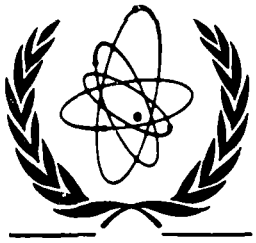
INDC(CCP)-85/L



International Atomic Energy Agency

INDC INTERNATIONAL NUCLEAR DATA COMMITTEE

THE COMPUTER LIBRARY OF EXPERIMENTAL NEUTRON DATA

(Extract translation of Nuclear Constants Vol. 19)

V.M. Bychkov, V.N. Manokhin, V.V. Surgutanov

Translated by the IAEA
May 1976

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THE COMPUTER LIBRARY OF EXPERIMENTAL NEUTRON DATA

V.M. Bychkov, V.N. Manokhin, V.V. Surgutanov

ABSTRACT

The paper describes the computer library of experimental neutron data at the Obninsk Nuclear Data Centre. The format of the library (EXFOR) and the system of programmes for supplying the library are briefly described.

Introduction

The nuclear data requirements of the growing nuclear power engineering industry have led to a need for the systematic collection of bibliographic and numerical data on the subject of nuclear physics and for establishing a computerized library of experimental neutron data to serve as a basis for a library of recommended evaluated nuclear data. The establishment of a fairly complete experimental data library was possible thanks to the development of international co-operation in the exchange of experimental nuclear data.

At present an exchange of neutron data is being carried on under a system embracing four neutron data centres: Brookhaven (USA), Saclay (France), IAEA (Austria) and Obninsk (USSR). Each of the four centres collects and abstracts the entire literature from its geographical region for the CINDA computerized bibliographic catalogue; it also records factographic information in a special exchange format (EXFOR), which is processed and accepted for exchange purposes and which is now being improved and extended at the annual meetings of the four centres [1, 2]. The Obninsk Nuclear Data Centre is collecting and abstracting information on neutron physics within the USSR [3]. The documentation abstracted in exchange format is recorded on magnetic tape and sent out to the other centres abroad. In this way a computer-based worldwide library of experimental neutron data is being set up at each of the centres.

The exchange format provides for the recording not only of numerical value but also of additional information supplying facts about experimental conditions and methods of processing measured values, which is very important for the subsequent evaluation of these data. The exchange format is similar to the SCISRS-II library format (Brookhaven), a detailed description of which is given in a report of M.D. Goldberg, which also traces its background. In the case of the Nuclear Data Centre, EXFOR is not only the input format but also the format of the library itself. At present the library contains 1100 experimental studies, representing approximately 1.1 million lines of information, of which around 900 000 are lines with numerical data. The library has a computerized catalogue.

In the sections that follow we briefly describe the content of the library, the main positions and the structure of the exchange format, and also the associated system of programmes supplying the library, as processed and supplied to the Nuclear Data Centre for the M-222 computer.

Content of the library

The library of experimental neutron data in EXFOR format contains the following types of data:

(a) Total cross-sections obtained from transmission experiments;

(b) Cross-sections for elastic and inelastic scattering, radiative capture; cross-sections with emission of charged particles (p, d, t, α), differential (in terms of angle and energy) cross-sections for the reactions in question, partial cross-sections of excited levels of a residual nucleus, integrals and average cross-sections for various spectra;

(c) Resonance parameters (energy, spin, level width), neutron strength functions;

(d) Cross-sections for coherent and incoherent scattering and coherent scattering amplitude;

(e) Fission-reaction cross-sections, values of $\alpha, \bar{\nu}, \eta$, fission product yields.

In addition to numerical data on the above-mentioned reaction cross-sections and values, the library includes the following types of information concerning experimental conditions and methods of deriving and processing data:

(a) Neutron source characteristics (intensity, neutron energy, polarization);

(b) Characteristics of particles emitted or scattered by a sample;

(c) Standards used for normalizing cross-sections (in relative measurements);

(d) Experimental facility (type of reactor, accelerator etc);

(e) Experimental methods;

(f) Experimentally recorded particles and type of detector;

(g) Description of sample (isotopic composition, number of nuclei);

(h) Indication of systems of co-ordinates used for data on angular distribution;

(i) Method of processing experimental results, error analysis;

(j) Description of corrections applied to experimental data and error thereof.

