INTERNATIONAL ATOMIC ENERGY AGENCY

NUCLEAR DATA SERVICES

DOCUMENTATION SERIES OF THE IAEA NUCLEAR DATA SECTION

Short Guide to EXFOR

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Abstract: EXFOR is the agreed exchange format for the magnetic-tape transmission of experimental nuclear reaction data between national and international nuclear data centers for the benefit of nuclear data users in all countries.

This document gives a brief introduction to recipients of EXFOR data retrieved from the EXFOR data base. It describes the two output formats, "standard" and "edited", that are available from the IAEA Nuclear Data Section, either on magnetic tape or as printed listing, both free of charge.

This document describes EXFOR in its original version for neutron nuclear data. A similar guide to the more general EXFOR which includes also charged-particle nuclear data and photonuclear data, is in preparation.

The IAEA EXFOR system is documented in detail in the following reports:

IAEA-NDS-2: EXFOR Dictionaries

IAEA-NDS-3: NDS EXFOR Manual

IAEA-NDS-4: System Specifications for the NDS EXFOR System

IAEA-NDS-5: System Specifications for the NDS EXFOR Dictionary Sub-system

IAEA-NDS-6: System Specifications for the NDS Data Index System

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SHORT GUIDE TO EXFOR

EXFOR - a computerized EXchange FORmat - presents in a convenient compact form experimental numerical data as well as physical information necessary to understand the experiment and interpret the data. Keywords and codes make the information computer intelligible. The structure of EXFOR is briefly described in the following.

Each EXFOR "entry" consists of two or more "subentries". The first subentry of an entry contains information which is common to all the following subentries of that entry. Each subentry may include two types of information: Descriptive text information and numerical data. Each item of descriptive text information is identified by keywords such as TITLE, STANDARD, ISO-QUANT, which may exhibit a code within parenthesis, such as (GELI), (SCIN) for the keyword DETECTOR or (TOF), (COINC) for the keyword METHOD. The meaning of most keywords is self-explanatory. The meaning of most codes is given in the free text following the code. Of particular importance is the keyword "ISO-QUANT". Under this keyword are coded the "isotope and quantity" or, in other words, the reaction and parameter measured.

EXFOR information is available in two formats:

- the "standard format" primarily designed for the international exchange of data in computer processable form, and

- the "edited format" in which coded information and data tables are edited in an easily legible form.

The EXFOR structure, the standard and edited formats are illustrated in example 1.

There are several categories of numerical data:

