EXFOR source documents for better traceability

S.Dunaeva

NRDC-2025 Technical Meeting (17-20 June, 2025, Madrid, Spain)

How Entry was appeared in computer in 1960-1980

Interaction with author

Scanning journals

Sources for post checking information in EXFOR (data reliability)

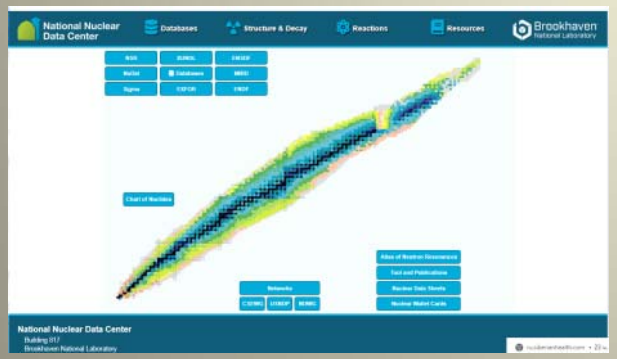
1. *Hard copy of the article*
2. *Letter from the author with additional information*
3. *Letter from the author with approval on final step of entry creating*

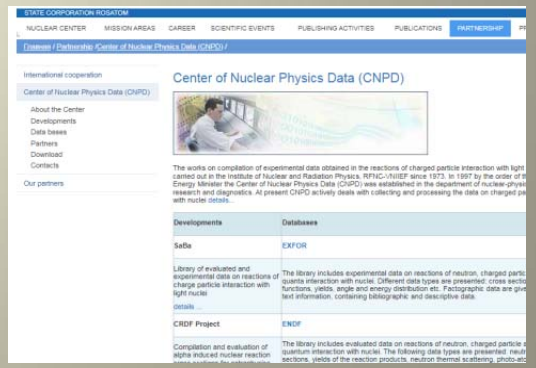
This information has to be kept for future. Why?

1. *Mistake in the data set can be overlook. (Easy to understand the source of error).*
2. *Part of data can be missed (not included in EXFOR, out of EXFOR interest at that time).*
3. *Not enough time or impossible to transfer all needed information from the hardcopy to computer (bad copy, huge dataset, etc.)*

From sixties any hard copy are carefully kept in the data centers.

For example:





Is it important today?

- *The entry creation today can take an 1 hour (instead of half of day or even much more). But it doesn't mean that we can exclude mistakes.*

- *Information exchange today can be done very quickly by e-mails. But these e-mails can disappear next time if we'll not keep them.*

- *It means that we cannot exclude the main source of mistakes: human factors. => We have to keep the primary source of information for the future.*

Sources for post checking information in EXFOR (data reliability) in nowadays

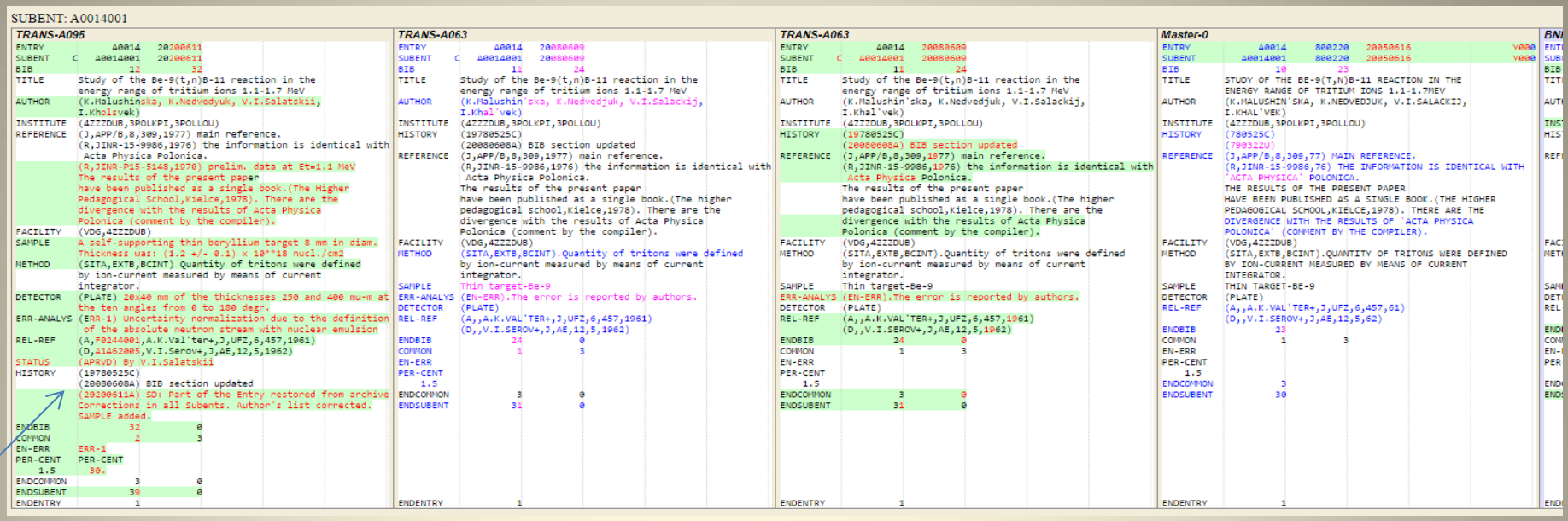
1. ***Web retrieval system that allows tracing the history of the EXFOR entry designed by Victor Zerkin, for example:***

