BNL Covariance Effort

P. Oblozinsky

National Nuclear Data Center
Brookhaven National Laboratory

oblozinsky@bnl.gov

We are developing broad capabilities

Covariance evaluation methodology, all under EMPIRE
• Fast neutron region, combines modeling and data
• Resonance region, based on Atlas of Neutron Resonances

Evaluations
• Sophisticated   8 isotopes of Gd
• Medium   55Mn and 90Zr
• Simple   35 materials for SG26, 307 materials for Low-Fidelity

Visualization and plotting
• New Sigma interface

Processing
• NJOY-99
• PUFF-IV

BNL covariance capabilities cnt'd

Covariance Projects

- Covariances for WPEC Subgroup 26
- Low-fidelity covariance project
- GNEP covariance library

Additional activities

- Covariance Workshop, Port Jeff, June 2008
- Special Issue of Nuclear Data Sheets on Covariances

Staff involved

- Herman, Mattoon, Mughabghab, Oblozinsky, Pigni (methodology, evaluations)
- Arcilla, Sonzogni, Pritychenko (processing, Sigma)
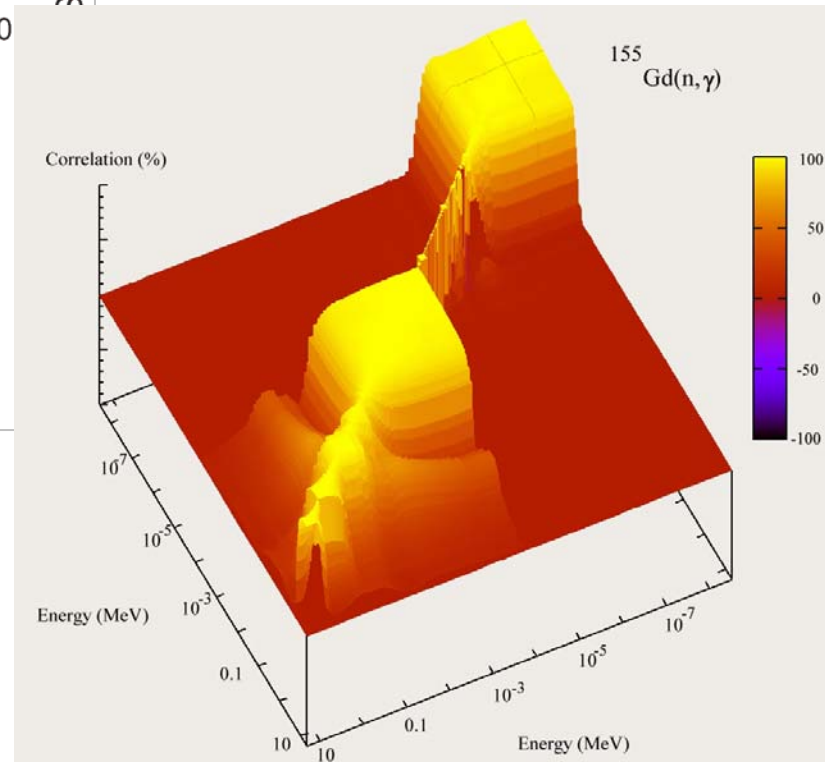- Active collaboration with several external scientists (Cho, …)

