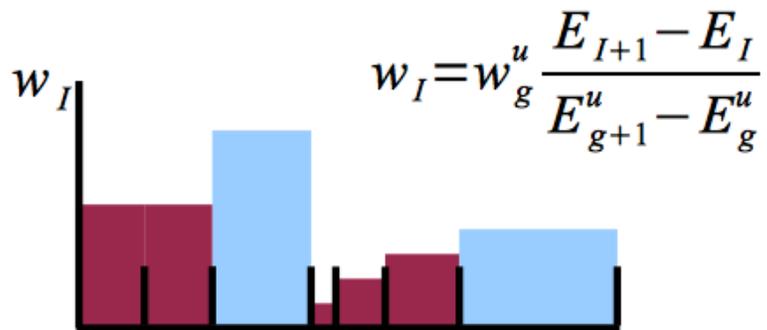
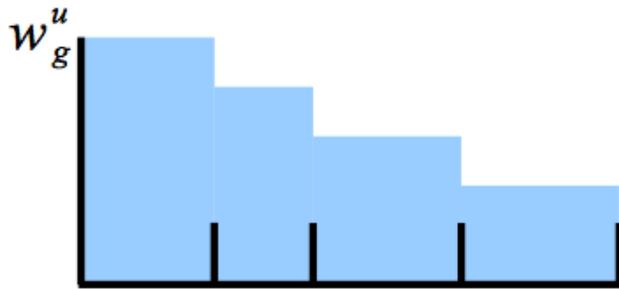
- MG library at 0 K is produced using NJOY.
- Use AMPX to convert NJOY GENDF file to AMPX master
- Run PUFF-IV
- Run ERRORR

Covariance matrices are compared with module COVCOMP.

Input files are automatically generated using a custom template in Exsite.

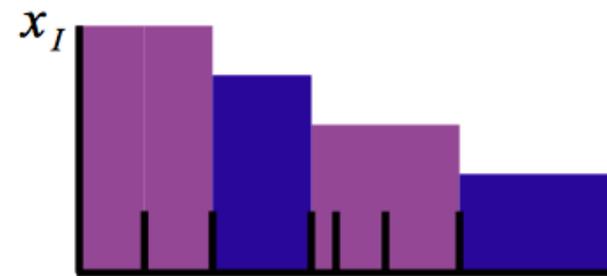
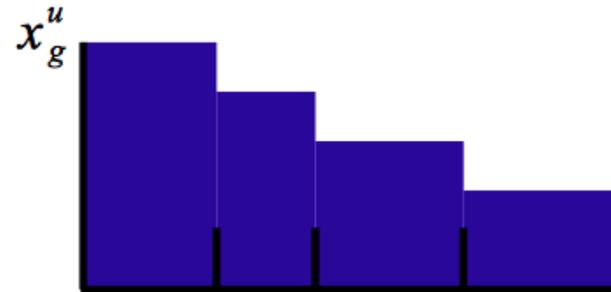


