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NUTSPEC: A PROGRAM FOR UNFOLDING NEUTRON SPECTRAL DATA
OBTAINED WITH SCINTILLATION DETECTORS AND GAS PROPORTIONAL COUNTERS

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MASTER

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SCINTILLATION DETECTORS AND GAS PROPORTIONAL COUNTERS**

ABSTRACT

NUTSPEC, an interactive program available on the LLL CDC 7600 Octopus Network computers, unfolds neutron spectral data obtained with NE213 and stilbene scintillation detectors, as well as CH_4 , H_2 , and ^3He gas proportional counters. This document explains how to obtain and execute the program, and describes the input and output data formats used by NUTSPEC. Examples of input files and output plots, along with the user/program interactions, are shown. NUTSPEC also has various graphical display capabilities (TMDS, RJET, FR80).

INTRODUCTION

The NUTSPEC program, available on the LLL CDC 7600 Octopus Network computers, reduces neutron detector data. The data is reduced by unfolding a pulse height distribution obtained with any of the following detector types:

- NE213 or stilbene scintillators;
- H_2 or CH_4 gas proportional counters;
- ^3He gas proportional counters.

NUTSPEC can display data on the Television Monitor Display System, the Remote Job Entry Terminal (Versatec printer), or the FR80 (microfiche). Details on executing NUTSPEC and the input and output data formats used by it follow. Examples of input files and output plots, along with the user/program interactions are shown. The physics of the neutron interactions in these detectors and the mechanics of the unfolding process are described in Ref. 1.

In examples throughout this report, data and instructions typed literally at the terminal are in upper case for readability; items in lower case are parameters for which either the value can be defaulted or another appropriate one substituted. Underlining indicates user input to the program; no underlining indicates NUTSPEC's response to the input.

AVAILABILITY

NUTSPEC is available online as follows:

ELF RDS .826588:NUTSPEC

The file NUTSPEC read from ELF is actually an executable LIX library containing the controllee, a detector parameter library, DETDATA, and the load map for the program. DETDATA contains detector dimensions, gas pressures and densities, cross section data, scintillator light output coefficients, and parameters describing the detector response functions.

NUTSRC, a LIX library, contains the source files for all routines in NUTSPEC. It is available as follows:

ELF RDS .826588:NUTSRC

EXECUTING NUTSPEC

Execute NUTSPEC by typing

NUTSPEC outfile BOX ann id rjet# tv# debug / 1 1

where:

outfile	is the name of the file containing all of the tabular output produced during the program execution.
BOX ann	gives a box number to which microfiche of both the graphical and tabular output is sent at the end of the program execution. Microfiche is produced by the FR80 only when a nonzero box number is given.
id	is a user identification label.
rjet#	is the unit number of the Remote Job Entry Terminal (Versatec printer) to which graphical and tabular output is sent at the end of the program execution. RJET output is produced only when a nonzero number is given.

tv# is the monitor number of the Television Monitor Display System to which selected frames of graphical output are sent as they are produced. TMDS output is produced only when a nonzero number is given.

debug is an integer indicating whether intermediate calculations are to be printed in the output file and additional frames of graphical data plotted for program diagnostics. When debug equals:
0 debug has no effect. This is the default value for debug.
1 the calculations are printed and the graphics are plotted.

From this point on, execution of NUTSPEC is controlled from the terminal by various keywords and parameters.

HELP Facilities

For assistance when using NUTSPEC, type HELP any time the program prints a prompt (OK:). HELP provides online information on keyword definitions.

KEYWORDS

After the labeling and output device information is provided on the initial execute line, NUTSPEC prompts (with OK:) to indicate its readiness to receive the keywords. Eight keywords control the execution of the NUTSPEC program. Keywords can be followed by a string of up to nine space-delimited parameters. In most cases, a parameter has a default value which persists until changed. The default value is set whenever a zero is supplied for the parameter. Some of the parameters are alphanumeric; others are floating point (e.g., E10.3).

There are three types of keywords: one provides the input data (DATA), another processes the input data (PROCESS), and the third changes the status of the output devices (either the TMDS, the RJET, or the FR80).

