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COPY_FILE

DECEMBER 1988

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1.0 Program Name: COPY_FILE

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing program COPY_FILE.

The program COPY_FILE reads experimental events from the input data file and performs selection of all stopping events with "caution" bit equal to zero, and not negligible signal in the C-layer of a detector. Additional selection is performed to remove the Helium and Hydrogen elements. For the selected events, the energy deposited in the detector layers and a tag word in decimal representation are written to the output_file.

The program COPY_FILE uses input data file with experimental events and produces the output data file with selected events which can be used in next stages of data analysis.

1.2 Program Execution

The program COPY_FILE is an interactive program. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)COPY_FILE.EXE into the user's directory e.g.

copy $DISK2:(LUKASIAK.STOPPING)COPY_FILE.EXE *.*

b) type command

run COPY_FILE

An example of the interactive session is given in Appendix A.

2.0 Input and Output Data

The program COPY_FILE reads three input data parameters (data_file, output_file, i_type) from the terminal (LUN = 5). The experimental events are read from the data_file (LUN = 91) and the output is written to the output_file (LUN = 60).

2.1 Input Description

The program COPY_FILE reads in three data parameters from the terminal (LUN = 5). The meanings of these parameters are given below

data_file - name of a data file with experimental events

output_file - name of a data file for results

i_type - two values are allowed
0 - is for AS (A-stopping)
1 - is for BS (B-stopping)

The experimental events are read from the file data_file which contains records with information about experimental events and the experimental data.

2.2 Output Description

The program COPY_FILE uses data file with the symbolic name output_file (LUN = 60) to write output results. An example of the part ot the output file is given in Appendix B. The output consists of four columns with four quantities ID1, ID2, IC and i_tagw.

For A-stopping type the three variables ID1, ID2, and IC correspond to energies deposited in detector layers A1, A2, and C123, respectively.

For B-stopping type the three variables ID1, ID2, and IC correspond to energies deposited in detector layers B1, B2, and C432, respectively.

The fourth column has the tag word in the decimal representation.

3.0 Description of program COPY_FILE

The program COPY_FILE uses 5 subroutines.

In Fig. 1 the block diagram shows organization of the program "COPY_FILE". The entry subroutine is MAIN.

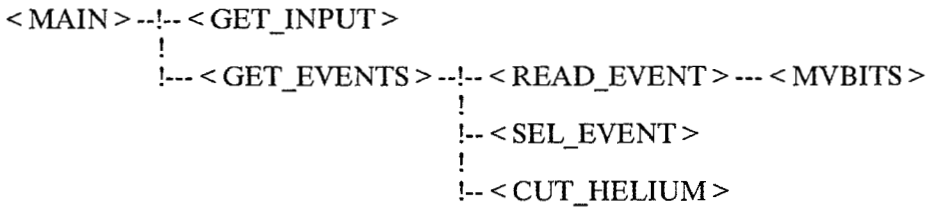

Fig.1 The block diagram of the software COPY_FILE

The MAIN subroutine calls two subroutines, GET_INPUT and GET_EVENTS.

1. Subroutine GET_INPUT

Purpose

The subroutine reads three input data parameters (data_file, output_file, i_type) from the logical unit number (LUN = 5) .

The meanings of input/output parameters are given below

data_file - name of a data file with experimental events (LUN = 91)

output_file - name of a data file for results

i_type - a type of a stoping mode
0 - corresponds to A-stopping mode
1 - corresponds to B-stopping mode

2. Subroutine GET_EVENTS

Purpose

The subroutine GET_EVENTS reads all events and selects events with charges larger then Helium. The selected events are written to the output_file.

The meanings of input/output parameters are given below

data_file - name of a data file (LUN = 91)

i_type - a type of a stoping mode
0 - corresponds to A-stopping mode
1 - corresponds to B-stopping mode

The following steps are performed by the subroutine GET_EVENTS

1. it calls subroutine READ_EVENT to read experimental data (a TAG word and 3 pulse hights),

2. it calls the subroutne SEL_EVENT which checks a TAG word and energy deposited in detector layers to classify experimental event as one of three categories. Only, the category with i_ret = 0 is considered for further processing. All experimental events with i_ret < 0 are rejected as events which do not satisfy required conditions.

3. in the next step it loads energies deposited in three detector layers to ID1, ID2, and IC variables. Two different cases, A-stopping and B-stopping, are considered.

   For i_type = 0 the experimental event is of A-stopping type and three variables ID1, ID2, and IC correspond to energies deposited in detector layers A1, A2, and C123, respectively.

   In the case of i_type = 1 the experimental event is of B-stopping type and three variables ID1, ID2, and IC correspond to energies deposited in detector layers B1, B2, and C432.

4. in this step it calls the subroutine CUT_HELIUM which selects events with charges larger than Helium. The selection is based on two conditions which are different for A- and B-stopping events. The conditions take into account the energies deposited in B1, B2, and C432 layers for B-stopping events and A1, A2, and C123 for A-stopping events.

5. the TAG word is converted from binary to decimal representation

6. the four quantities ID1, ID2, IC and i_tagw are written to the file with symbolic name output_file (LUN = 60).

   For i_type = 0 the experimental event is of A-stopping type and three variables ID1, ID2, and IC correspond to energies deposited in detector layers A1, A2, and C123, respectively.

   In the case of i_type = 1 the experimental event is of B-stopping type and three variables ID1, ID2, and IC correspond to energies deposited in detector layers B1, B2, and C432.

7. in this step the number of good cases NGOOD is incremented

by one and the steps 1, 2, 3, 4, 5, 6, and 7 are repeated in a loop.

3. Subroutine READ_EVENT

Purpose

The subroutine READ_EVENT reads a TAG word and 3 pulse heights from the Voyager files. There is one input parameter data_file, and three output parameters i_tag, i_pha and i_end.

The meanings of input/output parameters are given below

data_file - name of a data file (LUN = 91)

i_tag a TAG word which particular elements are listed below

i_tag(1) - C1

i_tag(2) - C2

i_tag(3) - C3

i_tag(4) - C4

i_tag(5) - SLANT

i_tag(6) - G2*

i_tag(7) - G1.G3*

i_tag(8) - HG

i_tag(9) - value 0 for HET

i_tag(10) - value 0 for AS
value 1 for BS & PEN EVTS

i_tag(11) - BLOCK

i_tag(12) - CAUTION

i_pha a pulse height which elements are listed below

	AS events	BS events	PEN events
i_pha(1) -	C1 + C2 + C3	B1	B1
i_pha(2) -	A2	B2	C1
i_pha(3) -	A1	C2 + C3 + C4	C2 + C3 + C4

i_end - a flag indicating error conditions during reading of data_file (LUN = 91)
i_end = 0 read of record was succesful
i_end = -1 end of file found or error at open

The subroutine READ_EVENT performs the following steps

1. It reads from a data_file a record of 512 bytes and stores it

in Ibuf.

2. It takes first two bytes (16 bits) and loads to itbuf

3. The first 4 bits are loaded to i_tag(4), i_tag(3), i_tag(2), and i_tag(1).

4. The bits 9, 10,..., 16 are loaded to i_tag(12), i_tag(11),..., and i_tag(5).

5. the bytes 3 and 4 are loaded to i_pha(3)
   the bytes 5 and 6 are loaded to i_pha(2)
   the bytes 7 and 8 are loaded to i_pha(1)

6. it checks if it is not the end of data on the file data_file.
   The end of data is marked with i_pha(1) = i_pha(2) = i_pha(3) = 0.
   If the end of data is found then the value -1 is assigned to i_end and return to MAIN program is executed. If there are still some records with events on a file then the value 0 is assigned to i_end and return to MAIN subroutine is executed.

4. Subroutine SEL_EVENT

Purpose

The subroutine SEL_EVENT performs several checkups to find out if the considered experimental event can be used for further processing.

The meanings of input/output parameters are given below

i_type - two values are allowed
0 - is for AS (A-stopping)
1 - is for BS (B-stopping)

i_tag - a tag word which particular elements are listed below

i_tag(1) - C1

i_tag(2) - C2

i_tag(3) - C3

i_tag(4) - C4

i_tag(5) - SLANT

i_tag(6) - G2*

i_tag(7) - G1.G3*

i_tag(8) - HG

i_tag(9) - value 0 for HET

i_tag(10) - value 0 for AS
value 1 for BS & PEN EVTS

i_tag(11) - BLOCK

i_tag(12) - CAUTION

i_ret - output flag
i_ret = 0 - a considered case can be used
= -1 - an experimental event does not fullfill necessary conditions to be processed further.

The subroutine SEL_EVENT performs the following tests

a) it checks if the CAUTION bit is set up in the TAG word,

b) it checks if the particle penetrated all detector layers without stopping

c) it checks if the particle not entered detector

If none of these tests is true then the flag i_ret = 0 and the experimental event is considered in further processing. For the case when the caution bit is set up the flag i_ret = -1 and for the case when the particle did not enter detector or when it did not penetrated it the flag i_ret = -2.
For negative i_ret values the experimental event is not considered in further processing.

5. Subroutine CUT_HELIUM

Purpose

The subroutine CUT_HELIUM selects events for B-stopping mode according to the following two conditions

$$B1 + C432/2 < 80$$
$$1.25 * B2 + C432 < 100$$

where B1, B2 and C432 are energies deposited in detector layers.

For A-stopping mode the selection conditions are

$$A1/50 + C123/60 < 1$$
$$A2 + C123 < 60$$

where A1, A2 and C123 are energies deposited in detector layers.

If any of these conditions is satisfied then the return flag i_ret = -1 .
If none of these conditions is satisfied then i_ret = 0

The meanings of input/output parameters are given below

i_type - two values are allowed
0 - is for AS (A-stopping)
1 - is for BS (B-stopping)

ID1 - energy deposited in B1(in A1)
ID2 - energy deposited in B2(in A2)
IC - energy deposited in C432(in C123)

i_ret - a return flag with two values
= -1 is skipped in further processing
= 0 event is accepted for further processing

4.0 Compile and Link-Edit of the Program COPY_FILE

The sequence of steps leading to program compilation is

a) type commands

```
fort COPY_FILE
link COPY_FILE
```

5.0 Appendix A. Example of Input Data Interactive Session

An example of the interactive session, the part of the output is given in Appendix B.

```
---------------------------------
  COPY_FILE     (Version 1.1)
Modified and checked on 12/12/1988
---------------------------------

Enter name of a datafile with experimental events
'nv186ast.dat'
Enter name of an output file for selected events
's1v186ast.dat'
Enter type of file: 0 for AS, 1 for BS
        0
File nv186ast.dat                Opened
Evts read & selected:    2205   1826
```

6.0 Appendix B. Example of Output File

A small part of the output file produced with the program COPY_FILE.

```
   69   67  292  1139
  185  273   10  1073
  142  154 1358  1143
   13  103  738  1143
   19   17   47  1111
    4  476  508  1107
   66   74  272  1139
  179  223   60  1073
    8   13   80  1107
  247  326   32  1073
   76   80  238  1139
  173  193   75  1137
   12   35   93  1111
   86   95  203  1139
  422  438  732  1137
   18   25  202  1143
  132  131  745  1139
  222  225  454  1139
   55   54  383  1143
   34   36  235  1143
  238  292   39  1073
,.....
,.....
,.....
   16   14   65  1139
   -9   -9   -9   -9
 Evts read & selected:     2205     1826
```

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CUT_SIGNAL

DECEMBER 1988

Phillipe Ferrando and Andrew Lukasiak

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1.0 Program Name: CUT_SIGNAL

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing program CUT_SIGNAL.

Program CUT_SIGNAL selects events from a data file produced by the program COPY_FILE or by the program TREVTNEW. There are two selection conditions (one for A-stopping and another for B-stopping events) to remove noise events, such as events witha very low B1 value (or A1 value) compared to B2 and C432 (or to A2 and C123).

The program CUT_SIGNAL uses input data file with experimental events produced by the program COPY_FILE or by the program TREVTNEW, and produces the output data file with selected events which has the same data structure as the input data file.

1.2 Program Execution

The program CUT_SIGNAL is an interactive program. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)CUT_SIGNAL.EXE into the user's directory e.g.

copy $DISK2:(LUKASIAK.STOPPING)CUT_SIGNAL.EXE *.*

b) type command

run CUT_SIGNAL

An example of the interactive session is given in Appendix A.

An example of the part of the output is given in Appendix B.

2.0 Input and Output Data

The program CUT_SIGNAL reads four input data parameters (data_file, i_type, i_file, output_file) from the terminal (LUN = 5). The experimental events are read from the data_file (LUN = 91) and the output is written to the output_file (LUN = 60).

2.1 Input Description

The program CUT_SIGNAL reads in four data parameters from the terminal (LUN = 5). The meanings of these parameters are given below

data_file - name of a data file with experimental events

i_type - two values are allowed
0 - is for A-stopping
1 - is for B-stopping

i_file - two values are allowed
0 - is used when the input data file to the program CUT_SIGNAL is generated by the program COPY_FILE
1 - is used when the input data file to the program CUT_SIGNAL is generated by the program TREVTNEW

output_file - name of a data file for selected events

2.2 Output Description

The program CUT_SIGNAL uses data file with the symbolic name output_file (LUN = 60) to write output results. An example of the part ot the output file is given in Appendix B. For the case when the input data file to the program is produced by the program COPY_FILE, the output consists of four columns with four quantities ID1, ID2, IC and i_tagw.

For A-stopping type the three variables ID1, ID2, and IC correspond to energies deposited in detector layers A1, A2, and C123, respectively.

For B-stopping type the three variables ID1, ID2, and IC correspond to energies deposited in detector layers B1, B2, and C432, respectively.

The fourth column has the tag word in the decimal representation. Additionally, to the four quantities (ID1, ID2, IC, and i_tagw) the output file may have 10 more columns with 10 other quantities if the input data file to the program CUT_SIGNAL was produced by the program TREVTNEW.

3.0 Description of program CUT_SIGNAL

The program CUT_SIGNAL uses 4 subroutines.

In Fig. 1 the block diagram shows organization of the program CUT_SIGNAL. The entry subroutine is CUT_SIGNAL.

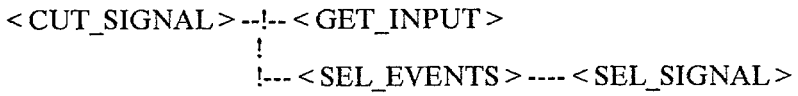

Fig.1 The block diagram of the software CUT_SIGNAL

The CUT_SIGNAL subroutine calls two subroutines, GET_INPUT and SEL_EVENTS.

3.1 Subroutine GET_INPUT

Purpose

The subroutine reads four input data parameters (data_file, i_type, i_file, output_file) from the logical unit number (LUN = 5).

The meanings of input/output parameters are given below

data_file - name of a data file with experimental events (LUN = 91)

i_type - a type of a stoping mode
0 - corresponds to A-stopping mode
1 - corresponds to B-stopping mode

i_file - type of input file
0 - corresponds to a file produced by the program COPY_FILE
1 - corresponds to a file produced by the program TREAT_EVENT

output_file - name of a data file for results

3.2 *Subroutine SEL_EVENTS*

Purpose

The subroutine SEL_EVENTS reads experimental events from the data file produced by the program COPY_FILE or by the program TREVTNEW, and removes events which are due to noise. The cut of these events is performed by the subroutine SEL_SIGNAL. The selected events are written to the output_file.

The meanings of input/output parameters are given below

data_file - name of a data file with experimental events

output_file - name of a data file for selected events

i_file - type of input file
0 - corresponds to a file produced by the program COPY_FILE
1 - corresponds to a file produced by the program TREVTNEW

The following steps are performed by the subroutine SEL_EVENTS

1. it reads experimental events from the data file

2. it calls the subroutine SEL_SIGNAL to check if the considered event can be related to noise region.

3. if the event is not in the noise region than the whole record describing an event is written to the output_file. The structure of the output record is the same as of the record read from the input data file. The end of the data with experimental events is marked with several "-9" numbers. In the last line the information about the number of read and selected events is written.

3.3 *Subroutine SEL_SIGNAL*

Purpose

The subroutine SEL_SIGNAL selects events according to the following two conditions

B1 < 0.455 * (C432 - 50.)
A1 < C123 * 4. / 60.

where B1, A1 , C432 , and C123 are energies deposited in detector layers.

If any of these conditions is satisfied then the return flag i_ret = -1 .

If none of these conditions is satisfied then i_ret = 0

The meanings of input/output parameters are given below

i_type - two values are allowed
0 - is for A-stopping
1 - is for B-stopping

ID1 - energy deposited in B1 (or in A1)
ID2 - energy deposited in B2 (or in A2)
IC - energy deposited in C432 (or in C123)

i_ret - a return flag with two values
0 the event can be processed further
-1 the event is in the noise region and should not be considered for further processing

4.0 Compile and Link-Edit of the Program CUT_SIGNAL

The sequence of steps leading to program compilation is

a) type commands

```
fort CUT_SIGNAL
link CUT_SIGNAL
```

5.0 Appendix A. Example of Input Data Interactive Session

An example of the interactive session

```
-------------------------------------------------------
CUT_SIGNAL  (Version 1.1)

Modified and checked on 12/15/1988
-------------------------------------------------------
Enter name of input data file with experimental events
Put the name of the file between quotes
's1v186ast.dat'

Enter type of experimental events on a file
For A-stopping events use value  0
For B-stopping events use value  1

      0

For the input data file
produced by the program COPY_FILE
type in number  0

For the input data file
produced by the program TREVTNEW
type in number  1

      0

Enter the output data file name
Put the name of the file between quotes

's2v186ast.dat'
Evts read & selected:     1826    1566
```

6.0 Appendix B. Example of Output

Part of the output from the program CUT_SIGNAL

```
   69    67   292  1139
  185   273    10  1073
  142   154  1358  1143
   19    17    47  1111
   66    74   272  1139
  179   223    60  1073
    8    13    80  1107
  247   326    32  1073
   76    80   238  1139
  173   193    75  1137
   12    35    93  1111
   86    95   203  1139
  422   438   732  1137
   18    25   202  1143
  132   131   745  1139
  222   225   454  1139
   55    54   383  1143
   34    36   235  1143
  238   292    39  1073
   49   198    17  1107
   52    54   398  1143
,.....
,.....
,.....
   16    14    65  1139
   -9    -9    -9    -9
Events read & selected:     1826     1566
```

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MATDRAW

JANUARY 1989

Phillipe Ferrando and Andrew Lukasiak

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1.0 Program Name: MATDRAW

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing software MATDRAW.

The program MATDRAW produces plots of experimental events and simulation tracks in a selected 2-dimensional energy space. The energy space is determined by the selected combination of detector layers. The program can be used to plot experimental events and simulation tracks with marked energy bins or to perform a fit of simulation tracks to experimental events.

There are five possible plots of experimental events and simulation tracks which can be plotted in the following 2-dimensional plots of energies deposited in detector layers

1 - A1 versus A2 (or B1 versus B2)
2 - A1 versus C123 (or B1 versus C432)
3 - A1 versus (A2+C123) (or B1 vs (B2+C432))
4 - A2 versus C123 (or B2 vs C432)
5 - (A1+A2) versus C123 (or (B1+B2) vs C432)

There are two possible types of data files with experimental events which can be used as input files. The first type of data file is produced by the CUT_SIGNAL program. This file has only information about energies deposited in detector layers and a TAG word.

The second type of a file with experimental events is produced by the program TREVTNEW. The events on this file have already determined charge. For these events with determined charge program has an option which allows to plot only these experimental events which are within a selected interval of a charge spread or within a given charge limits.

The program MATDRAW uses three input data files. The first file (DATAFILE) has experimental events and can be produced by the program CUT_SIGNAL or by the program TREVTNEW.

The second file (NASIM) with simulation tracks is generated by the program DETMOD.

The third file (NBINFILE) with energy bins is generated by the program EBINNEW.

1.2 Program Execution

The program MATDRAW is an interactive program. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)MATDRAW.EXE

into the user's directory.

b) type command
run MATDRAW

2.0 Input and Output Data

The program MATDRAW reads in the input data in an interactive way from the terminal (LUN = 5), the simulation data from the data file NASIM, the experimental events from the file DATAFILE, and the energy bins from the file NBINFILE.

2.1 Input Description

The input data parameters have to be given in an interactive way. They are divided into three sets. The first set is given only once and the other two sets have to be given every time when a new iteration step in the fit procedure is started or when another set of detector layers is selected to plot experimental and simulation tracks.

First set of input data parameters

The meanings of the parameters from the first set are given below

1. NASIM - name of a file with simulation events
   This is a file which is produced by the program DETMOD. The name of the file has to be given in quotes.

2. NGAIN - type of gain
   e.g. 'LG' is a low gain and
   'HG' is a high gain.
   The type of a gain has to be given in quotes.

3. NMODE - a stopping mode, two cases are allowed
   'AS' is for A-stopping
   'BS' is for B-stopping
   The stopping mode has to be given in quotes.

4. DATAFILE - name of a data file with experimental events. This file has to be produced by the programs CUT_SIGNAL or TREVTNEW. The name of the file has to be given in quotes.

5. ISMO - a parameter which is used to select or skip smoothing of a track.
   For ISMO = 1 the events which form "kink" type irregularities are removed, what effectively leads to a smooth dependence in a simulation track.

6. ISELDET - a parameter which is used to perform additional selection of all events which

stopped in a selected C-detector layer.
The selection is performed if ISELDET = 1.

7. INUMDET - a sequential number of a selected C-detector layer.
The three values of INUMDET = 1,2,3 correspond to C1, C2, and C3 detector layers.

8. ISEL - two values can be used
0 - all events are considered
1 - This option can be used only if data_file is produced by the program TREVTNEW. For ISEL = 1 only the events which are within a given charge distribution interval are considered.

Comment - the input data parameters 8.a and 8.b are needed only if ISEL = 1. To get ASIG and BSIG parameters it is necessary to perform charge analysis with the program PLRESZ.

