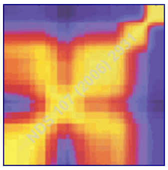


Extension of EMPIRE to Covariances in the Resonance Region

Young-Sik Cho*[,a], R. Arcilla[b], M. Herman[b], S.F. Mughabghab[b], P. Obložinský[b], Young-Ouk Lee[a]

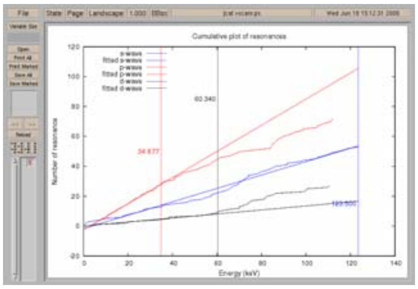
[a]Nuclear Data Evaluation Lab., KAERI, Daejeon, Korea

[b]National Nuclear Data Center, Brookhaven National Laboratory, Upton, NY 11973-5000

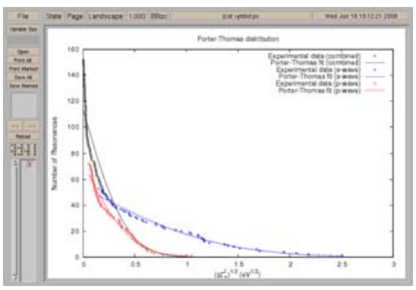
*Presenting author: yscho@kaeri.re.kr

The resonance module in EMPIRE automates most of the evaluation procedures:

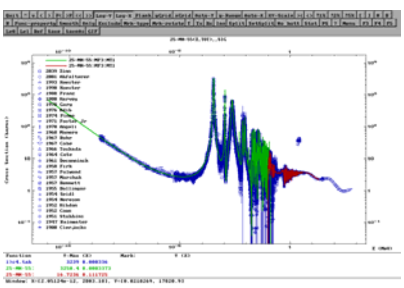
- ***Graphical analysis of resonance energies -*** *helps to determine the upper boundary of the resolved resonance region.*

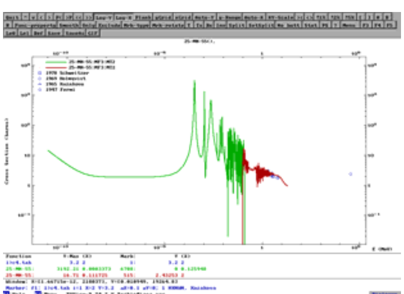


- ***Plot of the Porter-Thomas distribution -*** *helps to determine the average resonance parameters such as a level spacing and neutron strength functions for s- and p-waves.*



- ***Comparison of cross sections*** *with experimental data and ENDF/B-VII.0.*





- ***Generation of the ENDF-6 formatted file***

Resonance module

Extends capabilities of the code system EMPIRE to provide the ENDF-6 formatted data in the resolved and the unresolved resonance region (MF=2) using information collected in the

Atlas of Neutron Resonances recently published by Mughabghab, 2006.

The resonance module:

- *Reads data from the electronic version of the Atlas*
- *Makes statistically justified guesses for unknown parameters*
- *Uses average resonance properties to construct unresolved resonance region*
- *Allows manual adjustment of parameters, their uncertainties, energy ranges, average quantities*
- *Creates ENDF-6 files MF = 2 and MF = 32*

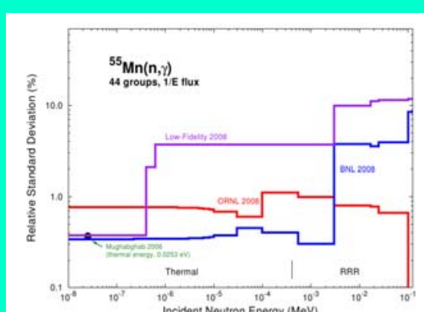
Determination of covariances:

- *Uncertainties compiled in the Atlas used as a basis*
- *Missing uncertainties are estimated*
- *Correlations between resonance parameters can be introduced*
- *Ensuring consistency between uncertainties assigned to parameters for the first few resonances and experimental uncertainties for the thermal cross sections*

Preliminary covariance estimations for ^{55}Mn and ^{90}Zr

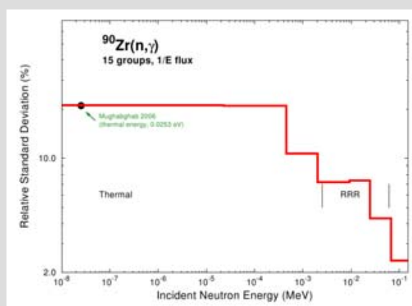
- *Uncertainties on the first resonances (including bound states) adjusted to reproduce thermal capture uncertainty*
- *No correlations between neutron and capture widths assumed*
- *No correlations among different resonances*

n + ^{55}Mn



- *Three covariance estimates/evaluations are available*
  - *'Low-fidelity' (2008)*
  - *'High-fidelity' (ORNL 2008)*
  - *Present work (BNL/KAERI 2008)*
- ***Thermal Region:*** *~0.4% is honored by Low-fi and BNL but considered too optimistic by Oak Ridge*
- ***Resolved Resonance Region:***
  - *Low-fi in 0.1 eV - 5 keV is based on the resonance integral uncertainty*
  - *BNL/KAERI estimate honors thermal uncertainty implying reduction of RRR uncertainties*
  - *Low-fi above 5 keV is based on the statistical model estimate*

n + ^{90}Zr



- *Semi-magic nucleus (N=50) => very low capture cross section (20 mb at thermal) => high experimental uncertainty (20.7%)*
- *Uncertainties in RRR lower than in thermal region*
- *Large uncertainties assigned to the radiative and neutron width of the bound level*
- *Recent measurement (A. Lone, Chalk River) suggests even lower thermal cross section => reevaluation of cross sections and uncertainties recommended*

Sponsored by the Office of Nuclear Physics - Office of Science – U.S. Department of Energy