DATA

To provide the input data, type

DATA infile outfile hifile scalin scalehi elo ehi

where:

DATA causes NUTSPEC to read an input file containing the pulse height data. In the case of gas proportional counters, another file is also read which contains the high energy spectrum data. The high energy data is based on an independent measurement made with a detector whose response at high energies is well-known.

infile is the name of the file containing a maximum of 256 channels of pulse height data. This file contains titles for the data, the length of time during which the data was obtained, energy calibration information, and the detector identification number. A detailed description of the format of this file is given below in the section on Data Formats.

outfile is the name of the file where the unfolded spectrum is placed. This file is for later reuse by NUTSPEC or display by the RESULTS program.*

hifile is the name of the file containing the unfolded high energy spectrum. This spectrum is used to calculate the rate of events due to high energy neutrons. These events are subtracted from the pulse height data (infile) before unfolding. This option may be omitted if correction for wall events due to energetic neutrons is not needed. The format of this file is described below in the section on Data Formats.

scaln is a number by which the pulse height data (infile) is multiplied before it is unfolded. The default value for scaln is 1.0.

scalehi is a number by which the high energy spectrum data (hifile) is multiplied before it is used to correct wall events. The default value for scalehi is 1.0.

*The RESULTS program merges, into a mosaic, the results of several neutron spectra measured with different detectors over different energy ranges. The mosaic displays the neutron spectrum over a wide energy range. RESULTS also offers a variety of smoothing and renormalization options and produces tabular and graphical output in high resolution and 30 energy group formats. It is available as follows:

ELF ADS .826588:RESULTS

There are HELP facilities to assist the user in running the program.

elo is the low energy bound (MeV) below which high energy spectrum data (hifile) is not used. The default value for elo is 0.

ehi is the high energy bound (MeV) above which high energy spectrum data (hifile) is not used. The default value for ehi is 30.

PROCESS

To process the input data, type

PROCESS nst nmX np η X debug s0 s1 npass

where:

PROCESS causes the pulse height data (infile) to be unfolded as specified in the following parameters.

nst is the channel number below which the pulse height data (infile) is not used for unfolding. The default value for nst is 1.

nmX is the channel number above which the pulse height data (infile) is not used for unfolding. The default value for nmX is 256 or the number of channels in the input data, whichever is smaller.

np is an integer indicating the number of data points used by a digital filter to calculate the slope of the pulse height data. The default value for np is 0. If the default value is chosen, then a variable width filter is used. The variable width filter is calculated at each sampling point as $np = s0 + s1 \times (\text{channel number})$ where s0 and s1 are described below. (Their default values are 3. and 0.05, respectively.) If a nonzero value is supplied for np, then a filter of constant width np is used over the whole spectrum. This constant width value will override any constraints imposed by s0 and s1. See Ref. 1, Eq. 22.

η has two meanings, depending on how the pulse height data (infile) has been obtained. If the input data has been obtained by a gas proportional counter, η determines the magnitude of correction from one iteration to the next, and hence, the rate of convergence. The default value for η is then 1.0.

If the input data has been obtained by a scintillation detector, η is the number of channels (up to 150) wanted in the output

table. The default value for n is then 64 channels. See Ref. 1, Eq. 57.

χ is only used during the iterative unfolding of gas proportional counter data. The parameter χ is the value of χ^2 at which the iterative procedure is stopped and the current result accepted as the unfolded solution. This value (χ^2) is defined in Ref. 1, Eq. 56. The default value for χ is 3.0.

debug is an integer indicating whether intermediate calculations are to be printed in the output file and additional frames of graphical data plotted for program diagnostics. When debug equals:

0 debug has no effect. This is the default value for debug.

1 the calculations are printed and the graphics are plotted.

s0,s1,npass control the smoothing of the unfolded spectral results and the number of channels used to determine the slope of the pulse height data (infile). The default value for s0 is 3., for s1 0.05, and for npass 3. The pulse height data and output spectrum are smoothed by a Gaussian filter. The filter's width is given by:

$$FWHM = s0 + s1 \times (\text{channel number}).$$

This filter is passed over the data npass times. If np = 0, then the derivative filter used to find the slope of the pulse height data is also given by:

$$np = s0 + s1 \times (\text{channel number}).$$

OUTPUT DEVICES

The following keywords change the status of output devices.

TVON monitor-number turns on a TMS monitor so that graphics are displayed there as each frame is produced.

TVOFF turns off the TMS monitor.

RJON unit-number turns on an RJET printer so that subsequent graphical and tabular output is sent there at the end of the program execution.

RJOFF turns off the RJET printer.

