Akademie der Wissenschaften der DDR
Zentralinstitut für Isotopen- und Strahlenforschung
Leipzig

Contents

Herausgeber : Akademie der Wissenschaften der DDR
Zentralinstitut für Isotopen- und Strahlenforschung (RIS 0903)
DDR 7050 Leipzig, Permoserstr. 15
Direktor: Prof. Dr. habil. Dr. sc. K. Wetzel

Redaktion : Akademie der Wissenschaften der DDR
Zentralinstitut für Isotopen- und Strahlenforschung, Informations- und Rechenzentrum,
Wissenschaftliche Redaktion
DDR 7050 Leipzig, Permoserstr. 15
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Chefredakteur: Fachinf. Dipl.-Lehrer R. Schröter

Innerbetriebliche Druckgenehmigung: ZfI/FR-84/80-764

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I. Introduction

The Evaluated Nuclear Structure Data File (ENSDF) is the world-wide accepted standard data file for nuclear structure and decay data.
This computer-based file is maintained by the National Nuclear Data Center (NNDC) at Brookhaven National Laboratory for the International Nuclear Structure and Decay Data Network /1/.

A detailed description of ENSDF, its organisation and format is given in a special manual /2/.

The most recent version of ENSDF now available (version 84.1) contains 8.824 data sets. One data set represents data concerning a reaction, a decay or adopted levels of a nuclide. Special data sets had been introduced to store comments and references for a complete mass chain.

The whole data file is replaced twice a year by a new version. The aim is to ensure a rise years cycle of updating every mass chain.

Since 1976 ENSDF is used by the Central Institute for Isotope and Radiation Research (ZfI). In order to improve the possibilities for the representation of data from ENSDF we developed a series of computer codes during the last year.

This codes provide now:

- representation of ENSDF data content
- analysis of ENSDF data content
- plots of nuclear level schemes
- retrieval and graphical display of decay chains based on data taken from ENSDF

All codes make use of the PLOT software package and are written in FORTRAN-IV.

They are run on the institutes own ES 1040 computer under operation system OS/ES.

A plotter of the DIGIGRAF type is used.

II. Representation of ENSDF data content

Using a plot in a form similar to that of a nuclide chart is relatively easy to get a survey of the data content of a whole ENSDF version. This figure may also serve as a survey of nuclides that have been experimentally verified.

Two computer codes have been written (author A. Hanisch) that produce plots of ordinary number (Z) versus neutron number (N) or Z versus mass number (A).

For examples of such outputs see figs. 1,2 and 3.

A special procedure has been worked out to produce plots (Z versus N) for selected data sets. In this way it is possible to get an overview of recently introduced data sets, reaction data sets, special decay data sets etc. (see fig. 3).

Application of this codes makes it is possible to get overall-information about the ENSDF data content without using voluminous catalogues. The codes need as input data a special index file prepared from based on the ENSDF-Identification record /see 2,3/.

Each record of the index file also contains additional information to identify the ENSDF version used and the Z-number for every the nuclide.

III. Plots of nuclear level schemes

The structure of an ENSDF data set is designed to store nuclear level information as well as information concerning nuclear decay. A graphical representation of the nuclear levels of a selected nuclide and (if given) the corresponding gamma transitions is produced by the computer code PLOTLG (author A. Hanisch).

The code reads the whole data set, converts the data values of the Level and Gamma records and prepares the drawing.

In order to obtain a well structured output the following parameters may be choosen:

- scale factor of the whole figure
- length of the energy-axis

- use of two different pens for bicoloured representation
  (e.g. red for gamma-transitions,
  black for levels and scales)
- "erase" of parts of the energy scale which contain no useful information in the low energy part

PLOTLG uses the FORSTR-library for data handling and interpretation. Special subroutines have been developed for different functions. This makes it possible to include additional data in this figures if needed in future.

IV. Retrieval and graphical display of decay chains

To solve the problem of presenting information concerning the history of a given nuclide a solution based on data selected from ENSDF was found.
The following steps had been necessary:

1. Preparation and installation of a special data file containing

   nuclide
   parent nuclide
   halflife
   decay mode

   based on Parent-records from ENSDF /2/. This file will be updated after receiving new ENSDF versions.

2. Development of a retrieval program.
   The first input information of this code is a standard ENSDF nuclide identifier (e.g. 235U).
   The result is a table of all parent-daughter relations in which the given nuclide occurs.
   In addition all parent and all daughter nuclides found during the first step are also checked for this history.

3. The table yielded as the result of the retrieval program is used to prepare a standard plot by computer code DECPLOT.
   This plot covers the range

   $Z - 4 \leq Z \leq Z + 4$
   $A - 8 \leq A \leq A + 8$

(A is the mass number and Z the ordinary number of the requested nuclide).

The size of the whole figure may be choosen by a parameter.

For nuclides not yet included in ENSDF (e.g. not yet verified) a card input version of DECPLOT is available. This code makes if possible to include additional information (e.g. generating reaction of nuclides).

Authors of this codes are A. Görner and S. Quaasdorf.