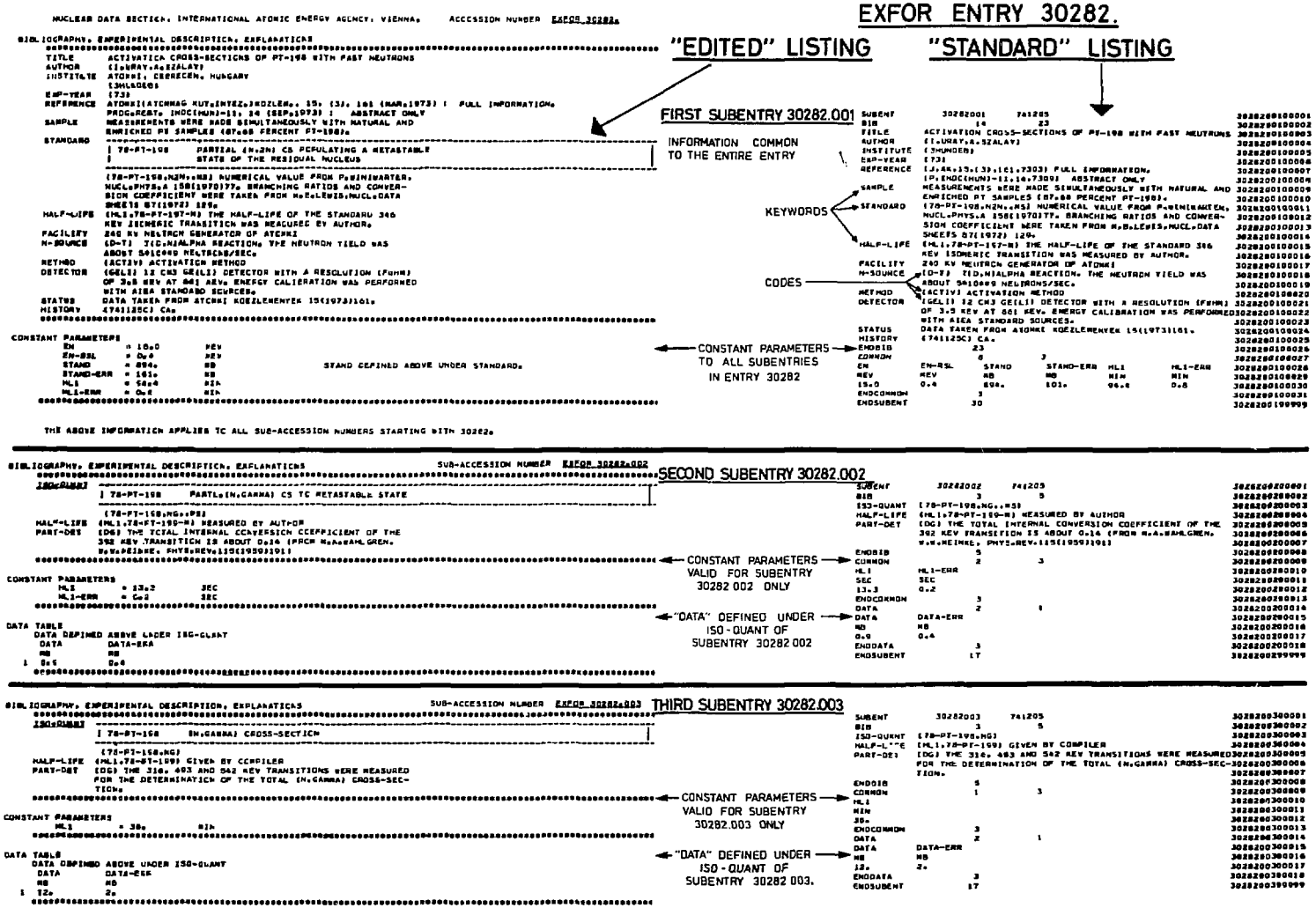
- In the DATA TABLE the numerical data of the quantity defined above under ISO-QUANT are given under DATA (or RATIO) together with the columns of independent variables, errors, etc.

- Constant numerical values which are common to the entire data table of a given subentry, are given in the CONSTANT PARAMETERS (also called COMMON in the standard format) section.

- Constant numerical values which are common to all subentries of a given entry, are given in the CONSTANT PARAMETERS (resp. COMMON) section of the first subentry of that entry.

All numerical data are defined by Data-heading keywords (e.g. DATA, EN = incident neutron energy, STAND = standard) and by Data-unit keywords (e.g. EV, MB). The list of Data-heading keywords presently used is given on page 6.

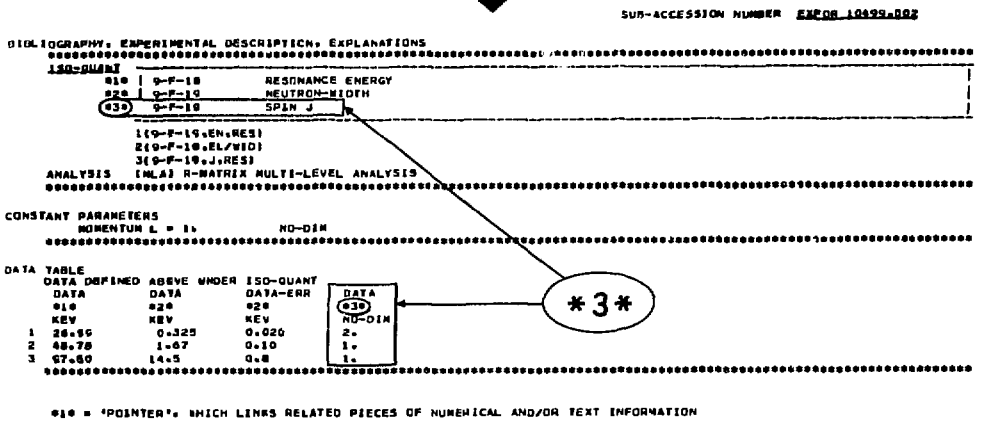
Some data tables may have a more complex structure, for example there may be several ISO-QUANT per subentry; in this case each ISO-QUANT is connected to its pertinent column in the DATA TABLE by means of a "pointer", as illustrated in example 2. More generally a pointer can be used to connect related pieces of information (see example 3).



