Compilation of Data Corrected or Derived by Other Than Author

(N. Otsuka, O. Schwerer, 2014-04-30)

Introduction

The EXFOR library is a collection of experimental data sets reported by the people who performed the experiments in principle. However, several cases of data corrected or derived by non-authors came up which may be useful for compilation, where a policy and compilation format need to be formulated. This paper gives a summary of the (1) examples of non-trivial non-author data, (2) questions on policy, and (3) possible technical implementation (e.g., coding rule) for further discussion in the NRDC 2014 Meeting. See also Memo CP-D/841 for a review of data renormalized by non-authors and compiled in EXFOR.

Examples of Non-trivial Non-author Data

Renormalization based on the latest reference parameters (*e.g.*, U-235 fission cross section, delayed gamma intensities) is routinely done by evaluators, and it is not realistic to perform it for all relevant data sets by EXFOR compilers. The INDC meeting working group 2 "Data Dissemination, International Coordination and Training" also recommends to maintain a parallel data base for such corrected data sets (see appendix of the memo). Viktor Zerkin is developing a system to perform renormalization due to change in reference parameters (see Action 68 of the NRDC 2013 Meeting). Furthermore, the code `RNORM` is not used appropriately (i.e., without cross reference to the original data (See Memo CP/D-841). Under this situation, we propose to discourage compilers collection of renormalized data or recalculated ratio by EXFOR compilers.

However some corrections and derivations are beyond this level, for example,

1. Helium-3 neutron scattering experimental data measured at KFK [1] and corrected by M. Drosg et al. [2] – *data corrected by other than author.*
2. Uranium inelastic scattering cross sections corrected for neutrons unresolved from the elastic peak [3] and corrected again considering contribution of the compound process by R. Capote [4] – *data corrected by other than author.*
3. Double differential cross sections for 14 MeV neutrons measured at LLNL [5] and integrated over angle by Legendre fitting performed by T. Kawano [6] – *data derived by other than author.*
4. $^{16}O(n,\alpha)^{13}C$ cross section derived by the detailed balance relation [7] based on $^{13}C(\alpha,n)^{16}O$ cross section measured at ORNL [8]. - *data derived by other than author.*
5. Data sets for standard neutron-induced reactions from various experimental works compiled as an input file for the GMA code originally by W.P. Poenitz et al. [9], and extended by the IAEA neutron standard project. See also Memo CP-D/699=WP2011-15.

Example 1 is clearly documented (*i.e.*, traceable) in an article published in a peer-reviewed journal (*i.e.*, accepted by the community).

Example 2 is unpublished, but another evaluator (T. Kawano) also points out the same problem. Under the current policy, the comment by the evaluator must be kept under the keyword CRITIQUE, for example,

```
SUBENT        22158009   20130412
BIB                7         12
REACTION   (92-U-238(N,INL)92-U-238,,SIG,,,DERIV)
ANALYSIS   sig(continuum) + sig(Q~0.7 MeV) + sig(2+,4+,6+),
            where the last term was obtained by ECIS79 and
…
CRITIQUE   R.Capote (2013-02-15):
            The experimental data set recorrected by considering
            the compound process contribution to 2+,4+ and 6+
            excitations are 3.21 b @ 2.0 MeV, 2.77 b @ 4.2 MeV,
            and 2.55 b @ 6.0 MeV.
          T.Kawano (2013-04-29):
            Contribution of the compound process is not considered
            in derivation of the data set.
…
EN         DATA       DATA-ERR   MISC1      MISC1-ERR  MISC2
MEV        B          B          B          B          B
 2.0        2.83       0.15                             3.88
 4.2        2.67       0.18       2.03       0.17       4.67
 6.1        2.68       0.18       2.10       0.17       4.18
ENDDATA              5          0
ENDSUBENT           22          0
```

Note that the corrected data are given here in free text in the keyword CRITIQUE. With a new formalism these corrected data could appear in the DATA table of a new entry with cross-reference (through STATUS and REL-REF) to the original data.

Example 3 is unpublished .The derivation seems rather straightforward (integration of original partial angular differential cross sections through Legendre fitting).

Example 4 is published in a progress report without detailed description of derivation. The derivation seems rather straightforward (detailed balance relation).

Example 5 could be most difficult case for decision. Some experimental works compiled in the GMA input file are missing in EXFOR, and therefore it could be useful for improvement of the EXFOR completeness. On the other hand, it is known that some data sets in the GMA input are corrected (*e.g.*, renormalized) and/or accompanied with partial uncertainties guessed **by non-authors** (*e.g.*, by Poenitz), and distinction of such information is not easy on the GMA input file. The NRDC 2011 Meeting asked centers to assess experiments missing in EXFOR and compile them with a special status code PENTZ when appropriate. Note that TABLE is used instead of PENTZ when the numerical data are found in the original publication.

Question on Policy (with Our Suggestion and Opinions)

What should be compiled? What should not be compiled?

1. Data corrected by a non-author for reference parameters – *not recommended?*

   →LEXFOR "Status" mentions that only in exceptional cases should renormalizations or reassessments of the data as given by an evaluator be compiled.