STOP number ends the program execution. When number equals:
 or
 END number 0 sends graphical and tabular output to the FR80 (for microfiche) and the RJET automatically if a nonzero box number and a nonzero RJET number were given, respectively, in the initial execute line of NUTSPEC.
 1 does not send graphical and tabular output to the RJET.
 2 does not send graphical and tabular output to the FR80 for microfiche.
 3 does not send graphical and tabular output to the RJET and the FR80 for microfiche.

DATA FORMATS

There are two types of input formats: one for pulse height data, the other for high energy spectrum data. The three types of output data are spectral, graphical, and tabular. The data format types are described below.

Input Pulse Height Data

Line 1: 80-character title. The title is reproduced on all tabular data and each frame of graphics output. This line is in format 8A10.
 Line 2: x1, x2, x3. This line is in format 10E10.3.
 x1 is the number of data channels.
 x2 is not used.
 x3 is the elapsed time in seconds.
 Line 3: y1, y2, y3, y4. This line is in format 10E10.3.
 y1 is the channel that corresponds to zero energy deposition in the detector.
 y2 is a calibrated channel. A calibrated channel is the channel at which the energy deposition is known.
 y3 is the calibration energy. This is the energy deposition (MeV) for channel y2. Energy deposition in a scintillator by either e^- or p may be used. Electron energy deposition is denoted by a negative y3 value (e^-) while proton energy calibration is denoted by a positive y3 value (p).
 y4 is the detector identification number. See Ref. 1.

Line 4 and all succeeding lines contain pulse height data in format 10I7.

Detector Identification. The detector identification number refers to an entry in the DETDATA parameter library that contains a description of the detector types, dimensions, gas composition, density, useful energy range, resolution, etc. The identification numbers are grouped into series:

- 100 - 199 NE213 scintillation detectors,
- 200 - 299 hydrogen gas proportional counters,
- 300 - 399 ^3He gas proportional counters,
- 400 - 499 stilbene crystal scintillation detectors,
- 500 - 599 is not used,
- 600 - 699 CH_4 gas proportional counters.

Input High Energy Spectrum Data

- Line 1: 80-character title copied from the input pulse height data which was used to produce this spectrum. This line is in format 8A10.
- Line 2: number of $E, \phi(E)$ pairs to a maximum of 64. This line is in format I5.
- Line 3: are the lowest and highest energies (MeV) in the input spectrum. This line is in format E12.3,5X,E12.3.
- Line 4 and all succeeding lines contain $E, \phi(E)$ pairs in format 2E15.3.

Output Spectrum Data

The format for output spectral data is the same as that for high energy spectrum data (see above).

Graphics Output

All the graphics output is contained in an FR80 file that includes:

- A point plot of the pulse height data.
- A plot for data obtained with a gas proportional counter and corrected (by having given a hifile name along with the DATA keyword) for energetic neutron events. The plot shows the rebinned 64 channel pulse height spectrum in comparison to the calculated response due to the energetic neutrons.
- A plot showing, if the data was unfolded iteratively (as for a gas proportional counter), the final refold pulse height spectrum in

comparison to the experimental pulse height spectrum after subtraction of events due to energetic neutrons.

- A plot of the unfolded differential neutron intensity, $\phi(E)$ n/s/MeV/cm², against energy in a linear-linear coordinate system.
- A plot of $\phi(E)$ against energy in a semilogarithmic coordinate system.
- A plot of the differential dose equivalent rate, $D(E)$ mR/h/MeV.

Tabular Output

The format for the tabular output is shown in detail in Examples 1 and 2 below. In general, each keyword given at the terminal is echoed in the output together with its associated parameters. The unfolded spectral data is presented in a table that includes:

- The title copied from the input pulse height data.
- The date, time, and computer on which the data was unfolded.
- The date, time, and computer designation for the current version of the NUTSPEC program.
- The number of iterations during the unfolding process and the final χ^2 .
- The differential neutron spectrum. The data, given in several columns, includes:
 - (a) the pulse height channel number at the sampling point;
 - (b) the energy at the sampling point (MeV);
 - (c) $\phi(E)$ n/cm²/s/MeV;
 - (d) $\delta\phi(E)$ (the uncertainty in $\phi(E)$; it is enclosed in parentheses);
 - (e) the differential kerma rate, $K(E)$, erg/g/s/MeV;
 - (f) the differential dose equivalent rate, $D(E)$ mR/h/MeV;
 - (g) integral flux from Ref. 1, Eq. 76;
 - (h) integral kerma rate;
 - (i) integral dose equivalent rate.