V. Conclusions

A set of special computer codes had been developed at ZfI Leipzig to produce graphical outputs of data stored in the Evaluated Nuclear Structure Data File. This codes also permit to include new functions in future.

The authors would be greatfull to receive comments and suggestions.

To obtain such graphical outputs or additional information please contact to one of the authors.

VI. References

/1/ IAEA Advisory Group Meeting on Nuclear Structure and Decay Data,
Vienna 1980, INDC(NDS)-111/NE

/2/ J.K. Tuli
Evaluated Nuclear Structure Data File - A Manual for Preparation of Datasets,
March 1983, BNL-NCS-51655

/3/ B. Letz
Use of Nuclear Data Files at ZfI Leipzig,
November 1982, ZfI-28

VII. Figures and their explanation

ENSDF data content

Fig. 1 Data content of ENSDF version 84.1 (Z versus N)

Fig. 2 Data content of ENSDF version 1977 (Z versus N). In this first version of ENSDF we received, 16 mass chains had been completely missed.

Fig. 3 Selected Datasets from ENSDF 84.1 describing isomeric transitions (IT DECAY).

Plots of nuclear level schemes

Fig. 4 Level scheme for the β-decay of 208TL

parameters used:
- scale factor for energy axis: 0.5
- erase of low energy part (no levels)

Fig. 5 Level scheme for electron capture decay of 206BI (format reduction by photocopy)

Nuclear decay chains

Fig. 6 Decay scheme for Uranium 235 derived from ENSDF

Fig. 7 One possible continuation of fig. 6 (question 227AC)

Fig. 8 A new decay scheme proposed for element 108 (produced upon user request and based on the users own data).