Weight function



$$x_g^u = \frac{1}{w_g^u} \int_{E_g^u}^{E_{g+1}^u} w(E) \sigma(E) dE$$

Cross section on super grid



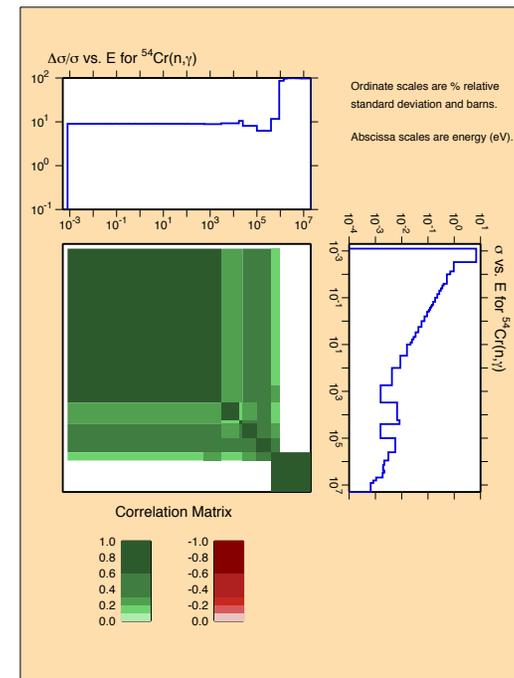
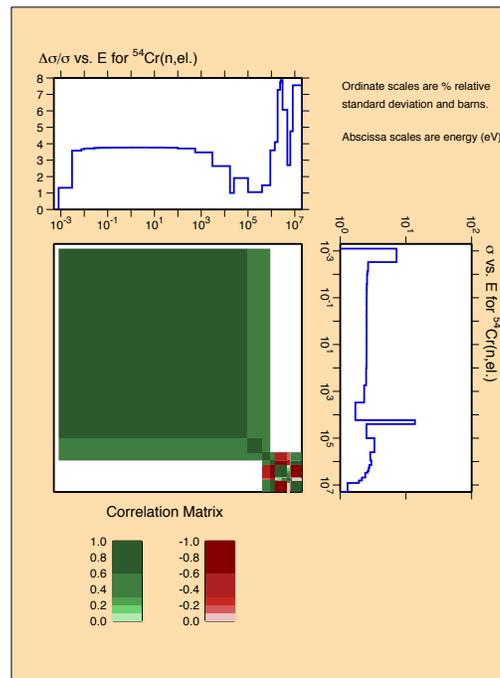
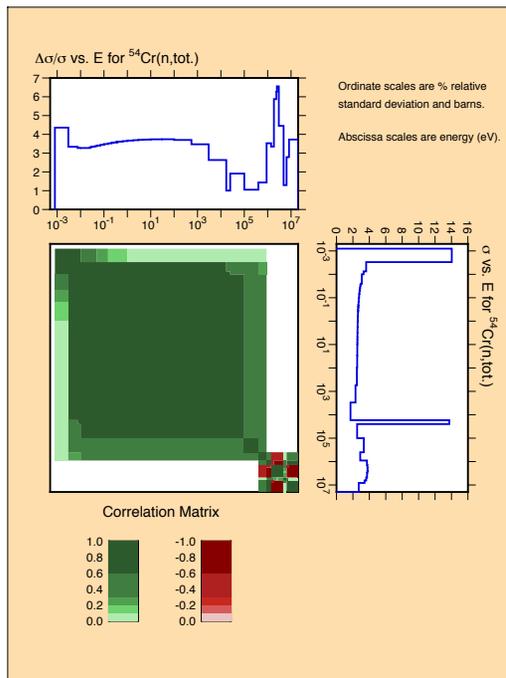
$$x_I = \frac{1}{w_I} w_g^u x_g^u \frac{E_{I+1} - E_I}{E_{g+1}^u - E_g^u}$$

$$w_g^u = \int_{E_g^u}^{E_{g+1}^u} w(E) dE$$

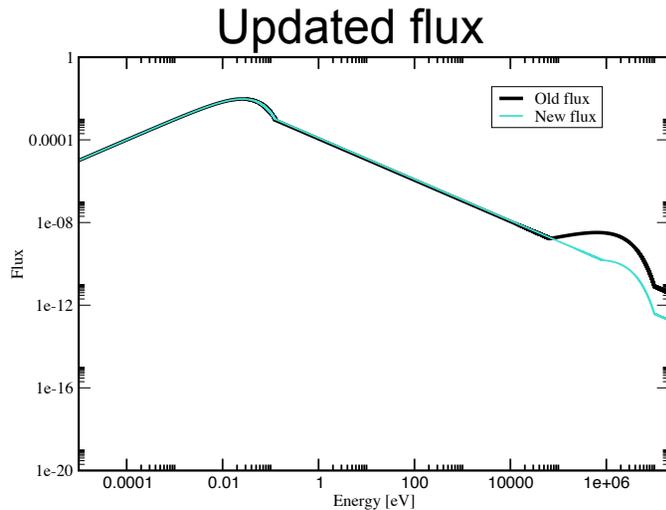
- CI35, CI37, Cr53, K39, K41 and Na23 only contain File 32 and do not allow a direct comparison.
 - Ti50 has an LTY=0 section that sums over non-existent constituent covariance matrices.
 - F19 uses LRF=7 and cannot be processed with ERRORR.
 - O16 has 2717 groups in the supergrid. Neither code can process the file without changing upper limits. (AMPX can create MG library but PUFF-IV only processes if limits are increased).
 - Pu240 only runs through PUFF-IV without errors after the file is converted to standard form using BNL code standef (otherwise resonance parameters in File 2 and File 32 do not agree within limits specified in ENDF-102 manual).
In addition the least significant digit for one resonance is changed in File 32. ERRORR does not process unless the error condition for non-existing coding for the unresolved cross section data is commented out (File 32 does not contain uncertainties for unresolved range).
 - Th232 only runs through PUFF-IV without errors after the least significant digit for several resonances is changed in File 32.
 - Li6 has an inconsistent number for the number of descriptive records in File 1.
- Results between NJOY AND AMPX agree within expected limits