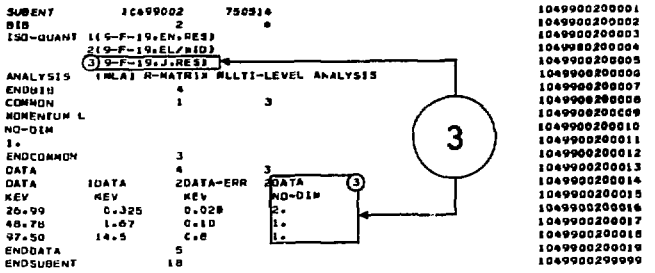
1 3 1

EXAMPLE 1

"EDITED" LISTING



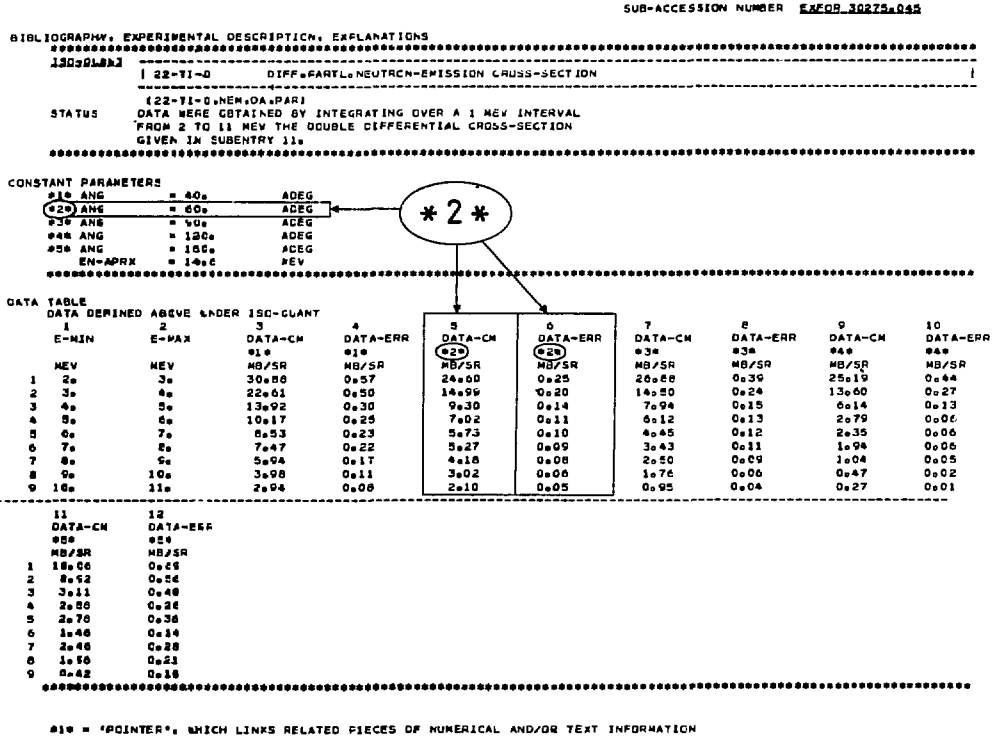
"STANDARD" LISTING



POINTERS LINK RELATED PIECES OF NUMERICAL AND/OR TEXT INFORMATION. IN THIS EXAMPLE, A POINTER (E.G. 3) LINKS AN ISO-QUANT WITH ITS CORRESPONDING DATA COLUMN.