In preparing their reports experimenters must include essential information on the points listed above. Analysis of errors and of corrections is particularly important. In view of the different correlation characteristics of errors, it is essential to indicate separately the statistical error, the standard errors and the corrections made.

The library format

At present the format of the experimental neutron data library is the exchange format (EXFOR). The exchange format provides for the recording of numerical and bibliographic information, the latter term being understood as meaning not only a reference to the data but also a description of the methods used for processing them. Each input into the library corresponds to a published item containing the results of a neutron experiment and is termed an ENTRY. The entry is divided into SUBENTRIES in such a way that the subentry is a record of information relating to only one type of cross-section for a single isotope.

The subentry is divided in turn into three sections: BIB, COMMON and DATA. The BIB section contains information which can be used in making a bibliographic search (reference, authors' names, institute) and a description of the experiment by means of key words, codes and free text. The COMMON section contains data common to all the subentries, e.g. energy of incident neutrons in the case of differential scattering cross-sections.

The DATA section contains direct numerical data from experiments. The words ENTRY, SUBENTRY, BIB, COMMON, DATA are systems identifiers and denote, respectively, the start of operations, subentries, the bibliographic sections, the common data sections and the data sections. The systems identifiers used to denote the termination of operations, sub-operations or work with one of the subsections are: ENDENTRY, ENDSUBJECT, ENDBIB, ENDCOMMON and ENDDATA.

The fact that the relevant section is lacking is indicated by the identifiers NOBIB, NOCOMMON, NODATA.

The first subentry under every entry concerns only the BIB and COMMON sections, which contain bibliographic and common numerical data relating to subentries under the particular entry. Within the bibliographic section BIB the information is differentiated in terms of key words (see Annex No. 1), the data themselves being presented by means of special codes which can be used for computer retrieval of essential information. The BIB section contains free text, which is used for the description of bibliographic information. For the input of information written in the exchange format use is made of a format based on a standard 80-column punch card, i.e. the line length of an individual recording is limited to 80 symbols. Columns 1-66 are occupied by the text (bibliographic information and numerical data). The system identifiers and key words are placed in columns 1-11, the codes are placed in brackets and begin from the 12th column. After this comes the free text. Columns 67-80 are used for the sample identification of each line. Columns 67-71: ENTRY number; 72-74: SUBENTRY number; 75-79: number of line in SUBENTRY. The symbol of the data editing body appears in column 80. With the format organized in this way, any line or subentry can be corrected, replaced or deleted by means of the programmes used for supplying the system.

The first figure of the ENTRY number denotes the number of the centre which wrote the paper in the exchange format:

1 - NNCSC (Brookhaven, USA)
2 - NDCC (Saclay, France)
3 - NDS (Vienna, Austria)
4 - TsYaD (Obninsk, USSR)

The centres are working continuously to improve and extend the format with a view to including new types of data and also to recording the data in a more convenient and compact form.

Programme support of the library

A system of programmes has been developed and set up in the Nuclear Data Centre for the purpose of processing the flows of information. Depending on the purpose for which they are intended the programmes can be subdivided into a number of groups.

The first group of programmes covers the preliminary preparation of neutron data for input into the library.

The second group has to do with internal library operations: sorting, ordering, cataloguing etc.

The third group is concerned with exchanges of information with centres abroad.

The fourth group covers the retrieval and extraction of data relating to inquiries of users by printouts, perforated tapes, recordings on magnetic tape in various formats. The programmes of the system are written in ALGOL (translator TA-1M) [5, 6] and FORTRAN [7].

