NAVAL NUCLEAR LABORATORY

NDEX Overview CSEWG 2025

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Overview

- NDEX enhancements completed
  - All nuclear data needed by MC21 are generated independent of NJOY
- We reanalyzed previous / common assumptions and approaches
  - Some issues identified in the calculation of KERMA
  - Identified different approximations which can be made in how resonance integrals are calculated
  - Support for the Blatt-Biedenharn formalism
- No significant progress on supporting GNDS

KERMA Assumptions

- For most reactions we typically use a simple energy balance

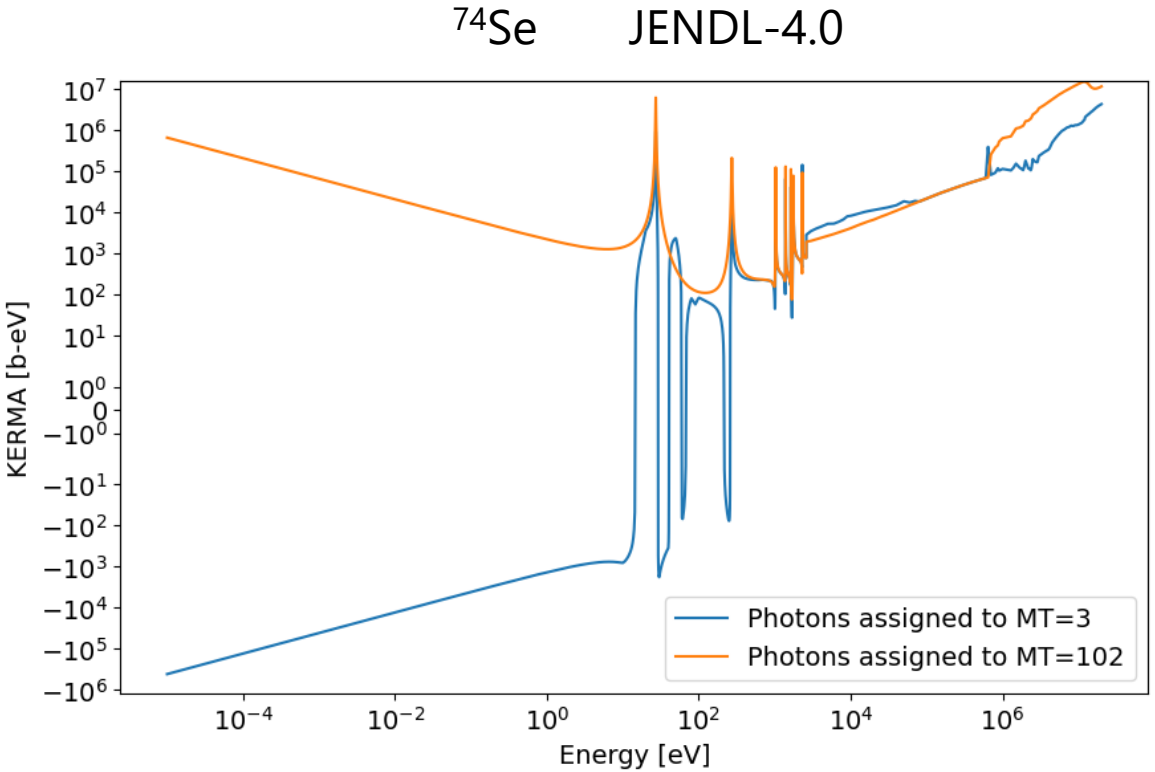
$$K = \left[E + Q - \overline{E_n} - \overline{E_\gamma}\right]\sigma$$

- For MT=102, we usually attempt to account for recoil momentum

$$K = \left[\frac{E}{A+1} + \frac{\overline{E_\gamma^2}}{2(A+1)m_n c^2}\right]\sigma$$

- For cases where MT=3 contains all secondary photons, significant lose in accuracy at low incident energy occurs

- **Processing codes may choose to handle situations differently**
- **How the evaluation is assembled matters**



Resonance Integral Calculations

- Normally cross sections are reconstructed to some precision such that the cross section is linearly interpolable between tabulated points

$$\sigma_i(E) = m_i E + b_i$$

- The resonance integral is defined as

$$RI = \int_{E_{min}}^{E_{max}} \frac{\sigma(E)}{E} dE = \sum_i \int_{E_i}^{E_{i+1}} \frac{\sigma_i(E)}{E} dE$$

- To be consistent with the assumed shape of the cross section we should use

$$RI = \sum_i \int_{E_i}^{E_{i+1}} \frac{m_i E + b_i}{E} dE = \sum_i m_i (E_{i+1} - E_i) + b_i \log\left(\frac{E_{i+1}}{E_i}\right)$$