EXAMPLE 2

"EDITED" LISTING



SUB-ACCESSION NUMBER EXFOR 30275.045

BIBLIOGRAPHY, EXPERIMENTAL DESCRIPTION, EXPLANATIONS

ISO-QUANT [22-YI-0,NEM,DA,PAR]

22-YI-0 DIFF.PARTL.NEUTRON-EMISSION CROSS-SECTION

(22-YI-0,NEM,DA,PAR)

STATUS DATA WERE OBTAINED BY INTEGRATING OVER A 1 MEV INTERVAL FROM 2 TO 11 MEV THE DOUBLE DIFFERENTIAL CROSS-SECTION GIVEN IN SUBENTRY 11.

CONSTANT PARAMETERS

#1. ANG	= 40.	ADEG	
#2. ANG	= 60.	ADEG	
#3. ANG	= 90.	ADEG	
#4. ANG	= 120.	ADEG	
#5. ANG	= 150.	ADEG	
EN-APRX	= 14.6	MEV	

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DATA TABLE

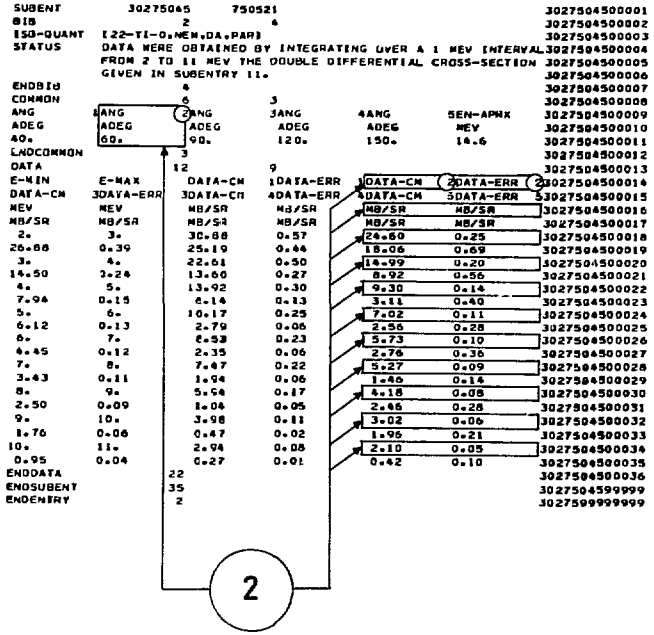
DATA DEFINED ABOVE UNDER ISO-QUANT

	1 E-MIN	2 E-MAX	3 DATA-CM #1.	4 DATA-ERR #1.	5 DATA-CM #2.	6 DATA-ERR #2.	7 DATA-CM #3.	8 DATA-ERR #3.	9 DATA-CM #4.	10 DATA-ERR #4.
	MEV	MEV	MB/SR	MB/SR	MB/SR	MB/SR	MB/SR	MB/SR	MB/SR	MB/SR
1	2.	3.	30.88	0.57	24.60	0.25	26.88	0.39	25.19	0.44
2	3.	4.	22.61	0.50	14.99	0.20	14.50	0.24	13.60	0.27
3	4.	5.	13.92	0.30	9.30	0.14	7.94	0.15	6.14	0.13
4	5.	6.	10.17	0.25	7.02	0.11	6.12	0.13	2.79	0.06
5	6.	7.	6.53	0.23	5.73	0.10	4.65	0.12	2.35	0.06
6	7.	8.	7.47	0.22	5.27	0.09	3.43	0.11	1.94	0.06
7	8.	9.	5.94	0.17	4.18	0.08	2.50	0.09	1.04	0.05
8	9.	10.	3.98	0.11	3.02	0.06	1.76	0.06	0.47	0.02
9	10.	11.	2.94	0.08	2.10	0.05	0.95	0.04	0.27	0.01

	11 DATA-CM #5. MB/SR	12 DATA-ERR #5. MB/SR
1	18.06	0.69
2	8.92	0.56
3	3.11	0.40
4	2.56	0.28
5	2.76	0.36
6	1.46	0.16
7	2.46	0.28
8	1.56	0.21
9	0.42	0.18