The nucleus of the system consists of programmes which serve to perform the following operations:

1. Preparation of the information for input into the library

This process covers programmes of reading standard IBM tapes which come from foreign centres; it involves the preparation of a recording of the contents on magnetic tapes of an M-222 computer or the preparation of printouts. Programmes prepared by the Nuclear Data Centre for recording in an ML-222 compilation also come under this heading.

2. Checking the prepared information

The prerequisite for avoiding uncertain situations in operations with data in EXFOR format is strict compliance with the formalism of EXFOR. This involves:

- The external structure, as described in the introduction, i.e. subdivision of the information into entries, subentries and sections of subentries, each part being differentiated by means of identifier words, auxiliary information and numerical identification of lines;
- Internal structure, i.e. key words, the information associated with them, the retrieval mnemonic codes, rules for recording numerical tables etc.

The programme checks compliance with the conditions of external and internal structure in the recording of compilations and indicates the errors which have been found.

In principle there is also the possibility of making checks for meaning in the compilation of the separate groups of recordings in the entries. It is intended to supplement this step in future on the basis of advanced mathematical treatment.

3. Correction of errors

The condition of unique identification of each line of the data library on EXFOR format provides a fairly simple means of identifying the place for introducing changes in the original text. The programmes for error correction constitute operations either on individual lines or on groups of lines in the subentries and on the subentries as a whole, involving the deletion, introduction or exchange of data items, as appropriate.

4. Compilation of catalogues

In order to familiarize data users with the contents of the library, the programmes are devised for formulating data catalogues. These include the catalogue of the library as a whole or of parts thereof and the catalogue of exchange tapes sent to foreign centres. The first-mentioned catalogue is a list of the data available at the Nuclear Data Centre. The catalogue data are concentrated in lines which are ordered on the basis of the elements of the periodic table and by reactions. Each line contains information about the element (isotope), reaction, energy interval, number of points, brief bibliographical information and number of the reference in which the corresponding material is to be found. To some extent this catalogue is identical with the CINDA catalogue.

The second catalogue is an abridged version of the first, the items recorded corresponding to the order of the numbers of the entries and subentries in the exchange tape.

There are also programmes for the compilation of specific catalogues in response to internal requirements connected with library processes.

5. The input of information into the library

At present the library consists of texts of studies recorded on M-222 magnetic tape in EXFOR format. The studies are arranged in ascending order of the numbers assigned to them. The inclusion of new studies is effected by merging incoming information with that already included in

the library and by simultaneous re-ordering in accordance with established rules. The recording of the original library is conserved, so that the operation can be repeated if errors are found or if difficulties occur in the compilation of a new data library.

6. Extraction of data from the library

At the Nuclear Data Centre a number of programmes have been developed and written for the retrieval and extraction of data from libraries on magnetic tape, punched tape, punched cards and printouts. A special programme transforms the data into some intermediate format for subsequent processing by an M-222 computer and output on a plotter.

In conclusion the authors would like to mention that at various stages of the work of developing algorithms and of writing and setting up the programmes for supplying the data library, they had the benefit of co-operation from the following associates of the Nuclear Data Centre: S.M. Nasyrova, V.M. Pan'kov, N.E. Kuznetsov and E.N. Korol'.