Sample covariances for ENDF/B-VII.0
8 isotopes of Gd: BNL – ORNL collaboration in 2006
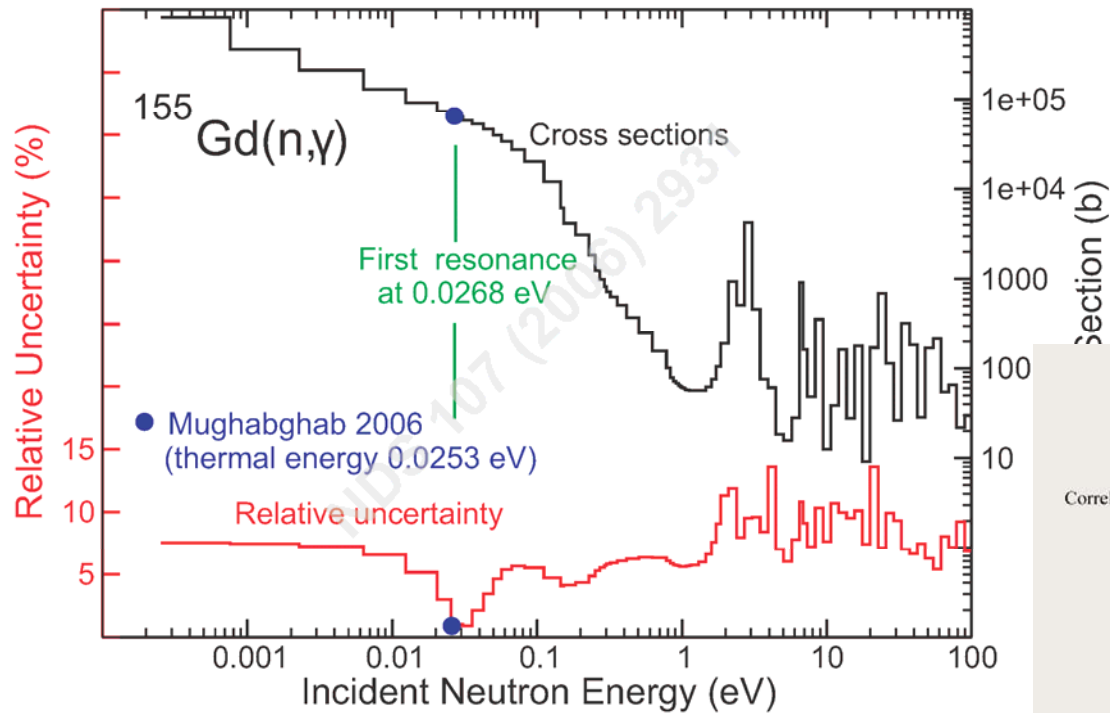
Show case for ENDF/B-VII.0:
- Simultaneous evaluation
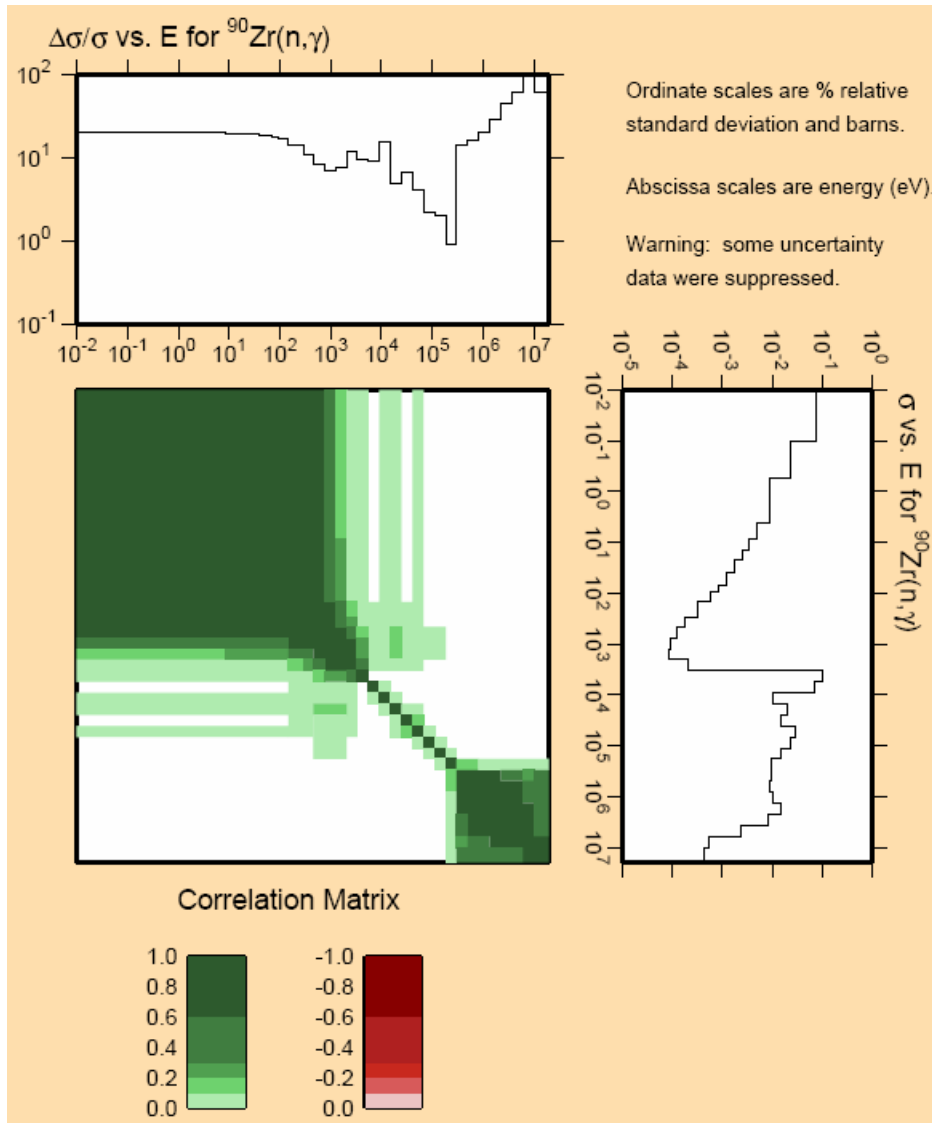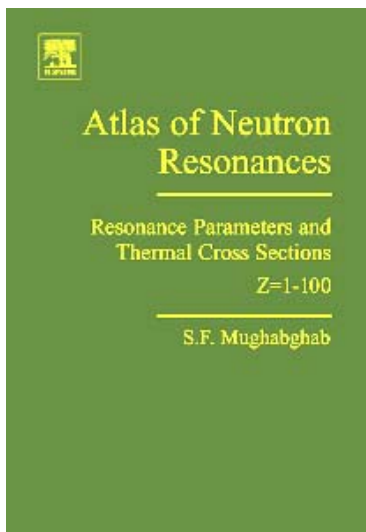- Complete isotopic chain
- Cross sections
- Covariances