#1. = 'POINTER', WHICH LINKS RELATED PIECES OF NUMERICAL AND/OR TEXT INFORMATION

"STANDARD" LISTING



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SUBENT      30275045   750521                                    30275045000001
BIB                 2        4                                   30275045000002
ISO-QUANT  [22-YI-0,NEM,DA,PAR]                                  30275045000003
STATUS     DATA WERE OBTAINED BY INTEGRATING OVER A 1 MEV INTERVAL30275045000004
           FROM 2 TO 11 MEV THE DOUBLE DIFFERENTIAL CROSS-SECTION 30275045000005
           GIVEN IN SUBENTRY 11.                                 30275045000006
ENDBIB              4                                            30275045000007
COMMON              6        3                                   30275045000008
ANG         1ANG    2ANG     3ANG     4ANG     5EN-APRX          30275045000009
ADEG        ADEG    ADEG     ADEG     ADEG     MEV               30275045000010
40.         60.     90.      120.     150.     14.6              30275045000011
ENDCOMMON           3                                            30275045000012
DATA               12        9                                   30275045000013
E-MIN       E-MAX   1DATA-CM 1DATA-ERR 2DATA-CM 2DATA-ERR 3DATA-CM 3DATA-ERR 30275045000014
DATA-CM     2DATA-ERR 2DATA-CM 2DATA-ERR 3DATA-CM 3DATA-ERR 4DATA-CM 4DATA-ERR 30275045000015
MEV         MEV     MB/SR    MB/SR    MB/SR    MB/SR    MB/SR    MB/SR    30275045000016
MB/SR       MB/SR   MB/SR    MB/SR    MB/SR    MB/SR    MB/SR    MB/SR    30275045000017
2.          3.      30.88    0.57     24.60    0.25     26.88    0.39     30275045000018
26.88       0.39    25.19    0.44     18.06    0.69     14.50    0.24     30275045000019
3.          4.      22.61    0.50     14.99    0.20     13.60    0.27     30275045000020
14.50       3.24    13.60    0.27     8.92     0.56     7.94     0.15     30275045000021
4.          5.      13.92    0.30     9.30     0.14     6.14     0.13     30275045000022
7.94        0.15    6.14     0.13     3.11     0.40     2.79     0.06     30275045000023
5.          6.      10.17    0.25     7.02     0.11     6.12     0.13     30275045000024
6.12        0.13    2.79     0.06     2.56     0.28     1.76     0.06     30275045000025
6.          7.      6.53     0.23     5.73     0.10     4.65     0.12     30275045000026
4.65        0.12    2.35     0.06     2.76     0.36     2.50     0.09     30275045000027
7.          8.      7.47     0.22     5.27     0.09     3.43     0.11     30275045000028
3.43        0.11    1.94     0.06     1.46     0.16     1.04     0.05     30275045000029
8.          9.      5.94     0.17     4.18     0.08     2.50     0.09     30275045000030
2.50        0.09    1.04     0.05     2.46     0.28     1.76     0.06     30275045000031
9.          10.     3.98     0.11     3.02     0.06     0.95     0.04     30275045000032
1.76        0.06    0.47     0.02     1.96     0.21     0.27     0.01     30275045000033
10.         11.     2.94     0.08     2.10     0.05     0.95     0.04     30275045000034
0.95        0.04    0.27     0.01     0.42     0.10                       30275045000035
ENDDATA            22                                            30275045000036
ENDSUBENT          35                                            30275045999999
ENDENTRY            2                                            30275999999999
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IN THIS EXAMPLE, A POINTER LINKS AN ANGLE AND THE CORRESPONDING DIFFERENTIAL CROSS - SECTION. ALSO NOTE THAT TABLES WITH MORE THAN 6 COLUMNS WHICH ARE TEDIOUS TO DECIPHER IN "STANDARD" FORMAT, ARE CLEARLY PRESENTED IN THE "EDITED" LISTING.