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```
ENTRY            30038       710202                          3003800000001
SUBENT           30038001    710202                          3003800100001
BIB                 14          23                           3003800100002
TITLE       FLUCTUATIONS IN THE TOTAL CROSS-SECTION OF (N,2N) 3003800100003
            REACTIONS                                         3003800100004
AUTHOR      (J.CSIKAI)                                        3003800100005
INSTITUTE   (3HUNDEB)                                         3003800100006
REFERENCE   (P,EANDC-50S,2,(1021,6507) CONF PROC, DATA TABLE  3003800100007
            (C,65ANTWERP,,27,6507) ABSTRACT,FULL PAPER =EANDC-50S 3003800100008
            (J,AK,5,79,6606) PART OF THESIS. SHORT DESCRPTN,TABLE 3003800100009
FACILITY    (ACCEL) 300 KEV GENERATOR, LOCALLY BUILT          3003800100010
N-SOURCE    (D-T) DEUTERIUM-TRITIUM REACTION                  3003800100011
METHOD      (ACTIV) ACTIVATION                                3003800100012
DETECTOR    (NAICR) NAI(TL) SCINTILLATOR FOR GAMMA LINES      3003800100013
            (GMC) GEIGER COUNTER FOR BETA PARTICLES, COUNTERS WERE 3003800100014
            CALIBRATED WITH STANDARD SOURCES, FLUX MONITORED WITH 3003800100015
            LONG COUNTER AND PLASTIC SCINTILLATOR             3003800100016
ERR-ANALYS  NOINF                                             3003800100017
CORRECTION  RESULTS WERE CORRECTED FOR THE LABORATORY ANGULAR 3003800100018
            DISTRIBUTION OF THE NEUTRONS                      3003800100019
STANDARD    (29-CU-63,N2N) VALUE AT 14.6 MEV TAKEN AS ABSOLUTE 3003800100020
            BASED ON EXCITATION FUNCTION AND VALUE AT 14.1 MEV(SEE 3003800100021
            ALSO SUBENTRY .007)                               3003800100022
PART-DET    (DG) DECAY-GAMMA                                  3003800100023
STATUS      (PUBL) DATA TAKEN FROM EANDC-50S PAPER 102,TABLE 2 3003800100024
HISTORY     (700909C)                                         3003800100025
ENDBIB              25                                        3003800100026
COMMON               3           3                            3003800100027
EN-NRM      EN-RSL       STAND                                3003800100028
MEV         MEV          MB                                   3003800100029
14.6        0.1          541.0                                3003800100030
ENDCOMMON            3                                        3003800100031
ENDSUBENT           30                                        3003800199999
SUBENT         30038005        710202                         3003800500001
BIB                  1           1                            3003800500002
ISO-QUANT   (26-FE-54,N2N)                                    3003800500003
ENDBIB               1                                        3003800500004
NOCOMMON                                                      3003800500005
DATA                 4           1                            3003800500006
EN          EN-RSL       DATA         DATA-ERR                3003800500007
MEV         MEV          MB           MB                      3003800500008
14.6        0.1          16.0         3.0                     3003800500009
ENDDATA              3                                        3003800500010
ENDSUBENT            9                                        3003800599999
```

Bibliographic index of studies included in the compendium of the international system CINDA*)

ISOTOPE	CROSS SEC-TION TYPE	INSTITU-TE	MIN ENERGY	MAX (EV)	REFERENCE			DATE	FIRST AUTHOR, COMMENTS
96-Cm-244	NF	FEI	PILE		YFI	19	3	75	ZHURAVLEV SIG=1,0+0,2 BARN
96-Cm-245	NF	FEI	PILE		YEI	19	3	75	SIG=2055±150 BARN
96-Cm-246	NF	FEI	PILE		YEI	19	3	75	SIG=0.14±0.05 BARN
