SAMMY Workshop Part 5

Dr. Nancy M. Larson
Oak Ridge National Laboratory

Part 5, Integral Quantities

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Integral quantities

- **Quantities which can be included in the SAMMY fitting procedure…**
  - **Energy- and angle-differential data**
  - **Energy-differential data but angle-integrated data**
  - **Integral data (energy- and angle- integrated data)**

- **First, consider differential data…**

Usual cross section analysis: differential data only are included.

- **Transmission**
- **Fission**
- **Capture cross sections**
- **Absorption**
- **η**
- **etc.**

To analyze, use SAMMY:

0. **Estimate values for (resonance & other) parameters**
1. **Generate theoretical values & partial derivatives (using appropriate theory such as Reich-Moore approx. to multilevel R-matrix)**
2. **Correct for "real world" effects (e.g. finite sample thickness)**
3. **Find "best fit" values for parameters using Bayes' method (generalized least squares)**
4. **Iterate steps 1-3 for nonlinearities, more data, etc.**

RESULT:

- **A non-unique* set of resonance parameters which describe the differential data; and a covariance matrix describing the uncertainties on and interrelationships among those parameters.**
  - **Why non-unique? Because of uncertainties and correlations**
  - **(Also because Reich-Moore is not the only possibility)**

NJOY, AMPX, PREPRO, or other codes are used to calculate values:

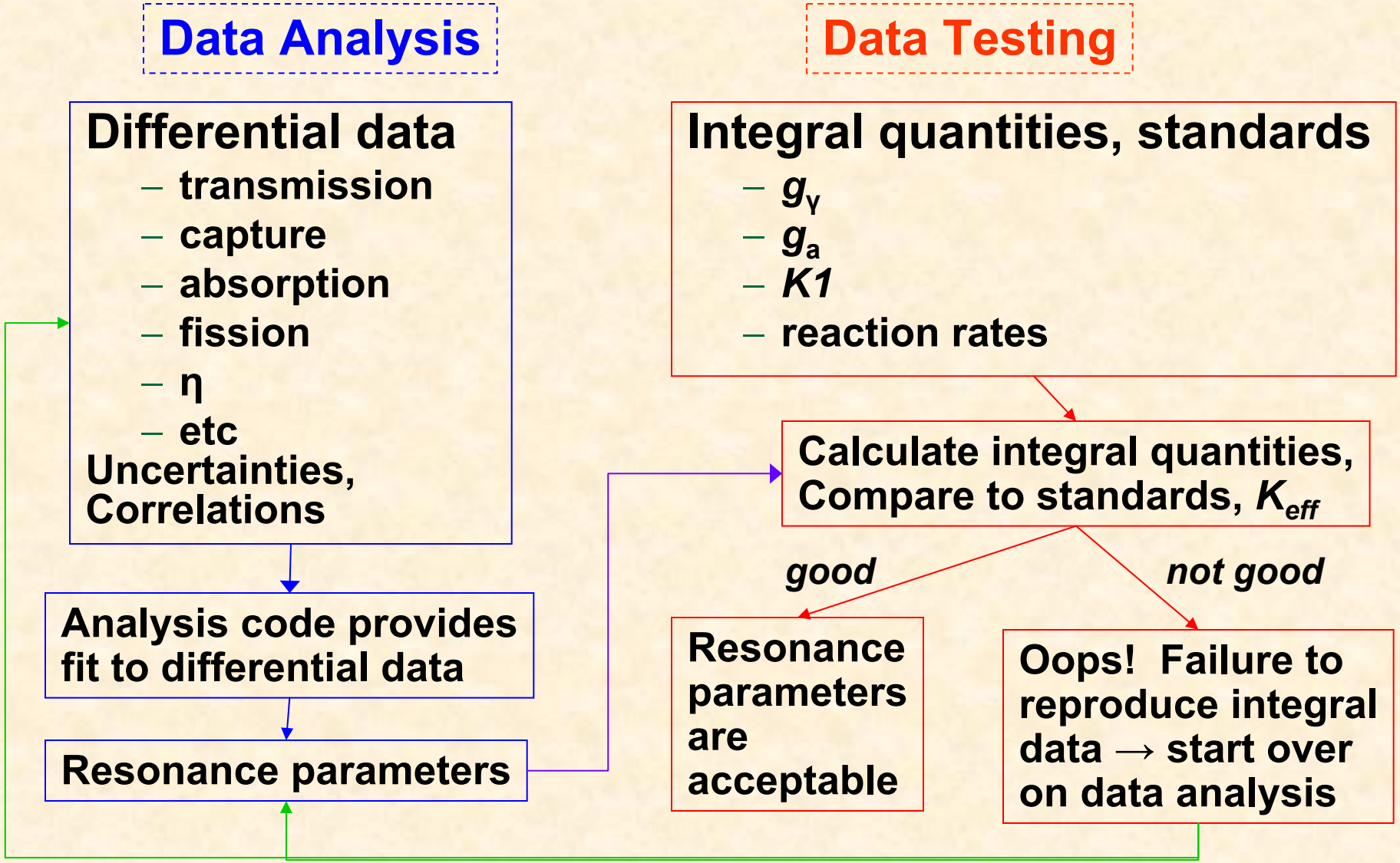
0. **Use resonance parameter values from differential analyses**
1. **Generate theoretical values**
2. **Correct for "real world" effects**