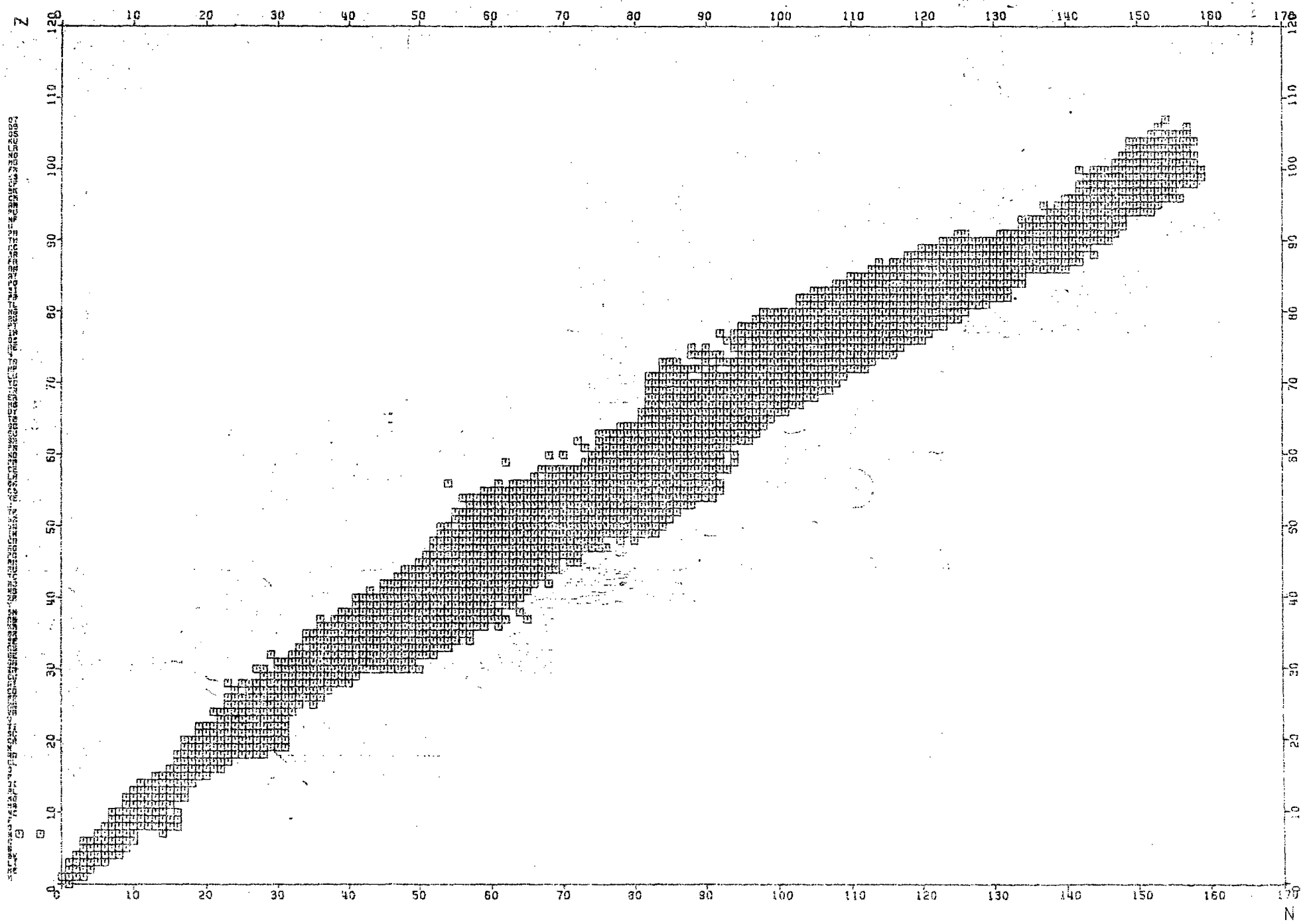

Fig. 1

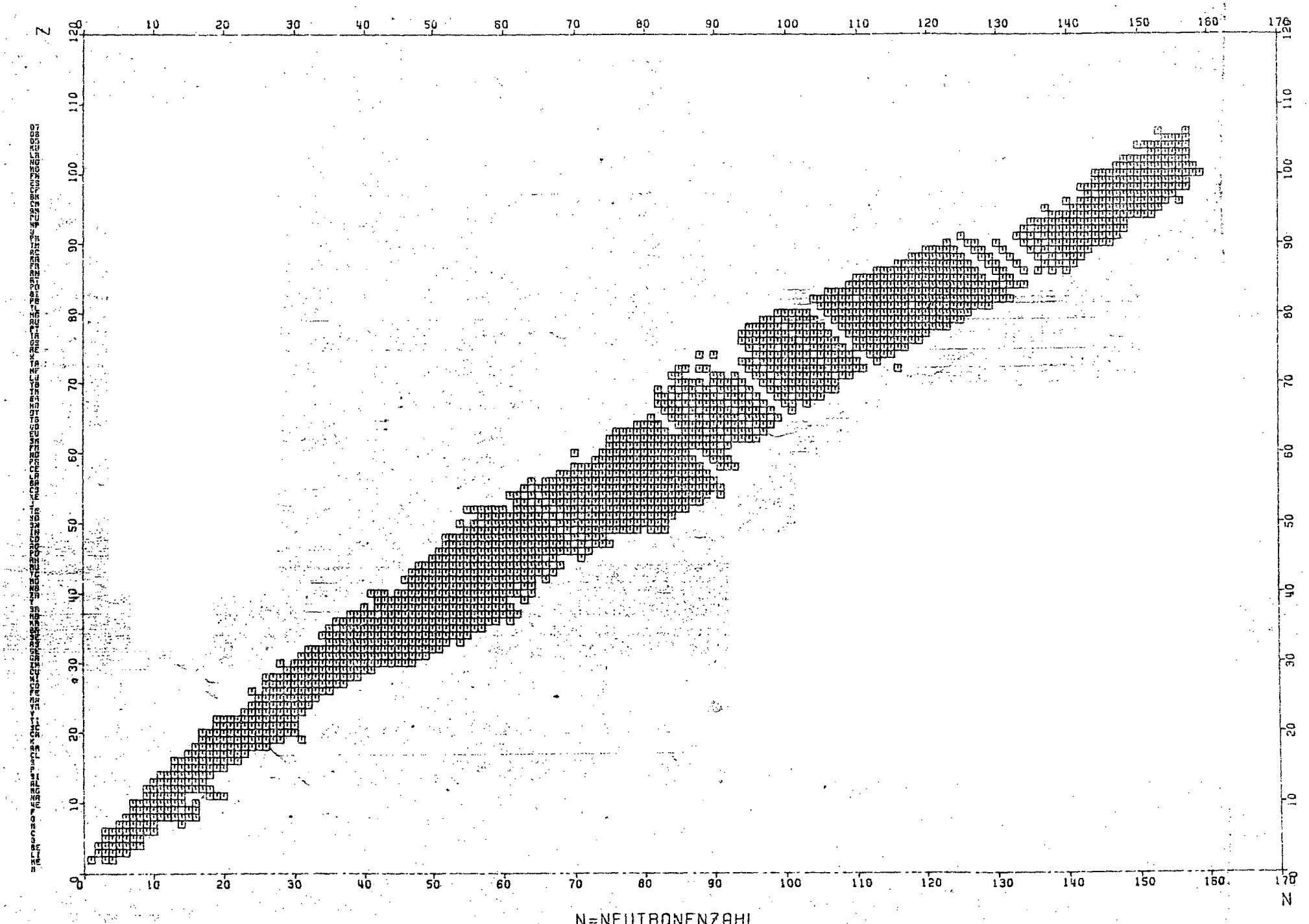

Fig. 2

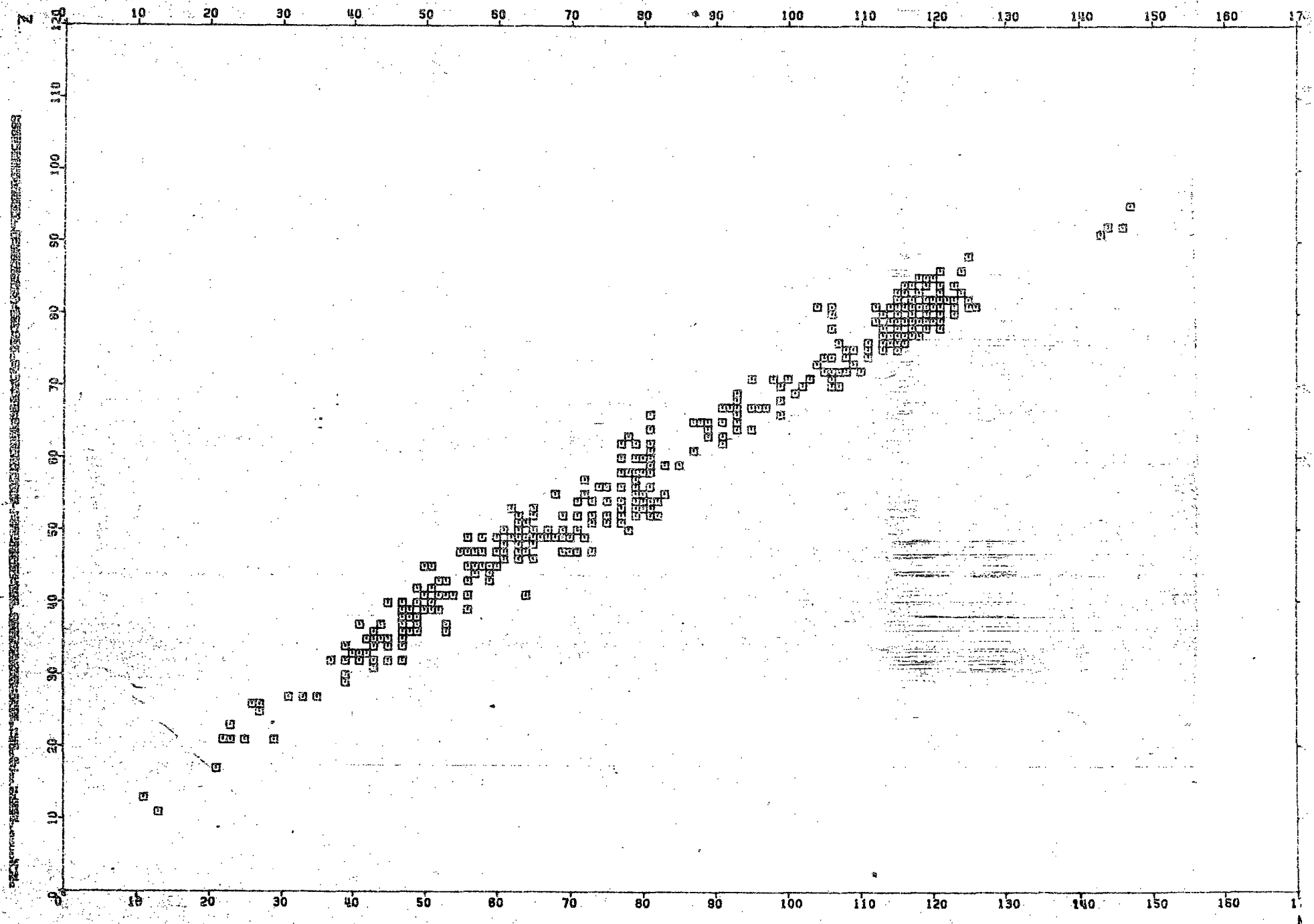

Fig. 3

N=NEÛTRONENZAHL
Z=ORDNUNGSZAHL

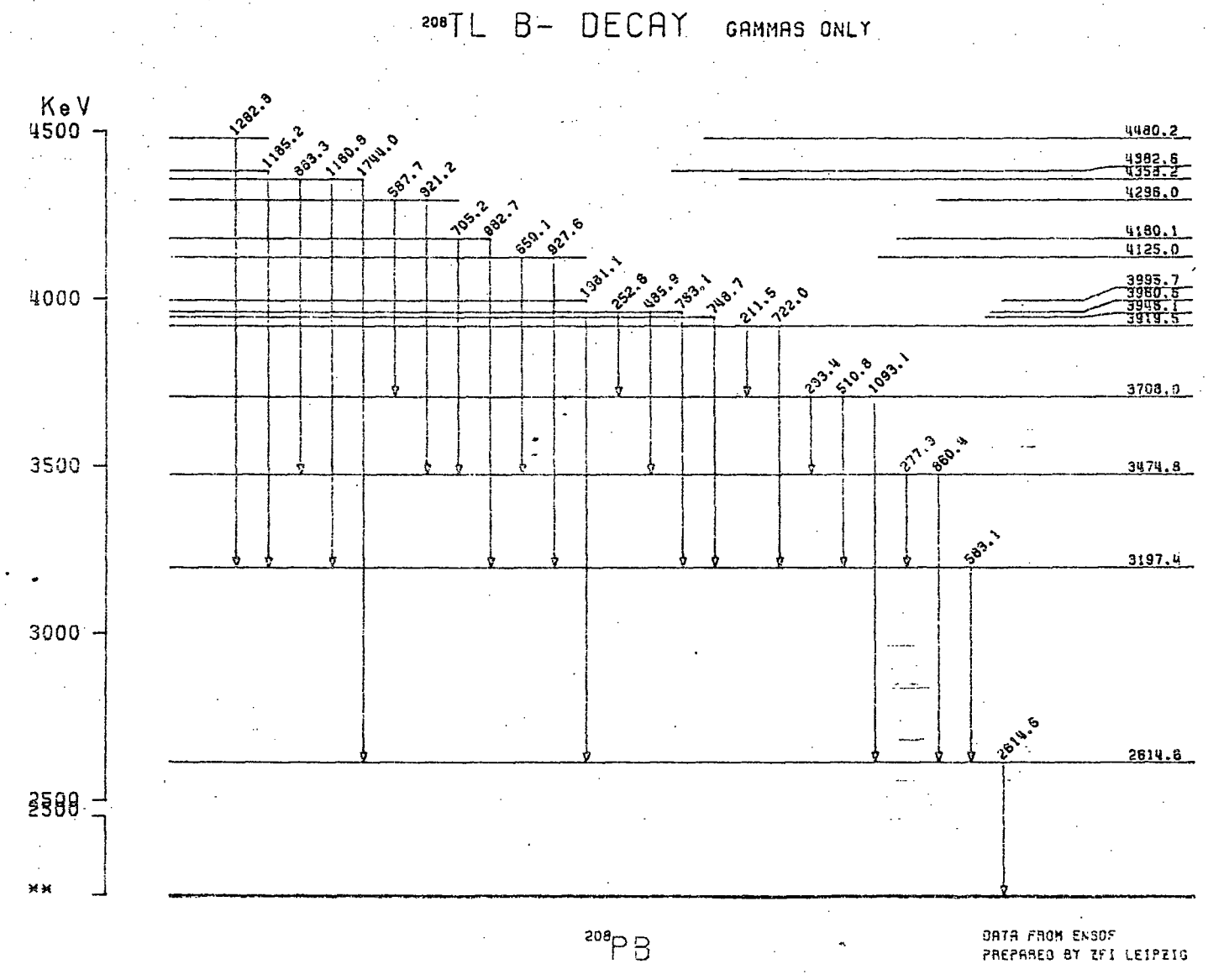
208TL B- DECAY GAMMAS ONLY
KeV
4500
4000
3500
3000
2500
2300
**
1282.8