SUBENT: A0014* ☑ show extended info

#	*Subentry*	*(1) TRN-A095*	*(2) TRN-A063*	*(3) TRN-A063*	*(4) Master-0*	*(5) BNL2005*	*(6) RU2002*	*(7) CD2001*	*(8) X4M98*
1	A0014001 [cmp]	2020-06-11 lines:41	2008-06-09 lines:33	2008-06-09 lines:33	1980-02-20 lines:32	1980-02-20 lines:32	1980-02-20 lines:34	1980-02-20 lines:34	1980-02-20 lines:34
2	A0014002 [cmp]	2020-06-11 lines:127 data:5×111 4-BE-9	2008-06-09 lines:138 data:5×120 4-BE-9	2008-06-09 lines:138 data:5×120 4-BE-9	1980-02-20 lines:139 data:5×120 4-BE-9	1980-02-20 lines:139 data:5×120 4-BE-9	1980-02-20 lines:88 data:14×20 4-BE-9	1980-02-20 lines:88 data:14×20 4-BE-9	1980-02-20 lines:88 data:14×20 4-BE-9
3	A0014003 [cmp]	2020-06-11 lines:215 data:5×200 4-BE-9					1980-02-20 lines:67 data:6×44 4-BE-9		1980-02-20 lines:67 data:6×44 4-BE-9
4	A0014004 [cmp]	2020-06-11 lines:35 data:4×20 4-BE-9					1980-02-20 lines:71 data:6×44 4-BE-9		1980-02-20 lines:71 data:6×44 4-BE-9
5	A0014005 [cmp]	2020-06-11 -nosub-					1980-02-20 lines:71 data:6×44 4-BE-9		1980-02-20 lines:71 data:6×44 4-BE-9
6	A0014006 [cmp]	2020-06-11 -nosub-					1980-02-20 lines:71 data:6×44 4-BE-9		1980-02-20 lines:71 data:6×44 4-BE-9
7	A0014007 [cmp]	2020-06-11 -nosub-					1980-02-20 lines:60 data:6×33 4-BE-9		1980-02-20 lines:60 data:6×33 4-BE-9
8	A0014008 [cmp]	2020-06-11 -nosub-					1980-02-20 lines:38 data:6×11 4-BE-9		1980-02-20 lines:38 data:6×11 4-BE-9

Clearly seen when and what was corrected or deleted from the Entry

This system really helps in restoring information



SUBENT: A0014001

TRANS-A095

```
ENTRY          A0014   20200611
SUBENT    C    A0014001   20200611
BIB              12        32
TITLE       Study of the Be-9(t,n)B-11 reaction in the
            energy range of tritium ions 1.1-1.7 MeV
AUTHOR      (K.Malushinska, K.Nedvedyuk, V.I.Salatskii,
            I.Kholsvek)
INSTITUTE   (4ZIZDUB,3POLKPI,3POLLOU)
REFERENCE   (J,APP/B,8,309,1977) main reference.
            (R,JINR-15-9986,1976) the information is identical with
             Acta Physica Polonica.
            (R,JINR-P15-5148,1970) prelim. data at Et=1.1 MeV
            The results of the present paper
            have been published as a single book.(The Higher
            Pedagogical School,Kielce,1978). There are the
            divergence with the results of Acta Physica
            Polonica (comment by the compiler).
FACILITY    (VDG,4ZIZDUB)
SAMPLE      A self-supporting thin beryllium target 8 mm in diam.
            Thickness was: (1.2 +/- 0.1) x 10**18 nucl./cm2
METHOD      (SITA,EXTB,BCINT) Quantity of tritons were defined
            by ion-current measured by means of current
            integrator.
DETECTOR    (PLATE) 20x40 mm of the thicknesses 250 and 400 mu-m at
            the ten angles from 0 to 180 degr.
ERR-ANALYS  (ERR-1) Uncertainty normalization due to the definition
             of the absolute neutron stream with nuclear emulsion
REL-REF     (A,F0244001,A.K.Val'ter+,J,UFZ,6,457,1961)
            (D,A1462005,V.I.Serov+,J,AE,12,5,1962)
STATUS      (APRVD) By V.I.Salatskii
HISTORY     (19780525C)
            (20080084) BIB section updated
            (20200611A) SD: Part of the Entry restored from archive
            Corrections in all Subents. Author's list corrected.
            SAMPLE added.
ENDBIB           32         0
COMMON            2         3
EN-ERR       ERR-1
PER-CENT     PER-CENT
    1.5         30.
ENDCOMMON         3         0
ENDSUBENT        30         0
ENDENTRY          1
```