2. Data corrected by a non-author with well documented justification and procedure, and the corresponding original data are available – *obligatory?*

   →LEXFOR "Corrections" mention that the re-assessed data is useful information to the user of EXFOR data and should, therefore, be compiled.

3. Data derived by a non-author –*not compile?*

   →We think we should be restrictive for the third case

   - to keep the database "clean" in its definition as being a trustworthy database for original experimental data. If it should be "flooded" with derived data, this could endanger the proper profile (and even reputation) of EXFOR,
   - to make sure that compilers will not suddenly be expected to compile any numbers somebody happens to derive from somebody else's experiment.

Where should we compile?

- Which entry should be used for compilation of such a data set? – *in another entry under the name of the person who performed the correction or derivation?*

Possible Technical Implementation (Coding Rule)

Apart from discussion on the policy, we need coding rules which inform EXFOR users

1. existence of the corrected or derived data
2. authenticity of data (obtained by authors or non-authors).

Note that the LEXFOR allows us to use the data type code `DERIV` only for values derived by the experimentalists from their own data.

Function of REACTION SF9 and STATUS

Before discussion of possible coding, it would be valuable to summarize the different functions of SF9 and STATUS codes:

REACTION SF9 (Data type): By default (empty SF9), it is experimental. Any code (other than the obsolete `EXP`) in SF9 indicates that the data are non-experimental. We have `CALC`, `EVAL`, `RECOM`, and `DERIV`. `DERIV` means that **authors** derived (another) quantity in a non-trivial way, e.g. by using a special formula or input from theory or other data.

STATUS: It gives information on two things:

- Codes for **data source:** `BERMN`, `CPX`, `CURVE`, `DASTR`, `NACRE`, `NDD`, `PENTZ`, `RIDER`, `SCSRS`, `SBMBS`, and `TABLE`.
- Codes for **data status:** `APRVD`, `COREL`, `DEP`, `NCHKD`, `OUTDT`, `PRELM`, `RCALC`, `RNORM`, `SPSDD`, `UNOBT`.

These are rather distinct types of information, and it is for historical reasons, that we use the same keyword for both.

If we introduce, as suggested below, a SF9 code (e.g. CRCTD) for data corrected by other than author, it does not fit to 100% into the definition that SF9 codes define non-experimental data. However, it can probably be justified because such data should always go into a separate entry different from the original experiment (and will have different REFERENCE and AUTHOR), so it is somewhat more remote from the original experimental data.

Example 1: Original and corrected data

The original [1] and corrected [2] data sets are compiled in different entries of the same area separately (21883 and 29883). The keywords AUTHOR and REFERENCE of the entry 29883 give information on who performed the correction and where the correction is documented. Two data sets are cross-referenced by the keyword REL-REF and STATUS (OUTDT and CRCTD). The data type code CRCTD in REACTION SF9 indicates that the authors who performed the correction are different from the authors who performed this experiment. The use of OUTDT in this situation implies that the expansion of this code is changed from "Normalization out-of-date".

```
ENTRY            21883   20110227
SUBENT        21883001   20110227
BIB                 15         48
AUTHOR     (B.Haesner)
REFERENCE  (R,KFK3395,1982)
…
(Description on the experimental procedure)
…
SUBENT        21883010   20110227
BIB                  3          4
REACTION   (2-HE-3(N,EL)2-HE-3,,DA)
REL-REF    (N,,M.Drosg+,J,NSE,172,87,2012)
           Corrected data given
STATUS     (TABLE) Appendix (p66) of KFK-3395
           (OUTDT,29883002) Data corrected by M.Drosg available
ENDBIB               4
NOCOMMON             0          0
DATA                 4        183
EN         ANG-CM     DATA-CM    DATA-ERR
MEV        ADEG       MB/SR      MB/SR
 5.0        33.1       409.6       41.0
 5.0        58.7       264.0       15.8
...

ENTRY            29883   20140506
SUBENT        29883001   20140506
BIB                 15         48
AUTHOR     (M.Drosg, R. Avalos Ortiz, P.W. Lisowski)
REFERENCE  (J,NSE,172,87,2012)
…
(Description on the correction procedure)
…
SUBENT        29883002   20140506
BIB                  3          4
REACTION   (2-HE-3(N,EL)2-HE-3,,DA,,,CRCTD)
ANALYSIS   Corrections with better knowledge on …
REL-REF    (R,,B.Haesner,R,KFK3395,1982)
           Original data given
STATUS     (TABLE) Table VIII of Nucl.Sci.Eng.172(2012)87
           (CRCTD,21883010) Original data given
ENDBIB               4
NOCOMMON             0          0
DATA                 4        183
EN         ANG-CM     DATA-CM    DATA-ERR
MEV        ADEG       MB/SR      MB/SR
 5.0        33.1       399.        43.
 5.0        58.7       259.        18.

...
```