1185.2
883.3
1180.9
1744.0
587.7
921.2
705.2
882.7
850.1
927.6
1081.1
252.8
485.9
783.1
748.7
211.5
722.0
233.4
510.8
1093.1
277.3
860.4
583.1
2614.6
4480.2
4382.6
4353.2
4296.0
4180.1
4125.0
3995.7
3960.5
3945.1
3919.5
3708.0
3474.8
3197.4
2614.6
208PB
DATA FROM ENSDF
PREPARED BY ZFI LEIPZIG

Fig. 4

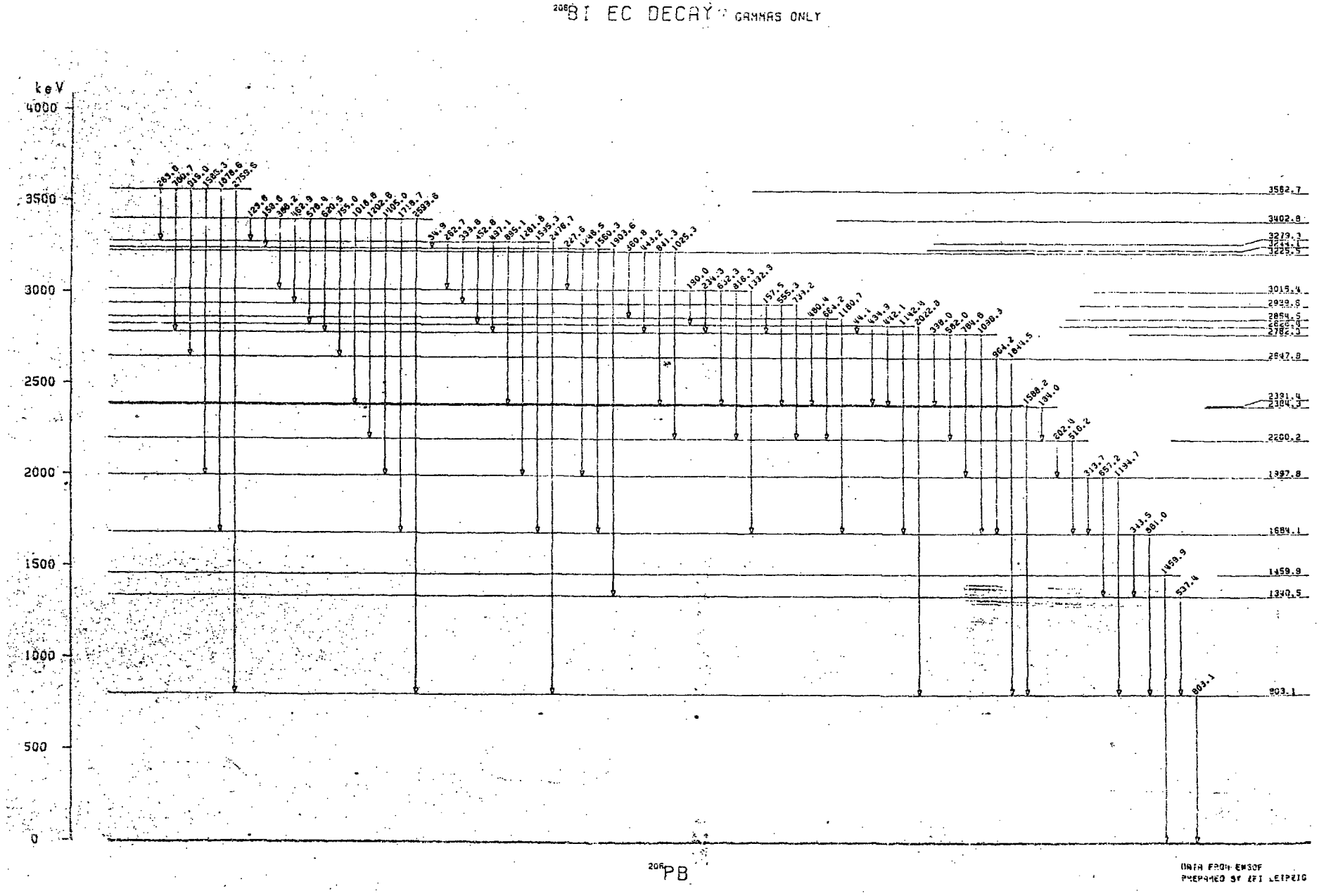
206BI EC DECAY GAMMAS ONLY
keV
4000
3500
3000
2500
2000
1500
1000
500
0
3562.7
3402.8
3279.3
3211.1
3225.5
3015.4
2939.6
2854.5
2666.8
2782.3
2647.8
2391.4
2304.3
2200.2
1897.8
1684.1
1459.9
1340.5
803.1
206PB
DATA FROM ENSDF
PREPARED BY IFI LEIPZIG