EXAMPLE 3

LIST OF DATA-HEADING KEYWORDS

KEYWORD	EXPLANATION
EN	INCIDENT NEUTRON ENERGY, LAB-SYSTEM
EN-APRX	APPROXIMATE VALUE OF INCIDENT NEUTRON ENERGY
EN-CM	INCIDENT NEUTRON ENERGY, C-M-SYSTEM
EN-MIN	LOW LIMIT OF INCIDENT N-ENERGY RANGE, LAB-SYSTEM
EN-CM-MIN	LOW LIMIT OF INCIDENT N-ENERGY RANGE, C-M-SYSTEM
EN-MAX	HIGH LIMIT OF INCIDENT N-ENERGY RANGE, LAB-SYSTEM
EN-CM-MAX	HIGH LIMIT OF INCIDENT N-ENERGY RANGE, C-M-SYSTEM
EN-DUMMY	DUMMY ENERGY, USED AS THE NUMERICAL EQUIVALENT OF AN INCIDENT NEUTRON SPECTRUM WHERE NO NUMERICAL ENERGY VALUE IS GIVEN BY THE AUTHOR
EN-RSL	INCIDENT-NEUTRON ENERGY-RESOLUTION
+EN-RSL	+UNSYMMETRIC ENERGY RESOLUTION
-EN-RSL	-UNSYMMETRIC ENERGY RESOLUTION
EN-ERR	ERROR OF MONOCHROMATIC INCIDENT-NEUTRON ENERGY OR UNCERTAINTY OF THE CENTRAL ENERGY IN AN INCIDENT NEUTRON-SPECTRUM.
EN-ERR1	ENERGY ERROR, IF MORE THAN ONE ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'.
EN-ERR2	SECOND ENERGY ERROR, IF MORE THAN ONE ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
+EN-ERR	+ UNSYMMETRIC ENERGY-ERROR
-EN-ERR	- UNSYMMETRIC ENERGY-ERROR
EN-NRM	NORMALIZATION ENERGY. TO BE USED WHEN A DATA SET IS NORMALIZED TO ONE ENERGY ONLY.
EN-RES	RESONANCE ENERGY
EN-RES-ERR	ERROR OF RESONANCE-ENERGY
MU-ADLER	MU IN ADLER-ADLER RESONANCE-ANALYSIS. EQUIVALENT TO RESONANCE ENERGY
E	ENERGY OF OUTGOING PARTICLE, LAB-SYSTEM
E1	ENERGY OF OUTGOING PARTICLE, AS DEFINED IN BIB-SECTION
E2	ENERGY OF OUTGOING PARTICLE, AS DEFINED IN BIB-SECTION
E-APRX	
E-CM	ENERGY OF OUTGOING PARTICLE, C-M-SYSTEM
E-MIN	LOW LIMIT OF OUTGOING-PARTICLE E-RANGE, LAB-SYSTEM
E-CM-MIN	LOW LIMIT OF OUTGOING-PARTICLE E-RANGE, C-M-SYSTEM
E-MAX	HIGH LIMIT OF OUTGOING-PARTICLE E-RANGE, LAB-SYSTEM
E-CM-MAX	HIGH LIMIT OF OUTGOING-PARTICLE E-RANGE, C-M-SYSTEM
E-RSL	OUTGOING-PARTICLE ENERGY-RESOLUTION
E-ERR	OUTGOING-PARTICLE ENERGY-ERROR
E-EXC	EXCITATION-ENERGY
E-EXC-MIN	LOW LIMIT OF EXCITATION-ENERGY
E-EXC-MAX	HIGH LIMIT OF EXCITATION-ENERGY
E-LVL	LEVEL-ENERGY
E-LVL-INI	INITIAL LEVEL OF GAMMA-TRANSITION
E-LVL-FIN	FINAL LEVEL OF GAMMA-TRANSITION
E-LVL-ERR	LEVEL-ENERGY ERROR
E-LVL-MIN	LOW ENERGY-LIMIT OF A DISCRETE LEVEL-GROUP
E-LVL-MAX	HIGH ENERGY-LIMIT OF A DISCRETE LEVEL-GROUP
LVL-NUMB	LEVEL-NUMBER, TO BE USED ONLY IF OTHER INFORMATION IS NOT AVAILABLE.
Q-VAL-APRX	APPROXIMATE Q-VALUE
Q-VAL	Q-VALUE
Q-VAL-RSL	Q-VALUE RESOLUTION
Q-VAL-ERR	Q-VALUE ERROR
Q-VAL-MIN	LOWER LIMIT OF Q-VALUE
Q-VAL-MAX	UPPER LIMIT OF Q-VALUE
E-GAIN	GAIN IN NEUTRON ENERGY
E-GAIN-ERR	ERROR OF GAIN IN NEUTRON ENERGY
E-DGD	DEGRADATION IN NEUTRON ENERGY
E-DGD-ERR	ERROR OF DEGRADATION IN NEUTRON ENERGY
ANG	ANGLE, LAB-SYSTEM
ANG1	ANGLE, DEFINITION SPECIFIED IN THE BIB-SECTION
ANG2	ANGLE, DEFINITION SPECIFIED IN THE BIB-SECTION
ANG3	ANGLE, DEFINITION SPECIFIED IN THE BIB-SECTION
ANG-CM	ANGLE, C-M-SYSTEM
ANG-MIN	LOW LIMIT OF ANGLE RANGE, LAB-SYSTEM
ANG-CM-MIN	LOW LIMIT OF ANGLE RANGE, C-M-SYSTEM
ANG-MAX	HIGH LIMIT OF ANGLE RANGE, LAB-SYSTEM
ANG-CM-MAX	HIGH LIMIT OF ANGLE RANGE, C-M-SYSTEM
ANG-RSL	ANGULAR RESOLUTION
ANG-ERR	ANGLE-ERROR
COS	COSINE OF ANGLE, LAB-SYSTEM
COS-CM	COSINE OF ANGLE, C-M-SYSTEM
COS-MIN	LOW LIMIT OF COSINE-RANGE OF ANGLE, LAB-SYSTEM
COS-CM-MIN	LOW LIMIT OF COSINE-RANGE OF ANGLE, C-M-SYSTEM