Example 2: Original and derived data

The original [5] and derived [6] data sets are compiled in two different entries of the same area separately (14329 and 19329). The keywords AUTHOR and REFERENCE of the entry 19329 give information on who performed the derivation and where the correction is documented. Two data sets are cross-referenced by the keyword REL-REF and STATUS. The data type code (DERIV/OTH) in REACTION SF9 indicates that the authors who reported the derived data set are different from the authors who performed this experiment.

```
ENTRY            14329   20130626
SUBENT        14329001   20130626
BIB                 15         68
AUTHOR      (J.L.Kammerdiener)
REFERENCE   (R,UCRL-51232,1972)
…
(Description on the experimental procedure)
…
SUBENT        14329090   20130626
BIB                  3          3
REACTION    (92-U-235(N,X)0-NN-1,,DA/DE)
REL-REF     (N,19329002,T.Kawano,W,KAWANO,20130509)
            EDX derived from DDX given
STATUS      (CURVE) Fig.87 of UCRL-51232 (1972)
…
DATA                 3         67
E           DATA
MEV         MB/SR/MEV
  9.329E-02  7.850E+02
  1.399E-01  5.686E+02
…

ENTRY            19329   20140506
SUBENT        19329001   20140506
BIB                 15         68
AUTHOR      (T.Kawano)
REFERENCE   (W.KAWANO,20130509)
…
(Description on the derivation procedure)
…
SUBENT        19329002   20140506
BIB                  3          4
REACTION    (92-U-235(N,X)0-NN-1,,DE,,,DERIV/OTH)
REL-REF     (R,14329090,J.L.Kammerdiener+,R,UCRL-51232,1972)
            Double differential cross section given
STATUS      (TABLE) Data received from T.Kawano
            (DEP,14329090)
…
E-MIN       E-MAX       DATA
MEV         MEV         MB/MEV
 6.5         8.0         127.01
 8.0         9.5          69.86
…
```

References

[1] B. Haesner, Report KfK-3395 (1982). EXFOR 21883.
[2] M. Drosg et al., Nucl. Sci. Eng. 172 (2012) 87.
[3] M. Baba et al., J. Nucl. Sci. Technol. 27 (1989) 601. EXFOR 22158.
[4] R. Capote, T. Kawano, private communication (2013).
[5] J.L. Kammerdiener, Report UCRL-51232 (1972). EXFOR 14329.
[6] T. Kawano, private communication (2013).
[7] C.H.Johnson et al., Report ORNL-4743, p37 (1972). EXFOR 14043.
[8] J.K. Bair et al., Phys. Rev. C7 (1973) 1356. EXFOR C0489.
[9] W.P. Poenitz et al., Report ANL/NDM-139 (1997).

Appendix

Current LEXFOR "Status"

Normalization

If the codes `OUTDT` and `RNORM` are absent, the data are compiled as resulting from the author's corrections and normalizations.

Only in exceptional cases should renormalizations or reassessments of the data as given by an evaluator be compiled. However, some "renormalizations" are not trivial multiplication by a factor; for instance, when a detector-efficiency curve or the geometry of the experiment is involved. For such cases, see **Corrections**.

A data set that is renormalized by an evaluator is labeled with the status code `RNORM`. The older data set that is superseded by the later renormalization or reassessment is labeled with the status code `OUTDT`. Both must give a cross reference to the other data set as follows:

Examples:

```
STATUS      (OUTDT,10231002)
STATUS      (RNORM,10231003)
```

Renormalization, in general, should be done by the compiler *only* with the advice and/or consent of the author.

If the data were measured relative to a standard (with given source), but the authors quote only the cross section but not the ratio to the standard, and an expert such as an evaluator provides the **ratio** of the cross section to the standard to the data centre, this ratio, as recalculated, **may** be added to the compilation in addition to the cross section data published by the original authors, with `STATUS` code `RCALC` and appropriate explanation in free text.

Example:

```
STATUS      (RCALC) Ratio to monitor recalculated by A.
                    Trkov, 2006-03-09
```

Notes:

- If the authors published themselves both the cross section and the ratio to the standard, it is anyway obligatory to compile both quantities (as multiple reactions).
- If this option is used, information must be given in free text from which source the ratio was obtained plus any other information needed to trace the procedure used.

Current LEXFOR "Corrections"

> **Consideration, depending on the compiler's judgment**
> In general, the data resulting from the corrections applied by the author are compiled. However, evaluators frequently re-assess old data using improved corrections because they may have better knowledge on the theory of the experiment than that which was available to the author at the time of the experiment. (This may concern items such as spectra shapes, detector-efficiency curves, *etc*.) In such cases, the re-assessed data is useful information to the user of EXFOR data and should, therefore, be compiled. They would be labeled under `STATUS` as `(RNORM)`. The author's original values must be kept.
>
> Compare: **Status** (Normalization).

INDC WG2 Recommendation 1.10
(M. Herman ,T. Kawano, N.B. Janeva, F. Leszcyński, N. Van Do, C. Nordborg, J.-C Sublet, A. Blokhin)

> The working group recommends further development of the method and parallel database of experimental data derived from EXFOR by renormalizing the data according to the current standards, newer decay data, etc. In addition to these IAEA-performed renormalizations, this database may also contain data modified by evaluators during the evaluation process. The working group encourages discussion related to the construction and format of the new database and web tools to assess them.