96-Cm-247	NF	FEI	PILE		YEI	19	3	75	SIG= 79 ± 7 BARN
96-Cm-248	NF	FEI	PILE		YEI	19	3	75	SIG=0.39±0.7 BARN
96-Cm-244	RIF	FEI	PILE		YEI	19	3	75	SIG=13.4±1.5 BARN
96-Cm-245	RIF	FEI	PILE		YEI	19	3	75	SIG=802 ± 80 BARN
96-Cm-246	RIF	FEI	PILE		YEI	19	3	75	SIG=13.3±1.5 BARN
96-Cm-247	RIF	FEI	PILE		YEI	19	3	75	SIG=726 ±70 BARN
96-Cm-248	RIF	FEI	PILE		YEI	19	3	75	SIG=13.1±1.5 BARN
3-Li-006	NA	FEI	2,5-2	1.0^5	YFI	19	10	75	SEREGINA SIG(NEUT-E), TBL, GRAPH
98-Cf-252	S..	FEI	SPON		YFI	19	16	75	VOROB'EVA KE OF FRAGS, TBLS
92-U-235	SFN	FEI	THR		YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBLS
92-U-238	SFN	FEI	SPON		YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBLS
94-Pu-240	SFN	FEI	SPON		YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBLS

*) NF - FISSION; RIF - RES INT FISS; NA - N, ALPHA; SFN - SPECT FISS N; GF - PHOTO-FISSN;
NG - N, GAMMA; DEL - DIFF ELASTIC; DIN - DIFF INELAST; DNG - INELST GAMMA; EVL - EVALUATION

ISOTOPE	CROSS SECTION TYPE	INSTITUTE	MIN ENERGY	MAX (EV)	REFERENCE	DATE	FIRST AUTHOR, COMMENTS
94-Pu-242	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
96-Cm-244	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
96-Cm-246	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
96-Cm-248	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
96-Cm-250	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
98-Cf-246	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
98-Cf-248	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
98-Cf-250	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
98-Cf-252	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
98-Cf-254	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
99-Es-253	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
100-Fm-254	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
100-Fm-256	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS

ISOTOPE	CROSS SECTION TYPE	INSTITUTE	MIN ENERGY	MAX (EV)	REFERENCE	DATE	FIRST AUTHOR, COMMENTS
90-Th-229	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
92-U-233	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
94-Pu-239	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
94-Pu-241	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
95-Am-241	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
96-Cm-245	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
98-Cf-249	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
98-Cf-251	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
99-Es-254	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
100-Fm-255	SFN	FEI	THR		YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
90-Th-232	SFN	FEI	1.4^6	5.6^6	YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS
98-Cf-252	SFN	FEI	1.9^6	4.8^6	YEI 19 16	75	VOROB'EVA KE OF FRAGS, TBLS

[illegible]	[illegible]	INSTITU-TE	MIN ENERGY	MAX (EV)	REFERENCE			DATE	FIRST AUTHOR, COMMENTS
[illegible]	[illegible]	FEI	0	6	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
[illegible]	[illegible]	FEI	7.0-2	5.4^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
[illegible]	SFN	FEI	3.0^{5}	4.7^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
[illegible]	SFN	FEI	2.6-2	1.0^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
[illegible]	SFN	FEI	1.2^{5}	6.0^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
[illegible]	SFN	FEI	8.0-2	5.0^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
[illegible]	SFN	FEI	2.0^{5}	9.0^{5}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
92-U-235	SFN	FEI	1.2^{5}	6.0^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
92-U-238	SFN	FEI	1.3^{6}	5.3^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
92-U-238	SFN	FEI	1.5^{6}	5.6^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
92-U-238	SFN	FEI	0	6	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