Fig. 5

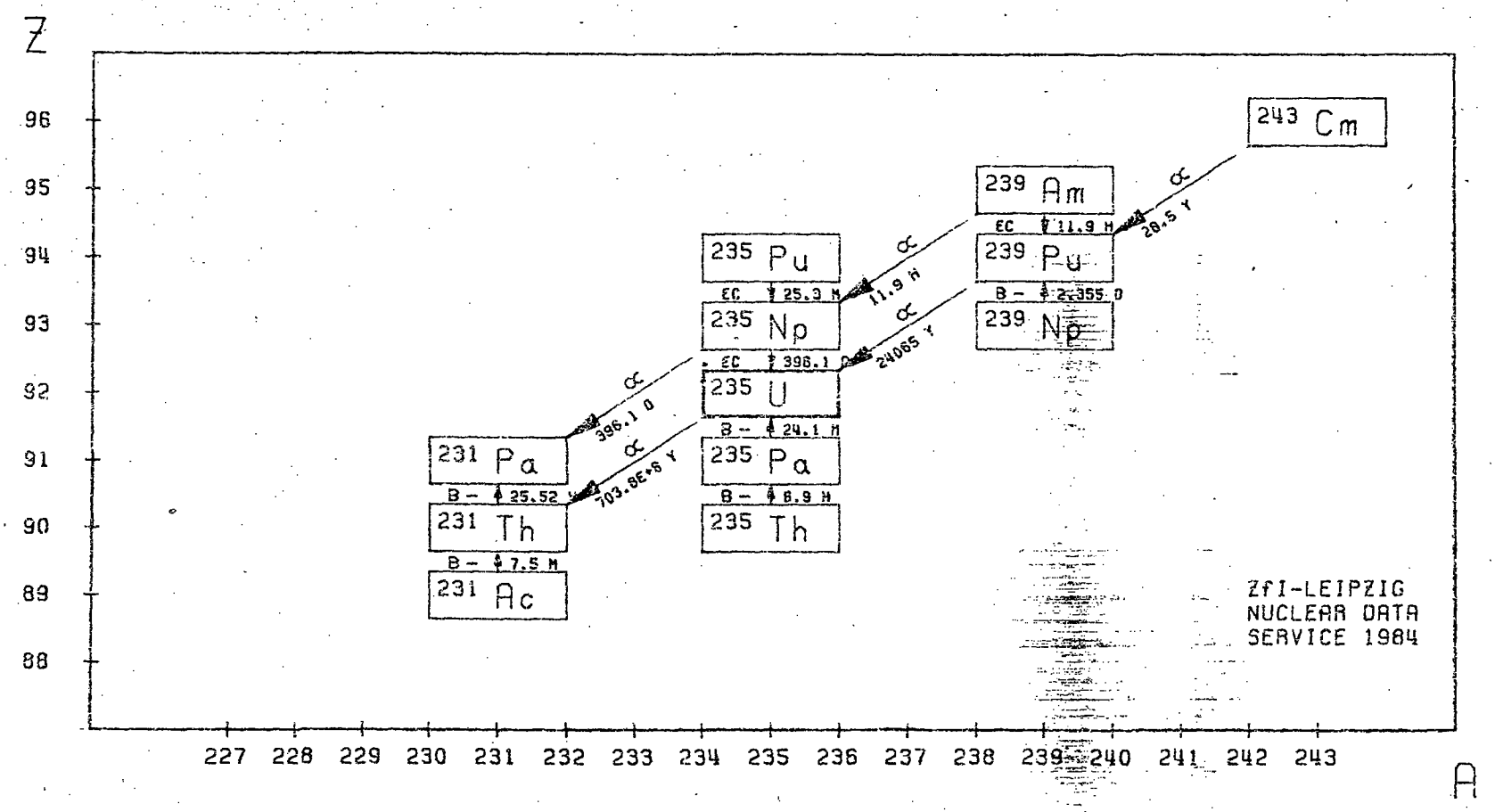
Z
96
95
94
93
92
91
90
89
88
243 Cm
239 Am
EC 11.9 H
239 Pu
B- 2.355 D
239 Np
235 Pu
EC 25.3 M
235 Np
EC 396.1 D
235 U
B- 24.1 M
235 Pa
B- 8.9 M
235 Th
231 Pa
B- 25.52 H
231 Th
B- 7.5 M
231 Ac
α
28.5 Y
11.9 M
24065 Y
396.1 D
703.8E+8 Y
ZfI-LEIPZIG
NUCLEAR DATA
SERVICE 1984
227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243
A