Files submitted to ENDF/A

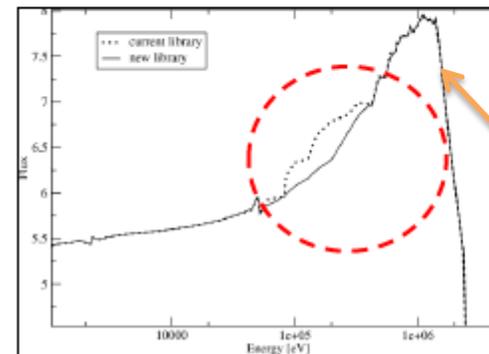
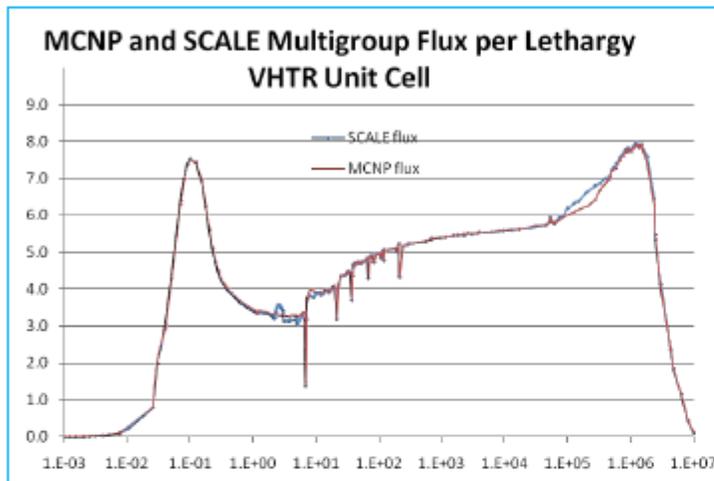
- Cr54 containing a new evaluation in collaboration with FZK and ORNL.
- Cr50 containing a new evaluation in collaboration with FZK and ORNL is in the final stages of assemblage
- Cr52 was updated to conform with ENDF-102 standard
- Ti48 containing a new resonance evaluations will be submitted by LANL after being combined with their new evaluation.
- ORNL's retroactive covariances for Ti46, Ti47, Ti49 and Ti50 will be submitted by LANL after being combined with their new evaluations.



Updated criticality libraries for SCALE



- A new flux similar to the one used for VITAMIN-B7 was used to create the MG library
- ENDF/VI.8 and ENDF/VII.0 libraries were updated
- Updated double precision version of AMPX was used
- Results in improved flux for VHTR graphite
- K_{eff} values are not affected