TRANS-A063

```
ENTRY          A0014   20080609
SUBENT    C    A0014001   20080609
BIB              11        24
TITLE       Study of the Be-9(t,n)B-11 reaction in the
            energy range of tritium ions 1.1-1.7 MeV
AUTHOR      (K.Malushin'ska, K.Nedvedjuk, V.I.Salackij,
            I.Khal'vek)
INSTITUTE   (4ZIZDUB,3POLKPI,3POLLOU)
HISTORY     (19780525C)
            (20080608A) BIB section updated
REFERENCE   (J,APP/B,8,309,1977) main reference.
            (R,JINR-15-9986,1976) the information is identical with
             Acta Physica Polonica.
            The results of the present paper
            have been published as a single book.(The higher
            pedagogical school,Kielce,1978). There are the
            divergence with the results of Acta Physica
            Polonica (comment by the compiler).
FACILITY    (VDG,4ZIZDUB)
METHOD      (SITA,EXTB,BCINT).Quantity of tritons were defined
            by ion-current measured by means of current
            integrator.
SAMPLE      Thin target-Be-9
ERR-ANALYS  (EN-ERR).The error is reported by authors.
DETECTOR    (PLATE)
REL-REF     (A,,A.K.VAL'TER+,J,UFZ,6,457,1961)
            (D,,V.I.SEROV+,J,AE,12,5,1962)
ENDBIB           24         0
COMMON            1         3
EN-ERR
PER-CENT
    1.5
ENDCOMMON         3         0
ENDSUBENT        31         0
ENDENTRY          1
```