8.a ASIG - parameter determining spread of charge distribution
8.b BSIG - parameter determining spread of charge distribution

9. XCUT - this is read only if ISEL = 1 . The parameter XCUT represents the number of sigma values used to calculate charge cutoff interval.

10. ISELZ1 - a selection parameter, two values can be used
0 - all elements are considered
1 - This option can be used only if DATAFILE is produced by the program TREVTNEW. For this option only these events are considered which are within a given charge interval <Z1MIN, Z1MAX>.

Comment - the input data parameters 10.a and 10.b are read only if ISELZ1 = 1 .

10.a Z1MIN - lower limit determining charge boundary of a selected charge interval
10.b Z1MAX - upper limit determining charge boundary of a selected charge interval

Second set of input data parameters

The second set of input data parameters has to be given by a user in an interactive way. The set has six parameters needed to fit simulation tracks to experimental events.

1. OFFB1 - offset for A1 (or B1) detector layer.

2. FSB1 - full scale MeV factor for A1 (or B1) detector layer

3. OFFB2 - offset for A2 (or B2) detector layer

4. FSB2 - full scale MeV factor for A2 (or B2) detector layer

5. OFFC - offset for C123 (or C432) detector layer

6. FSC - full scale MeV factor for C123 (or C432) detector layer

Third set of input data parameters
---

1. LUPL --- selects terminal graphic number

2. ITMAT --- it is read only if LUPL is not negative.
The 5 possible values of ITMAT are given below with corresponding quantities which can be plotted

   1 - event is presented as energy deposited in A1 detector layer versus energy deposited in A2 detector layer.

   2 - A1 versus C123 (or B1 versus C432)

   3 - A1 versus (A2+C123) (or B1 vs (B2+C432))

   4 - A2 versus C123 (or B2 vs C432)

   5 - (A1+A2) versus C123 (or (B1+B2) vs C432)

3. CMIN - minimum value on a horizontal axis (units are channels)

4. CMAX - maximum value on a horizontal axis (units are channels)

5. BMIN - minimum value on a vertical axis (units are channels)

6. BMAX - maximum value on a vertical axis (units are channels)

7. IRESP - two values are allowed
   0 - simulation events are not plotted
   1 - simulation events are plotted

8. This is requested only if IRESP = 1

   IPLTEBIN - two values are allowed
   0 - values of energy bins are not marked on simulation tracks
   1 - values of energy bins are marked on simulation tracks. The input data file with information about energy bins has to be given if plotting of energy bins is requested

9. This is requested only if IPLTEBIN = 1

   NBINFILE - name of a file with energy bin limits

10. ITHICK - a selection parameter, two values are possible

0 - a thin lines used in plotting
1 - a thick lines used in plotting

11. IPRINT - a selection parameter, two values are possible
0 - a hardcopy of a plot is not generated
1 - a hardcopy of a plot is generated

The file DATAFILE contains records with the experimental data. The meanings are given below

ID1 --- energy deposited in A1 (for A-stopping mode)
or in B1 (for B-stopping mode)

ID2 --- energy deposited in A2 (for A-stopping mode)
or in B2 (for B-stopping mode)

IC --- energy deposited in C123 (for A-stopping mode)
or in C432 (for B-stopping mode)

ITAGW --- a TAG word in a decimal representation

ZEVT(1) - charge determined in the analysis of energy deposited in A1-C123 (A-stopping mode) or in B1-C432 (B-stopping mode).

ZEVT(2) - charge determined in the analysis of energy deposited in A2-C123 (A-stopping mode) or in B2-C432 (B-stopping mode).

The file NASIM contains simulation events for different classes of events. The class of events is determined here by a selected mode, gain, and charge. For a description of records from the file NASIM see Section with description of the subroutine READSI2.

The file NBINFILE contains energy bins for A-stopping or B-stopping particles. For a description of records from the file NBINFILE see Section with description of the subroutine FILEBIN.

2.2 *Output Description*

The program MATDRAW produces plots on the graphic terminal and if requested the hardcopy on the laser printer.

3.0 Description of program MATDRAW

The program MATDRAW uses 3 subroutines.

In Fig. 1 the block diagram shows organization of the program MATDRAW. The entry subroutine is MAIN.

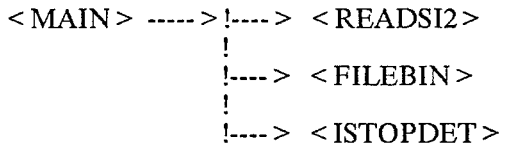


Fig.1 The block diagram of the program MATDRAW.

The following steps are performed by the MAIN subroutine

1. in the first step it reads several input data parameters given from the terminal (LUN = 5). For a description of input data parameters see Section (2.1).

2. it calls the subroutne READSI2, which reads all simulation data events and performs selection for a specified gain and mode. The gain and mode are given in the input data list.

   The input parameters to the READSI2 subroutine are

   NASIM - the name of the file with simulation data

   NGAIN - type of a gain (e.g. low gain is LG, high gain is HG)

   NMODE - type of event (AS is for A-stopping,
   BS is for B-stopping)

   The output parameters from the READSI2 subroutine are

   RANGE - range

   ENUC - energy / nucleon

   D1 - energy deposited in the first detector layer
   (A1 detector layer for A-stopping mode,
   B1 detector layer for B-stopping mode).

D2 - energy deposited in the second detector layer
(A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

C - energy deposited in C detector layers
(C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

GEO - geometric factor

NSIM - number of events in every set

IZSIM - charge

ASIM - mass

NISOT - total number of simulation events

IOK - the flag which can be 1 or -1. In the case when the number of events in a track exceeds 200 events the IOK = -1, and for this case the execution of the program is stopped. If IOK = 1 then the execution is continued.

3. it performs a selection of the events with energy deposited in C detector layers (C123 for A-stopping and C432 for B-stopping) larger than 0.001. The cases with C < 0.001 are considered as stopped in A2 (or in B2) and are not considered in further analysis. The quantities D1, D2, C, ENUC, GEO and RANGE are renumbered due to selection.

4. This step is executed only if it is requested via the input parameter ISMO = 1.
In this step a new selection is performed which removes all cases which are not monotonic as a function of energy. Effectively, this selection smooths out tracks in the regions corresponding to dead layers of a detector.

5. it reads several input data parameters (ISELDAT, INUMDET, ISEL, ASIG, BSIG, XCUT, ISELZ1, Z1MIN, Z1MAX) given from the terminal (LUN = 5). For a description of input data parameters see Input Description (Sect. (2.1)).

6. it reads several quantities (ID1, ID2, IC, ITAGW, ZEVT(1), ZEVT(2)) from the file with experimental events. The charges ZEVT(1) and ZEVT(2) are read only if the parameter ISEL = 1.

7. it checks the flag SUMFLG. If the flag SUMFLG < -10 then reading of next records from data file with experimental events is terminated and the execution is transferred to the second part of the program which performs plotting.

8. This step is performed only if ISELDET = 1.
The sequential number of a detector layer in which particle stopped is calculated by the subroutine ISTOPDET.
Only these events which stopped in a selected stop detector layer (parameter INUMDET) are considered for plotting.

9. This step is performed only if ISEL = 1.

In this step the average charge ZAV, the charge distribution parameter SIGMA, the charge cutoff parameter ZLIM, and the charge spread DZ of an experimental event are calculated. All events with charge spread DZ larger than the charge cutoff parameter ZLIM are not included in further analysis. All other events are considered as good and used in a second part of the program to plot a selected quantity.

The second part of the subroutine MAIN

The second part performs plotting of a selected quantity. There are two types of data which can be plotted simultaneously the experimental events and the simulation track.

10. in this step several input data parameters
(OFFB1, FSB1, OFFB2, FSB2, OFFC, FSC, LUPL, ITMAT, CMIN, CMAX, BMIN, BMAX, IRESP, IPLTEBIN) are
given from the terminal (LUN = 5). For a description
of input data parameters see Input Description (Sect. (2.1))
In this step program can stop execution if the parameter
OFFB1 is less than -999.

11. in this step the plotting subroutines are used to plot
experimental events in 2-dimensional space for
energies deposited in different detector layers.

12. this step is performed only if IRESP = 1.
In this step simulation events are plotted along with
energy bin limits.

13. programs starts next loop with steps 10, 11, and 12.

3.1 READSI2

Purpose

The subroutine READSI2 reads simulation tracks from the file NASIM and performs selection of all cases which have the same gain and mode parameters as given in the input data file. The six quantities (range, energy per nucleon, energies deposited in detector layers , and geometric factor) are stored in two-dimensional arrays for selected events. The first index in every array denotes the set. Every set has two quantities, charge and mass, which can differ from set to set. The second index denotes the event within a set. Every event has six component quantities (range, energy per nucleon, energies deposited in A1, A2, C1C2C3 or in B1, B2, C4C3C2, and geometric factor) which can be different for different events.

There are two loops in a subroutine. The outer loop (index NISO) changes charge (IZD) and mass (AD) which determine set. The inner loop (index NREA) changes an event within a set.

Input/Output
parameters

Input

NASIM - name of the simulation file

NGAIN - type of gain (e.g. low gain is LG, high gain is HG)

NMODE - type of event (AS is for A-stopping,
BS is for B-stopping)

Output quantities

RANGE (NISO, NREA) - range

ENUC (NISO, NREA) - energy per nucleon

D1 (NISO, NREA) - energy deposited in the first detector layer
(A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

D2 (NISO, NREA) - energy deposited in the second detector layer
(A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

C (NISO, NREA) - energy deposited in C detector layers
(C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

GEO (NISO, NREA) - geometric factor

NSIM (NISO) - number of events in every set

NISO - index of a set (every set is marked
with the same mode and gain, and
different charge)

NREA - index numbering events in a set

IOK - a flag which indicates if the number of
events in a set exceeded 200.
= 1 (number of cases smaller than 200)
= -1 (number of cases larger than 200)

IZSIM (NISO) - charge
ASIM - mass

The subroutine READSI2 performs the following steps

1. It reads data from the simulation file with name NASIM (LUN = 40)

2. It reads dummy 48 records.

3. Opens loop for sets and reads record with 5 parameters
(IZD, AD, NAMEL, NDGAIN, NDMODE).

The meanings of these parameters are

IZD - charge
AD - mass
NAMEL - name of an element (symbol)
NDGAIN - gain
NDMODE - mode

4. It checks for the end of data on a file. The end of data is marked with IZD = 0. For IZD = 0 it returns to main subroutine.

5. It selects all sets with gain and mode parameters equal to gain and mode parameters given in the input to the subroutine. For every selected set, counter NISO is incremented and two quantities, charge (IZD) and mass (AD) are stored in arrays IZSIM and ASIM, respectively.

6. It reads record with five parameters NREG(I) (I = 1,...,5). The variable NREG is not used in further processing.

7. It starts loop for events.
It reads 8 parameters, which meaning is given below

XR - range

ENERG - energy/nucleon

CH1 - energy deposited in the first detector layer
(units are channels,
A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

CH2 - energy deposited in the second detector layer
(units are channels,
A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

CH3 - deposited energy in C detector layers
(units are channels,
C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

IB - unused

SL - unused

SOL - geometric factor

8. It checks if it is the last event from the set.
The last event is always marked with negative range XR.
The number of events from the same set is stored in NSIM(NISO), where the parameter NISO numbers different sets corresponding to different charges and masses.

For the last event from the selected set, program starts the outer loop and reads again charge, mass, name of the element, gain and mode.

If the range XR is not negative, the counter NREA is incremented with every case and 6 quantities are stored

in two-dimensional arrays. The stored quantities are range, energy per nucleon, deposited energies in A1, A2, C1C2C3 for A-stopping (or B1, B2, C432 for B-stopping), and geometric factor. The first index in all these arrays, NISO, denotes a selected set, and the second index a particular event in a set. Every set has fixed charge, mass, gain and mode. Every event in a set differs from others with range, energy per nucleon, energies deposited in detector layers, and geometric factor.

9. It reads next event from the same set.

10. The return from the subroutine is executed if the record which marks the end of data is read in or if the number of events in a set exceeds 200 events.

3.2 Subroutine FILEBIN

Purpose

The subroutine FILEBIN calculates values of energies deposited in the A-, B-, and C-detector layers which correspond to energy bins for a selected element.

Input

The input to the FILEBIN is 1 parameter NMODE

NMODE - typ of mode

Output

The output from the subroutine are 3 quantities

CLIM --- energies deposited in the C-detector layer
by the events with energies equal to limits
of energy bins.

B1LIM - energies deposited in the A1 (A-stopping mode)
or in the B1 (B-stopping mode) detector layers
by the events with energies equal to limits
of energy bins.

B2LIM - energies deposited in the A2 (A-stopping mode)
or in the B2 (B-stopping mode) detector layers
by the events with energies equal to limits
of energy bins.

The subroutine FILEBIN performs the following steps

1. It reads energy bins from the data file NBINFILE
   The first four records are skipped.
   The next 30 records which are read have the same structure.
   The meanings of these quantities are given below

   IZ --- charge

   A --- mass

   ELIMIT(1) ... ELIMIT(8) ---- energy bin limits

2. It starts a loop (variable IELT) for simulation tracks.
   The first track corresponding to hydrogen is not considered
   in the further processing by the FILEBIN.

3. the second loop is for simulation events from a selected
   simulation track.

4. in this step a simulation event is selected according
   to the condition that the energy of the simulation event is
   larger or equal than the energy of the sequential energy
   bin limit. For this simulation event, the three limits
   in the energy deposited in three detector layers are
   calculated. For A-stopping particles the limits are found
   from the energies deposited in A1, A2, and C123 detector layers.
   These limits determine the energy which would be deposited in
   A1, A2, and C123 detector layers if the energy of the
   particle would correspond to the energy bin limit.
   For the B-stopping particle the energies deposited
   in B1, B2, and C432 detector layers are used.
   There are 8 energy bin limits. Whenever a simulation
   event with an energy higher or equal to the energy
   bin limit is found then the next bin limit is considered.
   The process stops when all energy bin limits are used.

3.3 Subroutine ISTOPDET

Purpose

The subroutine ISTOPDET finds which of four detectors
C1, C2, C3, and C4 was entered by the particle.

Input

The input to the ISTOPDET is only one parameter, ITAGW

ITAGW - is a decimal representation of a TAG word

Output

The output is the ISTOPDET value

ISTOPDET --- four values are possible, 1, 2, 3,and 4.

1 - denotes the case when the particle entered only C1 detector (if A-stopping mode). For B-stopping mode this is C4.

2 - denotes the case when the particle entered C1 and C2 detectors.

3 - denotes the case when the particle entered C1, C2, and C3 detectors.

4 - denotes the case when the particle entered C1, C2, C3 and C4 detectors.

For B-stopping mode the sequence of C-detector layers is opposite.

The subroutine ISTOPDET performs the following steps

1. It converts a TAG word from the decimal representation to the binary representation.

2. It calculates a sum of four bits which are set up only if the particle passes through corresponding C1, C2, C3, and C4 detector layers. If the sum is equal 0 then the particle did not enter the C-detector. If the sum is 4 then the particle passed through all four detectors.

4.0 Compile and Link-Edit of the Program MATDRAW

Type commands

```
fort MATDRAW
link MATDRAW, MONGO$DISK:MONGO/LIB
```

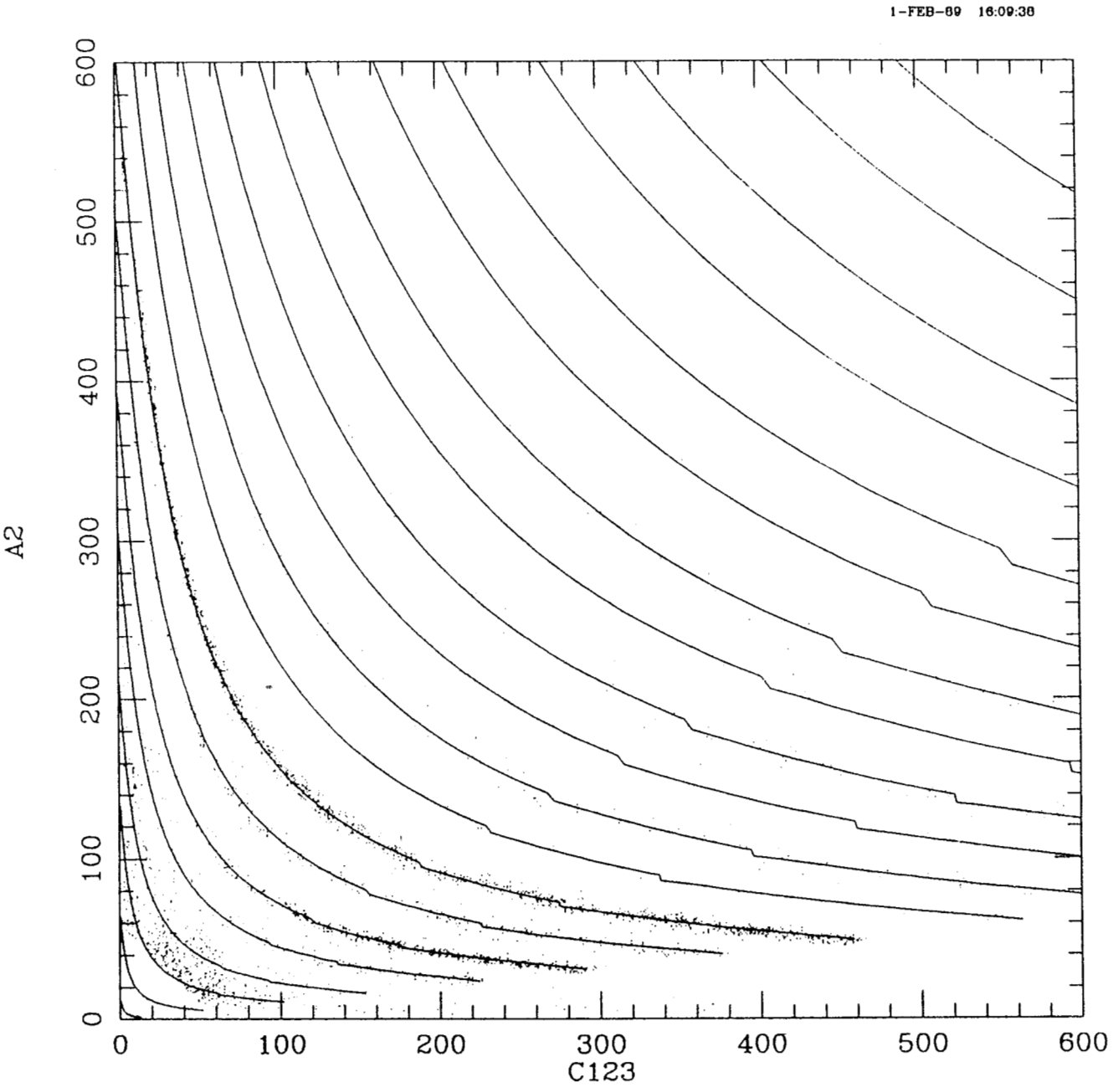
5.0 Appendix A. Example of Input Data Interactive Session

```
Example of interactive  data session.
---------------------------------------------------------------------

Enter name of simulation file in * format
repv1dl1.sim
Enter gain and mode in * format
'LG' 'AS'
Enter name of data file in * format
zv1ast8687.dat
Detector file: ihetiidl1.dat

Read simulation data for Z & A      1   1.000000
Read simulation data for Z & A      2   3.930000
Read simulation data for Z & A      3   6.520000
Read simulation data for Z & A      4   7.960000
Read simulation data for Z & A      5   10.69000
Read simulation data for Z & A      6   12.06000
Read simulation data for Z & A      7   14.49000
Read simulation data for Z & A      8   16.06000
Read simulation data for Z & A      9   19.00000
Read simulation data for Z & A     10   20.76000
Read simulation data for Z & A     11   23.00000
Read simulation data for Z & A     12   24.57000
Read simulation data for Z & A     13   26.91000
Read simulation data for Z & A     14   28.26000
Read simulation data for Z & A     15   31.00000
Read simulation data for Z & A     16   32.63000
Read simulation data for Z & A     17   35.62000
Read simulation data for Z & A     18   37.20000
Read simulation data for Z & A     19   39.82000
Read simulation data for Z & A     20   41.92000
Read simulation data for Z & A     21   45.00000
Read simulation data for Z & A     22   47.15000
Read simulation data for Z & A     23   49.61000
Read simulation data for Z & A     24   51.56000
Read simulation data for Z & A     25   53.94000
Read simulation data for Z & A     26   55.82000
Read simulation data for Z & A     27   58.02000
Read simulation data for Z & A     28   58.78000
Read simulation data for Z & A     29   63.54000
Read simulation data for Z & A     30   65.35000
Smoothing of C432 response (1) ?
     1
Selection on stop detector (0-1) ?
     0
Data Selection on Z2-Z1 (1) ?
```

```
      0
Select Z1 min and max ? (0-1)
      0
   1000        999
   2000       1999
   3000       2999
   4000       3999
nevt, # selected:         4079        4079
Enter offset and FSMeV for D1 (-1000 stops)
  0.0000000E+00   935.0000
Enter offset and FSMeV for D2
  0.0000000E+00   915.0000
Enter offset and FSMeV for D432
  0.0000000E+00   17400.00
Terminal graphics number ? (-1 to change param)
      1
Matrix: D1-D2   (1), D1-C    (2), D1-D2+C (3),
      D2-C432 (4), D1+D2-C (5) ?
      4
Enter X min & max, Y min & max
   0.0000000E+00   600.0000      0.0000000E+00   600.0000
Draws simulated responses ? (1)
      1
Shows energy bin limits ? (1)
      0
Print of graphics ? (1)
      1
Thick lines (1) ?
      0
10163 vectors plotted
Terminal graphics number ? (-1 to change param)
     -1
Enter offset and FSMeV for D1 (-1000 stops)
  -1000.000      -1000.000
```

6.0 Appendix B. Plot of Fitted Simulation Tracks

Plot corresponding to the input session in Appendix A.
Fit of simulation tracks to A-stopping experimental events
(Voyager-1, 1986-87). The events are represented by energies
deposited in A2 and C123 detector layers.



data file: zv1ast8687.dat

evts read and selected: 4079 4079

No selection on charge consistency

simulation file: repv1dl1.sim

Offset D1, D2, C: 0.00 0.00 0.00

FSMeV D1, D2, C: 935. 915. 17400.