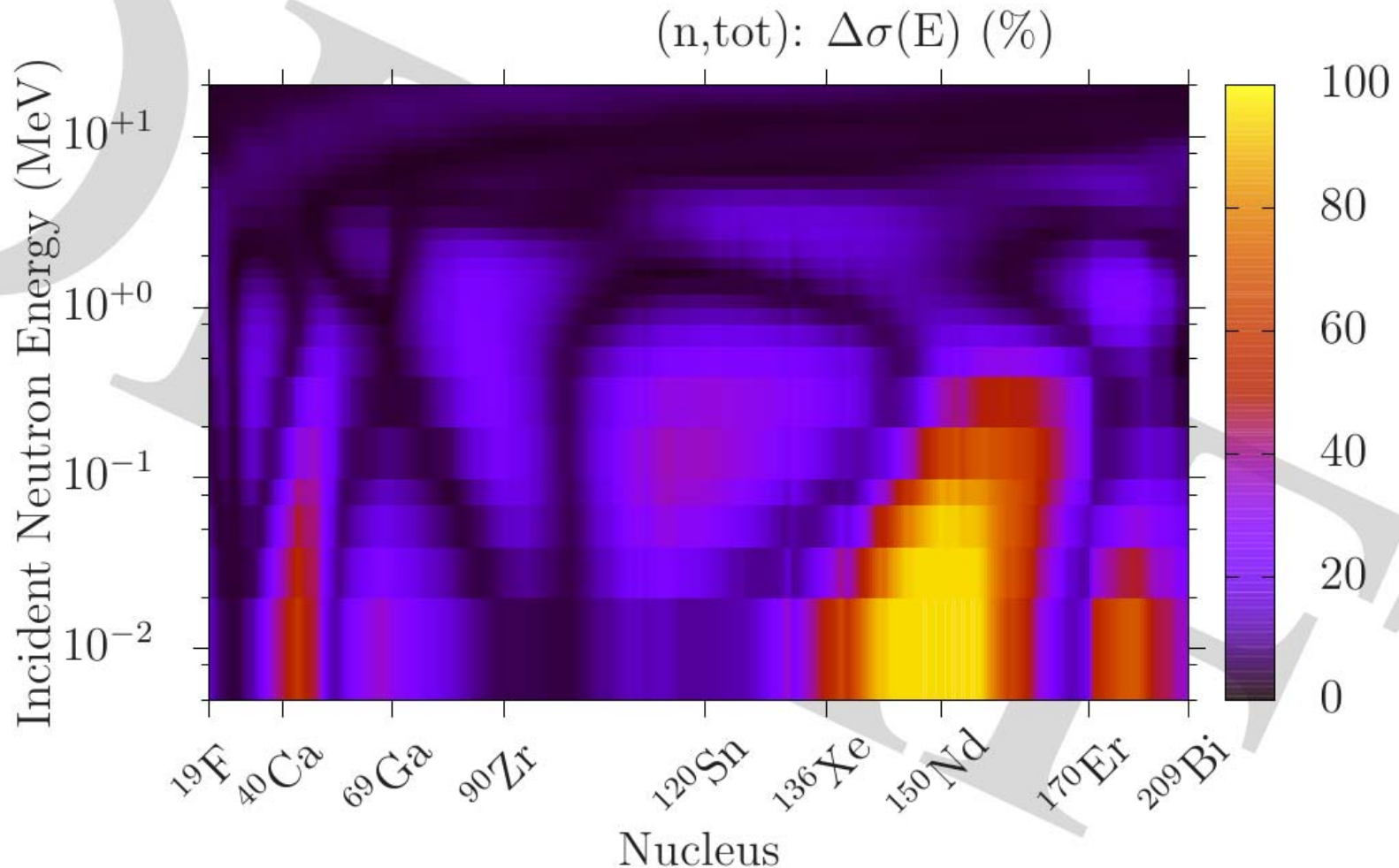# Example of new covariances
90-Zr by BNL in 2008