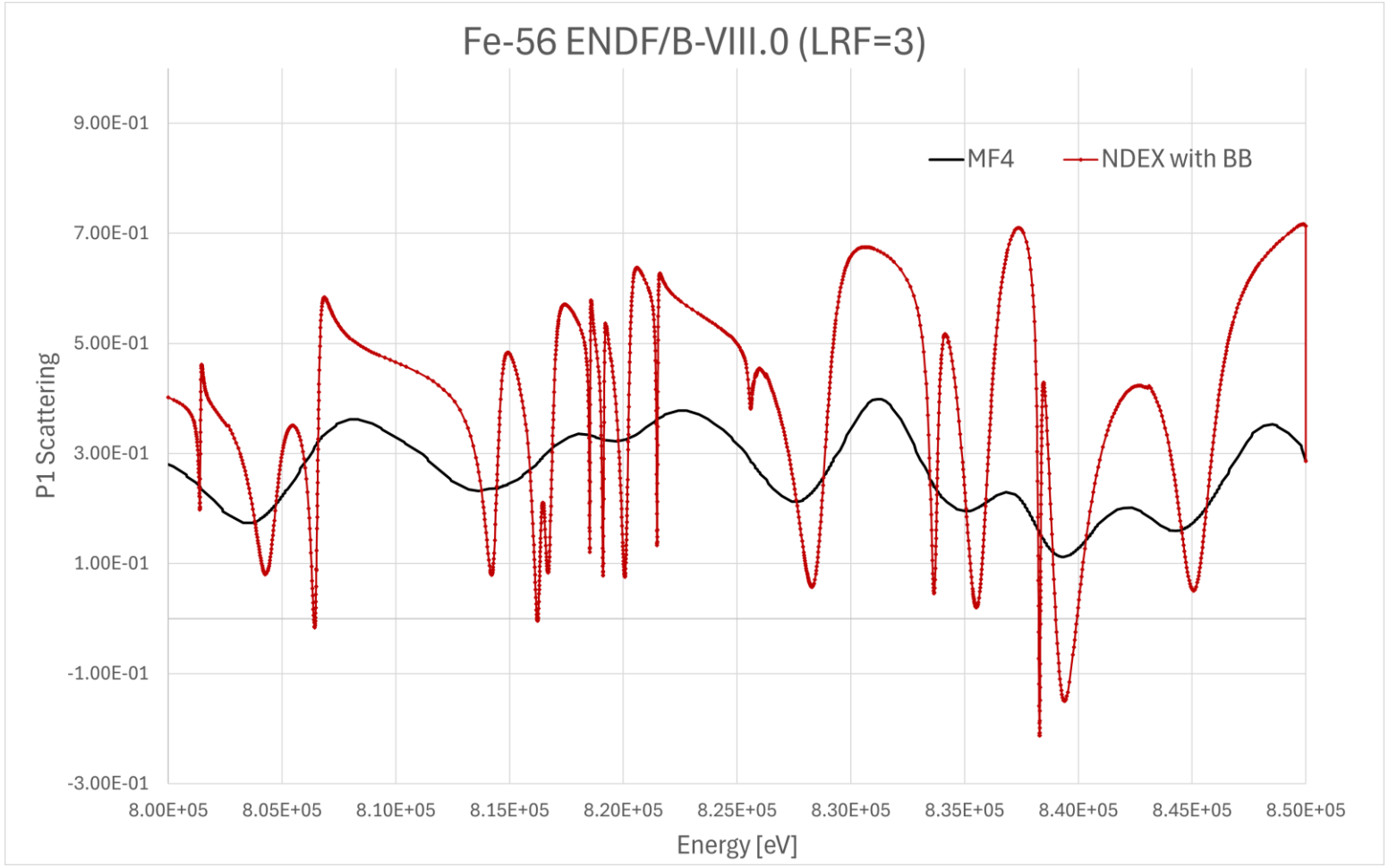
- But often we can assume the $\sigma(E)/E$ is linearly interpolable

$$RI = \sum_i \int_{E_i}^{E_{i+1}} (m_i E + b_i) dE = \sum_i \frac{m_i}{2} (E_{i+1} - E_i)^2 + b_i (E_{i+1} - E_i)$$

Some RI Examples from ENDF-VIII.1

- ^{56}Fe capture
  - Linear σ - 1.3501
  - Linear σ/E - 1.3517
- ^{56}Fe elastic scattering
  - Linear σ - 134.201
  - Linear σ/E - 134.297
- ^{141}Pr elastic scattering
  - Linear σ - 18.0600
  - Linear σ/E - 18.0667
- ^{141}Pr elastic scattering
  - Linear σ - 244.0055
  - Linear σ/E - 244.1975

Blatt-Biedenharn



Next Steps and Conclusions

- NNL has transitioned from implementing basic data processing support to integral verification with MC21
- We're implementing more thorough data checks and better ways to interrogate evaluations and visualize nuclear data
- **How evaluations are formatted can have impacts on how the data is processed, and this can vary from processing code to processing code**
  - **Identifying these differences may help guide evaluation construction so processing codes can use the data as the evaluator intends**