TRANS-A063

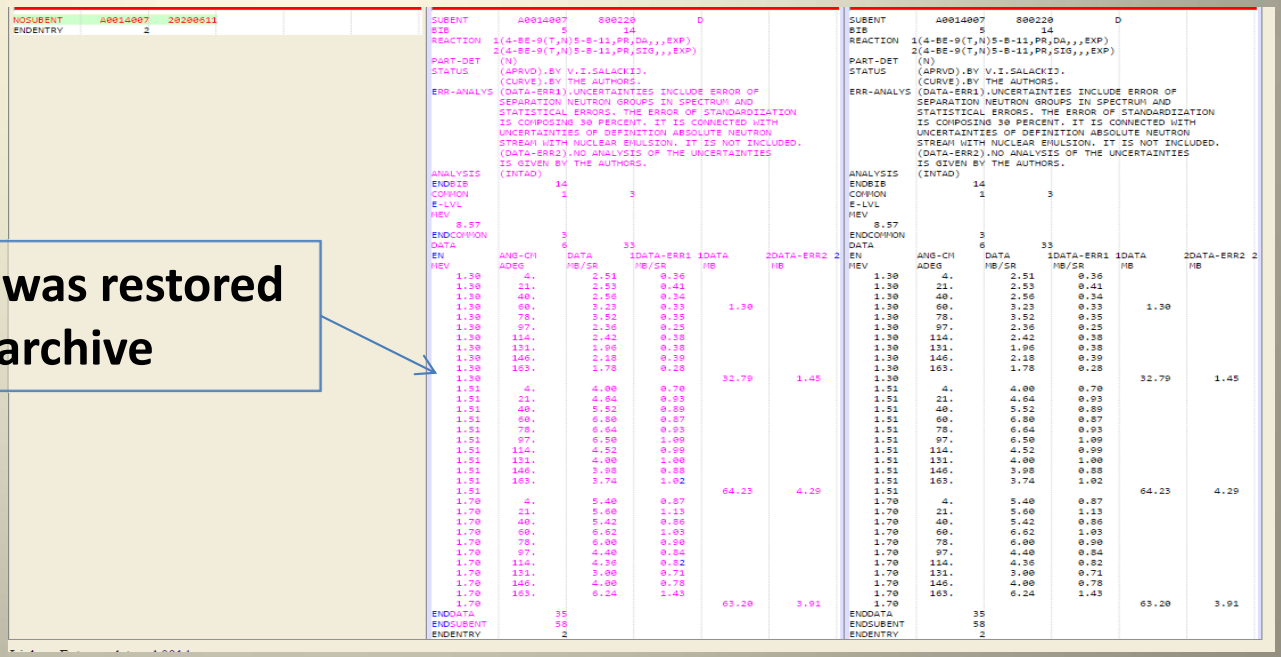
```
ENTRY          A0014   20080609
SUBENT    C    A0014001   20080609
BIB              11        24
TITLE       Study of the Be-9(t,n)B-11 reaction in the
            energy range of tritium ions 1.1-1.7 MeV
AUTHOR      (K.Malushin'ska, K.Nedvedjuk, V.I.Salackij,
            I.Khal'vek)
INSTITUTE   (4ZIZDUB,3POLKPI,3POLLOU)
HISTORY     (19780525C)
            (20080608A) BIB section updated
REFERENCE   (J,APP/B,8,309,1977) main reference.
            (R,JINR-15-9986,1976) the information is identical with
             Acta Physica Polonica.
            The results of the present paper
            have been published as a single book.(The higher
            pedagogical school,Kielce,1978). There are the
            divergence with the results of Acta Physica
            Polonica (comment by the compiler).
FACILITY    (VDG,4ZIZDUB)
METHOD      (SITA,EXTB,BCINT).Quantity of tritons were defined
            by ion-current measured by means of current
            integrator.
SAMPLE      Thin target-Be-9
ERR-ANALYS  (EN-ERR).The error is reported by authors.
DETECTOR    (PLATE)
REL-REF     (A,,A.K.VAL'TER+,J,UFZ,6,457,1961)
            (D,,V.I.SEROV+,J,AE,12,5,1962)
ENDBIB           24         0
COMMON            1         3
EN-ERR
PER-CENT
    1.5
ENDCOMMON         3         0
ENDSUBENT        31         0
ENDENTRY          1
```

Master-0

```
ENTRY          A0014   800220   20050616          Y000
SUBENT        A0014001   800220   20050616          Y000
BIB              10        23
TITLE       STUDY OF THE BE-9(T,N)B-11 REACTION IN THE
            ENERGY RANGE OF TRITIUM IONS 1.1-1.7MEV
AUTHOR      (K.MALUSHIN'SKA, K.NEDVEDJUK, V.I.SALACKIJ,
            I.KHAL'VEK)
INSTITUTE   (4ZIZDUB,3POLKPI,3POLLOU)
HISTORY     (7805251)
            (7903221)
REFERENCE   (J,APP/B,8,309,77) MAIN REFERENCE.
            (R,JINR-15-9986,76) THE INFORMATION IS IDENTICAL WITH
            'ACTA PHYSICA' POLONICA.
            THE RESULTS OF THE PRESENT PAPER
            HAVE BEEN PUBLISHED AS A SINGLE BOOK.(THE HIGHER
            PEDAGOGICAL SCHOOL,KIELCE,1978). THERE ARE THE
            DIVERGENCE WITH THE RESULTS OF 'ACTA PHYSICA
            POLONICA' (COMMENT BY THE COMPILER).
FACILITY    (VDG,4ZIZDUB)
METHOD      (SITA,EXTB,BCINT).QUANTITY OF TRITONS WERE DEFINED
            BY ION-CURRENT MEASURED BY MEANS OF CURRENT
            INTEGRATOR.
SAMPLE      THIN TARGET-BE-9
DETECTOR    (PLATE)
REL-REF     (A,,A.K.VAL'TER+,J,UFZ,6,457,61)
            (D,,V.I.SEROV+,J,AE,12,5,62)
ENDBIB           23
COMMON            1         3
EN-ERR
PER-CENT
    1.5
ENDCOMMON         3
ENDSUBENT        30
ENDENTRY          1
```