KEYWORD (cont'd)	EXPLANATION (cont'd)
COS-MAX	HIGH LIMIT OF COSINE-RANGE OF ANGLE, LAB-SYSTEM
COS-CM-MAX	HIGH LIMIT OF COSINE-RANGE OF ANGLE, C-M-SYSTEM
COS-RSL	COSINE OF ANGULAR RESOLUTION
COS-ERR	COSINE OF ANGLE-ERROR
DATA	HEADING FOR COLUMN GIVING THE QUANTITY SPECIFIED UNDER 'ISO-QUANT'
DATA-CM	DATA GIVEN IN THE CENTRE OF MASS SYSTEM
DATA-APRX	APPROXIMATE VALUE OF DATUM
DATA-MIN	LOW LIMIT OF DATUM
DATA-MAX	HIGH LIMIT OF DATUM
DATA-ERR	DATA-ERROR, EXPLANATION TO BE GIVEN UNDER 'ERR-ANALYS'
DATA-ERR1	FIRST DATA-ERROR, IF MORE THAN ONE ERROR-COL IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
DATA-ERR2	SECOND DATA-ERROR, IF MORE THAN ONE ERROR-COL IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
DATA-ERR3	THIRD DATA-ERROR, IF MORE THAN ONE ERROR-COL IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
+DATA-ERR	+ UNSYMMETRIC DATA-ERROR, EXPLANATN UNDER 'ERR-ANALYS'
-DATA-ERR	- UNSYMMETRIC DATA-ERROR, EXPLANATN UNDER 'ERR-ANALYS'
RATIO	HEADING FOR COLUMN GIVING THE RATIO SPECIFIED UNDER 'ISO-QUANT', OR THE QUANTITY/STANDARD RATIO
RATIO-MIN	LOW LIMIT OF RATIO
RATIO-MAX	HIGH LIMIT OF RATIO
RATIO-ERR	RATIO-ERROR
RATIO-ERR1	FIRST RATIO-ERROR, IF MORE THAN ONE RATIO-ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
RATIO-ERR2	SECOND RATIO-ERROR, IF MORE THAN ONE RATIO-ERROR IS GIVEN. EXPLANATION UNDER 'ERR-ANALYS'
+RATIO-ERR	+UNSYMMETRIC RATIO-ERROR, EXPLANATN UNDER 'ERR-ANALYS'
-RATIO-ERR	-UNSYMMETRIC RATIO-ERROR, EXPLANATN UNDER 'ERR-ANALYS'
STAND	HEADING FOR COLUMN GIVING THE NUMERICAL VALUE ASSUMED FOR THE ISO-QUANT SPECIFIED UNDER 'STANDARD'
STAND-ERR	STANDARD-ERROR
STAND1	FIRST STANDARD-VALUE IF MORE THAN ONE IS GIVEN. EXPLANATION UNDER 'STANDARD'
STAND2	SECOND STANDARD-VALUE IF MORE THAN ONE IS GIVEN. EXPLANATION UNDER 'STANDARD'