Fig. 6

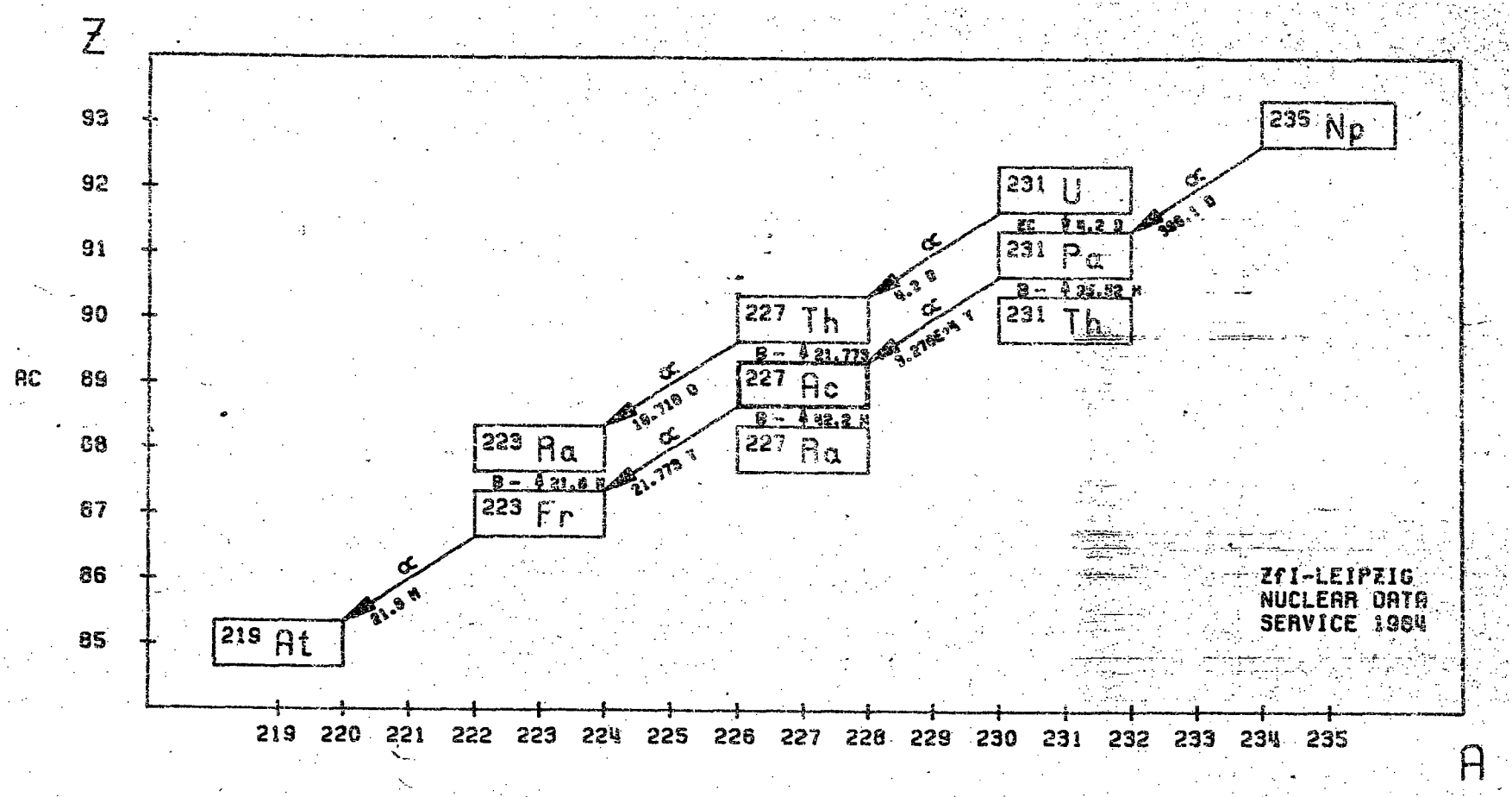
Z
93
92
91
90
89
88
87
86
85
AC
219 At
223 Fr
223 Ra
227 Ra
227 Ac
227 Th
231 Th
231 Pa
231 U
235 Np
α
21.9 M
19.718 D
21.773 Y
9.3 D
3.2765E-4 Y
398.1 D
219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235
A
ZfI-LEIPZIG
NUCLEAR DATA
SERVICE 1984