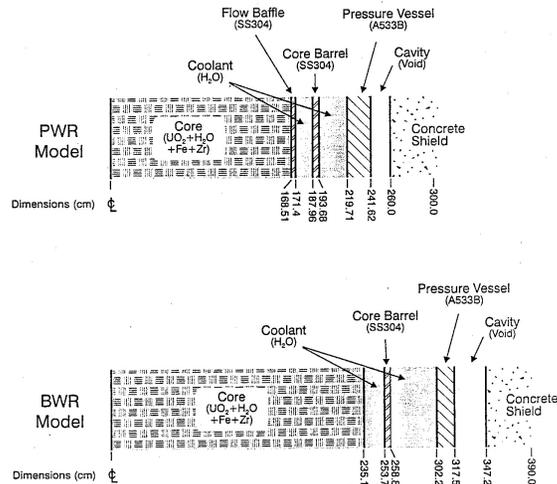


MG library specialized for HTGR applications

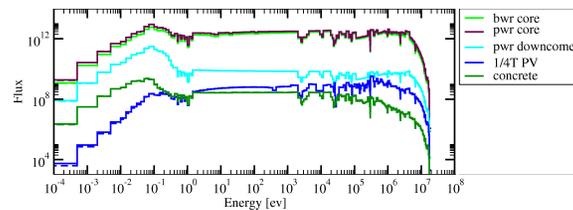
- Based on a collapse from a 999 group MG library, a suitable group structure of 81 neutron groups was determined
- A specialized 81 neutron group library was created from ENDF/VII.0 data using a HTGR pin cell flux generated by centrm.
- The library contains λ factors for all isotopes and f-factors based on the intermediate-resonance approach for U238. It is planned to add f-factors for additional isotopes.
- The library is currently tested in various benchmark cases. Results look promising.

New VitaminB7/BugleB7 library

199n/42g → 47n/20g based on ENDF/VII.0

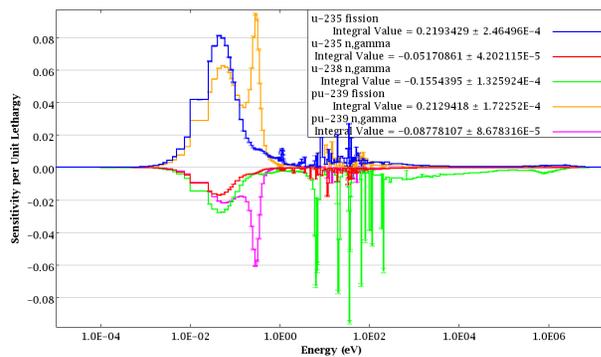


- Initial versions of VitaminB7 and BugleB7 have been given to RSICC and await NRC approval.
- Initial report has been send to NRC for approval.
- In the absence of benchmark cases for gamma production data we used unit test to compare to MCNP results.

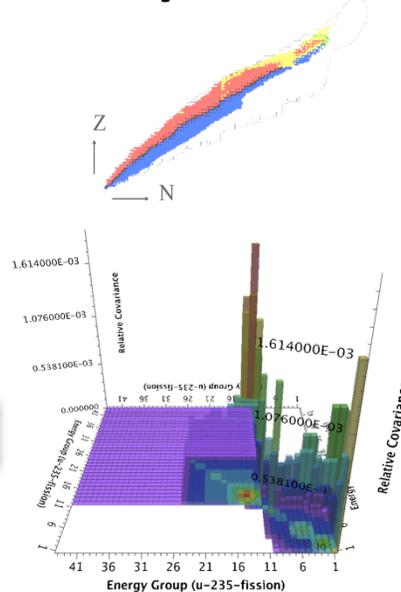


Data Uncertainty Propagation for Depletion

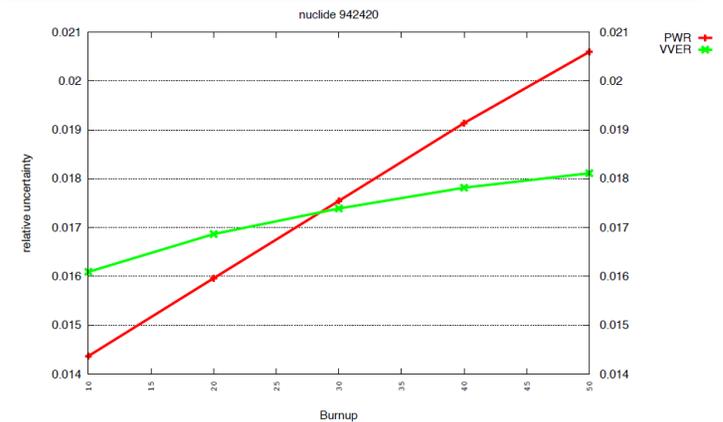
- An adjoint solver recently integrated into ORIGEN
- Sensitivity module developed to calculate sensitivities of concentrations (and other responses) to nuclear data
 - TSUNAMI-IP used to get nuclide concentration uncertainties due to cross-section uncertainties in ENDF/B
 - Covariance data are included in the uncertainty evaluation
 - Total and partial cross-section uncertainties are evaluated to help better understand uncertainty sources