(4)

TREVTNEW

JANUARY 1989

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Table of Contents

1.0 Program Name: TREVTNEW

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing program TREVTNEW

The program TREVTNEW determines three quantities ("fractional" charge ZEVT, energy per nucleon EK , and geometric factor GEOFAC) essential for charge analysis in the next stage of data analysis and two other quantities (the energy ENEW and geometric factor GNEW) used to determine spallation corrections.

The first three quantities are found by considering several simulation tracks generated for different charges in two different two-dimensional spaces for energies deposited in detector layers.

The first components of "fractional" charge ZEVT(1), energy per nucleon EK(1), and geometric factor GEOFAC(1) result from analysis of energies deposited in A1 and C123 (if A-mode is requested) or in B1 and C432 (if B-mode is requested).

The second components of "fractional" charge ZEVT(2), energy per nucleon EK(2), and geometric factor GEOFAC(2) result from analysis of energies deposited in A2 and C123 (if A-mode is requested) or in B2 and C432 (if B-mode is requested).

The method used in this program finds a minimum distance between a point corresponding to the experimental event and points from closest neighboring simulation tracks.

Two other quantities, the energy ENEW and geometric factor GNEW are calculated using the energy deposited in the C detector layer and adding corrections due to energy deposited in the first two detector layers (A1 and A2 if A-stopping is selected or B1 and B2 if B-stopping is selected). The energy and range calculated with this method are used to calculate spallation corrections SPACOR (see Ref. (1) and (2)).

The geometry factor GNEW, energy EK and range XK are interpolated from simulation values corresponding to the two simulation events which are in a shortest distance from the considered experimental event. For the energy EK additional corrections are included due to energy deposited in the two first detector layers.

The program TREVTNEW takes into account all simulation events which produce signals in the C-detector (energy deposited has to be larger than 0.001 MeV). The simulation tracks are smoothed out by rejecting some of the events which produce a "kink" type irregularities.

The experimental events are read from the file which is produced by the program COPY_FILE or CUT_SIGNAL. Both programs perform selection of experimental events (for more information see documents COPY_FILE and CUT_SIGNAL).

1.2 Program Execution

The program TREVTNEW can be used as a batch job or in an interactive way. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)TREVTNEW.EXE
into the user's directory.

b) copy $DISK2:(LUKASIAK.STOPPING)TREVTNEW.COM
into the user's directory.

c) to run program in a forground type command
@TREVTNEW

The example of TREVTNEW.COM file is given in Appendix A.

d) to run program in an interactive way type command

run TREVTNEW

and type in all necessary input data parameters
(see Appendix A).

Comment

The program TREVTNEW has to be run twice. The first time it is run to determine charge, energy and geometric factor. The second run is performed when the charge analysis is finished. During the second run of the program the spallation corrections are calculated.

2.0 Input and Output Data

The program TREVTNEW reads input data parameters from the file TREVTNEW.COM or from the terminal (LUN = 5).

The data with experimental events are on the file with symbolic name DATAFILE (LUN = 42) . The data with simulation events are read from the data file NASIM.

The symbolic name of the data file for results is NAMRE (LUN = 60). The current disk file names DATAFILE and NAMRE are given via the input data list.

The file DATAFILE with experimental events is produced by the program COPY_FILE or by CUT_SIGNAL and the data file NASIM is produced by the program DETMOD.

2.1 Input Description

The program TREVTNEW uses two input data files for reading. We start this section with short table which contains the symbolic name of the file, its logical unit number, name of the subroutine which reads the file and the place where the current name of the file is given.

TABLE 1.

NAME	LUN	LOCATION of READ	PLACE WITH CURRENT NAME OF FILE
DATAFILE	LUN = 42	MAIN	DATAFILE determined via input data
NASIM	LUN = 40	READSI2	input parameter

The input data parameters which have to be given in an interactive way or via TREVTNEW.COM file are listed below

NASIM - the name of the file with simulation tracks

NGAIN - type of gain (e.g. low gain is LG, high gain is HG)

NMODE - type of event (AS is for A-stopping,
BS is for B-stopping)

DATAFILE - name of a file with experimental events

OFFB1 - offset for B1 (given in channels)

FSB1 - full scale MeV for B1 (MeV)

OFFB2 - offset for B2 (given in channels)

FSB2 - full scale MeV for B2 (MeV)

OFFC - offset for C (given in channels)

FSC - full scale MeV for C (MeV)

NAMRE - name of a file for results

ZLIMI - charge limits for all elements

The file DATAFILE contains records with information about experimental events and the experimental data.

The file NASIM contains simulation events for different classes of events. The class of events is determined here by a selected mode and gain, and the track by a selected charge.

2.2 *Output Description*

The program TREVTNEW uses data file with the symbolic name NAMRE (LUN = 60) to write output results. The name of this file is given as input data parameter. The output consists of several output quantities which meanings are given below

IB1 - energy deposited in the first detector layer
(units are channels,
A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

IB2 - energy deposited in the second detector layer
(units are channels,
A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

IC - energy deposited in C detector layers
(units are channels,
C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

ITAGW --- a TAG word in a decimal representation

ZEVT(1) --- charge determined in the analysis of energy deposited in A1-C123 (A-stopping mode) or in B1-C432 (B-stopping mode).

ZEVT(2) --- charge determined in the analysis of energy deposited in A2-C123 (A-stopping mode) or in B2-C432 (B-stopping mode).

EK(1) --- energy per nucleon determined in the analysis of energy deposited in A1-C123 (A-stopping mode) or in B1-C432 (B-stopping mode).

EK(2) --- energy per nucleon determined in the analysis of energy deposited in A2-C123 (A-stopping mode) or in B2-C432 (B-stopping mode).

GEO(1) --- geometric factor determined in the analysis of energy deposited in A1-C123 (A-stopping mode) or in

B1-C432 (B-stopping mode).

GEO(2) --- geometric factor determined in the analysis of energy deposited in A2-C123 (A-stopping mode) or in B2-C432 (B-stopping mode).

ENEW --- energy of an experimental event determined from the analysis of energy deposited in the C-detector layers (corrections due to energy deposited in A1, A2 or B1, B2 are included).

GEONEW --- geometric factor of an experimental event determined from the analysis of energy deposited in the C-detector layers.

SPACOR(1) - spallation correction (method 1)

The fragmentation is computed along the whole range. The variation of the cross section with energy is taken into account. For this spallation correction program uses table sigvar with average values of cross sections factors for different energy intervals. The values are taken from Ref.(2). The average cross section is given as sigvar*SIG, where SIG is the asymptotic cross section.

SPACOR(2) - spallation correction (method 2)

The contribution to fragmentation from the last 3/4 of D1 (A1 or B1) and the first 3/4 of D2 is considered. Fragmentation outside these limits is neglected. The mode of the particle has to be used in this approach. The dependence of cross section on energy is not included here (Ref.(1)).

3.0 Description of the Program TREVTNEW

The program TREVTNEW uses 7 subroutines.

In Fig. 1 the block diagram shows organization of the program TREVTNEW. The entry subroutine is MAIN.

Fig.1 The block diagram of the program TREVTNEW

The following steps are performed by the MAIN subroutine

1. in the first step it reads several input data parameters from the file NAMATDAT assigned to LUN=41 (for description of input data parameters see Input Description, Section 2.1).

2. it loads an array ZLIMI with charge bounderies for all elements. The charge bounderies have to be given in the input.

   Comment:
   If the data file with experimental events is processed first time by the program TREVTNEW, then the following charge bounderies have to be used for all elements (0.5, 1.5, 2.5, ..., 29.5, 30.5).

   The good place to determine charge boundaries is a next stage of data analysis where the program PLRESZ is used.

3. it calls the subroutne READSI2, which reads all simulation data events and performs selection for a specified gain and mode. The gain and mode are given in the input data list.

The input parameters to the READSI2 subroutine are

NASIM - the name of the file with simulation data

NGAIN - type of a gain (e.g. low gain is LG, high gain is HG)

NMODE - type of event (AS is for A-stopping,
BS is for B-stopping)

The output parameters from the READSI2 subroutine are

RANGE - range

ENUC - energy / nucleon

D1 - energy deposited in the first detector layer
(A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

D2 - energy deposited in the second detector layer
(A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

C - energy deposited in C detector layers
(C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

GEO - geometric factor

NSIM - number of events in every set

IZSIM - charge

ASIM - mass

NISOT - total number of simulation events

IOK - the flag which can be 1 or -1. In the case when the number of events in a track exceeds 200 events the IOK = -1, and for this case the execution of the program is stopped. If IOK = 1 then the execution is continued.

4. it performs a selection of the events with energy deposited in C detector layers (C123 for A-stopping and C432 for B-stopping) larger than 0.001. The cases with C < 0.001 are considered as stopped in A2 (or in B2) and are not considered in further analysis. The quantities D1, D2, C, ENUC, GEO and RANGE are renumbered due to selection.

5. in this step a new selection is performed which removes all cases which are not monotonic as a function of energy. Effectively, this selection smooths out tracks in the regions corresponding to dead layers of a detector.

6. it changes the units of the three quantities D1, D2, and C from MeV to channels. Additionally, it shifts all three quantities by the corresponding offsets. At the end of this

step the selection of the simulation events and processing of the energies from a simulation track is finished.

The second part of the subroutine MAIN

7. it reads experimental data from the file DATAFILE (pulse hights in A1, A2, and C123 for A-stopping or B1, B2, C432 for B-stopping, and a TAG word).
   Further processing of data is terminated if the end of data record is found. The end of data record is recognized by condition that a sum of all pulse hights is smaller than -10 .

8. it calls the subroutine ZDET, which searches for the closest simulation track curve to the considered experimental event.

   The subroutine ZDET performs calculation of fractional charge ZEVT, energy per nucleon EK, and geometric factor GEOFAC. These quantities are found by considering several simulation tracks generated for different charges and by using the method of minimum distance between a point corresponding to the experimental event and points from closest neighboring tracks.
   The quantities (charge, energy and geometric factor) are calculated for two cases which are given below

   Case 1 (IDET = 1) C123 and A1 for A-stopping or
   C432 and B1 for B-stopping

   Case 2 (IDET = 2) C123 and A2 for A-stopping or
   C432 and B2 for B-stopping

9. it calls the subroutine EDET which performs calculation of energy EK, geometric factor GEOFAC, range XR and spallation correction SPALLCOR (see Ref. (1) and (2)).

   The geometry factor, energy and range are interpolated from simulation values corresponding to the two simulation events which are closest to the considered experiment event.

   In the case of energy, additional corrections are included due to energy deposited in the first two detector layers.

10. the output parameters from the subroutines ZDET and EDET are written to the file with symbolic name NAMRE (LUN = 60). The list of output quantities is given in the Output Description (Section 2.2).

11. in this step the loop for reading and processing of experimental data is repeated (steps 7 to 10).

3.1 READSI2

Purpose

The subroutine READSI2 reads simulation tracks from the file NASIM and performs selection of all cases which have the same gain and mode parameters as given in the input data file. The six quantities (range, energy per nucleon, energies deposited in detector layers , and geometric factor) of selected events are stored in two-dimensional arrays. The first index in every array denotes the set. Every set has two quantities, charge and mass, which can differ from set to set. The second index denotes the event within a set. Every event has six component quantities (range, energy per nucleon, energies deposited in A1, A2, C1C2C3 or in B1, B2, C4C3C2, and geometric factor) which can be different for different events.

There are two loops in a subroutine. The outer loop (index NISO) changes charge (IZD) and mass (AD) which determine set. The inner loop (index NREA) changes an event within a set.

Input/Output
parameters

Input

NASIM - name of the simulation file

NGAIN - type of gain (e.g. low gain is LG, high gain is HG)

NMODE - type of event (AS is for A-stopping,
BS is for B-stopping)

Output quantities

RANGE (NISO, NREA) - range

ENUC (NISO, NREA) - energy per nucleon

D1 (NISO, NREA) - energy deposited in the first detector layer
(A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

D2 (NISO, NREA) - energy deposited in the second detector layer
(A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

C (NISO, NREA) - energy deposited in C detector layers
(C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

GEO (NISO, NREA) - geometric factor

NSIM (NISO) - number of events in every set

NISO - index of a set (every set is marked
with the same mode and gain, and

different charge)

NREA - index numbering events in a set

IOK - a flag which indicatesif the number of events in a set exceeded 200.
= 1 (number of cases smaller than 200)
=-1 (number of cases larger than 200)

IZSIM (NISO) - charge
ASIM - mass

The subroutine READSI2 performs the following steps

1. It reads data from the simulation file with name NASIM (LUN=40)

2. It reads dummy 48 records.

3. Opens loop for sets and reads record with 5 parameters (IZD, AD, NAMEL, NDGAIN, NDMODE).

   The meanings of these parameters are

   IZD - charge
   AD - mass
   NAMEL - name of an element (symbol)
   NDGAIN - gain
   NDMODE - mode

4. It checks for the end of data on a file. The end of data is marked with IZD = 0. For IZD = 0 it returns to main subroutine.

5. It selects all sets with gain and mode parameters equal to gain and mode parameters given in the input to the subroutine. For every selected set, counter NISO is incremented and two quantities, charge (IZD) and mass (AD) are stored in arrays IZSIM and ASIM, respectively.

6. It reads record with five parameters NREG(I) (I=1,...,5). The variable NREG is not used in further processing.

7. It starts loop for events.
   It reads 8 parameters, which meaning is given below

   XR - range

   ENERG - energy/nucleon

   CH1 - energy deposited in the first detector layer (units are channels,
   A1 detector layer for A-stopping mode,
   B1 detector layer for B-stopping mode).

   CH2 - energy deposited in the second detector layer (units are channels,
   A2 detector layer for A-stopping mode,
   B2 detector layer for B-stopping mode).

CH3 - deposited energy in C detector layers
(units are channels,
C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

IB - unused

SL - unused

SOL - geometric factor

8. It checks if it is the last event from the set.
The last event is always marked with negative range XR.
The number of events from the same set is stored in NSIM(NISO),
where the parameter NISO numbers different sets corresponding
to different charges and masses.

For the last event from the selected set, program starts
the outer loop and reads again charge, mass, name of
the element, gain and mode.

If the range XR is not negative, the counter NREA is
incremented with every case and 6 quantities are stored
in two-dimensional arrays. The stored quantities are range,
energy per nucleon, deposited energies in A1, A2, C1C2C3
for A-stopping (or B1, B2, C432 for B-stopping), and
geometric factor. The first index in all these arrays, NISO,
denotes a selected set, and the second index a particular event
in a set. Every set has fixed charge, mass, gain and mode.
Every event in a set differs from others with range, energy
per nucleon, energies deposited in detector layers, and
geometric factor.

9. It reads next event for the same set.

10. The return from the subroutine is executed if the record
which marks the end of data is read in or if the number of
events in a set exceeds 200 events.

3.2 ZDET

Purpose

The subroutine ZDET performs calculation of three quantities for a given experimental event. The event is determined by the three energies (B1, B2 and C432 for B-stopping or A1, A2 and C123 for A-stopping mode) deposited in detector layers. The three calculated quantities of the experimental event are fractional charge ZEVT, energy per nucleon EK, and geometric factor GEOFAC. These quantities are found by considering several simulation tracks generated for different charges and by using the method of minimum distance between point corresponding to the experimental event and points from closest neighboring tracks. The three quantities are calculated for two cases which are given below

Case 1 (IDET = 1)	C123 and A1	for A-stopping or
	C432 and B1	for B-stopping
Case 2 (IDET = 2)	C123 and A2	for A-stopping or

Input/Output
parameters

Input

IB1 - energy deposited in the first detector layer
(A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

IB2 - energy deposited in the second detector layer
(A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

IC432 - energy deposited in C detector layers
(C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

Output

ZEVT - atomic number of an event (2 components)
EK - energy / nucleon (2 components)
GEOFAC - geometric factor (2 components)

The analysis is performed in the following steps

1. First, the case is selected (e.g. B1 versus C432 is analyzed)

2. the set of simulated events to be analyzed is established
(the set is determined by charge, mode and gain parameters)

3. the subroutine TABFILL is called. For the
selected set of simulation events, it stores the energies
deposited in two detector layers (e.g. C432 and B1)
in one-dimesional arrays, XSIM and YSIM, for
further processing. These two arrays generate a simulation
track in the selected two-dimensional energy space.

For the selected case (e.g. B1 versus C432)
only one experimental point is analyzed by the subroutine ZDET
This experimental point is represented as a point (XD,YD)
in the two-dimensional energy space and its values are assigned
by the subroutine TABFILL

4. the function IPOSIT is called, which determines the position
of an experimental point (XD,YD) in respect to a simulation
track given by arrays XSIM(), YSIM(). If the data point
is above (or on) simulation track then the function
IPOSIT = 1, if the data point is below the simulation track
then IPOSIT = -1.

5. in this step the position of an experimental event in respect
to two sequential simulation tracks is determined.

6. the shortest distance is found between the experimental point
(XD,YD) and considered two sequential simulation tracks.

The distance is calculated by the subroutine DIST.

7. the whole procedure is repeated for the next sequential set with higher charge (all sets differ with charge). This procedure is continued as long as the two sequential tracks are successfully found with the experimental point located between them. Once two sequential simulation tracks are found then the the experimental event is analyzed. This analysis produces the fractional charge ZAV, energy EK and geometric factor GEOFAC. These three quantities are calculated finding shortest distances of experimental events from both simulation tracks.

8. The fractional charge is calculated as a weighted quantity with weights equal to the shortest distances of both tracks from the experimental event. The energy EK and geometric factor GEOFAC are approximated by the energy and geometric factor of an event from a simulation track. The event from a simulation track is selected using criterion of a shortest distance between the experimental event and simulation event in a selected energy space (e.g. A1 versus C123).

9. the same procedure is repeated for the second case (e.g. B2 versus C432) .

3.3 TABFILL

Purpose

The subroutine TABFILL stores the energies deposited in two detector layers (e.g. C432 and B1) for a selected simulation track. The energies are stored in one-dimesional arrays, XSIM and YSIM, for further processing. These two arrays generate a simulation track in the selected two-dimensional energy space.

For the selected case (e.g. B1 versus C432) two values (XD,YD) are assigned to an experimental event. They correspond to two energy components determining energy deposited in two detector layers.

Input
parameters

IDET - a parameter determining energy space

(IDET = 1) C123 and A1 for A-stopping or
C432 and B1 for B-stopping

(IDET = 2) C123 and A2 for A-stopping or
C432 and B2 for B-stopping

ISO - index of a track

IB1 - energy deposited in the first detector layer
(units are channels,

A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

IB2 - energy deposited in the second detector layer
(units are channels,
A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

IC432 - energy deposited in C detector layers
(units are channels,
C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

Output
parameters

XD - event coordinate in 2-dim energy space

YD - event coordinate in 2-dim energy space

XSIM - array with x-coordinates for a selected simulation track

YSIM - array with y-coordinates for a selected simulation track

3.4 IPOSIT

Purpose

The function IPOSIT determines the position of an experimental point (XD,YD) in respect to a simulation track given by arrays XSIM(), YSIM(). If the data point is above (or on) simulation track then the function IPOSIT = 1, if the data point is below simulation track then IPOSIT = -1.

Input
parameters

XD - event coordinate in 2-dim energy space

YD - event coordinate in 2-dim energy space

XSIM - array with x-coordinates for a selected simulation track

YSIM - array with y-coordinates for a selected simulation track

NSIMU - number of simulation events

Output
parameters

IPOSIT - determines location of experimental
event in respect to a simulation track
= 1 above or on a simulation track
= -1 below.

3.5 DIST

Purpose

The subroutine DIST performs projection of an experimental event on a given simulation track. The projection is performed using shortest distance algorithm which finds the shortest distance between the experimental event and events on a simulation track. If it is possible, then the subroutine uses interpolation to improve accuracy. As a result of the projection operation on the simulation track, the coordinates, energy per nucleon and geometric factor of the experimental event are found.

Input/Output
parameters

Input

XX - event coordinate in 2-dim energy space

YY - event coordinate in 2-dim energy space

XSIM - array with x-coordinates for a selected track

YSIM - array with y-coordinates for a selected track

ISO - index of a track

IFL - not active

Output

XCLO - x-coordinate of the closest point on a track

YCLO - y-coordinate of the closest point on a track

GEOM - geometric factor of the closest point on a track

ENERG- energy corresponding to the closest point on a track

The analysis is performed in the following steps

1. First, the event from the simulation track is selected

2. The distance from the point corresponding to experimental event to the point corresponding to a selected event from simulation track is found. Every point has two coordinates which correspond to two energies deposited in two detector layers.

3. From all distances corresponding to all events in the track the minimum distance is found. The coordinates of the simulation event corresponding to this minimum distance, the energy per nucleon, and the geometric factor are stored.

4. The first and the last points from the simulation track are compared with the shortest distance point. If the selected shortest distance point is above for the first point or below for the last point, then return is executed.

5. Two distances between an experimental event and two closest points to the shortest distance point are found if the shortest distance point is not the first or last on the track. From the two events corresponding to these two distances, the event with shortest distance is stored (coordinate, energy per nucleon, and geometric factor).

6. As a result of the first five steps, there are selected two events on a simulation track with the smallest distances from the experimental event. For these three points, two on the simulation track and one experimental, the quantity PSCAL is calculated which checks if the changes in the simulation track are not to fast. For fast changes the quantity PSCAL is negative. The quantity PSCAL is a scalar product of two vectors. One vector connects a point corresponding to experimental event and its projection on a line with two points corresponding to two events from a track with the smallest distances from the experimental point. The second vector is directed along the line with two shortest distance points.
   If the projection of an experimental point on a line is outside of the interval determined by two smallest distance points then the quantity PSCAL is negative.
   If the projection point is within the interval then the quantity PSCAL is positive. In this case the subroutine DIST finds the coordinates, energy per nucleon and geometric factor of the point on a simulation track which is a projection of an experimental event.
   If the closest distance event on a track is in the region of fast changes then no interpolation is performed and coordinates, energy per nucleon and geometric factor are assumed as those of the closest distance event from the track.

