Covariance Testing at BNL

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U.S. DEPARTMENT OF ENERGY

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Testing implemented in FUDGE & ADVANCE

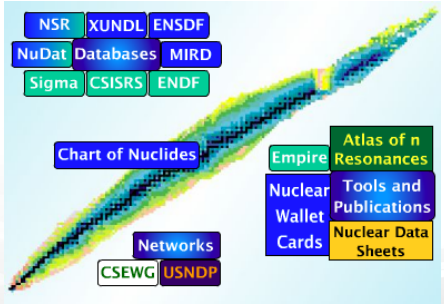
- Proper ENDF formatting: STAN, STANEF, CHECKR
- FUDGE (see next page)
- NJOY:
  - Convert to BOXR format
  - Plotting
- endfcovreport.py — overview of ENDF library's covariance contents

git.nndc.bnl.gov

Changes

advance2.nndc.bnl.gov

Deploy



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Testing implemented in FUDGE & ADVANCE

`covarianceMatrix` class implements core of all GNDS covariance

Checks:

- symmetric
- real
- positive definite
- condition # of Eigenvalues
- too big uncertainties

Can fix too big/small uncertainties

Can plot matrices (or at least it used to!)

Further testing recommended by CSEWG, but not yet implemented

- **Documentation** (needs a human)
- **Completeness** (partially complete)
- **Reasonableness** (not started)

Guidance on Generating Neutron Reaction Data Covariances for the ENDF/B Library

Prepared by the CSEWG Covariance Committee

Notice: The recommendations in this document are intended to apply primarily to evaluated neutron cross-sections, neutron spectra, and nu-bar data in the neutron sub-library of ENDF/B for all new evaluations as well as those that have undergone major revisions since the release of ENDF/B-VII.1. Evaluations that are grandfathered from earlier versions of ENDF/B or that have undergone only minor revisions are exempted.

1. Basic Mathematical Properties

1.1 The numerical data and recipes provided in an evaluated covariance file should enable complete, square, and symmetric covariance matrices, that provide both correlations and standard deviations (uncertainties), to be generated from the included values by the most widely used contemporary evaluated data processing codes.

1.2 Complete correlation matrices that are derived from the evaluated covariance data should have unity values along the matrix diagonal and off-diagonal elements with magnitudes generally less than unity, to the extent allowed by the numerical precision of the file and consistent with limitations of the ENDF formats.

1.3 Covariance matrices for evaluated normalized neutron-emission spectra (MF = 35) should satisfy the mathematically mandatory "sum-to-zero" property for rows and columns of the matrix, to the extent allowed by the numerical precision of the file and consistent with limitations of the ENDF formats.

2. Matrix Eigenvalues

2.1 Full covariance matrices generated from information provided by the evaluator should be at least positive semi-definite (*i.e.*, involve only non-negative eigenvalues) on the evaluator's original energy grid, to the extent allowed by the numerical precision of the file and consistent with limitations of the ENDF formats. However, the presence of zero eigenvalues may be mandated by physical constraints such as normalization (see Section 1.3), the need for consistency of partial reaction channel data, or other conditions that apply to sums or differences of data for two or

More on reasonableness: only cross section documented

Reaction Process	Minimum Uncertainty
(n,tot)	1%
(n,el)	2%
(n,γ)	2%
(n,inel)	3%
(n,f)	1%
(n,p)	3%
(n,α)	3%
nu-bar	1%
Other	3%

- Need similar limits on CP reactions cross sections
- Need maximum limits too (tricky since ENDF assumes Normal PDFs)
  - Thresholds
  - Other small cross sections
- Other observables?