Sensitivity and Uncertainty Analysis



Depletion Uncertainty Analysis



Doppler Broadened Rejection Correction in KENO

- Based on Becker, Dagan, and Lohnert's study:
 - “Proof and implementation of the stochastic formula for ideal gas, energy dependent scattering kernel,” ANE 36 (2009) 470–474

LWR pin cell at 1200(fuel)/600(mod) K		
NO DBRC	DBRC	Diff. (pcm)
1.314138	1.310908	-323

- -346pcm reported by the authors

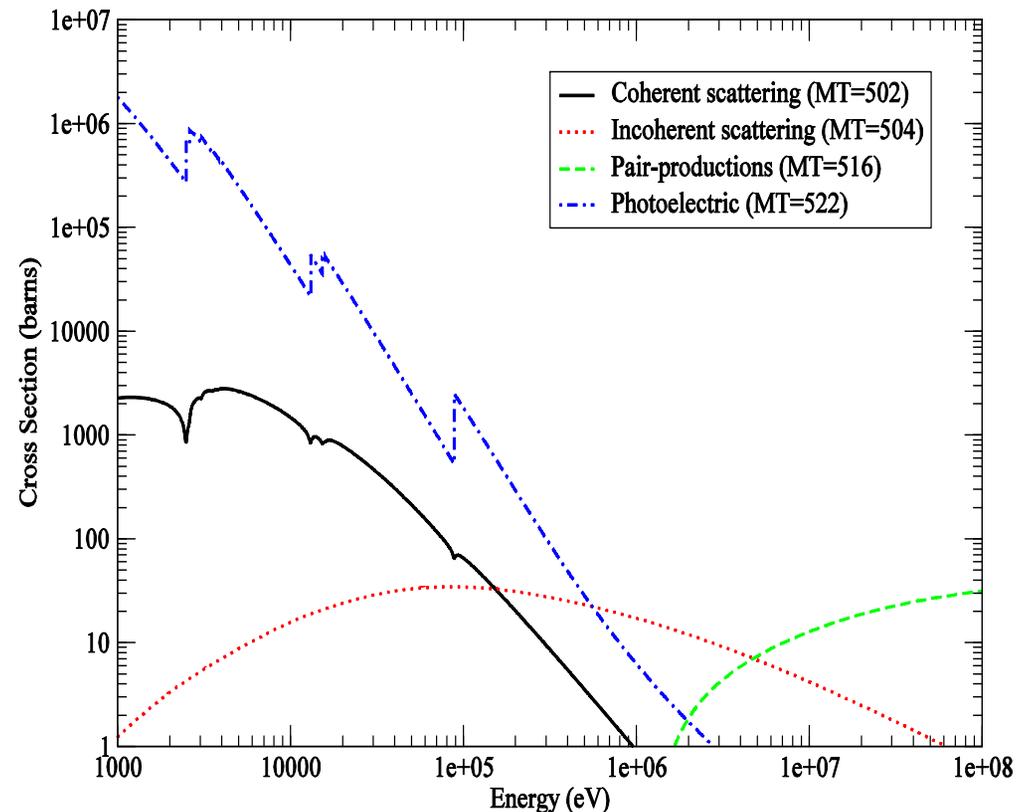
AMPX updates

- All modules have been converted to double-precision
- Y12 (module to create point-wise scattering matrices) treatment of gamma production matrices has been improved for File 6 scattering matrices. File 12, 13, 14 and 15 treatment has been updated to use endflib.
- Templates for multi-group and continuous energy library creation have been finalized.
- Package has been sent to RSICC at the end of September
- Documentation needs to be finalized