3.6 EDET

Purpose

The subroutine EDET performs calculation of energy ENEW, geometric factor GEONEW, range XR and spallation correction SPACOR. The geometric factor GEONEW, energy ENEW and range XR are interpolated from simulation values corresponding to the two closest simulation events to the considered experimental event. In the case of energy, additional corrections are included due to energy deposited in two first detector layers.

Input/Output
parameters

Input

IB1 - energy deposited in the first detector layer
(units are channels,
A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

IB2 - energy deposited in the second detector layer
(units are channels,
A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

IC432 - energy deposited in C detector layers
(units are channels,
C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

ZEVT - atomic number of an event

Output

ENEW - energy / nucleon

GEONEW - geometric factor

SPACOR - spallation correction

The processing is performed in the following steps

1. First, the subroutine EDET calculates the average charge
ZAV = (ZEVT(1) + ZEVT(2))/2
for the considered experimental event. If the charge is negative, the case is not processed further and the the subroutine EDET executes return statement.

2. In the second step, the subroutine EDET selects two charge limits ZLIM(I) and ZLIM(I-1) determining a simulation track. The charge index IZ of the experimental event is determined by comparing two charge limits with the average charge ZAV of the considered experimental event.
In this step, also mass XMASS is determined for the selected experimental event. In the case when there is no two neighboring simulation tracks to the considered event the further processing is stoped and -1 value is assigned to all output quantities.

3. In the third step the subroutine EDET calculates geometric factor GEONEW, energy ENEW, range XR, and spallation correction SPACOR. The calculations are performed using the energy deposited in the C-detector.

There are three situations considered by the subroutine. In the first case the experimental energy deposited in the C-detector layers is smaller than the first (the smallest) value on a simulation track. In this case the geometric factor, energy and range are approximated by the simulation track values corresponding to the first element of the simulation track.

In the second case, the energy C432 deposited in the C detector layers is between the energies C(IZ, I-1) and C(IZ, I) of the two simulation events from the simulation track with charge index IZ. For this case the geometric factor GEONEW, energy ENEW and range XR are interpolated from simulation values corresponding to two simulation events with indexes I and (I-1). The geometric factor is calculated as

GEONEW = GEO(IZ,I-1) + (DEL GEO)/(DEL C) * (C432 - C(IZ,I-1))

where GEO(IZ,I-1) is a geometric factor and C432 is the energy deposited in the C-detector layer by an experimental event. The quantity DEL GEO is calculated as

DEL GEO = GEO(IZ,I) - GEO(IZ,I-1)

and the quantity DEL C is given by

DEL C = C(IZ,I) - C(IZ,I-1)

The other quantities are interpolated in a similar way, however in the case of energy, additional corrections are included due to energy deposited in B1 and B2 layers.

In the third case, the energy deposited in the C detector is larger than the corresponding energy of the last (largest value) element from the simulation track. In this case, the geometric factor and the range are approximated by the values of the last element from the simulation track. The energy has linear interpolation correction which takes into account energy loss in detector layers.
In all three cases, the energy is calculated in MeV/n.
Additionally, the subroutine EDET calls the subroutine SPALL to calculate the spallation corrections. (See Ref. (1) and (2)).

3.7 SPALL

Purpose

The function SPALL calculates spallation corrections SPACOR.

The spallation correction is the amount of fragmentation in silicon. There are two types of spallation corrections which are selected with input parameter IND.

Input
parameters

IND - two values are possible

1 - the fragmentation is computed along the whole range. The variation of the cross section with energy is taken into account. For this spallation correction program uses table sigvar with average values of cross sections factors for different energy intervals. The values are taken from Ref.(2). The average cross section is given as sigvar*SIG, where SIG is the asymptotic cross section.

2 - the contribution to fragmentation from the last 3/4 of D1 (A1 or B1) and the first 3/4 of D2 is considered. Fragmentation outside these limits is neglected. The mode of the particle has to be used in this approach. The dependence of cross section on energy is not included here (Ref.(1)).

NMODE - type of event (AS is for A-stopping, BS is for B-stopping)

XMASS - a mass of the experimental event

ENERGY --- energy ENEW of an experimental event determined from the analysis of energy deposited in the C-detectorlayers

RANGE - range

Output
parameters

SPALL - spallation correction

4.0 Compilation and Link Steps

Type commands

a) fort TREVTNEW

a) link TREVTNEW

5.0 Appendix A. Example of Command File with Input Data

This is an example of a TREVTNEW.COM file which was used
to run program TREVTNEW for experimental data from
Voyager-1 (A-stopping mode, 86-87 year)

```
$run trevtnew
 'repv1dl1.sim'
 'LG' 'AS'
 'zv18687ast.dat'
 0.0 935.
 0.0 915.
 0.0 17400.
 'zv18687res.dat'
    0.5 1.5 2.5 3.5 4.5   5.4   6.4   7.4   8.4   9.4
   10.5 11.3 12.5 13.5 14.5 15.5 16.5 17.5 18.5  19.4
   20.5 21.4 22.5 23.4 24.6 25.5 26.5 27.4 28.5  29.5
   30.5
$exit
```

6.0 Appendix B. Example of Output File

This is part of the output file from TREVTNEW program
produced with input data given via TREVTNEW.COM file.

```
  69 67 292  1139     8.072   7.951    82.23   82.32    1.0579  1.0575    82.31    1.0576    1.0691
1.0016
  185 273 10  1073     5.976   5.874    12.44   12.50    1.2835  1.2835    12.14    1.2835    1.0030
1.0021
  142 154 1358 1143   15.916  16.003   167.68  185.71    0.8552  0.8072   182.85    0.8173    1.1657
1.0018
   19 17  47  1111     2.976   2.801    32.61   33.01    1.1707  1.1682    32.45    1.1710    1.0300
1.0016
   66 74 272  1139     7.784   8.021    78.93   74.55    1.0702  1.1089    74.50    1.1084    1.0590
1.0017
  179 223 60  1073     7.641   7.970    23.56   21.99    1.2835  1.2835    21.57    1.2835    1.0069
1.0025
    8 13  80  1107     2.853   2.987    54.41   53.85    0.9565  0.9603    53.89    0.9588    1.0733
1.0014
  247 326 32  1073     7.889   7.989    17.05   16.70    1.2835  1.2835    16.58    1.2835    1.0043
1.0025
   76 80 238  1139     7.870   7.965    66.12   65.99    1.1455  1.1460    65.89    1.1462    1.0483
1.0018
  173 193 75  1137     7.962   8.000    25.24   25.05    1.2835  1.2835    25.03    1.2835    1.0089
1.0024
   12 35  93  1111     3.051   4.479    63.49   50.29    0.8727  1.1174    53.82    1.0701    1.0530
1.0015
   86 95 203  1139     7.911   8.113    57.53   57.11    1.1753  1.1768    57.42    1.1758    1.0385
1.0019
  422 438 732 1137    19.801  19.849    79.35   79.29    1.2565  1.2567    78.86    1.2573    1.0407
1.0024
```

(here go all other records, not shown in this example of the output)

```
   -9   -9   -9  -9.000 -9.000   -9.00  -9.00  -9.0000 -9.0000   -9.00  -9.0000  -9.0000 -9.0000
Read:  4079  Evts selected:   4079
```

7.0 References

(1) J. JAROS , Phys. Rev. C18 (1978) p. 2273
(sigma0 parameter is taken from this Ref.).

(2) J. R. LETAW, The Astroph. Journal (Suppl. Series)
51 (1983) p.271 (Fig.2 and formula (5)).

5

PLRESZ

JANUARY 1989

Phillipe Ferrando and Andrew Lukasiak

Table of Contents

1.0 Program Name: PLRESZ

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing program PLRESZ.

The program PLRESZ can be used to plot

* charge histograms
* spread (Z2-Z1) versus average charge (Z1 + Z2)/2
* charge Z2 versus Z1

There are three types of histograms which can be plotted.

* histogram of charge Z1
  The charge Z1 is determined in the analysis of events in A1-C123 in the case of A-stopping mode (or B1-C432 for B-stopping mode)

* histogram of charge Z2
  The charge Z2 is determined in the analysis of events in A2-C123 in the case of A-stopping mode (or B2-C432 for B-stopping mode)

* histogram of average charge determined in the analysis in A1-C123 and A2-C123 in the case of A-stopping mode (or B1-C432 and B2-C432 for B-stopping mode).

The program PLRESZ uses the file DATAFILE produced by the program TREVTNEW.

1.2 Program Execution

The program PLRESZ is an interactive program. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)PLRESZ.EXE
   into the user's directory.

b) type command
   run PLRESZ

2.0 Input and Output Data

The program PLRESZ reads seven input data parameters (DATAFILE, ITYPE, ITYPGR, ISELDET, INUMDET, ISEL, XCUT) from the terminal (LUN = 5).

The experimental events are read from the file DATAFILE (LUN = 60) produced by the program TREVTNEW.

2.1 Input Description

The program PLRESZ reads seven input data parameters (DATAFILE, ITYPE, ITYPGR, ISELDET, INUMDET, ISEL, XCUT) from the terminal (LUN = 5) in the first part of the program.

There are also several input data parameters which have to be given in the second part of the program to perform selection of plots.

We present three examples of input sessions in Appendix A. The part of the output corresponding to Example 1 from Appendix A is given in Appendix B and the three figures (Figs 1, 2, and 3) corresponding to Examples 1, 2,and 3 are given in Appendix C.

The meanings of the input data parameters from the first group are given below

DATAFILE --- file with the experimental data.
For A-stopping the file contains records
with the energy deposited in the detector layers
A1, A2, C123, a TAG word in decimal representation
and two charges ZEVT(1) and ZEVT(2).
The first charge ZEVT(1) corresponds to the analysis
performed in A1-C123 space, and the second charge
ZEVT(2) is determined in A2-C123 space.

For B-stopping the file contains records
with the following quantities
B1, B2, C432, a TAG word in decimal representation
and two charges ZEVT(1) and ZEVT(2).
The first charge ZEVT(1) corresponds to the analysis
performed in B1-C432 space, and the second charge
ZEVT(2) is determined in B2-C432 space.

ITYPE --- an integer variable used to select A-stopping
or B-stopping mode.
ITYPE = 1 selects B-stopping
ITYPE = 2 selects A-stopping

ITYPGR --- an integer used to select a type of plot
= 1 selects histogram
= 2 selects DEL Z versus <Z>/2
= 3 selects plot of Z2 vs Z1

ISELDET --- selection parameter which has two values

= 0 all experimental events are considered
= 1 only a subset of experimental events will be considered. The subset of events is determined by one of the C-detectors in which event has stopped.

INUMDET --- number of a "stop detector" four values 1, 2, 3, and 4 correspond to C1, C2, C3, and C4 (for A-stopping) and to C4, C3, C2, and C1 (for B-stopping).

ISEL --- selection parameter which has two values

= 0 all events are considered without checking charge spread (Z2-Z1)

= 1 only these events which have charge spread smaller than the calculated charge spread interval are considered in further analysis. The charge spread interval is calculated on the basis of given ASIG, BSIG and XCUT input parameters.

ASIG --- parameter determining charge spread. The value of this parameter determines linear dependence of charge spread on charge Z

SIGMA = ASIG + BSIG * Z

The software FRSP (Flux Ratios for Stopping Particles) uses this parameter in several programs to calculate charge spread interval equal to three SIGMA to eliminate events with too large spread (Z2-Z1).

The value of this parameter can be found using program PLRESZ and plotting spread (Z2-Z1) versus average charge for all charges (Z = 3-30). The user on this level of analysis has to make his own decision concerning which events have to large (Z2-Z1) spread and how to draw three SIGMA charge spread line. Once this decision is made then intersection ASIG and slope BSIG can be easily calculated from figure.

BSIG --- parameter determining charge spread. The value of this parameter determines linear dependence of charge spread on charge Z

SIGMA = ASIG + BSIG * Z

See description of ASIG parameter above.

XCUT --- selection of number of SIGMA parameters used for charge cutoff parameter. A good guess here is 3. (XCUT has to be given only if ISEL = 1).

The meanings of the input data parameters from the second group are given below

LUPL --- input parameter used to select plotting or to stop further execution of program

LUPL < 0 ---- terminates further execution
LUPL = 1 ---- performs plotting

The following set of input parameters has to be given only if a plot of charge histogram is selected.

IDET --- selects one of three possible charge histograms

IDET = 1 corresponds to histogram of charge Z1 determined in the analysis of events in A1-C123 in the case of A-stopping mode (or B1-C432 for B-stopping mode). The selection of A-stopping or B-stopping mode is performed already with the ITYPE parameter. The mode A-stopping is selected with ITYPE = 2 and B-stopping with ITYPE = 1.

IDET = 2 corresponds to histogram of charge Z2 determined in the analysis of events in A2-C123 in the case of A-stopping mode (or B2-C432 for B-stopping mode). The selection of A-stopping or B-stopping mode is performed already with the ITYPE parameter. The mode A-stopping is selected with ITYPE = 2 and B-stopping with ITYPE = 1.

IDET = 3 corresponds to histogram of an average charge determined in the analysis of events in A1-C123 and in A2-C123 in the case of A-stopping mode (or B1-C432 and B2-C432 for B-stopping mode). The selection of A-stopping or B-stopping mode is performed already with the ITYPE parameter. The mode A-stopping is selected with ITYPE = 2 and B-stopping with ITYPE = 1.

XMIN --- minimum value of charge interval for which histogram will be plotted

XMAX --- maximum value of charge interval for which histogram will be plotted

YMAX --- maximum value of histogram function to be plotted

The following set of input parameters has to be given only if a plot of charge spread (Z2-Z1) versus average charge or a plot of charge Z1 versus charge Z2 is selected.

XMIN --- minimum value on the x-axis
, more precisly for ITYPGR = 2 it has to
be minimum value of average charge (Z1 + Z2)/2
and for ITYPGR = 3 it has to be minimum value of Z1
which will be plotted.

XMAX --- maximum value on the x-axis
, more precisly for ITYPGR = 2 it has to
be maximum value of average charge (Z1 + Z2)/2
and for ITYPGR = 3 it has to be maximum value of Z1
which will be plotted.

YMIN --- minimum value on the y-axis
, more precisly for ITYPGR = 2 it has to
be minimum value of charge spread (Z2-Z1)
and for ITYPGR = 3 it has to be minimum value of Z2
which will be plotted.

YMAX --- maximum value on the y-axis
, more precisly for ITYPGR = 2 it has to
be maximum value of spread charge (Z2-Z1)
and for ITYPGR = 3 it has to be maximum value of Z2
which will be plotted.

The experimental events are read from the file DATAFILE. The file DATAFILE is produced by the program TREVTNEW.

For A-stopping the file contains records with the quantities A1, A2, C123, a TAG word in decimal representation and two charges ZEVT(1) and ZEVT(2).

For B-stopping the file contains records with the quantities B1, B2, C432, a TAG word in decimal representation and two charges ZEVT(1) and ZEVT(2).

2.2 *Output Description*

The histograms are written to the file LUN = 40. The plots are directed to the laser printer or to the graphic terminal.

The example of histogram output is given in Appendix B, the examples of plots corresponding to the examples in Appendix A are in Figures 1,2 and 3.

3.0 Description of program PLRESZ

The program PLRESZ uses 1 function, ISTOPDET, and several plotting subroutines from the graphic package MONGO.

The following steps are performed by the MAIN subroutine

1. in the first step it reads several input data parameters (DATAFILE, ITYPE, ITYPGR, ISELDET, INUMDET, ISEL, ASIG, BSIG, XCUT) from the terminal (LUN = 5).

2. it starts a loop for reading and processing of experimental events A record with events is read from the DATAFILE (LUN = 60). The program checks if the record of data is not the end of data record. The end of data record is identified by program with condition that the sum of values A1 + A2 is smaller than -10. For the end of data record the execution is transferred to the second part of the program which performs plotting.

3. it performs selection of all experimental events which stopped in the same detector as selected in the input data (parameter INUMDET). To get the detector number in which the particle stopped, the MAIN subroutine calls the subroutine ISTOPDET.

4. it performs selection of all events for which charge spread DZ is larger than the charge spread given in the input data. This step is executed only if the input parameter ISEL = 1. From two charges ZEVT(1) and ZEVT(2), the charge spread interval is calculated, and all events with charge spread larger than charge spread interval are neglected.

5a. this step is performed only if histogram option is selected (ITYPGR = 1). In this step array with data for three histograms is built. The first histogram collects all cases corresponding to a first charge ZEVT(1). The second histogram collects all cases corresponding to the second charge ZEVT(2). The third histogram collects all cases corresponding to the third charge ZEVT(3) which represents the average from both charges . All histograms have 0.1 proton charge bins.

5b. this step is performed only if plot (Z2-Z1) versus (Z1 + Z2)/2 is selected (ITYPGR = 2). As an x-variable (XXD), the average charge value is used. As an Y-variable(YYD), the spread DZ is used.

5c. this step is performed only if Z2 varsus Z1 is selected.

As an x-variable (XXD), the charge ZEVT(1) is used.
As an y-variable (YYD), the charge ZEVT(2) is used.

6. in this step the next loop starts and steps 3, 4, 5a, 5b, and 5c are repeated. The processing within this loop can be terminated due to two reasons

   - the end of data record is read

   - the number of read records exceeded 20000.

7. This step is performed only if histogram option is requested (ITYPGR = 1).
   In this step histograms are written to the file LUN = 40.

   The first record has the following quantities

   DATAFILE --- name of a file with experimental events.

   NEVT --- number of events read from DATAFILE

   NSEL --- number of events selected from the DATAFILE

   NM3 --- number of events with two defined charges

   XCUT --- number of sigma parameters used to get charge cutoff parameter
   (it is used only if ISEL = 1) .

   The next 150 records have values for charge histograms. The charge histograms are build here as the number of counts versus charge bins. There are 300 bins with widths equal to 0.1 of proton charge. For every bin there are three histograms. The first histogram corresponds to a charge determined in the analysis of A1-C123 (A-stopping) or B1-C432 (B-stopping mode). The second histogram corresponds to a charge determined in the analysis of A2-C123 (for A-stopping) or B2-C432 (for B-stoppping). The third histogram is the average from charges determined in the previous two cases.

The second part of the MAIN subroutine

This part of the program reads several input data parameters and generates plots. Program uses graphic package MONGO to generate plots.

There are three types of plots

- charge histograms

- spread (Z2-Z1) versus average charge (Z1 + Z2)/2

- charge Z2 versus Z1

Three different kinds of histograms can be generated

* histogram of charge Z1 determined in the analysis of events in A1-C123 in the case of A-stopping mode (or B1-C432 for

B-stopping mode)

* histogram of charge Z2 determined in the analysis of events in A2-C123 in the case of A-stopping mode (or B2-C432 for B-stopping mode)

* histogram of average charge determined in the analysis in A1-C123 and A2-C123 in the case of A-stopping mode (or B1-C432 and B2-C432 for B-stopping mode).

The second type of plot represents the spread (Z2-Z1) versus average charge (Z1 + Z2)/2. Additionally, the plot presents two solid lines which represent given limits for charge spread. The lines are symmetric in respect to (Z2-Z1). and are determined by two constants ASIG and BSIG and sigma charge cutoff parameter XSEL.

The third type of plot represents charge Z2 versus Z1 Additionally, the plot presents two solid lines which are symmetric in respect to Z1 = Z2. The lines are determined by two constants ASIG and BSIG and charge sigma cutoff parameter XSEL.

3.1 Subroutine ISTOPDET

The subroutine ISTOPDET finds which of four detectors C1, C2, C3, and C4 was entered by the particle.

The input to the ISTOPDET is only one parameter, ITAGW

ITAGW - is a decimal representation of a TAG word

The output is the ISTOPDET value

ISTOPDET --- four values are possible, 1, 2, 3,and 4.
- 1 - denotes the case when the particle entered only C1 detector (if A-stopping mode). For B-stopping mode this is C4.
- 2 - denotes the case when the particle entered C1 and C2 detectors.
- 3 - denotes the case when the particle entered C1, C2, and C3 detectors.
- 4 - denotes the case when the particle entered C1, C2, C3 and C4 detectors.

For B-stopping mode the sequence of C-detector layers is opposite.

The subroutine ISTOPDET performs the following steps

1. It converts a TAG word from the decimal representation to the binary representation.

2. It calculates a sum of four bits which are set up only if the particle passes through corresponding C1, C2, C3, and C4 detector layers. If the sum is equal 0 then the particle did not enter the C-detector. If the sum is 4 then the particle passed through all four detectors.