All corrections were mentioned in the HISTORY

This data was restored from the archive



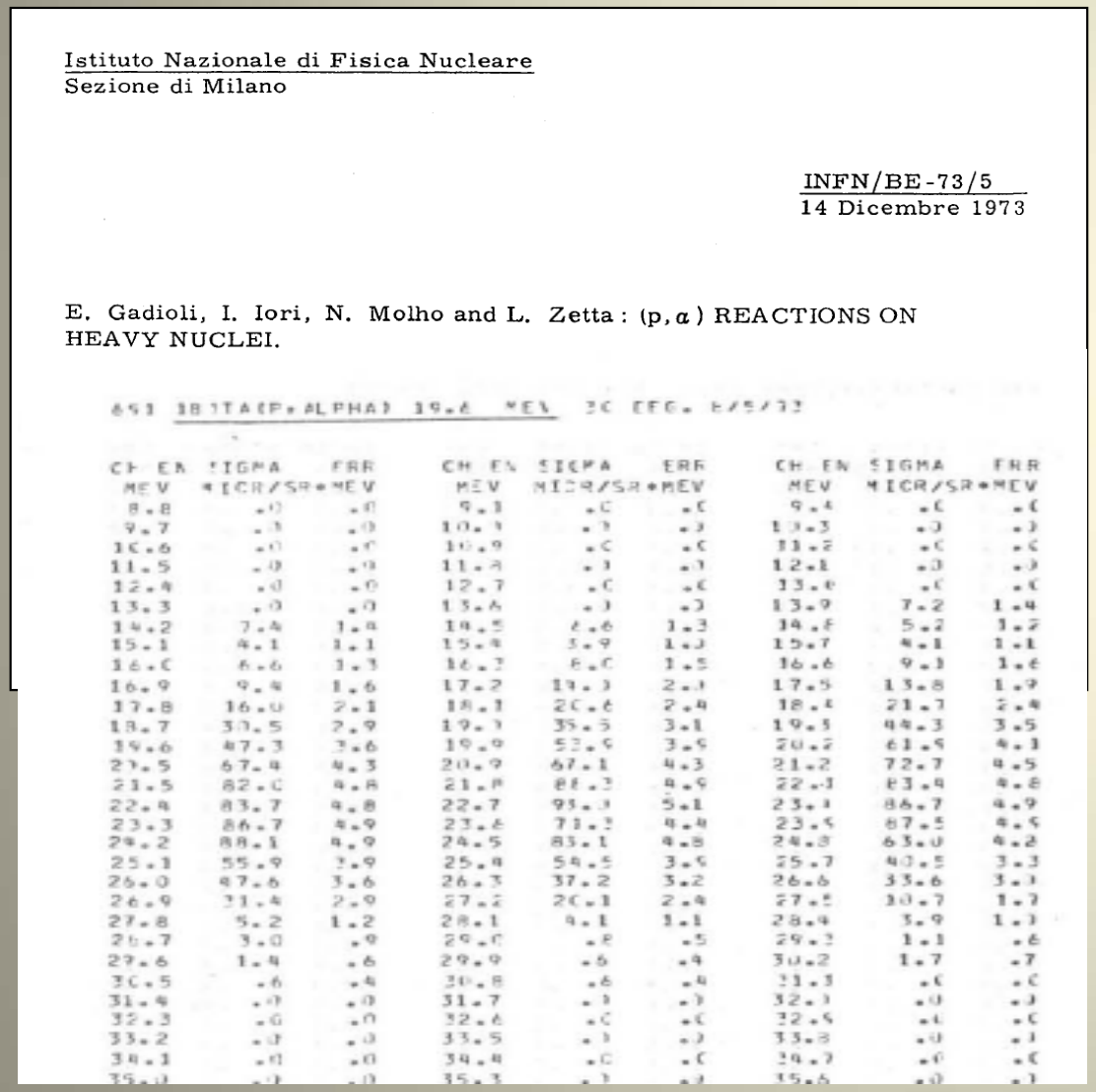
```
NOSUBENT      A0014007   20200611
ENDENTRY             2
```

```
SUBENT        A0014007      800220          D
BIB                  5          14
REACTION  1(4-BE-9(T,N)5-B-11,PR,DA,,,EXP)
          2(4-BE-9(T,N)5-B-11,PR,SIG,,,EXP)
PART-DET  (N)
STATUS    (APRVD).BY V.I.SALACKIJ.
          (CURVE).BY THE AUTHORS.
ERR-ANALYS (DATA-ERR1).UNCERTAINTIES INCLUDE ERROR OF
          SEPARATION NEUTRON GROUPS IN SPECTRUM AND
          STATISTICAL ERRORS. THE ERROR OF STANDARDIZATION
          IS COMPOSING 30 PERCENT. IT IS CONNECTED WITH
          UNCERTAINTIES OF DEFINITION ABSOLUTE NEUTRON
          STREAM WITH NUCLEAR EMULSION. IT IS NOT INCLUDED.
          (DATA-ERR2).NO ANALYSIS OF THE UNCERTAINTIES
          IS GIVEN BY THE AUTHORS.
ANALYSIS  (INTAD)
ENDBIB               14
COMMON                1          3
E-LVL
MEV
    8.57
ENDCOMMON             3
DATA                  6         33
EN        ANG-CM    DATA      1DATA-ERR1 1DATA      2DATA-ERR2 2
MEV       ADEG      MB/SR     MB/SR      MB         MB
    1.30      4.       2.51       0.36
    1.30     21.       2.53       0.41
    1.30     40.       2.56       0.34
    1.30     60.       3.23       0.33       1.30
    1.30     78.       3.52       0.35
    1.30     97.       2.36       0.25
    1.30    114.       2.42       0.38
    1.30    131.       1.96       0.38
    1.30    146.       2.18       0.39
    1.30    163.       1.78       0.28
    1.30                                     32.79       1.45
    1.51      4.       4.00       0.70
    1.51     21.       4.64       0.93
    1.51     40.       5.52       0.89
    1.51     60.       6.80       0.87
    1.51     78.       6.64       0.93
    1.51     97.       6.50       1.09
    1.51    114.       4.52       0.99
    1.51    131.       4.00       1.00
    1.51    146.       3.98       0.88
    1.51    163.       3.74       1.02
    1.51                                     64.23       4.29
    1.70      4.       5.40       0.87
    1.70     21.       5.60       1.13
    1.70     40.       5.42       0.86
    1.70     60.       6.62       1.03
    1.70     78.       6.00       0.90
    1.70     97.       4.40       0.84
    1.70    114.       4.36       0.82
    1.70    131.       3.00       0.71
    1.70    146.       4.00       0.78
    1.70    163.       6.24       1.43
    1.70                                     63.20       3.91