3,4. **? no options for fitting or iterating ?**

RESULT:

- **Compare measured (or standard) values with calculation; either they agree or they don't.**

Last Century's Methodology



This Century's Methodology

Data Analysis

Data Testing

Differential data + Integral quantities

- transmission
- capture
- absorption
- fission
- η
- etc
- g_γ
- g_a
- *K1*
- reaction rates

Uncertainties, Correlations

Analysis code provides fit to differential and integral data

Resonance parameters

Integral quantities

- g_γ
- g_a
- *K1*
- reaction rates

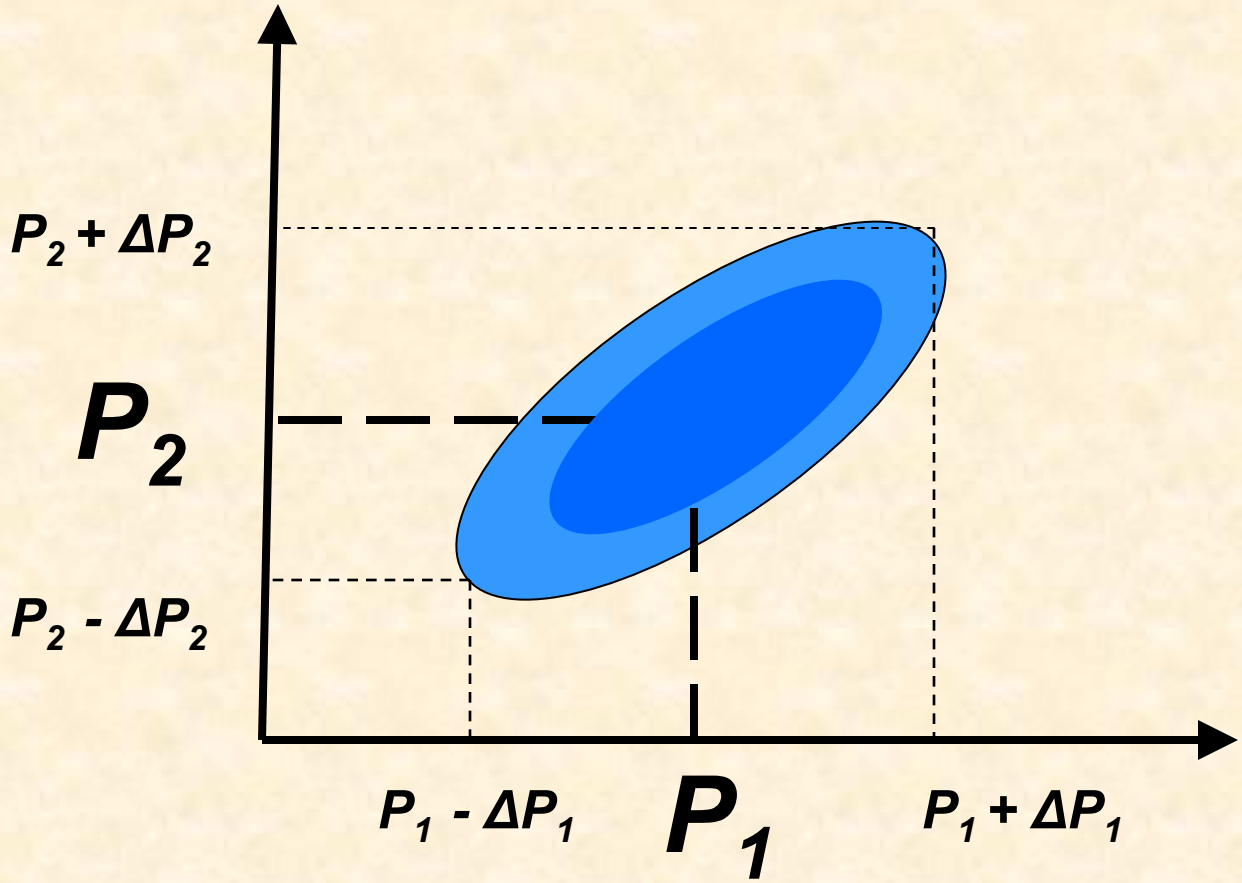
Calculate integral quantities, Compare to standards, K_{eff}

good

Resonance parameters are acceptable

Why can this work?

- **Because the resonance parameter set is not unique**
  - **Parameters are "correct" only within the confines of the parameter covariance matrix**
  - **So when more & different data are fitted, there is (limited) freedom to modify the parameter values to fit the new information**
    - **These modifications do *not* degrade the fit to the differential data**
- **See 2-parameter illustration on next page…**



"True" values of P_1 and P_2 are somewhere in the shaded area.

Which integral quantities can be included in SAMMY analyses?

- **Thermal cross section**
- **Maxwellian average at thermal energy**
- **Westcott's *g*-factor**
- **Resonance integral**
- **Average integral**
- **Watt spectrum average**
- ***K*1**
- ***α***
- ***NJOY's α***
- ***NJOY's η***

(At present SAMMY has no capability for including geometry-dependent integral quantities.)