4.0 Compile and Link-Edit of the Program PLRESZ

Type commands

```
fort PLRESZ
link PLRESZ, MONGO$DISK:MONGO/LIB
```

5.0 Appendix A. Examples of Input

Example 1 of input data session.

```
Enter datafile
'zv1last8687.dat'
Enter type: B stopping (1) or A stopping (2)
        2
Type of plot ?
       Histograms:1, Dz vs <Z>:2, or Z1 vs Z2:3
        1
Selection of stop detector (0-1)?
        0
Selection on z1-z2 ? (1 - 0)
        0
# evts read and selected: 4079       4079
# of evts with 2 defined charges: 4079
Histo written on for040.dat
Terminal graphics unit number ? (mongo, -1 stop)
        1
Charge determination:
A1 (1), A2 (2), average A1-A2 (3) ?
        3
Enter z min, z max, and y max value
  0  30 100
Print of graphics ? (1)
        1
Terminal graphics unit number ? (mongo, -1 stop)
       -1
```

Example 2 of input data session.

```
Enter datafile
'zv1last8687.dat'
Enter type: B stopping (1) or A stopping (2)
        2
Type of plot ?
       Histograms:1, Dz vs <Z>:2, or Z1 vs Z2:3
        2
Selection of stop detector (0-1)?
        0
Selection on z1-z2 ? (1 - 0)
        0
# evts read and selected: 4079       4079
Terminal graphics unit number ? (mongo, -1 stop)
        1
Enter x min, x max, y min, and y max value
```

```
 0 30 -5 5
Draw selection line ? (1)
        0
Print of graphics ? (1)
        1
Terminal graphics unit number ? (mongo, -1 stop)
       -1
```

Example 3 of input data session.

```
Enter datafile
'zv1ast8687.dat'
Enter type: B stopping (1) or A stopping (2)
        2
Type of plot ?
       Histograms:1, Dz vs <Z>:2, or Z1 vs Z2:3
        3
Selection of stop detector (0-1)?
        0
Selection on z1-z2 ? (1 - 0)
        0
# evts read and selected: 4079       4079
Terminal graphics unit number ? (mongo, -1 stop)
        1
Enter x min, x max, y min, and y max value
 0 30  0  30
Draw selection line ? (1)
        0
Print of graphics ? (1)
        1
Terminal graphics unit number ? (mongo, -1 stop)
       -1
```

6.0 Appendix B. Examples of Output

The part of the output listed below represents a histogram output produced in the first example. See also Fig. 1. Figures 2 and 3 correspond to examples 2 and 3.

zv1last8687.dat Evts read and selected: 4079 4079
Evts with 2 defined charges: 4079
Cut at: 0.00 sigma for !Z2-Z1!

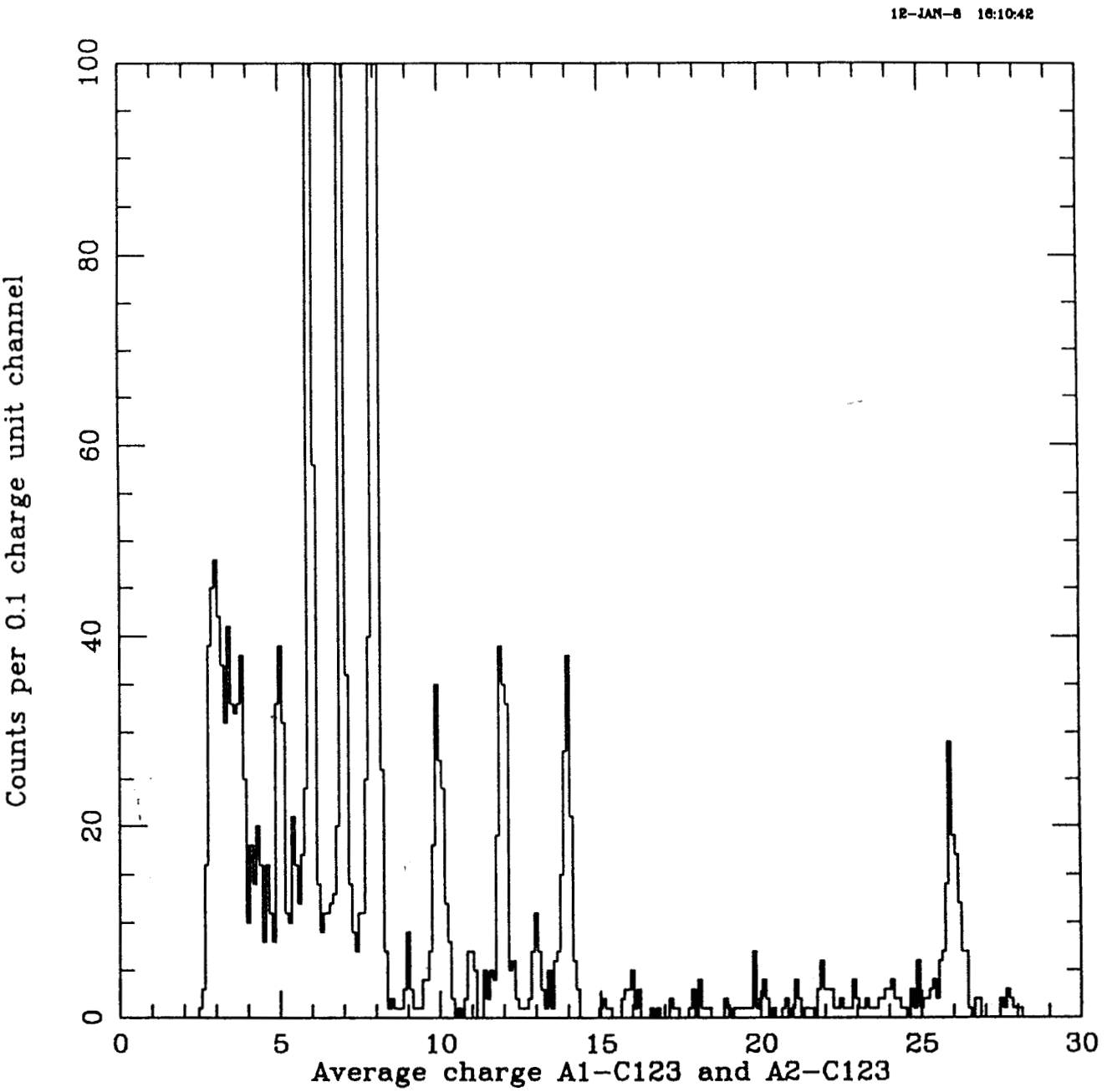
Z	A1	A2	A1+A2/2	*!*	Z	A1	A2	A1+A2/2
0.1	0	0	0	*!* 15.1	1	1	2	
0.2	0	0	0	*!* 15.2	1	1	1	
0.3	0	0	0	*!* 15.3	0	0	1	
0.4	0	0	0	*!* 15.4	0	0	0	
0.5	0	0	0	*!* 15.5	1	0	0	
0.6	0	0	0	*!* 15.6	2	0	0	
0.7	0	0	0	*!* 15.7	4	1	2	
0.8	0	0	0	*!* 15.8	3	5	3	
0.9	0	0	0	*!* 15.9	4	2	3	
1.0	0	0	0	*!* 16.0	1	3	5	
1.1	0	0	0	*!* 16.1	3	3	1	
1.2	0	0	0	*!* 16.2	0	2	3	
1.3	0	0	0	*!* 16.3	1	3	0	
1.4	0	0	0	*!* 16.4	0	0	0	
1.5	0	0	0	*!* 16.5	0	1	0	
1.6	0	0	0	*!* 16.6	0	0	1	
1.7	0	0	0	*!* 16.7	1	0	0	
1.8	2	2	0	*!* 16.8	2	1	1	
1.9	3	0	0	*!* 16.9	0	0	0	
2.0	0	5	0	*!* 17.0	0	0	0	
2.1	1	2	0	*!* 17.1	0	0	0	
2.2	2	1	0	*!* 17.2	2	1	2	
2.3	6	2	0	*!* 17.3	0	0	1	
2.4	7	5	0	*!* 17.4	0	1	1	
2.5	11	5	1	*!* 17.5	0	0	0	
2.6	13	12	3	*!* 17.6	1	0	0	
2.7	41	13	16	*!* 17.7	1	1	0	
2.8	46	30	39	*!* 17.8	1	1	1	
2.9	74	35	45	*!* 17.9	1	0	3	
3.0	69	47	48	*!* 18.0	3	1	0	
3.1	51	37	42	*!* 18.1	1	2	4	
3.2	30	42	37	*!* 18.2	1	3	1	
3.3	35	37	31	*!* 18.3	0	0	1	
3.4	25	31	41	*!* 18.4	1	0	1	
3.5	23	23	33	*!* 18.5	0	1	0	
3.6	25	27	32	*!* 18.6	0	0	0	
3.7	25	28	33	*!* 18.7	1	0	0	
3.8	24	13	38	*!* 18.8	1	0	0	
3.9	25	24	25	*!* 18.9	0	1	2	

7.0 Appendix C. Examples of Plots

Fig.1 The histogram of average charge for A-stopping events (Voyager-1, 1986-87).

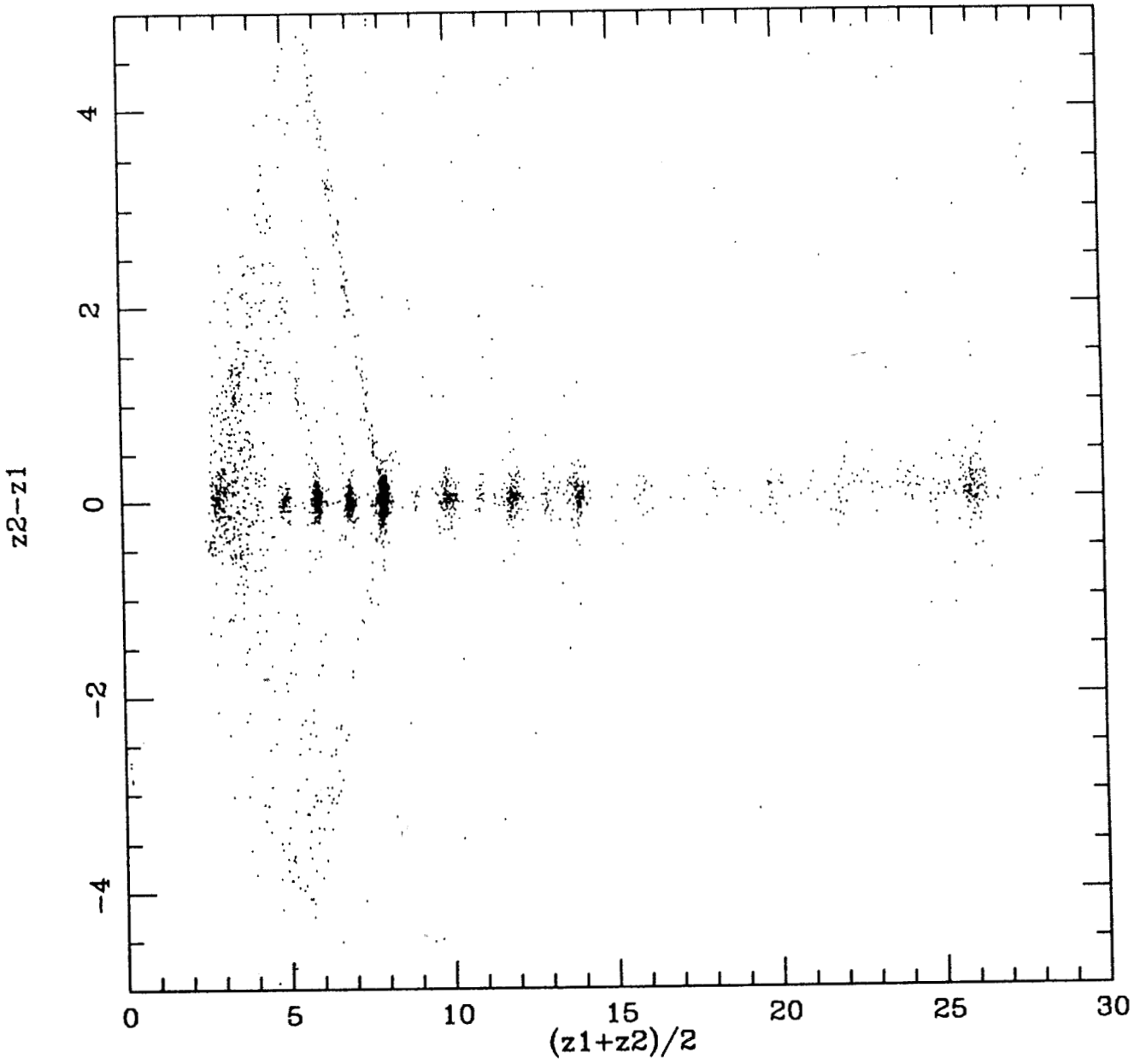
Fig.2 Charge spread versus average charge for A-stopping events (Voyager-1, 1986-87).

Fig.3 Charge Z2 determined in A2-C123 versus charge Z1 determined in A1-C123 (Voyager-1, 1986-87).



data file: zv1ast8687.dat

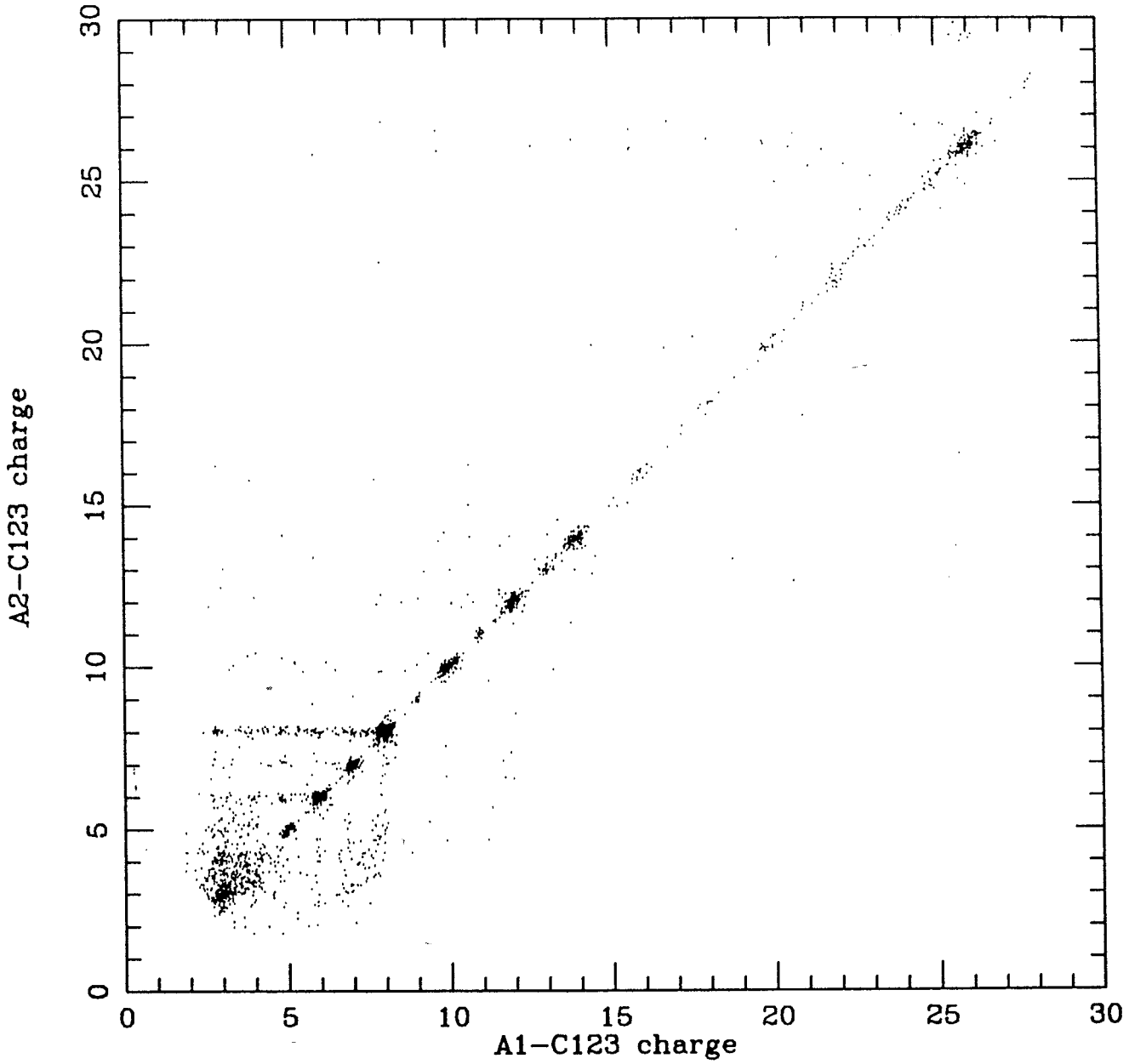
evts read: 4079



data file: zv1ast8687.dat

evts read: 4079

13-JAN-6 11:02:30



data file: zv1ast8687.dat

evts read: 4079

(6)

EBINNEW

JANUARY 1989

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Table of Contents

1.0 Program Name: EBINNEW

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing program EBINNEW.

Program EBINNEW calculates energy range interval for every considered element. The energy range interval is given by two quantities EKMIN and EKMAX. Additionally to energy range, the program calculates the energies ELIM determining boundaries of energy bins. There are seven energy bins which are determined by EKMIN, EKMAX, and six ELIM values.

The program EBINNEW uses data file with simulation tracks produced by the program DETMOD. The output results from the program EBINNEW are used by the program SPECTRE to calculate fluxes for several energy bins.

1.2 Program Execution

The program EBINNEW can be used as a batch job or in an interactive way. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)EBINNEW.EXE
into the user's directory.

b) copy $DISK2:(LUKASIAK.STOPPING)EBINNEW.COM
into the user's directory.

c) to run program in a forground type command
@EBINNEW

The example of EBINNEW.COM file is given in Appendix A.

d) to run program in an interactive way type command

run EBINNEW

and type in all necessary input data parameters
(see Appendix A).

2.0 Input and Output Data

The program EBINNEW reads the input data parameters from the file EBINNEW.COM or gets in the input from a terminal.

The simulation events are read from the data file which name is specified by the user in EBINNEW.COM or from a terminal.

An example of output file corresponding to the input in EBINNEW.COM is given in Appendix B.

2.1 Input Description

The input data parameters which have to be given in an interactive way or via EBINNEW.COM file are listed below

NASIM - the name of a file with simulation tracks

NGAIN - type of a gain (e.g. low gain is LG, high gain is HG)

NMODE - type of event (e.g. AS is A-stopping and BS is B-stopping)

XRL - six ranges to calculate energy bins

The file NASIM contains simulation events for different simulation tracks. The simulation track is determined here by a selected mode, gain and charge of an element. For the selected mode and gain there are different sets of simulation events which are characterized by charge and mass (different elements). For a description of quantities from the file with simulation tracks see Section (3.1) with description of the subroutine READSI2.

2.2 Output Description

The results are directed to the output data file (LUN = 40) and to the printer. The results are stored in several records, where the first record has four quantities, NASIM, NGAIN, NMODE, and XRL. The next records have the same structure. For every simulation track there is one record with eight energies determining seven bins. The meanings of energies are given below

EKMIN --- minimum kinetic energy determined for all events from a simulation track

ELIM(1) - ELIM(6)

six values of energies which together with EMIN and EMAX determine seven energy bins.

EKMAX --- maximum kinetic energy determined for all events from a simulation track. The energy range is determined energy interval <EKMIN, EKMAX>.

3.0 Description of Program EBINNEW

The program EBINNEW uses only one subroutine, READSI2.

The following steps are performed by the MAIN subroutine

1. in the first step it reads several input data parameters (NASIM, NGAIN, NMODE, and XRL) from the command file or from the terminal (for description of input data parameters see the Input Description (Section 2.1))

2. it calls the subroutine READSI2, which reads all simulation data events and performs selection for a specified gain and mode.

   The six quantities (range, energy per nucleon, energies deposited in detector layers, and geometric factor) of selected events are stored in two-dimensional arrays. The first index in every array denotes the set. Every set has two quantities, charge and mass, which can differ from set to set. The second index denotes the event within a set. Every event has six component quantities (range, energy per nucleon, energies deposited in detector layers, and geometric factor) which can be different for different simulation events.

   The input parameters to the READSI2 subroutine are NASIM, NGAIN, and NMODE. The output parameters are RANGE, ENUC, D1, D2, C, GEO, NSIM, IZSIM, ASIM, NISOT, IOK (for description of these parameters see section with description of the subroutine READSI2)

3. it performs a selection of the events with energy deposited in C-detector layers larger than 0.001 MeV. For A-stopping mode the C-detector layers are C123 and for B-stopping mode the C-detector layers are C432. The cases with C < 0.001 are considered as stopped in A2 or B2 and are not considered in further analysis. The quantities D1, D2, C, ENUC, GEO and RANGE are renumbered due to this selection.

4. in this step a new selection is performed which removes all cases which produce "kink" type irregularities in simulation tracks. Effectively, this selection smooths out tracks in the regions corresponding to dead layers of a detector.

5. it writes a first record to an output file (LUN = 40). The first record has the quantities, NASIM, NGAIN, NMODE, and XRL.

6. in this step the energy bins are calculated from the range values.

In this block of software there are two loops. The first loop (ISO index) selects a simulation track and the second loop (I index) selects a simulation event from a track. For every simulation track it is found a minimum energy EKMIN and a maximum energy EKMAX. The range is divided into 7 intervals. There are six values given in the XRL which determine 7 intervals. The first interval is between 0 and XRL(1), the second between XRL(1) and XRL(2), and so on. From all simulation events there are selected only six events with ranges just above the values taken from the table XRL. These events are used to calculate energy bins ELIM corresponding to the selected values of XRL range. In this procedure a linear dependence between a range and energy of a particle is assumed.

7. In this step for every simulation track the results are written to the output file (LUN = 40) and send to printer in the form of several identical records with the following quantities

   EKMIN --- minimum kinetic energy determined for all events from a simulation track

   ELIM(1) - ELIM(6)
   six values of energies determining seven energy bins

   EKMAX --- maximum kinetic energy determined for all events from a simulation track

3.1 READSI2

Purpose

The subroutine READSI2 reads simulation tracks from the file NASIM and performs selection of all cases which have the same gain and mode parameters as given in the input data file. The six quantities (range, energy per nucleon, energies deposited in detector layers , and geometric factor) of selected events are stored in two-dimensional arrays. The first index in every array denotes the set. Every set has two quantities, charge and mass, which can differ from set to set. The second index denotes the event within a set. Every event has six component quantities (range, energy per nucleon, energies deposited in A1, A2, C1C2C3 or in B1, B2, C4C3C2, and geometric factor) which can be different for different events.

There are two loops in a subroutine. The outer loop (index NISO) changes charge (IZD) and mass (AD) which determine set. The inner loop (index NREA) changes an event within a set.