ENDDATA              35
ENDSUBENT            58
ENDENTRY              2
```

```
SUBENT        A0014007      800220          D
BIB                  5          14
REACTION  1(4-BE-9(T,N)5-B-11,PR,DA,,,EXP)
          2(4-BE-9(T,N)5-B-11,PR,SIG,,,EXP)
PART-DET  (N)
STATUS    (APRVD).BY V.I.SALACKIJ.
          (CURVE).BY THE AUTHORS.
ERR-ANALYS (DATA-ERR1).UNCERTAINTIES INCLUDE ERROR OF
          SEPARATION NEUTRON GROUPS IN SPECTRUM AND
          STATISTICAL ERRORS. THE ERROR OF STANDARDIZATION
          IS COMPOSING 30 PERCENT. IT IS CONNECTED WITH
          UNCERTAINTIES OF DEFINITION ABSOLUTE NEUTRON
          STREAM WITH NUCLEAR EMULSION. IT IS NOT INCLUDED.
          (DATA-ERR2).NO ANALYSIS OF THE UNCERTAINTIES
          IS GIVEN BY THE AUTHORS.
ANALYSIS  (INTAD)
ENDBIB               14
COMMON                1          3
E-LVL
MEV
    8.57
ENDCOMMON             3
DATA                  6         33
EN        ANG-CM    DATA      1DATA-ERR1 1DATA      2DATA-ERR2 2
MEV       ADEG      MB/SR     MB/SR      MB         MB
    1.30      4.       2.51       0.36
    1.30     21.       2.53       0.41
    1.30     40.       2.56       0.34
    1.30     60.       3.23       0.33       1.30
    1.30     78.       3.52       0.35
    1.30     97.       2.36       0.25
    1.30    114.       2.42       0.38
    1.30    131.       1.96       0.38
    1.30    146.       2.18       0.39
    1.30    163.       1.78       0.28
    1.30                                     32.79       1.45
    1.51      4.       4.00       0.70
    1.51     21.       4.64       0.93
    1.51     40.       5.52       0.89
    1.51     60.       6.80       0.87
    1.51     78.       6.64       0.93
    1.51     97.       6.50       1.09
    1.51    114.       4.52       0.99
    1.51    131.       4.00       1.00
    1.51    146.       3.98       0.88
    1.51    163.       3.74       1.02
    1.51                                     64.23       4.29
    1.70      4.       5.40       0.87
    1.70     21.       5.60       1.13
    1.70     40.       5.42       0.86
    1.70     60.       6.62       1.03
    1.70     78.       6.00       0.90
    1.70     97.       4.40       0.84
    1.70    114.       4.36       0.82
    1.70    131.       3.00       0.71
    1.70    146.       4.00       0.78
    1.70    163.       6.24       1.43
    1.70                                     63.20       3.91
ENDDATA              35
ENDSUBENT            58
ENDENTRY              2
```

