

EXFOR: Improving the quality of international databases

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The NEA Data Bank is an international centre of reference for basic nuclear tools used for the analysis and prediction of phenomena in nuclear energy applications. The Data Bank collects, compiles, disseminates and contributes to improving computer codes and associated data.

In the area of nuclear data, the Data Bank works in close co-operation with other data centres that contribute to the worldwide compilation of experimental nuclear reaction data in the EXFOR database (NEA, 2012). EXFOR contains basic nuclear data on low- to medium-energy experiments for incident neutron, photon and various charged-particle-induced reactions on a wide range of nuclei and compounds. Today, with more than 150 000 data sets from more than 20 000 experiments performed since 1935, EXFOR is by far the most important and complete experimental nuclear reaction database. It is widely used to further improve nuclear reaction models and evaluated nuclear data libraries. The Data Bank supervises the development of the Joint Evaluated Fission and Fusion (JEFF) file, which is one of the major evaluated nuclear data libraries used in the field of nuclear science and technology.

As part of its mission, the Data Bank works to maintain the highest level of quality in its databases. One method that was proposed to check the mutual consistency of experimental data in EXFOR (see NEA, 2011) is to test for outlier measurements more than a few standard deviations from the mean value as, in principle, several measurements of the same reaction quantity should form a continuous distribution. More recently, another method was developed to crosscheck evaluated and experimental data in databases in order to detect aberrant values (SCM, 2014). It was noted that there is no evidence, on the basis of numerical comparisons only, that outliers represent “bad” data. The fact that such data deviate significantly from other data of the same reaction may, however, be helpful to nuclear data evaluators who focus on one or a few isotopes and may wish to discard such data after a thorough analysis.

The Data Bank also organised a comprehensive review of cross-section data. An efficient review system and associated strategy were developed to systematically compare more than 10 000 cross-section data sets from EXFOR with the corresponding values in the main evaluated nuclear data libraries, including JEFF. The review initially covered all

neutron-induced threshold and activation reactions such as (n,n') , $(n,2n)$, (n,p) and (n,α) (NEA, 2014). The resulting statistical information showed various interesting trends in the data, including a list of suspicious data sets for which the cross-section values deviate greatly from the major evaluated nuclear data libraries and/or other measurements. The original publications associated with these data have also been systematically checked. This work confirmed that most of the experimental data were compiled correctly in the EXFOR database, and it identified a few compilation mistakes that have since been corrected. A second part of the review devoted to the (n,γ) cross-section is underway. This part of the review is challenging because of the large fluctuations of data in the resonance region that make the comparison more difficult. If successful, the review could be completed with other non-threshold cross-sections such as (n,f) , (n,tot) and (n,n) .

All of these initiatives have been very useful to maintain the highest level of quality in the EXFOR database. In addition, future development versions of the JEFF library can be automatically benchmarked against other evaluated libraries and against a more reliable experimental database. Such work will contribute to improving the quality of evaluated nuclear data for the benefit of all users.

References

- NEA (2011), “Statistical methods for the verification of databases”, NEA News, Volume 29, No. 1, OECD, Paris.
- NEA (2012), “NEA contributions to the worldwide collection, compilation and dissemination of nuclear reaction data”, NEA News, Volume 30, No. 2, OECD, Paris.
- Société de Calcul Mathématique (SCM) (2014), “Cross-checking of large evaluated and experimental nuclear reaction databases”, International Conference on Nuclear Data for Science and Technology, *Nuclear Data Sheets*, Volume 120, pp. 277-280, Elsevier.
- NEA (2014), “Statistical verification and validation of the EXFOR database”, NEA Data Bank Report, NEA/DB/DOC(2014)3, OECD, Paris.

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