Input/Output
parameters

Input

NASIM - name of the simulation file

NGAIN - type of gain (e.g. low gain is LG, high gain is HG)

NMODE - type of event (AS is for A-stopping,
BS is for B-stopping)

Output quantities

RANGE (NISO, NREA) - range

ENUC (NISO, NREA) - energy per nucleon

D1 (NISO, NREA) - energy deposited in the first detector layer
(A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

D2 (NISO, NREA) - energy deposited in the second detector layer
(A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

C (NISO, NREA) - energy deposited in C detector layers
(C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

GEO (NISO, NREA) - geometric factor

NSIM (NISO) - number of events in every set

NISO - index of a set (every set is marked
with the same mode and gain, and
different charge)

NREA - index numbering events in a set

IOK - a flag which indicates if the number of
events in a set exceeded 200.
= 1 (number of cases smaller than 200)
=-1 (number of cases larger than 200)

IZSIM (NISO) - charge
ASIM - mass

The subroutine READSI2 performs the following steps

1. It reads data from the simulation file with name NASIM (LUN=40)

2. It reads dummy 48 records.

3. Opens loop for sets and reads record with 5 parameters
(IZD, AD, NAMEL, NDGAIN, NDMODE).

The meanings of these parameters are

IZD - charge
AD - mass
NAMEL - name of an element (symbol)
NDGAIN - gain
NDMODE - mode

4. It checks for the end of data on a file. The end of data is marked with IZD = 0. For IZD = 0 it returns to main subroutine.

5. It selects all sets with gain and mode parameters equal to gain and mode parameters given in the input to the subroutine. For every selected set, counter NISO is incremented and two quantities, charge (IZD) and mass (AD) are stored in arrays IZSIM and ASIM, respectively.

6. It reads record with five parameters NREG(I) (I = 1,...,5). The variable NREG is not used in further processing.

7. It starts loop for events.
It reads 8 parameters, which meaning is given below

XR - range

ENERG - energy/nucleon

CH1 - energy deposited in the first detector layer
(units are channels,
A1 detector layer for A-stopping mode,
B1 detector layer for B-stopping mode).

CH2 - energy deposited in the second detector layer
(units are channels,
A2 detector layer for A-stopping mode,
B2 detector layer for B-stopping mode).

CH3 - deposited energy in C detector layers
(units are channels,
C123 detector layers for A-stopping mode,
C432 detector layers for B-stopping mode).

IB - unused

SL - unused

SOL - geometric factor

8. It checks if it is the last event from the set.
The last event is always marked with negative range XR.
The number of events from the same set is stored in NSIM(NISO), where the parameter NISO numbers different sets corresponding to different charges and masses.

For the last event from the selected set, program starts the outer loop and reads again charge, mass, name of the element, gain and mode.

If the range XR is not negative, the counter NREA is incremented with every case and 6 quantities are stored

in two-dimensional arrays. The stored quantities are range, energy per nucleon, deposited energies in A1, A2, C1C2C3 for A-stopping or (B1, B2, C432 for B-stopping), and geometric factor. The first index in all these arrays, NISO, denotes a selected set, and the second index a particular event in a set. Every set has fixed charge, mass, gain and mode. Every event in a set differs from others with range, energy per nucleon, energies deposited in detector layers, and geometric factor.

9. It reads next event from the same set.

10. The return from the subroutine is executed if the record which marks the end of data is read in or if the number of events in a set exceeds 200 events.

4.0 Compilation and Link Steps

Type commands

a) fort EBINNEW

a) link EBINNEW

5.0 Appendix A. Example of Command File with Input Data

This is an example of a EBINNEW.COM file which was used
to run program EBINNEW for A-stopping mode, and low gain.

```
$run ebinnew
 'repv1dl1.sim'
 'LG' 'AS'
 673.  1237. 2507. 4179.  7018.  9870.
$exit
```

6.0 Appendix B. Example of Output File

This is the output file from EBINNEW program
produced with input data given via EBINNEW.COM file.

Energy bins for elements
Simulation file repv1dl1.sim Gain & Mode LG AS
Ranges for bin definition 673. 1237. 2507. 4179. 7018. 9870.

Energy bins							Z	A
6.96	9.92	14.02	20.86	27.79	37.15	44.95	57.21	1 1.00
6.36	10.00	14.15	21.06	28.06	37.50	45.39	57.78	2 3.93
7.48	11.86	16.77	24.97	33.26	44.46	53.83	68.55	3 6.52
9.16	14.65	20.69	30.80	41.03	54.87	66.45	85.10	4 7.96
9.90	15.89	22.48	33.49	44.63	59.70	72.34	92.68	5 10.69
11.30	18.19	25.75	38.37	51.14	68.46	82.99	106.43	6 12.06
12.05	19.45	27.56	41.11	54.82	73.42	89.03	114.25	7 14.49
13.17	21.28	30.18	45.04	60.08	80.52	97.69	125.47	8 16.06
13.55	22.01	31.27	46.71	62.35	83.61	101.47	130.38	9 19.00
14.45	23.51	33.42	49.98	66.75	89.55	108.75	139.83	10 20.76
15.09	24.63	35.06	52.46	70.10	94.10	114.32	147.09	11 23.00
15.89	26.03	37.13	55.66	74.42	99.99	121.54	156.52	12 24.57
16.41	26.98	38.52	57.79	77.32	103.94	126.40	162.88	13 26.91
17.28	28.45	40.66	61.05	81.75	109.95	133.78	172.52	14 28.26
17.66	29.13	41.66	62.60	83.84	112.81	137.29	177.13	15 31.00
18.37	30.35	43.45	65.33	87.56	117.90	143.56	185.33	16 32.63
18.57	30.79	44.17	66.50	89.17	120.11	146.30	188.96	17 35.62
19.24	31.99	45.90	69.14	92.76	125.05	152.38	196.95	18 37.20
19.62	32.66	46.89	70.68	94.86	127.92	155.93	201.62	19 39.82
20.08	33.50	48.16	72.66	97.59	131.68	160.57	207.75	20 41.92
20.32	33.87	48.76	73.67	98.99	133.63	162.92	210.98	21 45.00
20.74	34.65	49.95	75.53	101.56	137.18	167.32	216.79	22 47.15
20.99	35.21	50.85	77.03	103.66	140.11	170.97	221.64	23 49.61
21.44	36.03	52.09	79.00	106.37	143.85	175.61	227.80	24 51.56
21.75	36.65	53.08	80.54	108.52	146.84	179.31	232.73	25 53.94
22.19	37.49	54.31	82.50	111.20	150.56	183.94	238.88	26 55.82
22.49	38.10	55.29	84.09	113.44	153.69	187.75	244.10	27 58.02
23.19	39.33	57.10	86.91	117.32	159.05	194.41	252.93	28 58.78
22.85	38.92	56.63	86.34	116.63	158.20	193.39	251.65	29 63.54
23.26	39.69	57.82	88.21	119.22	161.81	197.89	257.64	30 65.35

(7)

SPECTRE

JANUARY 1989

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Table of Contents

1.0 Program Name: SPECTRE

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing program SPECTRE.

The program SPECTRE calculates the number of events for every charge starting with Z = 3 up to Z = 30.

The second quantity is partial flux calculated for every charge and seven energy bins for a selected stopping mode.

In the calculations of fluxes the effects of geometric factors and spallations corrections are also included.
The output from the program includes fluxes, values of energy ranges and energy bins for all elements.

To use the program SPECTRE it is necessary to perform earlier stages of data analysis with programs TREVTNEW, PLRESZ, and EBINNEW.

1.2 Program Execution

The program SPECTRE can be used as a batch job or in an interactive way. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)SPECTRE.EXE
into the user's directory.

b) copy $DISK2:(LUKASIAK.STOPPING)SPECTRE.COM
into the user's directory.

c) to run program in a forground, type command
@SPECTRE

The example of SPECTRE.COM file is given in Appendix A.
Part of the file with charge limits has to be edited.

d) to run program in an interactive way type command

run SPECTRE

and type in all necessary input data parameters

(see Appendix A).

2.0 Input and Output Data

The program SPECTRE reads several input data parameters (DATAFILE, NMODE, ASIG, BSIG, XCUT, ICOR, ZLIMI, and ELIM) from the command file SPECTRE.COM or from the terminal.

The program SPECTRE uses output results from previous stages of data analysis. The file (DATAFILE) with experimental events and with spallation corrections is generated by the program TREVTNEW, the values of ASIG and BSIG and charge limits ZLIMI are obtained from charge analysis with the program PLRESZ, and energy bins ELIM are calculated by the program EBINNEW.

There is only one data file (DATAFILE, LUN = 60) read by the the program SPECTRE. This file has data records with experimental events, charges, energies, geometric factors, new energies, new geometry factors, and spallation corrections.

The output is directed to the file FLUXRE.DAT assigned to LUN = 40.

2.1 Input Description

The program SPECTRE reads several input data parameters from the command file SPECTRE.COM or from the terminal (LUN = 5). The meanings of these parameters are given below

DATAFILE - name of a data file with experimental events.

NMODE - mode of the event. Two values are possible, AS for A-stopping events and BS for B-stopping events.

ASIG - parameter determining charge spread. The value of this parameter determines linear dependence of charge spread on charge Z

sigma = asig + bsig * Z

This parameter is used in this program to calculate charge spread interval to eliminate events with too large spread (Z2-Z1).

The value of this parameter can be found from charge analysis with program PLRESZ.

BSIG - parameter determining charge spread. The value of this parameter determines linear dependence of charge spread on charge Z

sigma = asig + bsig * Z

XCUT - selection of number of sigma parameters used for charge cutoff parameter. A good guess here is 3.

ICOR - three values are allowed

0 - geometric correction is included only, spallation correction is not included with this option

1 - geometric and spallation correction (case 1) are included

Spallation correction (method 1)

The fragmentation is computed along the whole range. The variation of the cross section with energy is taken into account.

2 - geometric and spallation correction (case 2) are included

Spallation correction (method 2)

The contribution to fragmentation from the last 3/4 of D1 (A1 or B1) and the first 3/4 of D2 is considered. Fragmentation outside these limits is neglected. The mode of the particle has to be used in this approach.

ZLIMI - an array with charge bounderies for all elements.

ELIM - energy bin limits

The program SPECTRE reads the experimental events from the file DATAFILE (LUN = 60). All records have the same structure. The file DATAFILE is generated by the program TREVTNEW. Every record has 14 variables which are explained below

IB1 - energy deposited in the first detector layer (units are channels, A1 detector layer for A-stopping mode, B1 detector layer for B-stopping mode).

IB2 - energy deposited in the second detector layer (units are channels, A2 detector layer for A-stopping mode, B2 detector layer for B-stopping mode).

IC - energy deposited in C detector layers (units are channels, C123 detector layers for A-stopping mode, C432 detector layers for B-stopping mode).

ITAGW --- a TAG word in a decimal representation

ZEVT(1) --- charge determined in the analysis of energy deposited in A1-C123 (A-stopping mode) or in B1-C432 (B-stopping mode).

ZEVT(2) --- charge determined in the analysis of energy deposited in A2-C123 (A-stopping mode) or in B2-C432 (B-stopping mode).

EK(1) --- energy per nucleon determined in the analysis of energy deposited in A1-C123 (A-stopping mode) or in B1-C432 (B-stopping mode).

EK(2) --- energy per nucleon determined in the analysis of energy deposited in A2-C123 (A-stopping mode) or in B2-C432 (B-stopping mode).

GEO(1) --- geometric factor determined in the analysis of energy deposited in A1-C123 (A-stopping mode) or in B1-C432 (B-stopping mode).

GEO(2) --- geometric factor determined in the analysis of energy deposited in A2-C123 (A-stopping mode) or in B2-C432 (B-stopping mode).

ENEW --- energy ENEW of an experimental event determined from the analysis of energy deposited in the C-detector layers (corrections due to energy deposited in A1, A2 or B1, B2 are included).

GEONEW --- geometric factor of an experimental event determined from the analysis of energy deposited in the C-detector layers.

SPACOR(1) - spallation correction (method 1)

SPACOR(2) - spallation correction (method 2)

2.2 *Output Description*

The program SPECTRE uses data file FLUXRE.DAT assigned to LUN = 40 to write the output results.

The meanings of the quantities from the first record are given below

NMODE - mode of the event. Two values are possible, AS for A-stopping events and BS for B-stopping events.

DATAFILE - file with experimental events

ICOR - two values are allowed
0 - geometric correction is included only
1 - geometric plus spallation correction is included

XCUT - number of sigma for cut off range of charge

ASIG - a constant determining a linear dependence of
a SIGMA parameter on charge.

BSIG - a constant determining a linear dependence of
a SIGMA parameter on charge.

NEVT - number of experimental events read from DATAFILE

NSEL - number of experimental events selected for further
processing

LIMI() - an array with charge bounderies for all elements.

The next NELT records have the following quantities

IZ --- index of an element charge

ABNOC(IZ) --- number of experimental events corresponding to
an element with charge determined by index IZ

ABCOR(IZ) --- number of experimental events corresponding to
an element with charge determined by index IZ
and corrected for geometric factor and/or
spallation corrections.

ELIM(...,1) --- lower limit of energy range

ELIM(...,8) --- upper limit of energy range

The spectrum part of the output has (NELT-1) sets of spectrum records. Every set has 9 records

1 record

IZ - index of an element charge

2-8 records

ELIM(IZ,IB) - lower limit of energy bin

ELIM(IZ,IB + 1) - upper limit of energy bin

FLNOC(IZ,IBIN) - number of experimental events corresponding to
an element with charge determined by index IZ
and energy within IBIN energy interval.
The bin energy interval IBIN is determined by
the two energy values ELIM(IZ, IBIN) and
ELIM(IZ,IBIN + 1) .

FLCOR(IZ IBIN) - number of experimental events corrected
for geometric factor and/or spallation corrections.
The events correspond to an element with charge
determined by index IZ and energy within a
bin interval IBIN.

FLU - flux per unit energy.
Flux is corrected for geometric factor and/for

spallation correction

9 record

SFLNOC - flux not corrected and summed up over all bins

SFLCOR - flux corrected and summed up over all bins

3.0 Description of Program SPECTRE

The program SPECTRE does not use subroutines or functions.

The following steps are performed by the MAIN subroutine in the first part

1. in the first step it reads several input data parameters, charge limits and energy bins. (see Input Description (Sect. 2.1) for explanation of input parameters).

2. in this step the energies deposited in detector layers, the TAG word, charges, energies, geometry factors, new energy , new geometric factor, and spallation corrections are read from the file DATAFILE (LUN = 60).

3. it calculates the average charge ZAV, spread of the charge DZ, the spread parameter SIGMA, and the charge cutoff parameter ZLIM.
   The parameter SIGMA is calculated as

   SIGMA = ASIG + BSIG * ZAV

4. All events with the charge spread DZ larger then the charge cutoff parameter are not considered in further data processing.

5. in this step a considered event is prescribed to one of several sets (index IZ) with events. The decision is made by comparing ZAV with charge limits given by ZLIMI.

6. it skips all events which are outside of the considered charge interval.

7. in this step for every charge interval (index IZ) two quantities are calculated , ABNOC and ABCOR. The meaning is given below.

   ABNOC(IZ) --- number of experimental events corresponding to an element with charge determined by index IZ (e.g. IZ = 5 corresponds to the experimental event with charge ZLIMI(5) < ZAV < ZLIMI(6) where ZAV = 0.5*(ZEVT(1) + ZEVT(2)) .

   ABCOR(IZ) --- number of experimental events corresponding to an element with charge determined by index IZ and corrected for geometric factor or geometric factor and spallation corrections.
   The option parameter ICOR is used to select the way

which ABCOR is calculated.

For ICOR = 0 only the geometric factor is included.

For ICOR = 1 the geometric factor and the spallation corrections (method 1) are included.

For ICOR = 2 the geometric factor and the spallation corrections (method 2) are included.

8. it finds the energy bin index IBIN for the considered event with charge within charge interval numbered with index IZ. If the bin is found then the processing is continued. If the bin is not found then the next data record is read from a DATAFILE (LUN = 60) (see step 2 and the following steps).

9. in this step it calculates the absolute flux FLNOC and the flux corrected FLCOR for geometric factor and/or and spallation correction. The meanings of both quantities are given below

FLNOC(IZ,IBIN) --- total number of experimental events with charge determined by index IZ and energy within IBIN energy interval. The bin energy interval IBIN is determined by the two energy values ELIM(IZ, IBIN) and ELIM(IZ,IBIN + 1) .

FLCOR(IZ IBIN) --- number of experimental events corrected for geometric factor and/or spallation corrections. The events correspond to an element with charge determined by index IZ and energy within a bin interval IBIN. The option parameter ICOR is used to select the way which FLCOR is calculated.

For ICOR = 0 only the geometric factor is included.

For ICOR = 1 the geometric factor and the spallation corrections (method 1) are included.

For ICOR = 2 the geometric factor and the spallation corrections (method 2) are included.

10. the final results are written to FLUXRE.DAT (LUN = 40) (see the Output Description (Section (2.2)).

11. It starts two loops. The first loop is for elements (different sets of events with charges within charge intervals corresponding to different elements). The second loop is for energy bins. It produces the spectrum part of the output with partial fluxes.

4.0 Compilation and Link Steps

Type commands

a) fort SPECTRE

a) link SPECTRE

5.0 Appendix A. Example of Command File with Input Data

This is an example of SPECTRE.COM file which was used to run program SPECTRE for experimental data from Voyager-1 (A-stopping mode, 86-87 year). Note that the part of the input data with charge limits should be edited before running this command file.

```
$ run spectre
   'zv1last8687.dat'
'AS'
0.0550  0.0055
3.0
2
   0.5   1.5   2.5   3.5   4.5   5.4   6.4   7.4   8.4   9.4
  10.5  11.3  12.5  13.5  14.5  15.5  16.5  17.5  18.5  19.4
  20.5  21.4  22.5  23.4  24.6  25.5  26.5  27.4  28.5  29.5
  30.5
  6.96   9.92  14.02  20.86  27.79  37.15  44.95  57.21
  6.36  10.00  14.15  21.06  28.06  37.50  45.39  57.78
  7.48  11.86  16.77  24.97  33.26  44.46  53.83  68.55
  9.16  14.65  20.69  30.80  41.03  54.87  66.45  85.10
  9.90  15.89  22.48  33.49  44.63  59.70  72.34  92.68
 11.30  18.19  25.75  38.37  51.14  68.46  82.99 106.43
 12.05  19.45  27.56  41.11  54.82  73.42  89.03 114.25
 13.17  21.28  30.18  45.04  60.08  80.52  97.69 125.47
 13.55  22.01  31.27  46.71  62.35  83.61 101.47 130.38
 14.45  23.51  33.42  49.98  66.75  89.55 108.75 139.83
 15.09  24.63  35.06  52.46  70.10  94.10 114.32 147.09
 15.89  26.03  37.13  55.66  74.42  99.99 121.54 156.52
 16.41  26.98  38.52  57.79  77.32 103.94 126.40 162.88
 17.28  28.45  40.66  61.05  81.75 109.95 133.78 172.52
 17.66  29.13  41.66  62.60  83.84 112.81 137.29 177.13
 18.37  30.35  43.45  65.33  87.56 117.90 143.56 185.33
 18.57  30.79  44.17  66.50  89.17 120.11 146.30 188.96
 19.24  31.99  45.90  69.14  92.76 125.05 152.38 196.95
 19.62  32.66  46.89  70.68  94.86 127.92 155.93 201.62
 20.08  33.50  48.16  72.66  97.59 131.68 160.57 207.75
 20.32  33.87  48.76  73.67  98.99 133.63 162.92 210.98
 20.74  34.65  49.95  75.53 101.56 137.18 167.32 216.79
 20.99  35.21  50.85  77.03 103.66 140.11 170.97 221.64
 21.44  36.03  52.09  79.00 106.37 143.85 175.61 227.80
 21.75  36.65  53.08  80.54 108.52 146.84 179.31 232.73
 22.19  37.49  54.31  82.50 111.20 150.56 183.94 238.88
 22.49  38.10  55.29  84.09 113.44 153.69 187.75 244.10
 23.19  39.33  57.10  86.91 117.32 159.05 194.41 252.93
 22.85  38.92  56.63  86.34 116.63 158.20 193.39 251.65
```

```
23.26  39.69  57.82  88.21  119.22  161.81  197.89  257.64
$ exit
```

6.0 Appendix B. Part of the Output File with Flux values

This is part of the output file from SPECTRE program
produced with input data given via SPECTRE.COM file.

