Summary of IAEA Technical Meeting on Neutron Cross-Section Covariances

IAEA Vienna
27-30 September 2010

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Presentation to CSEWG
1-3 November 2010

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The Technical Meeting on Neutron Cross-Section Covariances was organized by the IAEA Nuclear Data Section. The meeting brought together 26 covariance specialists, representing the fields of cross section measurement, modeling, and evaluation, as well as key data user communities. The objective of the meeting was to promote the generation of reliable covariance data and to facilitate their use in practical applications, especially in the field of nuclear power production.

The discussions were organized around three major themes:

- The resolved and unresolved resonance region,
- The fast neutron region, and
- User requirements for covariance data.

Some highlights of the discussions follow:

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Covariance Information from Nuclear Modeling

Stimulated by recent major technical advancements, this area is becoming increasingly important in the fast neutron energy range. A. Koning gave an detailed progress report on the Total Monte Carlo (TMC) method. He emphasized the value of TMC in studying the importance in applications of aspects of data uncertainties commonly neglected in current evaluations, such as material-material correlations and uncertainties of emission spectra.

R. Capote introduced a new formulation of the Unified Monte Carlo method in which each randomly-sampled set of parameters is assigned a weight that depends on the quality of the fit of the experimental data, including correlations.

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These and other model-based approaches were discussed and some of the advantages of each were mentioned. There was agreement that such comparisons should continue.

Uncertainties in Experimental Data

In view of the strong need for input from experimentalists in the evaluation of data covariances, the group reaffirmed the need for nuclear data measurers to pay more attention to the documentation of experimental uncertainties.

The group noted that this topic is not adequately addressed in the training of nuclear scientists. This fact is compounded by the pressures to publish results in archival journals, and the limitations on the content that can be included in such publications.

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To remedy the situation, the group recommended that

- Future experimenters keep better records of details governing measurement uncertainties, and
- Future compilers exert greater efforts in seeking out and compiling such information, going, where necessary, beyond the information given in archival journal articles.

The group also recognized that these “reforms” will take time to bear fruit, so that present-day evaluators will continue to need to supplement compilations such as EXFOR with their own rough estimates of systematic uncertainties. For traceability, it is important that evaluators clearly document any use of such estimates.

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V. Zerkin reported on the IAEA effort to create a new, Web-accessible library of experimental nuclear data, based on EXFOR but including corrections and additions. and presented in Computational Format (C4). The attendees strongly endorsed this initiative, and several evaluation groups indicated that they are planning to integrate this C4 library into their future developments.

Summary of Recommendations

1. Evaluated covariances must be reasonable, which implies that they must at least be positive semi-definite and be consistent with relevant experimental information. Other aspects of “reasonableness” depend on details of the intended application.

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2. Covariances should be provided for energy dependent unresolved resonance parameters.

3. Time-of-flight spectra should be archived directly in EXFOR.

4. The IAEA should consider an activity to further elaborate the comparison of proposed evaluation methods.

5. Covariances should be provided in ENDF for thermal scattering data in MF7.

6. The IAEA should continue to support activities to correct errors in EXFOR, along the lines of WPEC Subgroup 30.

7. The IAEA should monitor user requirements for reactor dosimetry data and continue to maintain IRDF.

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8. Information (documentation, instructions, examples) on techniques for the preparation and recording of uncertainty information should be provided to experimenters, for example on the IAEA website.

9. The EXFOR formats should be made flexible enough to accommodate information as provided by experimenters.

10. Authors of experimental data are urged to provide the full energy-to-energy covariance matrix or, alternatively, components of this matrix together with instructions for combining them to create the full matrix.

11. Authors of experimental data are urged to provide explicitly in EXFOR the data actually measured, especially ratios.

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12. The NRDC compilers should be instructed that is its mandatory, for each data set compiled, to seek and compile relevant covariance information in computer-retrievable form.

13. The activity to assess systematic uncertainties for existing entries in EXFOR and to add them to the compilation should continue.

14. The present Computational Format (C4) should be extended to accommodate partial uncertainty information stored in EXFOR.

15. Cross-reaction and cross-material correlations should be addressed in MF40 (covariances of activation cross sections).

16. Evaluators should consider evaluating MF35 for angle-integrated particle- and recoil-emission spectra (for DPA).