Produced by new covariance modules in EMPIRE:

- Low energy region: Atlas of Neutron Resonances + thermal and resonance region adjusted, MF32
- Fast region: modeling + experimental data, MF33

EMPIRE
Nuclear Reaction Model Code

Atlas of Neutron Resonances

Resonance Parameters and
Thermal Cross Sections
Z=1-100

S.F. Mughabghab

$\Delta\sigma/\sigma$ vs. E for ^{90}Zr(n,γ)

Ordinate scales are % relative standard deviation and barns.

Abscissa scales are energy (eV).

Warning: some uncertainty data were suppressed.

σ vs. E for ^{90}Zr(n,γ)

Correlation Matrix

1.0	-1.0
0.8	-0.8
0.6	-0.6
0.4	-0.4
0.2	-0.2
0.0	0.0

Model-based estimates for 307 materials
BNL contribution to low-fidelity project, 2007-2008

$(n,tot): \Delta\sigma(E)$ (%)

Sigma: Covariance retrieval and plotting
Direct visualization of MF33

Correlations,% uncertainties, and cross section with uncertainty band plots
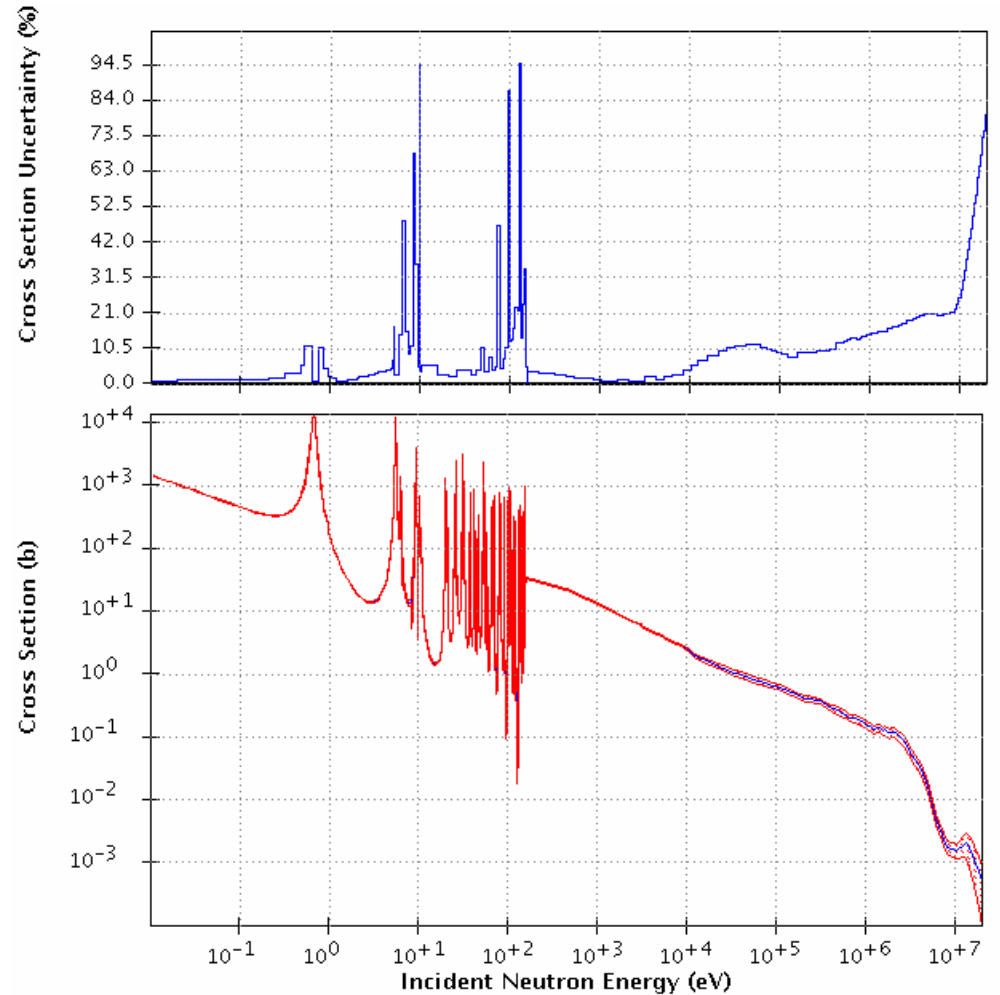
Covariance processing
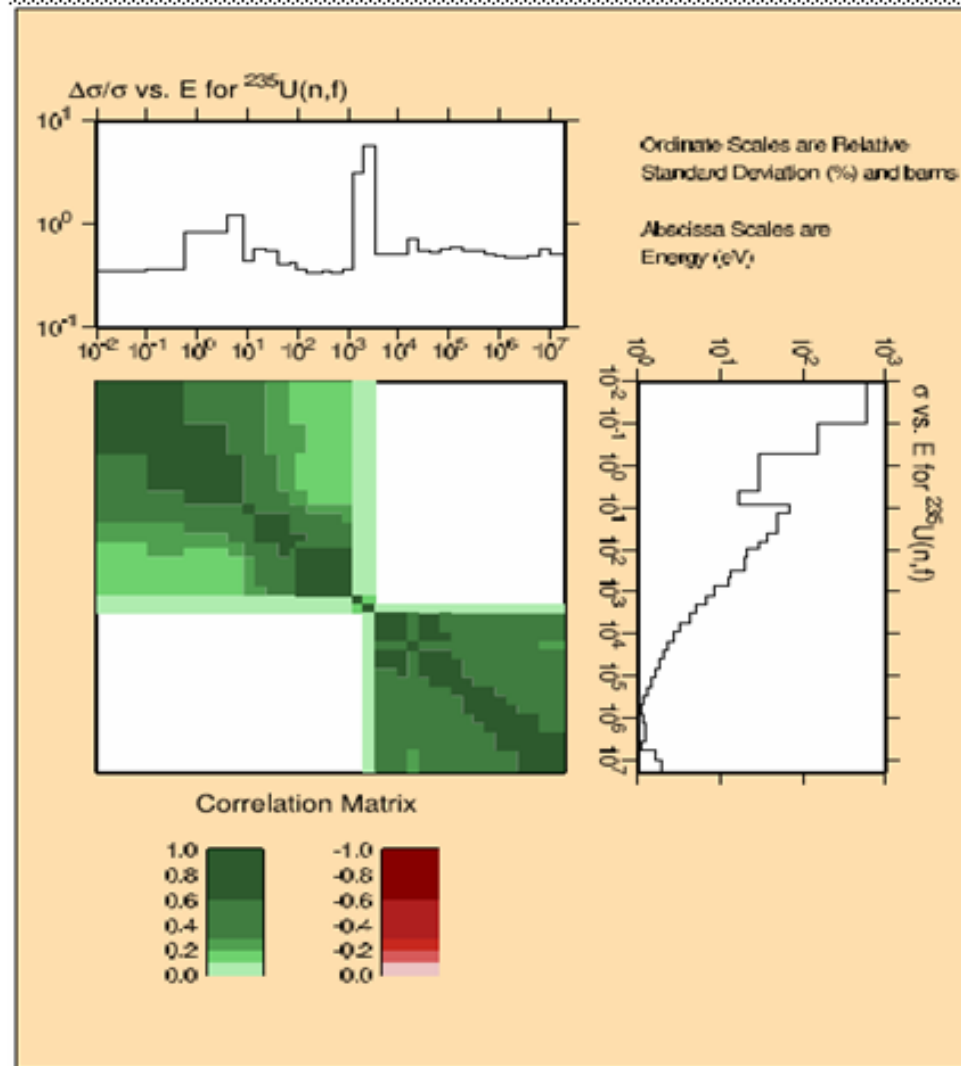## NJOY-99 and PUFF-IV

Probably the only lab actively using both NJOY-99 and PUFF-IV. These codes have somewhat different capabilities.

Having two processing codes is important: we get more confidence in the results.

The codes are used to check new evaluations, before inclusion into ENDF/A.

235-U(n,f) by ORNL-LANL 2008

Conclusions

Our covariance capabilities allow active participation in covariance evaluation effort and providing support as the data center:

- Covariance evaluation methodology, all under EMPIRE

- Evaluations

- Visualization and plotting

- Processing