AS Analysis for: zv1ast8687.dat Spall.corr.: 2
Evts selected with (Z2-Z1) < = 3.00*sigma
with sigma = 0.0550 + 0.0055*zav
Evts read, selected: 4079 3198
Charge limits:
0.5 1.5 2.5 3.5 4.5 5.4 6.4 7.4 8.4 9.4
10.5 11.3 12.5 13.5 14.5 15.5 16.5 17.5 18.5 19.4
20.5 21.4 22.5 23.4 24.6 25.5 26.5 27.4 28.5 29.5 30.5

Charge	# of evts	# /cm2.sr	Energy range (MeV/n)
1	0.	0.00	6.96 57.21
2	0.	0.00	6.36 57.78
3	138.	119.81	7.48 68.55
4	37.	30.46	9.16 85.10
5	80.	77.88	9.90 92.68
6	440.	423.62	11.30 106.43
7	285.	243.96	12.05 114.25
8	1531.	1308.92	13.17 125.47
9	14.	13.64	13.55 130.38
10	125.	115.71	14.45 139.83
11	17.	16.19	15.09 147.09
12	139.	133.60	15.89 156.52
13	33.	33.14	16.41 162.88
14	117.	111.77	17.28 172.52
15	3.	3.03	17.66 177.13
16	15.	14.37	18.37 185.33
17	3.	3.15	18.57 188.96
18	8.	7.21	19.24 196.95
19	2.	1.94	19.62 201.62
20	18.	17.40	20.08 207.75
21	5.	4.95	20.32 210.98
22	20.	18.79	20.74 216.79
23	9.	8.57	20.99 221.64
24	18.	17.29	21.44 227.80
25	20.	19.22	21.75 232.73
26	113.	105.37	22.19 238.88
27	3.	2.94	22.49 244.10
28	5.	4.89	23.19 252.93
29	0.	0.00	22.85 251.65
30	0.	0.00	23.26 257.64

Charge= 2

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
6.36 10.00	0.	0.0000	0.0000
10.00 14.15	0.	0.0000	0.0000
14.15 21.06	0.	0.0000	0.0000
21.06 28.06	0.	0.0000	0.0000
28.06 37.50	0.	0.0000	0.0000
37.50 45.39	0.	0.0000	0.0000
45.39 57.78	0.	0.0000	0.0000
Sum =	0.	0.0000	

Charge= 3

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
7.48 11.86	32.	24.9607	5.6988
11.86 16.77	10.	7.8034	1.5893
16.77 24.97	13.	10.1670	1.2399
24.97 33.26	22.	18.1965	2.1950
33.26 44.46	31.	27.4895	2.4544
44.46 53.83	13.	12.6305	1.3480
53.83 68.55	17.	18.5646	1.2612
Sum =	138.	119.8122	

Charge= 4

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
9.16 14.65	2.	1.5610	0.2843
14.65 20.69	9.	7.0254	1.1631
20.69 30.80	13.	10.1673	1.0057
30.80 41.03	7.	5.7946	0.5664
41.03 54.87	2.	1.7483	0.1263
54.87 66.45	2.	1.9828	0.1712
66.45 85.10	2.	2.1805	0.1169
Sum =	37.	30.4601	

Charge= 5

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
9.90 15.89	0.	0.0000	0.0000
15.89 22.48	7.	5.4653	0.8293
22.48 33.49	6.	4.6949	0.4264
33.49 44.63	8.	6.6561	0.5975
44.63 59.70	15.	13.3808	0.8879
59.70 72.34	11.	10.6357	0.8414
72.34 92.68	33.	37.0491	1.8215
Sum =	80.	77.8818	

Charge= 6

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
11.30 18.19	11.	8.5888	1.2466
18.19 25.75	18.	14.0550	1.8591
25.75 38.37	31.	24.2329	1.9202
38.37 51.14	58.	47.3288	3.7062
51.14 68.46	84.	74.4313	4.2974
68.46 82.99	93.	91.1895	6.2759
82.99 106.43	145.	163.7961	6.9879
Sum =	440.	423.6223	

Charge= 7

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n

12.05 19.45	93.	72.6264	9.8144
19.45 27.56	51.	39.8291	4.9111
27.56 41.11	34.	26.5584	1.9600
41.11 54.82	19.	15.3974	1.1231
54.82 73.42	30.	26.6234	1.4314
73.42 89.03	19.	18.7009	1.1980
89.03 114.25	39.	44.2227	1.7535
Sum =	285.	243.9584	

Charge = 8

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
13.17 21.28	619.	483.4609	59.6129
21.28 30.18	202.	157.7647	17.7264
30.18 45.04	179.	139.9179	9.4157
45.04 60.08	88.	72.0082	4.7878
60.08 80.52	116.	103.3752	5.0575
80.52 97.69	118.	116.0119	6.7567
97.69 125.47	209.	236.3727	8.5087
Sum =	1531.	1308.9115	

Charge = 9

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
13.55 22.01	1.	0.7811	0.0923
22.01 31.27	0.	0.0000	0.0000
31.27 46.71	0.	0.0000	0.0000
46.71 62.35	4.	3.1962	0.2044
62.35 83.61	2.	1.7580	0.0827
83.61 101.47	1.	0.9649	0.0540
101.47 130.38	6.	6.9367	0.2399
Sum =	14.	13.6370	

Charge = 10

Energy bin	Evts	#/cm2.sr	#/cm2.sr.MeV/n
14.45 23.51	17.	13.2812	1.4659
23.51 33.42	17.	13.2799	1.3400
33.42 49.98	12.	9.3908	0.5671
49.98 66.75	12.	9.7391	0.5807
66.75 89.55	11.	9.8534	0.4322
89.55 108.75	19.	18.4520	0.9610
108.75 139.83	37.	41.7187	1.3423
Sum =	125.	115.7151	

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FITGAL2

JANUARY 1989

Phillipe Ferrando and Andrew Lukasiak

Table of Contents

1.0 Program Name: FITGAL2

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing program FITGAL2.

The program FITGAL2 performs fit of a galactic part of flux versus energy with a two parameter function. The values of flux should have to be taken from the analysis of both, A-stopping and B-stopping modes. The used for fit experimental values for flux correspond to energy bins for A- and B-stopping modes.

Program allows to select a subset of experimental flux values for fit. Only values which are within energy interval which is of interest should be selected. Some of the experimental values of flux which do not follow general trend of other values from the considered set can be excluded from the fit procedure.

The output from the program is the plot of experimental points and of fitted curve. The fit parameters are printed in the plot.

To use the program FITGAL2 it is necessary to determine flux values for different energy bins with the program SPECTRE.

1.2 Program Execution

The program FITGAL2 can be used in an interactive way. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)FITGAL2.EXE
into the user's directory.

d) to run program type command

run FITGAL2

The example of interactive session is given in Appendix A.

2.0 Input and Output Data

The program FITGAL2 uses several input data parameters (NELT, IFILSYM, IZ, IASBS, TRAT, DATAFILE, NMODE, LUPL, IKEEP, ISTO, FACMAX, IPRINT) given by the user from the terminal.

The program FITGAL2 reads one or two data files with fluxes. Two data files are needed if A- and B-stopping modes are requested. The name of the file is DATAFILE (LUN = 40) and the file contains fluxes generated by the program SPECTRE in the previous stage of data analysis.

The plot from the program FITGAL2 can be displayed on a terminal or a hardcopy can be produced on a laser printer.

2.1 Input Description

The program FITGAL2 uses several input data parameters given from the terminal (LUN = 5).

The meanings of these parameters are given below

NELT - number of elements selected to make fit,
two values (1 or 2) are allowed.

IFILSYM - a selection parameter with two values
0 - different symbol used for different modes
1 - the same symbol used for all points

IZ - charge of the element for which fit is performed

IASBS - a selection parameter with two values
0 - only A-stopping or B-stopping mode is used
1 - both modes are used

TRAT - ratio of experiment time for A-stopping mode
to experiment time for B-stopping mode.
This parameter is used only when fit for both modes
is performed.

DATAFILE - name of a file with values of fluxes

NMODE - mode of the event. Two values are possible,
AS for A-stopping events
and BS for B-stopping events.

LUPL - a selection parameter, two values are allowed

1 - produces display of a plot on a terminal
-1 - stops execution of a program

IKEEP - a selection parameter, two values are allowed

1 - all experimental points are used to perform a fit
-1 - only some of the experimental points are used to perform fit. If this option is selected then in the next step user has to decide which of the experimental points should be included.

ISTO - a selection parameter, two values (1 and -1) are allowed. The user makes decision on the basis of two values (energy and flux) determining an experimental point.

1 - the experimental value of flux will be used in the fit procedure.
-1 - the experimental value of flux will not be used to calculate fit parameters.

FACMAX - a multiplication factor used for all experimental points from the same set determining one selected element (one charge value). The multiplication factor is used when two elements are used and experimental points for both elements overlap or differ to much and do not allow for convenient display.

IPRINT - a selection parameter, two values are allowed
1 - a file with plotting vectors is produced and can be used to produce hardcopy on a laser printer.
0 - hardcopy of a plot is not produced

The program FITGAL2 reads flux values from the file DATAFILE (LUN = 40). The file DATAFILE is generated by the program SPECTRE.

The program FITGAL2 reads only some records and quantities from the data file DATAFILE.

From the first record it reads one quantity which meaning is given below

NMODE - a mode type. Two values are possible, AS for A-stopping events and BS for B-stopping events.

The next 39 records which form the first part of the data file with total fluxes are read as dummy records.

The second part of the data file has partial fluxes for all elements and energy bins. This part of the file is analyzed by the program. There are 28 sets with 8 records in every set in the second part of the file DATAFILE. The meanings of the variables from a set are given below

1 record

IZD --- index of an element charge

2-8 records

E1 --- lower limit of energy bin

E2 --- upper limit of energy bin

XEVT --- number of experimental events corresponding to an element with charge determined by index IZ and energy within IB energy interval. The bin energy interval IB is determined by the two energy values E1 and E2.

FL --- number of experimental events corrected for geometric factor and/or spallation corrections. The events correspond to an element with charge determined by index IZ and energy within a bin interval IBIN.

FLUX --- flux per unit energy. Flux is corrected for geometric factor and/for spallation correction

9 record

SFLNOC - flux not corrected and summed up over all bins

SFLCOR - flux corrected and summed up over all bins

3.0 Description of Program FITGAL2

The program FITGAL2 uses subroutine FITLOG and several subroutines from the plotting package MONGO. The graphic package is link with the program as the library MONGO$DISK:MONGO/LIB.

The MAIN part of the program is divided into three parts.

In the first part program gets input data parameters from the terminal and reads partial fluxes for several energy bins for a selected element from a DATAFILE.

In the second part program performs fit of a two parameter function to several experimental flux values versus energy.

The third part performs plot of flux values and fitted function versus energy.

The following steps are performed by the MAIN subroutine in the first part

1. in the first step it reads several input data parameters
   (see Input Description (Sect. 2.1)
   for explanation of input parameters).

2. in this step the partial fluxes for seven energy bins
   are read from the file DATAFILE (LUN = 60) for a selected
   element. It is worth to notice that only few records
   from the second part of a data file are read. Only these
   records which correspond to a charge IZ given in the input data
   are read. For every stored flux value
   (the quantity FLUX) statistical error of a flux (the quantity
   ERFLUX) is calculated.

   Important comment

   This part of the program has a hidden assumption that
   the data file with fluxes always will have the same
   set of elements, starting with Z = 3 and ending with Z = 30.
   The data file with fluxes is produced by program SPECTRE
   and any change of the output from SPECTRE will affect
   analysis with the program FITGAL2 without producing
   warning messages.

3. in this step the selection of experimental values of
   flux is performed. The selection is performed with
   two input data parameters. The first parameter, IKEEP,
   can have two values. For IKEEP = 1 all seven values
   of flux corresponding to seven energy bins are used to
   perform fit. For IKEEP = 0 additional parameter is used, ISTO,
   which selects flux values for fit. For ISTO = 1 flux value is
   stored, otherwise it is discarded. For every bin there are

three quantities (energy, flux, and error) which are
stored in ESTO, YSTO, and ERYSTO.

The following steps are performed by the MAIN subroutine in the second part

1. subroutine FITLOG is used to perform a linear regression fit
in log(flux)-log(energy) space. There are two fit parameters
(alpha and gamma) which determine the following function
which is used to perform linear fit in log-log space.

$$flux = alpha * energy^{gamma}$$

Program uses the variable FACGAL as alpha, and GAMGAL as gamma

2. the fitting function and experimental values of flux
are shifted by the same value on a plot to avoid overlapping
of data from sets corresponding to different elements.
The value of factor FACMAX given by user is recalculated
to SHIFT in log scale and used to move a fitted function
and experimental points on a display.

The third part performs plot of flux values and of a fitted two parameter function versus energy.

1. the logarithmic values of middle values of energy bins
and logarithmic values of flux values are stored in XX and YY
arrays. The values for a fitted function are stored in
EKFIT (log of energy) and FLFIT(log of flux) .
The fitted line is determined by two points with
energy 10 MeV and 400 MeV.

2. several routines from a graphic package MONGO
are used to generate plot.

3.1 Subroutine FITLOG

Purpose

The subroutine FITLOG performs a linear regression fit
for a function given in a form

```
y = a * x ** b
```

Two parameters, a and b, are found. The estimate of
the errors of fit parameters a and b is performed.

Input/Output
Parameters

INPUT

XD - middle values of energy bins
YD - flux values corresponding to XD values
SIGY - statistical error of flux
NBIN - number of experimental values of fluxes (number of
selected bins)

OUTPUT

FACGAL - fit parameter a
GAMGAL - fit parameter b
SIGAML - error of a fit parameter b

4.0 Compilation and Link Steps

Type commands

a) fort FITGAL2

a) link FITGAL2, MONGO$DISK:MONGO/LIB

5.0 Appendix A. Example of Input Data Interactive Session

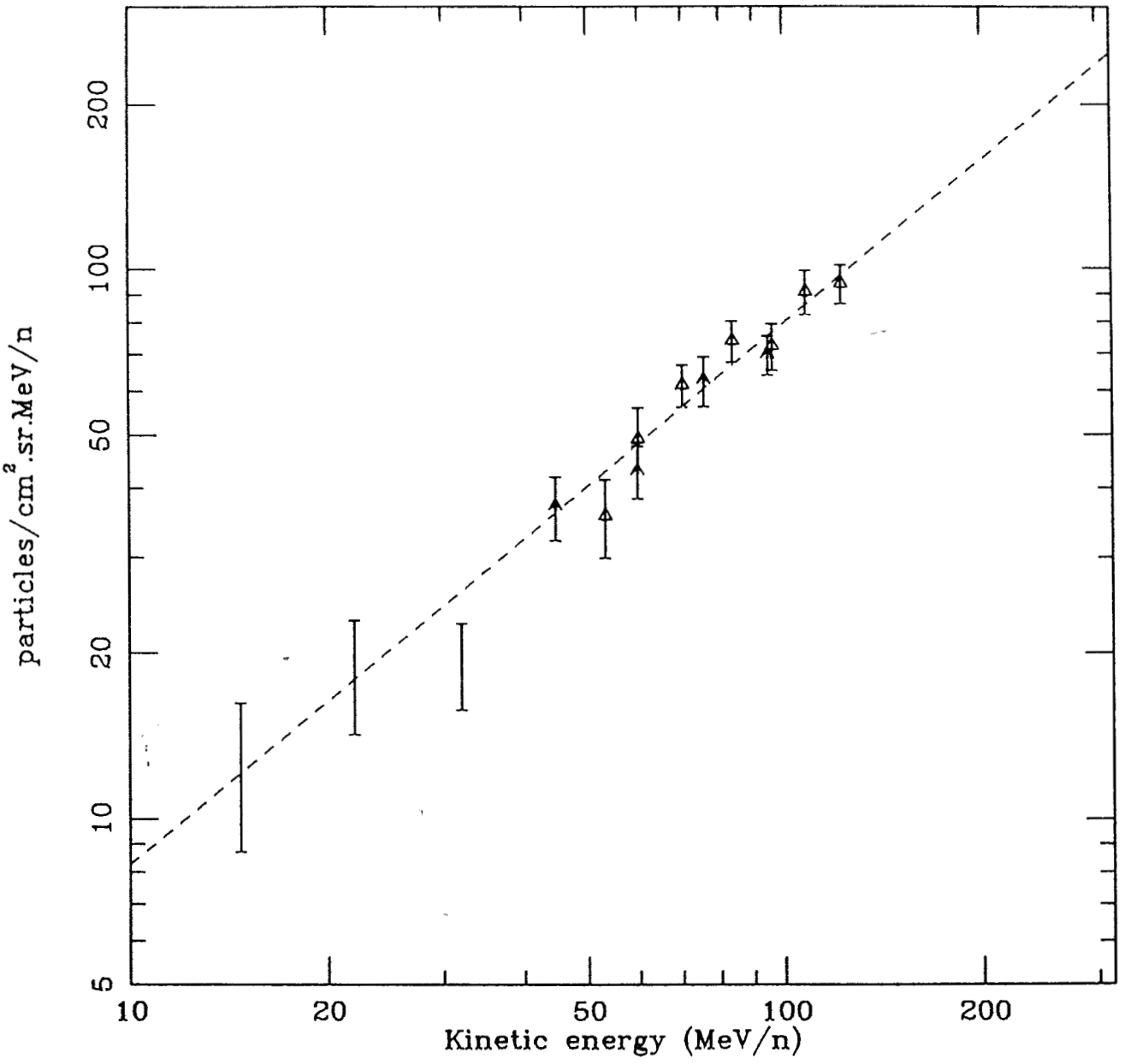
Example of the interactive session

```
Number of elements (1 or 2) ?
      1
Display all points with same filled symbol ? (0-1)
      0
Charge to be plotted ?
      6
Both AS and BS files ? (1-0)
      1
Ratio of time for AS to time for BS ?
     1.000000
Enter name of AS datafile
  'fluxre.dat'
Enter name of BS datafile
  'fbs2v18687.dat'
Terminal graphics unit number ? (mongo, -1 stop)
      1
Keeps all points for fit  (0-1) of elt
      0
Keep point Ek:  14.75   J:    1.25 ? (0-1)
      0
Keep point Ek:  21.97   J:    1.86 ? (0-1)
      0
Keep point Ek:  32.06   J:    1.92 ? (0-1)
      0
Keep point Ek:  44.76   J:    3.71 ? (0-1)
      1
Keep point Ek:  59.80   J:    4.30 ? (0-1)
      1
Keep point Ek:  75.72   J:    6.28 ? (0-1)
      1
Keep point Ek:  94.71   J:    6.99 ? (0-1)
      1
Keep point Ek:  53.30   J:    3.57 ? (0-1)
      1
Keep point Ek:  59.88   J:    4.92 ? (0-1)
      1
Keep point Ek:  70.11   J:    6.15 ? (0-1)
      1
Keep point Ek:  83.72   J:    7.41 ? (0-1)
      1
Keep point Ek:  96.28   J:    7.25 ? (0-1)
      1
```

```
Keep point Ek: 108.10   J:    9.10 ? (0-1)
      1
Keep point Ek: 122.51   J:    9.41 ? (0-1)
      1
Results for y = a.x**b
 a, delta a :   8.5449964E-02  5.2430764E-02
 b, delta b :   0.9847512      0.1080478
Multipl. factor forC
present one is:  0.0000000E+00
   10.00000
Print of graphics ? (1)
      1
6231 vectors plotted
Terminal graphics unit number ? (mongo, -1 stop)
     -1
```

6.0 Appendix B. Plot of Flux and Fitted Function

Fig. 1 Fit of an exponent factor for a galactic component of flux for element C. Flux values for both, A-stopping and B-stopping events (Voyager-1, 1986-87) are displayed. Only some of the experimental values of flux which are within energy interval of interest are used to calculate slope of a galactic component of flux.



C : ^ AS fluxre.dat Δ BS fbs2v18687.dat

Fitted Galactic spectrum: dJ/dE= 0.854E-01*E $^{0.985+-\ 0.108}$

All fluxes times 10.0 TimeAS/TimeBS = 1.000

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CORRATIO2

JANUARY 1989

Phillipe Ferrando and Andrew Lukasiak

Table of Contents

1.0 Program Name: CORRATIO2

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing program CORRATIO2.

The program CORRATIO2 calculates flux ratios of a galactic component of flux for selected pairs of elements with charge Z ranging from Z = 3 to Z = 30.

The most important part of the output from the program is the flux ratio, statistical and systematic errors and the average energy of measurement.

To use the program CORRATIO2 it is necessary to perform earlier stages of data analysis with programs SPECTRE and FITGAL2.

The output is directed to the file RESFILE and to the terminal.

1.2 Program Execution

The program CORRATIO2 has to be used in an interactive way. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)CORRATIO2.EXE
into the user's directory.

b) to run program in an interactive way type command

run CORRATIO2

The example of interactive input session is given in Appendix A.

The input data file ANOMGAM is given in Appendix B.
The input data file BSFILE with fluxes generated by
the program SPECTRE has to be calculated for B-stopping events.

The output from the program CORRATIO2 is in Appendix C.

2.0 Input and Output Data

The program CORRATIO2 uses several input data parameters (BSFILE, ANGAFILE, RESFILE, IZN, IZD) given by the user from the terminal.

There are two data files with input data used by the program CORRATIO2. The first file, BSFILE (LUN = 42), contains fluxes generated by the program SPECTRE.

The second file ANGAFILE is a file with charge values, exponent factors and errors of exponent factors for a galactic component of flux, and anomalous flux. This file has to be prepared or modified by the user. The second and the third columns in the file have values of exponent factor and of its error for a galactic part of a flux. These values have to be calculated using program FITGAL2 and edited in the file ANGAFILE.

The output from the program CORRATIO2 is written to the file RESFILE.

2.1 Input Description

Input data parameters from a terminal

The program CORRATIO2 uses several input data parameters given from the terminal (LUN = 5).

The meanings of these parameters are given below

BSFILE - the name of a data file with fluxes calculated for B-stopping events.

ANGAFILE - the name of a file with exponent coefficients for the galactic part of fluxes for different elements

RESFILE - the name of an output file

IZN - in the calculation of flux ratio the flux corresponding to element IZN is used in a nominator part of a ratio (further execution of program is stopped for negetavie values of IZN).

IZD - in the calculation of flux ratio the flux corresponding to element IZD is used in a denominator part of a ratio.

Input from the file BSFILE

The program CORRATIO2 reads flux values from the file BSFILE (LUN = 42) which is generated by the program SPECTRE. The file BSFILE has three different segments with output

quantities. The program CORRATIO2 uses only quantities from the second segment of the file BSFILE.

The first ten records from the file BSFILE are skipped. The next 30 records correspond to 30 elements with charge Z changing from Z = 1 to Z = 30. Every record has five quantities which are given below

IZ - charge index

XEVBS - number of events registered within energy range <EMINBS, EMAXBS> and charges within charge interval corresponding to charge IZ. The number of events XEVBS is not corrected for geometry or spallation effects. All the events considered here are B-stopping events.

FLBS - number of events registered within energy range <EMINBS, EMAXBS> and charges within charge interval corresponding to charge IZ. The number of events FLBS is corrected for geometry and/or spallation effects. All the events considered here are B-stopping events.

EMINBS - The minimum value of energy range

EMAXBS - The maximum value of energy range

Input from the file ANGAFILE

The program CORRATIO2 reads exponent coefficients of galactic part of fluxes from the file ANGAFILE(LUN = 43).

The first record is skipped. The next 30 records correspond to 30 elements with charge Z changing from Z = 1 to Z = 30. Every record has five quantities which are given below

IZ - charge index

GAM - exponent coefficient of a galactic part of flux for element with charge IZ

ERGAM - error of the coefficient GAM. The error ERGAM has contribution from statistical error in flux and from error due to fit procedure.