93-Np-237	SFN	FEI	7.0^{5}	5.4^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL

ISOTOPE	CROSS SECTION TYPE	INSTITUTE	MIN ENERGY	MAX (EV)	REFERENCE			DATE	FIRST AUTHOR, COMMENTS
93-Np-237	SFN	FEI	0	6	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
94-Pu-239	SFN	FEI	8.0^{4}	5.3^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
94-Pu-240	SFN	FEI	8.5^{5}	4.9^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
94-Pu-241	SFN	FEI	2.8^{5}	5.0^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
94-Pu-242	SFN	FEI	7.0^{5}	4.9^{6}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
88-Ra-226	SFN	FEI	7.8^{6}	1.2^{7}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
88-Ra-226	SFN	FEI	7.1^{6}	1.4^{7}	YEI	19	16	75	VOROB'EVA KE OF FRAGS, TBL
90-Th-232	GF	CCP	5.0^{6}	1.2^{7}	YEI	19	42	75	IVANOV YLD OF FRAGS, GRAPH, CFD, TBL
92-U-238	GF	CCP	5.0^{6}	1.2^{7}	YEI	19	42	75	IVANOV YLD OF FRAGS, GRAPH, CFD, TBL
93-Np-237	GF	CCP	5.0^{6}	1.2^{7}	YEI	19	42	75	IVANOV YLD OF FRAGS, GRAGS, GRAPH, CDD, TBL
94-Pu-239	GF	CCP	5.0^{6}	1.2^{7}	YEI	19	42	75	IVANOV YLD OF FRAGS, GRAGS, GRAPH, CFD, TBL

ISOTOPE	CROSS SECTION TYPE	INSTITUTE	MIN ENERGY	MAX (EV)	REFERENCE	DATE	FIRST AUTHOR, COMMENTS
19-K-	NG	FEI	5.0^3	8.0^4	YEI 19 57	75	SHORIN SIG(NEUT-E), TBL, GRAPH
53-I-127	NG	FEI	5.0^3	8.0^4	YEI 19 57	75	SHORIN SIG(NEUT-E), TBL, GRAPH
79-Au-197	NG	FEI	5.0^3	8.0^4	YEI 19 57	75	SHORIN SIG(NEUT-E), TBL, GRAPH
73-Ta-181	NG	FEI	5.0^3	8.0^4	YEI 19 57	75	SHORIN SIG(NEUT-E), TBL, GRAPH
4-Be-009	DEL	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
13-Al-027	DEL	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
39-Y-089	DEL	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
42-Mo	DEL	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
83-Bi-209	DEL	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
4-Be-009	DIN	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
13-Al-027	DIN	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
39-Y-089	DIN	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
42-Mo	DIN	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
83-Bi-209	DIN	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH

ISOTOPE	CROSS SECTION TYPE	INSTITUTE	MIN ENERGY	MAX (EV)	REFERENCE	DATE	FIRST AUTHOR, COMMENTS
40-Zr	DIN	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
40-Zr	DEL	FEI	4.4^6		YEI 19 66	75	TRYKOVA SIG(ANG), TBL, GRAPH
3-Li-006	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
3-Li-007	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
4-Be-009	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
5-B-010	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
6-C-012	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
7-N-014	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
8-O-016	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
13-Al-027	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
26-FE	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
73-Ta-181	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL
74-W	DNG	CCP	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG, TBL

ISOTOPE	CROSS SECTION TYPE	INSTITUTE	MIN ENERGY	MAX (EV)	REFERENCE	DATE	FIRST AUTHOR, COMMENTS
82-Pb	DNG	FEI	1.4^7		YEI 19 77	75	BEZOTOSNY TOF, SIG. TBL
24-Cr	DIN	FEI	9.1^6		YEI 19 84	75	BIRJUKOV DETERM OF SPIN CUT-OFF PAR
26-Fe	DIN	FEI	9.1^6		YEI 19 84	75	BIRJUKOV DETERM OF SPIN CUT-OFF PAR
27-Co-059	DIN	FEI	9.1^6		YEI 19 84	75	BIRJUKOV DETERM OF SPIN CUT-OFF PAR
28-Ni	DIN	FEI	9.1^6		YEI 19 84	75	BIRJUKOV DETERM OF SPIN CUT-OFF PAR
39-Y-089	DIN	FEI	9.1^6		YEI 19 84	75	BIRJUKOV DETERM OF SPIN CUT-OFF PAR
26-Fe-056	EVL	FEI	1.0^6	1.5^7	YEI 19 110	75	BYCHKOV SIG,NG,DIN,NP,MA, TOT, TBLS
41-Nb-093	DIN	FEI	1.4^7		YEI 19 143	75	SAPRYKIN METHOD OF ANAL DIN, GRAPHS
26-Fe-056	DIN	FEI	9.1^6		YEI 19 143	75	SAPRYKIN METHOD OF ANAL DIN, GRAPHS