Fig. 7

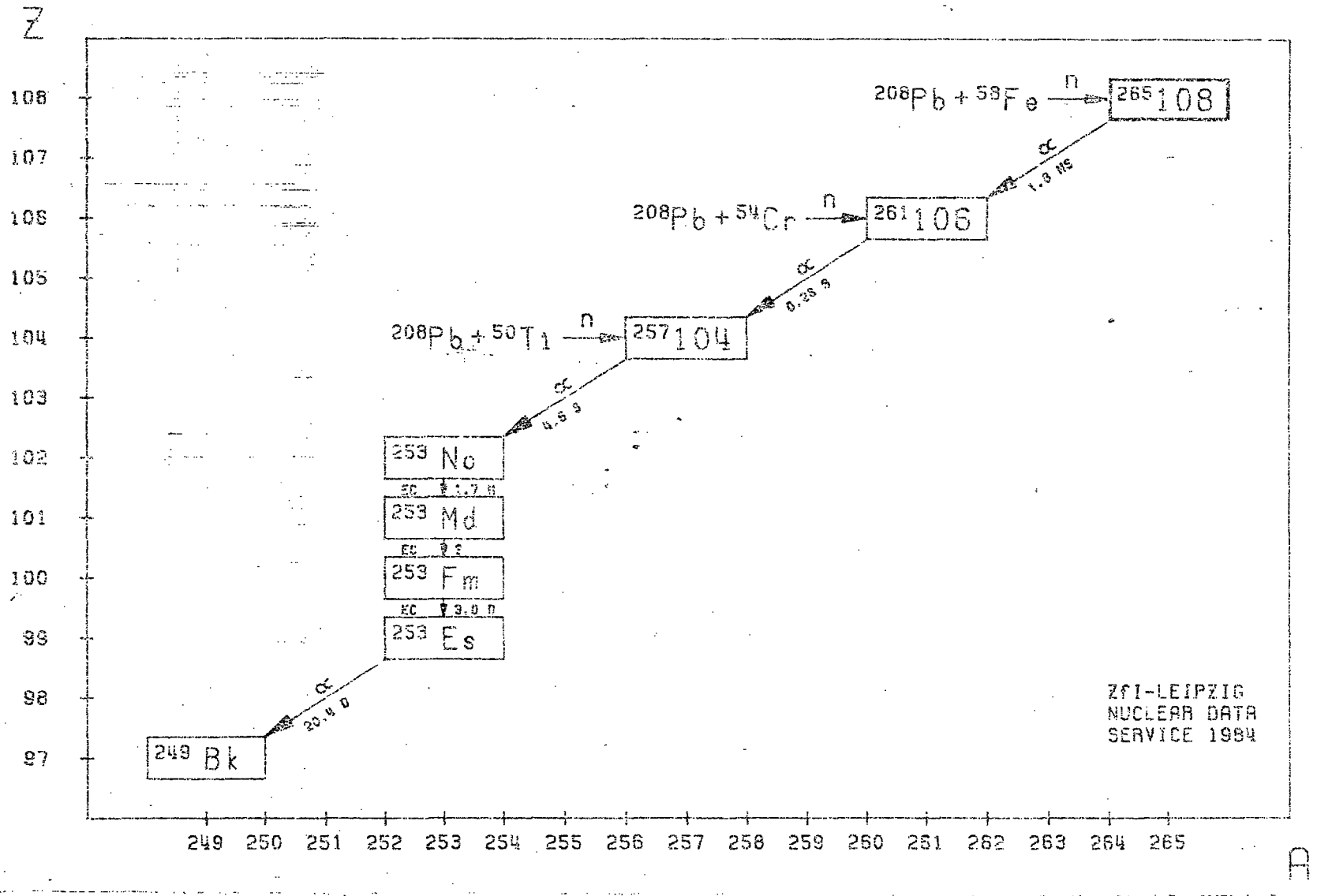
Z
108
107
106
105
104
103
102
101
100
99
98
97
249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265
A
249 Bk
253 Es
253 Fm
253 Md
253 No
257 104
261 106
265 108
α
n
ZfI-LEIPZIG
NUCLEAR DATA
SERVICE 1984

Fig. 8

1419