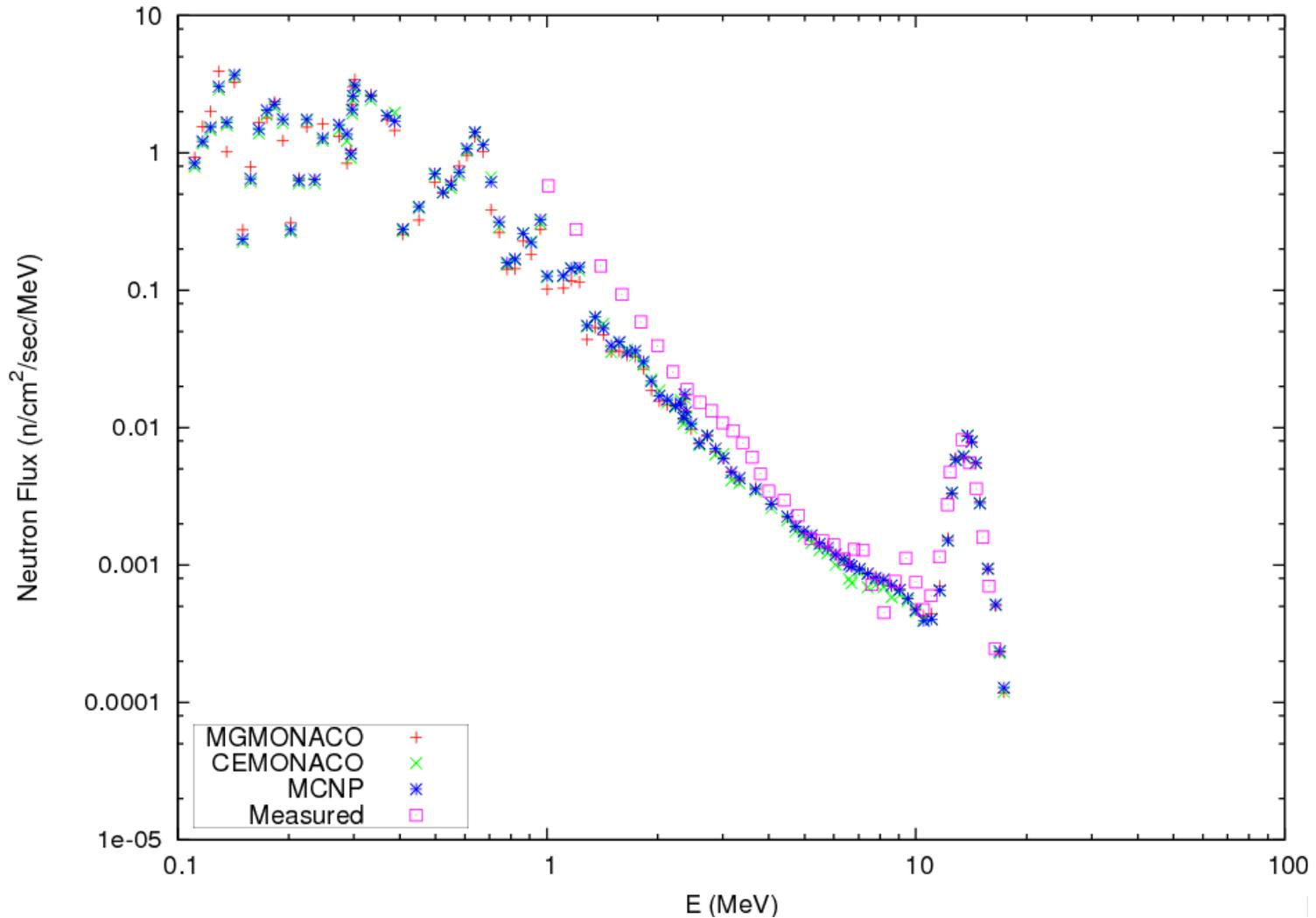
Continuous Energy Gamma Processing with AMPX for SCALE/CE-MONACO