FLAN - anomalous component of a flux

ERFLAN - error of FLAN

2.2 *Output Description*

The first segment of the output has three records.

The first record has a string of characters with title.

The second record has seven quantities from two input data files, BSFILE and ANGAFILE, which correspond to an element which flux is used in a nominator of flux ratio.

IELS - name of an element which flux is used in a nominator of a flux ratio

FLUXS - number of events registered within energy range <EMINBS, EMAXBS> and charges within charge interval corresponding to charge IZN. The number of events FLUXS is corrected for geometry and/or spallation effects. All the events considered here are B-stopping events registered for element which flux is used in a nominator of a flux ratio.

EVS - number of events registered within energy range <EMINS, EMAXS> and charges within charge interval corresponding to charge IZN. The number of events EVS is not corrected for geometry or spallation effects. All events considered here are B-stopping events. The events correspond to element which flux is used in a nominator of flux ratio.

EMINS - The lower value of energy range for an element which flux is used in a nominator of flux ratio.

EMAXS - The maximum value of energy range for an element which flux is used in a nominator of flux ratio.

FANS - anomalous component of a flux (for an element which flux is used in a nominator of flux ratio).

ERFANS - error of FANS

The third record has nine quantities which correspond to the element which flux is used in denominator. The first seven quantities (IELP, FLUXP, EVP, EMINP, EMAXP FANP, ERFANP) are the same as in the second record. Additional two quantities from the third record are listed below

GAMP - exponent coefficient of a galactic part of flux for an element with charge IZD

ERGAMP - error of the coefficient GAMP. The error has contribution from statistical error in flux and from error due to fit procedure.

The second segment of the output has seven records. Every record has the same four variables (RAT, FECOR, RATIO, ERATIO). Ratio, correction factor, ratio with included correction factor and error of ratio are calculated for seven different cases (see cases 1-7 in Section 3.0)

The last segment of output has two records. The first record has the following quantities

IELS - name of an element in a nominator

IELP - name of an element in a denominator

RATNOM - a flux ratio corrected for difference

in energy range of both considered elements.
(main result, calculated in case 1)

STATERR - a statistical error of ratio RATIO
(calculated in case 1)

SYSDIF - a systematic error

The last two quantities in this record are the quantity RATNOM and the total error given as a sum of statistical and systematic errors.

The last record has three quantities which are listed below

EKAV - average energy of measurement

(EMAXS - EKAV) - difference between upper value of energy range and average energy of measurement

(EKAV - EMINS) - difference between average energy and lower limit of energy range

3.0 Description of Program CORRATIO2

The program CORRATIO2 uses only one subroutine ECOR.

The MAIN part of the program is divided into three parts.

In the first part program gets input data parameters from the terminal and reads fluxes for 30 elements from the file BSFILE and exponent coefficients of a galactic part of flux from the file ANGAFILE (see Input Description (Sect. 2.1) for explanation of input parameters).

In the second part program calculates flux ratios for given in the input pairs of elements.

The third part writes output to the file RESFILE

The program calculates the same four quantities for several different cases. The meanings of these four quantities are given below

1. RAT - is calculated from the formula

   RAT = (FLUXS-FANS)/(FLUXP-FUNP)

   where FLUXS and FLUXP are fluxes within energy range for two selected elements. The quantities FANS and FANP correspond to anomalous contributions which are subtracted from fluxes, FLUXS and FLUXP.

2. FECOR - a correction factor which results from the difference in energy range for both elements. This correction is calculated by the subroutine ECOR.

3. RATIO - a flux ratio corrected for difference in energy range of both considered elements.

4. ERATIO - a statistical error of ratio RATIO

There are seven different cases for which flux ratio is calculated. The cases 2 to 7 are used to estimate three types of systematic errors.

The first is SYSDIFGAM and is related to an error in exponent coefficient of a galactic part of flux (SYSDIFGAM is calculated from cases 2 and 3).

The second is SYSDIFANS and represents contribution from errors in anomalous flux for element in IZN (cases 4 and 5).

The third is SYSDIFANP and represents contribution from errors in anomalous flux for element in IZD (cases 6 and 7).

The seven cases for which flux ratio is calculated are given below

1. flux ratio and error are calculated
   using the following expression for RAT

   RAT = (FLUXS-FANS)/(FLUXP-FUNP)

   The correction factor is calculated with an exponent
   coefficient of a galactic part of flux for element
   with charge IZD.

2. the minimum value of a coefficient of
   galactic part of flux for element with charge IZD
   is used to calculate the correction factor
   FECOR

3. the maximum value of a coefficient of
   galactic part of flux for element with charge IZD
   is used to calculate the correction factor
   FECOR

4. the minimum value of anomalous flux for element
   IZN is used to calculate flux ratio. The expression
   for flux ratio is given by

   RAT = (FLUXS - (FANS-ERFANS))/(FLUXP-FUNP)

   where the quantity ERFANS is error of anomalous flux.

5. the maximum value of anomalous flux for element
   IZN is used to calculate flux ratio. The expression
   for flux ratio is given by

   RAT = (FLUXS - (FANS+ERFANS))/(FLUXP-FUNP)

   where the quantity ERFANS is error of anomalous flux FANS

6. the minimum value of anomalous flux for element
   IZD is used to calculate flux ratio. The expression
   for flux ratio is given by

   RAT = (FLUXS - FANS))/(FLUXP-(FUNP-ERFANP))

   where the quantity ERFANP is error of anomalous flux FUNP.

7. the maximum value of anomalous flux for element
   IZD is used to calculate flux ratio. The expression
   for flux ratio is given by

   RAT = (FLUXS - FANS))/(FLUXP-(FUNP+ERFANP))

   where the quantity ERFANP is error of anomalous flux FUNP.

In the last part of the program two quantities are calculated.

The first is a total systematic error SYSDIF which has contribution of all three systematic errors, SYSDIFGAM, SYSDIFANS, and SYSDIFANP.

The second quantity is the average energy of measurement EKAV.

The ouput from the program is directed to RESFILE (LUN = 60) and to the terminal.

The output has three segments and all output quantities are described in the Output Section (2.2).

3.1 Subroutine ECOR

Purpose

The subroutine ECOR calculates a correction factor needed for flux ratios. The correction factor takes into account the difference in energy ranges for elements used to calculate flux ratio.

Input/Output Parameters

INPUT

EMINS - lower value of energy range for an element which flux is used in a nominator
EMAXS - upper value of energy range for an element which flux is used in a nominator
EMINP - lower value of energy range for an element which flux is used in a denominator
EMAXP - upper value of energy range for an element which flux is used in a denominator
GAMP - exponent coefficient of a galactic part of flux which flux is used in a denominator

OUTPUT

ECOR - correction factor

The correction factor is calculted as given below

```
ECOR = ( EMAXP ** (GAMP + 1) - EMINP ** (GAMP + 1) ) /
       ( EMAXS ** (GAMP + 1) - EMINS ** (GAMP + 1) )
```

4.0 Compilation and Link Steps

Type commands

a) fort CORRATIO2

a) link CORRATIO2

5.0 Appendix A. Example of Input Data Interactive Session

Example of the interactive input session

```
Enter BS fluxfile
'fbs2v18687.dat'
File for spectral indices and anomalous flux
'anomgam.dat'
Enter results datafile
'fluxrate.dat'
Enter numer. charge and denom. charge ( < = 0 stops)
  4          6
Enter numer. charge and denom. charge ( < = 0 stops)
  5          6
Enter numer. charge and denom. charge ( < = 0 stops)
  11         12
Enter numer. charge and denom. charge ( < = 0 stops)
  13         14
Enter numer. charge and denom. charge ( < = 0 stops)
  -1         -1
```

6.0 Appendix B. Example of Input Data File ANOMGAM

Example of the input data file ANOMGAM

Z	gamma	Error	Anomal.BS	error	File for corratio2.for
1	0.01	0.0	0.0	0.0	
2	0.01	0.0	0.0	0.0	
3	0.01	0.0	0.0	0.0	
4	0.01	0.0	0.0	0.0	
5	0.01	0.0	0.0	0.0	
6	0.985	0.108	0.0	0.0	
7	0.01	0.0	0.0	0.0	
8	0.49	0.13	0.0	0.0	
9	0.01	0.0	0.0	0.0	
10	0.14	0.30	0.0	0.0	
11	0.01	0.00	0.0	0.0	
12	0.955	0.217	0.0	0.0	
13	0.01	0.00	0.0	0.0	
14	0.432	0.201	0.0	0.0	
15	0.01	0.0	0.0	0.0	
16	0.59	0.60	0.0	0.0	
17	0.01	0.0	0.0	0.0	
18	0.01	0.0	0.0	0.0	
19	0.01	0.0	0.0	0.0	
20	0.01	0.0	0.0	0.0	
21	0.01	0.0	0.0	0.0	
22	0.01	0.00	0.0	0.0	
23	0.01	0.0	0.0	0.0	
24	0.01	0.00	0.0	0.0	
25	0.01	0.0	0.0	0.0	
26	0.330	0.243	0.0	0.0	] check the importance of corr.
27	0.01	0.0	0.0	0.0	
28	0.01	0.0	0.0	0.0	
29	0.01	0.0	0.0	0.0	
30	0.01	0.0	0.0	0.0	

7.0 Appendix C. Example of Output File

Example of the output from the program CORRATIO2. The output corresponds to the input given in Appendixes A and B

```
Elt   FluxBS  #evt  Emin   Emax    Anomal.  Error  Index error
Be     21.75   27.  40.16  104.51    0.00   0.00
C     592.71  737.  50.04  130.95    0.00   0.00    0.99  0.11
Assump.  Raw rat.  Rgecor      Ratio   Error
nominal   0.0367  1.5677     0.0575  0.0113
gam min   0.0367  1.5302     0.0562  0.0110
gam max   0.0367  1.6062     0.0589  0.0115

Be/C  =  0.0575 +- 0.0113 +- 0.0014    =  0.0575 +- 0.0127

Energy of measurement:  77.04  +  27.47 - 36.88 MeV/n

-------------------------------------------------------------------------

Elt   FluxBS  #evt  Emin   Emax    Anomal.  Error  Index error
B     108.62  137.  43.67  113.90    0.00   0.00
C     592.71  737.  50.04  130.95    0.00   0.00    0.99  0.11
Assump.  Raw rat.  Rgecor      Ratio   Error
nominal   0.1833  1.3206     0.2420  0.0225
gam min   0.1833  1.3009     0.2384  0.0222
gam max   0.1833  1.3405     0.2457  0.0229

B /C  =  0.2420 +- 0.0225 +- 0.0037    =  0.2420 +- 0.0262

Energy of measurement:  83.93  +  29.97 - 40.26 MeV/n

-------------------------------------------------------------------------

Elt   FluxBS  #evt  Emin   Emax    Anomal.  Error  Index error
Na     28.67   36.  68.56  181.63    0.00   0.00
Mg    186.86  241.  72.78  193.43    0.00   0.00    0.95  0.22
Assump.  Raw rat.  Rgecor      Ratio   Error
nominal   0.1534  1.1322     0.1737  0.0310
gam min   0.1534  1.1170     0.1714  0.0306
gam max   0.1534  1.1476     0.1761  0.0315

Na/Mg =  0.1737 +- 0.0310 +- 0.0024    =  0.1737 +- 0.0334

Energy of measurement: 133.25  +  48.38 - 64.69 MeV/n

-------------------------------------------------------------------------

Elt   FluxBS  #evt  Emin   Emax    Anomal.  Error  Index error
Al     32.91   41.  75.61  201.42    0.00   0.00
Si    156.87  202.  79.93  213.53    0.00   0.00    0.43  0.20
```

Assump.	Raw rat.	Rgecor	Ratio	Error
nominal	0.2098	1.0886	0.2284	0.0391
gam min	0.2098	1.0761	0.2258	0.0387
gam max	0.2098	1.1013	0.2310	0.0396

Al/Si = 0.2284 +- 0.0391 +- 0.0027 = 0.2284 +- 0.0418

Energy of measurement: 142.75 + 58.67 - 67.14 MeV/n

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(10)

PLSPECT

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Table of Contents

1.0 Program Name: PLSPECT

1.1 Introduction

This manual is provided to serve as a guide for the programmer who wants to use or to modify the existing program PLSPECT.

The program PLSPECT generates plots of fluxes in log(flux)-log(energy) space. The experimental values of flux correspond to several energy bins.

To use the program PLSPECT it is necessary first to use the program SPECTRE which generates the file with flux values for different energy bins.

1.2 Program Execution

The program PLSPECT can be used in an interactive way. The sequence of steps leading to program execution is

a) copy $DISK2:(LUKASIAK.STOPPING)PLSPECT.EXE
into the user's directory.

d) to run program type command

run PLSPECT

The example of interactive session is given in Appendix A.

2.0 Input and Output Data

The program PLSPECT uses several input data parameters (DATAFILE, IZ, IAN, LUPL, FACMAX, IPRINT) given by the user from the terminal.

The program PLSPECT can read fluxes from up to six data files. The name of the file with fluxes is DATAFILE (LUN = 40). The file is generated by the program SPECTRE in the previous stage of data analysis.

The plot from the program PLSPECT can be displayed on a terminal and a hardcopy can be produced on a laser printer.

2.1 Input Description

The program PLSPECT uses several input data parameters given from the terminal (LUN = 5).

The meanings of these parameters are given below

DATAFILE - name of a file with values of fluxes

IZ - charge of the element for which plot is generated

IAN - a selection parameter
= 1 program reads fluxes for another element
otherwise programs starts the graphic part
of the program.

LUPL - a selection parameter, two values are allowed

1 - produces display of a plot on a terminal
-1 - stops execution of a program

FACMAX - multiplication factor used to shift plots up and down
This factor is useful whenever two plots overlap.

IPRINT - a selection parameter, two values are allowed

1 - a file with plotting vectors is produced
and can be used to produce hardcopy on a laser
printer.

0 - hardcopy of a plot is not produced

The program PLSPECT reads flux values from the file DATAFILE (LUN = 40). The file DATAFILE is generated by the program SPECTRE.

The program PLSPECT reads only some records and quantities from the data file DATAFILE.

From the first record it reads one quantity which meaning is given below

NMODE - a mode type. Two values are possible, AS
for A-stopping events and BS for B-stopping events.

The next 39 records which form the first part of the data file with total fluxes are read as dummy records.

The second part of the data file has partial fluxes for all elements and energy bins. This part of the file is analyzed by the program. There are 28 sets with 8 records in every set in the second part of the file DATAFILE. The meanings of the variables from a set are given below

1 record

IZD --- index of an element charge

2-8 records

E1 --- lower limit of energy bin

E2 --- upper limit of energy bin

XEV --- number of experimental events corresponding to
an element with charge determined by index IZ
and energy within IB energy interval.
The bin energy interval IB is determined by
the two energy values E1 and E2.

FLC --- number of experimental events corrected
for geometric factor and/or spallation corrections.
The events correspond to an element with charge
determined by index IZ and energy within a
bin interval IBIN.

FLU --- flux per unit energy.
Flux is corrected for geometric factor and/for
spallation correction

9 record

SFLNOC - flux not corrected and summed up over
all bins

SFLCOR - flux corrected and summed up over all
bins

3.0 Description of Program PLSPECT

The program PLSPECT uses several subroutines from the plotting package MONGO. The graphic package is linked with the program as the library MONGO$DISK:MONGO/LIB.

The MAIN part of the program is divided into two parts.

In the first part program gets input data parameters from the terminal and reads partial fluxes from a DATAFILE for several energy bins for a selected element.

The second part performs plot of flux values.

The following steps are performed by the MAIN subroutine in the first part

1. in the first step it reads several input data parameters
   (see Input Description (Sect. 2.1)
   for explanation of input parameters).

2. in this step the partial fluxes for seven energy bins
   are read from the file DATAFILE (LUN = 60) for a selected
   element. It is worth to notice that only few records
   from the second part of a data file are read. Only these
   records which correspond to a charge IZ given in the input data
   are read. For every stored flux value
   (the quantity FLUX) statistical error of a flux (the quantity
   YERPC) is calculated.

The following steps are performed by the MAIN subroutine in the second part which performs plot of flux values

1. it calculates the average energy EK for a bin

   EK = (E1 + E2)/2

   where E1 and E2 are minimum and maximum energies
   determining the energy bin.

2. it calculates the statistical error YERPC
   given as

   YERPC = 1/sqrt(number of events)

3. it generates values for a horizontal axis as

   XX = LOG (EK)

4. it generates values for a vertical axis as

YY = LOG (FLUX)

5. it calculates error bars as

ERYP = LOG (1 + YERPC)

ERYM = LOG (1 / (1 - YERPC))

where ERYP is the value of the upper part of error bar and ERYM is the value of the lower part of error bar. These four quantities (XX, YY, ERYP, and ERYM) are used to produce logarithmic plots of fluxes for several elements (up to 6).

2. several routines from a graphic package MONGO are used to generate plots.

4.0 Compilation and Link Steps

Type commands

a) fort PLSPECT

a) link PLSPECT, MONGO$DISK:MONGO/LIB

5.0 Appendix A. Example of Input Data Interactive Session.

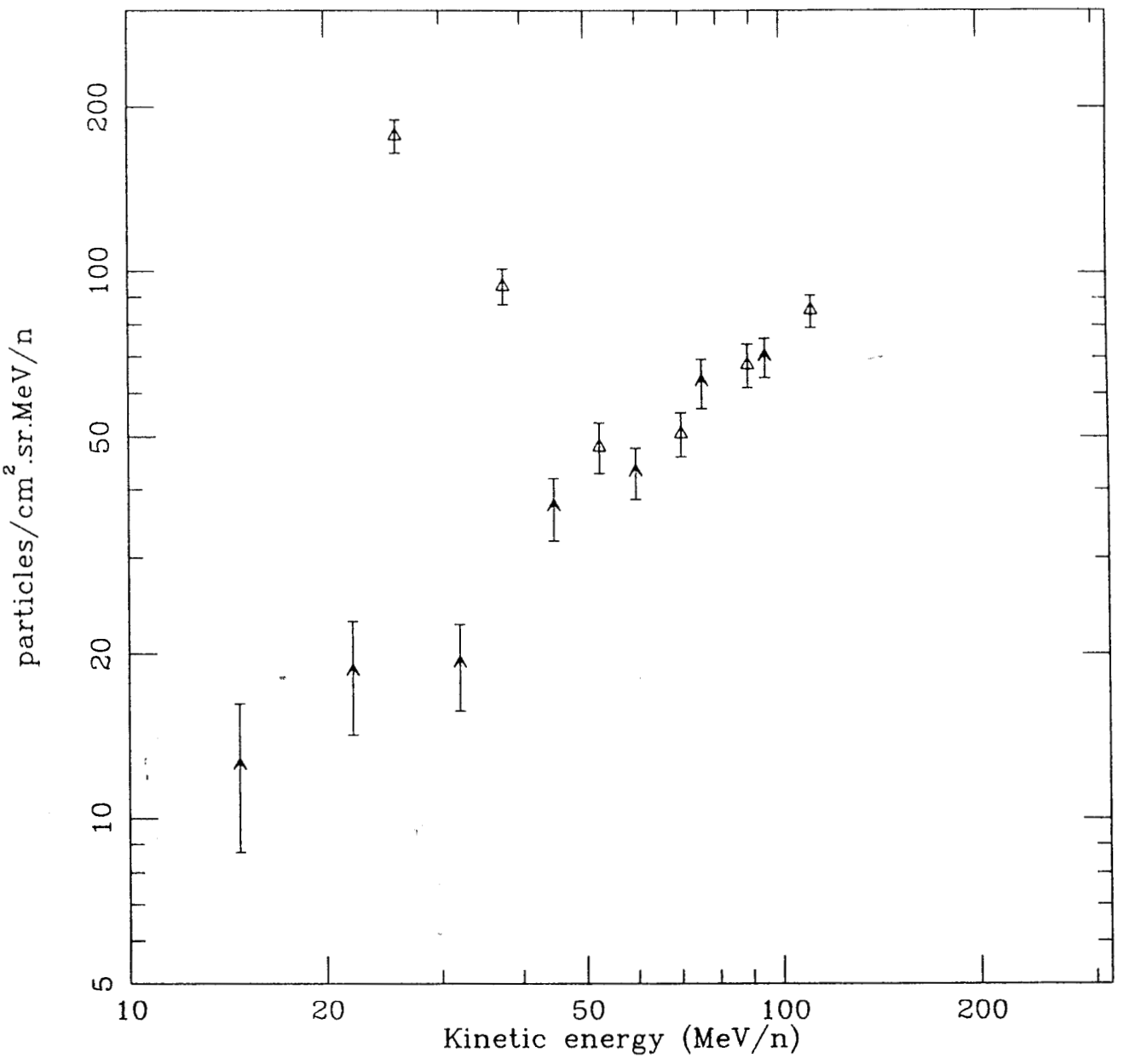
An example of the interactive input data session.
The plot corresponding to these input data is given in Appendix B.

```
Enter name of datafile
'fluxre.dat'
Charge to be plotted ?
      6
Another spectrum on the same plot (1) ?
      1
Enter name of datafile
'fluxre.dat'
Charge to be plotted ?
      8
Another spectrum on the same plot (1) ?
      0
Terminal graphics unit number ? (mongo, -1 stop)
      1
Multipl. factor for ASC
present one:   10.00000
Enter new one
     10.00000
Multipl. factor for ASO
present one:   10.00000
Enter new one
     10.00000
Print of graphics ? (1)
      1
  2895 vectors plotted
Terminal graphics unit number ? (mongo, -1 stop)
      -1
```

6.0 Appendix B. Plot of Flux versus Energy for C and O.

Fig. 1 Plot of flux versus energy for two elements, Carbon and Oxygen. The values of flux presented in figure are obtained from the analysis of A-stopping events (Voyager-1, 1986-87).

2-FEB-8 10:34:18



^ AS C flux times 10.0 fluxre.dat

Δ AS O flux times 10.0 fluxre.dat