2. Copy of the article (or other source of the publication) kept in pdf-format

For example: Gadioli et al's (p,α+x) dσ/dΩdE (EXFOR# O2263)



Istituto Nazionale di Fisica Nucleare
Sezione di Milano

INFN/BE-73/5
14 Dicembre 1973

E. Gadioli, I. Iori, N. Molho and L. Zetta : (p,α) REACTIONS ON HEAVY NUCLEI.

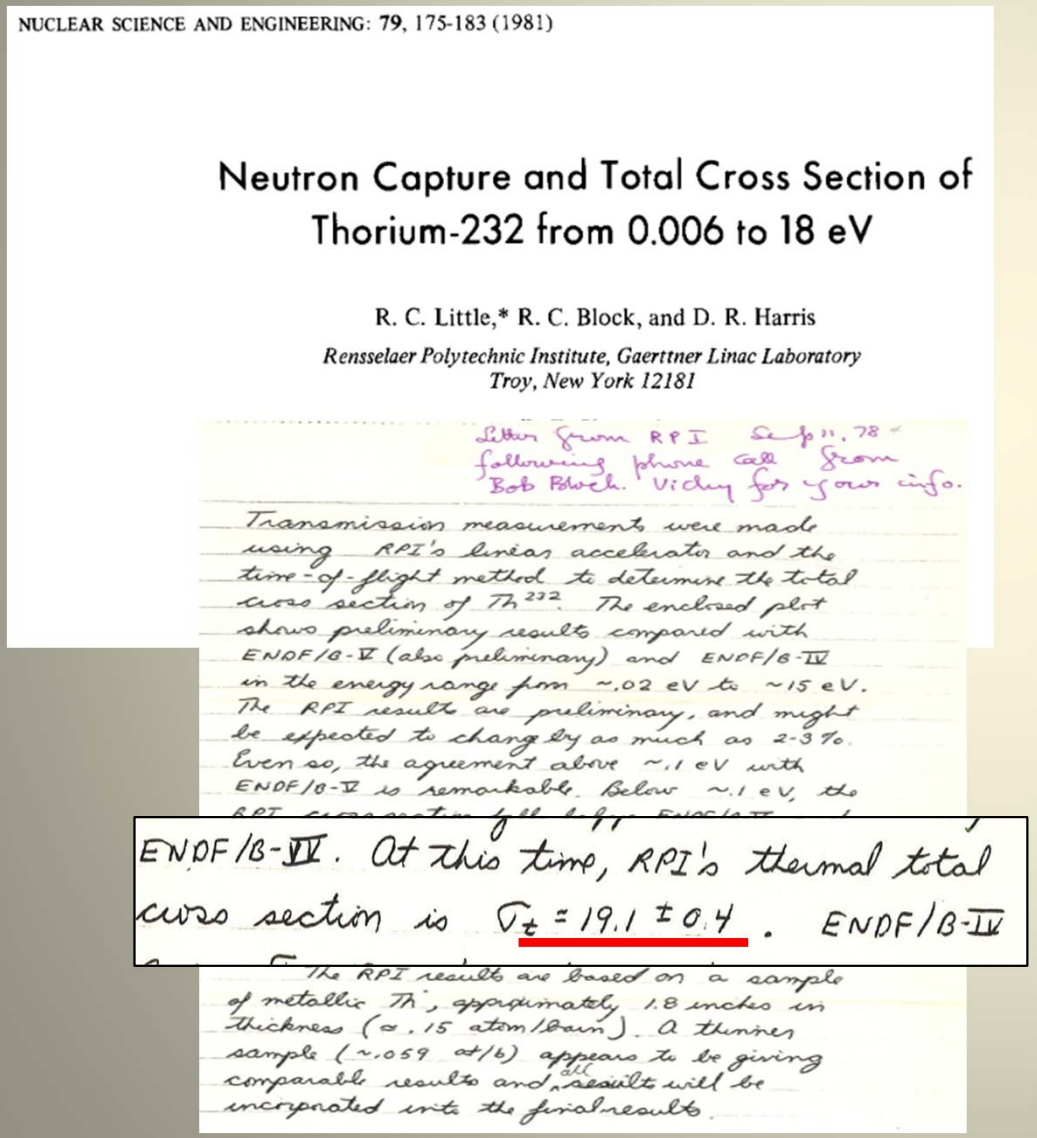
CH EN MEV	SIGMA MICR/SR	ERR MEV	CH EN MEV	SIGMA MICR/SR	ERR MEV	CH EN MEV	SIGMA MICR/SR	ERR MEV
8.8	.0	.0	9.1	.0	.0	9.4	.0	.0
9.7	.3	.0	10.1	.3	.3	10.3	.3	.3
10.6	.0	.0	10.9	.0	.0	11.2	.0	.0
11.5	.0	.0	11.8	.3	.3	12.1	.3	.3
12.4	.0	.0	12.7	.0	.0	13.0	.0	.0
13.3	.0	.0	13.6	.3	.3	13.9	7.2	1.4
14.2	7.4	1.8	14.5	6.6	1.3	14.8	5.2	1.2
15.1	4.1	1.1	15.4	5.9	1.3	15.7	4.1	1.1
16.0	6.6	1.3	16.3	6.0	1.5	16.6	9.3	1.6
16.9	9.4	1.6	17.2	13.3	2.3	17.5	13.8	1.9
17.8	16.0	2.1	18.1	20.6	2.4	18.4	21.7	2.4
18.7	30.5	2.9	19.1	35.5	3.1	19.5	44.3	3.5
19.6	47.3	3.6	19.9	53.9	3.9	20.2	61.9	4.1
21.5	67.4	4.3	20.9	67.1	4.3	21.2	72.7	4.5
21.5	82.0	4.8	21.8	88.3	4.9	22.1	83.9	4.8
22.4	83.7	4.8	22.7	95.3	5.1	23.1	86.7	4.9
23.3	86.7	4.9	23.6	71.3	4.4	23.5	87.5	4.5
24.2	88.1	4.9	24.5	83.1	4.8	24.8	63.0	4.2
25.1	55.9	3.9	25.4	54.5	3.5	25.7	40.5	3.3
26.0	47.6	3.6	26.3	37.2	3.2	26.6	33.6	3.1
26.9	31.4	2.9	27.2	20.1	2.4	27.5	10.7	1.7
27.8	5.2	1.2	28.1	9.1	1.1	28.4	5.9	1.1
28.7	3.0	.9	29.0	.8	.5	29.3	1.1	.6
29.6	1.4	.6	29.9	.6	.4	30.2	1.7	.7
30.5	.6	.4	30.8	.6	.4	31.3	.0	.0
31.4	.0	.0	31.7	.3	.3	32.1	.0	.3
32.3	.0	.0	32.6	.0	.0	32.9	.1	.0
33.2	.0	.0	33.5	.3	.3	33.8	.0	.3
34.1	.0	.0	34.4	.0	.0	34.7	.0	.0
35.0	.0	.0	35.3	.3	.3	35.6	.0	.3