- All CE cross section processing modules of AMPX have been modified considerably to save the gamma yield data with the CE neutron library files
- CE gamma cross section library files have been generated
 - AMPX modules KFC, MONTEGO, JAMAICAN, and PLATINUM are modified

Cross Sections for Gamma Interactions in Lead



neutron flux at 200cm from a D-T (with 5% D-D) neutron source transmitted through an iron spherical shell 30.45 cm thick



The screenshot displays the AMPX software interface. At the top, a menu bar includes File, Edit, View, Navigate, Benchmark, Scheduler, Ampy, Team, Tools, and Window. A toolbar below the menu contains various icons. A central text box labeled "Run AMPX" has arrows pointing to the "Run" icon in the toolbar and the "Run" button in the bottom right of the interface.

The main window is titled "testItem" and contains a code editor with the following XML configuration:

```

1  =pointId
2  point=point/point_ broaden=point/broaden_
3  temperatures=293 900.0 2000.0 input=input/point_
4  evals=/Users/dw8/ampx/running/puff_njoy/endl/Endfa.xml
5  end
6  =neutron_mg
7  master=neutron/neutron_ temperature=293
8  broaden=point/broaden_ neutgroups=238
9  thermalgroups=90 gamgroups=42 akt=4.8356
10 theta=1273000.0 fcut=820.8e3 makeyield=yes
11 input=input/neutron_
12 evals=/Users/dw8/ampx/running/puff_njoy/endl/Endfa.xml
13 end
14 =bondarenko
15 master=neutron/bond_ broaden=point/broaden_
16 nld=neutron/neutron_ temperature=293
17 neutgroups=238 thermalgroups=90 akt=4.8356
18 theta=1273000.0 fcut=820.8e3
19 sig0=<1.0E8 1000000.0 100000.0 10000.0 1000.0 100.0 10.0 1.0 1.0E-6>
20 temps=<293.0 900.0 2000.0> input=input/bond_
21 evals=/Users/dw8/ampx/running/puff_njoy/endl/Endfa.xml
22 end
23 =bind_mg
24 master=neutron/master_ neutron=neutron/neutron_
25 bond=neutron/bond_ input=input/stitch_
26 evals=/Users/dw8/ampx/running/puff_njoy/endl/Endfa.xml
27 end
28 =combine_mgs
29 master=FinalLibrary indmaster=neutron/master_
30 input=bindMaster.inp evals=/Users/dw8/ampx/running/puff_njoy/endl/Endfa.xml
31 end

```

An orange callout box labeled "Expand template" points to the "neutron_mg" section of the code. Another orange callout box labeled "Template input needed to generate MG from ENDF/A" points to the "neutron_mg" section.

A "Configure neutron_mg" dialog box is open, showing the following settings:

- Use: neutgroups 238
- Number of neutron groups to use.
- Use: thermalgroups 90
- Number of thermal groups.
- Use: neutuserdef Use a standard AMPX neutron group structure
- Use: neutbounds
- Energy boundaries for the neutron groups (eV)
- Use: gamgroups 42
- Number of gamma groups to use.
- Use: gamuserdef Use a standard AMPX gamma group structure
- Use: gambounds
- Energy boundaries for the gamma groups (eV)
- Use: weightuser Use a standard AMPX weighting function
- Use: weighting Maxwellian - 1/E - fission spectrum - 1/E
- Weighting function to use to create multigroup data
- Use: tmax 300.0
- Temperature of Maxwellian spectrum in weighting function (K) if the weighting function contains a Maxwellian part. If a Watt fission spectrum is generated this is the value of a.
- Use: akt 4.8356
- Cut-off energy in eV up to which Maxwellian is used: tmax * akt * 8.61664e-5 if the weighting function contains a Maxwellian part. If a Watt fission spectrum is generated this is the value of b.

At the bottom, an "SSH Command Window" shows the command "njoy_1_u238.inp AmpxRunner finished". A "Process List" is also visible. The bottom status bar shows "Total: 1 Finished: 1 Running: 0 Pending: 0 Failed: 0" and buttons for "Add Scheduler(s)", "Add Task(s)", "(Re)Schedule", "Update Status", "Remove", "Unschedule", "Rerun", and "No automatic reschedule".