STAND3	THIRD STANDARD-VALUE IF MORE THAN ONE IS GIVEN. EXPLANATION UNDER 'STANDARD'
STAND1-ERR	ERROR OF FIRST STANDARD-VALUE
STAND2-ERR	ERROR OF SECOND STANDARD-VALUE
STAND3-ERR	ERROR OF THIRD STANDARD-VALUE
TEMP	SAMPLE TEMPERATURE
TEMP-ERR	ERROR OF SAMPLE TEMPERATURE
ELEMENT	Z-NUMBER OF ELEMENTS, FOR FISSION-PRODUCT YIELDS ONLY
MASS	A-NUMBER OF ISOTOPES, FOR FISSION-PRODUCT YIELDS ONLY
HL	HALF-LIFE OF RESIDUAL NUCLEUS
HL1	HALF-LIFE OF NUCLEUS SPECIFIED IN THE BIB-SECTION
HL2	HALF-LIFE OF NUCLEUS SPECIFIED IN THE BIB-SECTION
HL3	HALF-LIFE OF NUCLEUS SPECIFIED IN THE BIB-SECTION
HL-ERR	ERROR OF HALF-LIFE OF RESIDUAL NUCLEUS
HL1-ERR	ERROR OF HALF-LIFE OF NUCLEUS SPECIFIED IN BIB-SECTION
HL2-ERR	ERROR OF HALF-LIFE OF NUCLEUS SPECIFIED IN BIB-SECTION
HL3-ERR	ERROR OF HALF-LIFE OF NUCLEUS SPECIFIED IN BIB-SECTION
FLAG	FLAG, MEANING OF FLAGS GIVEN UNDER THIS HEADING TO BE EXPLAINED IN BIB-SECTION UNDER 'FLAG'
NUMBER	COEFFICIENT-NUMBER OF LEGENDRE OR COSINE COEFFICIENTS
NUMBER-CM	COEFFICIENT-NUMBER OF LEGENDRE OR COSINE COEFFICIENTS WHEN THE FIT HAS BEEN DEDUCED FROM AN ANGULAR DISTRIBUTION IN WHICH THE ENERGIES ARE GIVEN IN THE CENTRE OF MASS SYSTEM
SPIN J	SPIN J OF RESONANCES, STRENGTH-FUNCTIONS, ETC.
MOMENTUM L	ANGULAR MOMENTUM L OF RESONANCES, STRENGTH-FFS, ETC.
PARITY	PARITY OF RESONANCE
STAT-W G	STATISTICAL-WEIGHT FACTOR G
MOM	LINEAR MOMENTUM OF INCOMING PARTICLES
MOM-MIN	MINIMUM LINEAR MOMENTUM OF INCOMING PARTICLES
MOM-MAX	MAXIMUM LINEAR MOMENTUM OF INCOMING PARTICLES
MISC	HEADING FOR A COLUMN WITH SUPPLEMENTARY INFORMATION FOR WHICH NO DATA-HEADING KEYWORD HAS BEEN DEFINED. EXPLANATION TO BE GIVEN UNDER 'MISC-COL' KEYWORD
MISC1	FIRST MISCELLANEOUS COLUMN - IF MORE THAN ONE IS GIVEN SAME USAGE AS -MISC-(SEE ABOVE)
MISC2	SECOND MISCELLANEOUS COLUMN -IF MORE THAN ONE IS GIVEN SAME USAGE AS -MISC-(SEE ABOVE)