Entry was compiled in 2015. Unfortunately, NDS had only bad copy of it. Only angular distributions given on figures were digitized and added to the Entry.

It is clear that quality of digitizing depends on many factors.

Later, in 2019 better copy was found in CANBERA (Australia). The compiler made them machine readable, checked the typed numbers against the original .

Little's σ_0 for ^{232}Th total (EXFOR #10956)



NUCLEAR SCIENCE AND ENGINEERING: 79, 175-183 (1981)

Neutron Capture and Total Cross Section of Thorium-232 from 0.006 to 18 eV

R. C. Little,* R. C. Block, and D. R. Harris

Rensselaer Polytechnic Institute, Gaerttner Linac Laboratory
Troy, New York 12181

Letter from RPI Sep 11, 78
following phone call from
Bob Block. Vicky for your info.

Transmission measurements were made using RPI's linear accelerator and the time-of-flight method to determine the total cross section of Th^{232}. The enclosed plot shows preliminary results compared with ENDF/B-V (also preliminary) and ENDF/B-IV in the energy range from ~.02 eV to ~15 eV. The RPI results are preliminary, and might be expected to change by as much as 2-3%. Even so, the agreement above ~.1 eV with ENDF/B-V is remarkable. Below ~.1 eV, the

ENDF/B-IV. At this time, RPI's thermal total cross section is $\sigma_t = 19.1 \pm 0.4$. ENDF/B-IV

The RPI results are based on a sample of metallic Th, approximately 1.8 inches in thickness (≈ .15 atom/barn). A thinner sample (~.059 at/b) appears to be giving comparable results and all results will be incorporated into the final results.

EXFOR 10956.003 provides 19.1 ±0.04 b as the ^{232}Th+n thermal total cross section interpolated from TOF data points from RPI. Uncertainty looked small.

Little's letter in Nov. 1981 was scanned (with other CSISRS archives in McLane's office) by NNDC. It shows the uncertainty must be 0.4 b.

Not only numerical data but private communications between data centres and authors must be preserved.

Conclusions

1. *Keep the source documents (including emails) used in compilation in a storage to ensure future traceability*

2. *Better to deposit their copies to NDS to secure their availability in the network on a long term basis*

THANK YOU