EXAMPLES

In the following examples, the input typed at the terminal is underlined. Responses from NUTSPEC are not underlined. All parameters are

initially set to their default values; once changed, the new values are preserved. Carriage returns are implied after each line of input.

Example 1: Unfolding NE213 Scintillator Data

A file, INOV08, contains pulse height data obtained with an NE213 scintillator, detector number 103. The first few lines of this file look like:

INOV08	NE213	1.5X3"	D.D	CHANGED	BIAS	TAG	21
256,256,2000.,							
0,184.,-1.062,103,							
13102	13260	11046	9769	9104	8240	7672	7334 7086 6457
6160	6087	5604	5542	5341	5176	5413	5160 5070 4970
5004	4550	4852	4700	4725	4578	4550	4518 4455 4365

The pulse height data was obtained during 2000 seconds and consists of 256 channels in format 1017. Energy calibration is based on the 1.062 MeV electron energy deposition occurring at channel 184. The user/program interactions are:

```

u:  NUTSPEC OUT1 BOX 072 SLAUGHTER 7
f/  OK:  DATA INOV08 FLUX1
p:  INOV08 NE213 1.5X3" D.D CHANGED BIAS TAG 21
p/u: OK:  PROCESS 30
p/u: OK:  PROCESS 25 0 21
p/u: OK:  END
p:  ALL DONE

```

The data was processed twice. First, it was processed using the default values with the exception that the data below channel 30 was ignored. Then it was processed using a threshold channel of 25, and the derivative filter, which normally has a variable width, was replaced by one having a constant width of 21 channels. Graphics output (including the raw data, the unfolded spectrum, and the differential dose equivalent rate spectrum) for this interaction is shown in Figs. 1-7.

For the first case processed, Fig. 1 shows the input pulse height spectrum and Fig. 2 the unfolded results in linear-linear coordinates. Note

Fig. 1. Input pulse height spectrum of Example 1 obtained with an NE213 scintillation detector exposed to 2.5 MeV neutrons.

Fig. 2. Unfolded neutron spectrum, $\phi(E)$, of Example 1 in linear-linear coordinates.

Fig. 3. Unfolded neutron spectrum, $\phi(E)$, of Example 1 in logarithmic-linear coordinates.

Fig. 4. Differential dose equivalent rate spectrum, $D(E)$, of Example 1.

that a variable width digital filter was used, i.e., the default value. Figure 3 expresses the same results in logarithmic-linear coordinates and Fig. 4 the corresponding differential dose equivalent rate spectrum.

For the second case processed, Fig. 5 shows the unfolded results in linear-linear coordinates. Note that here a constant width digital filter of 21 channels was used. The same results are shown in Fig. 6 but in logarithmic-linear coordinates. Figure 7 illustrates the differential dose equivalent rate spectrum for the second case.

The graphics output is sent to the FR80 for microfiche and to RJET number 7. All tabular data produced during the program execution is placed in a file, OUT1, and that file is also sent to the FR80 and the RJET. The contents of OUT1, annotated, are reproduced in Appendix A. In addition, the spectral data is written into a file called FLUX1 for later display by RESULTS or reuse by NUTSPEC.

Example 2: Unfolding ^3He Gas Proportional Counter Data

File 8OCT24A contains pulse height data gathered with a ^3He gas proportional counter, detector number 301. The first few lines of the input file look like:

```

8OCT24  HE3A  2.03MEV
128.,0,879.,100.,
0.,23.,.764,301.,
  1      2      6      28      523      871      807      788      786      701
633      586      608      528      516      560      573      553      626      738

```

The pulse height data was obtained during 879 seconds and consists of 128 channels in format 1017. The thermal neutrons underwent $^3\text{He}(n,p)\text{T}$ reactions and deposited 0.764 MeV energy at channel 23. A peak was produced in the pulse height spectrum. Zero energy deposition corresponds to channel 0. The user/program interactions are similar to those of Example 1.

```

u:  NUTSPEC OUT2 BOX 072 SLAUGHTER
p/u: OK: DATA 8OCT24A FLUX2
p:  8OCT24  HE3A  2.03MEV
p/u: OK: PROCESS

```

Fig. 5. Unfolded neutron spectrum, $\phi(E)$, of Example 1 in linear-linear coordinates.

Fig. 6. Unfolded neutron spectrum, $\phi(E)$, of Example 1 in logarithmic-linear coordinates.

Fig. 7. Differential dose equivalent rate spectrum, $D(E)$, of Example 1.

p/u: OK: END
p: ALL DONE

In this example, a response matrix was calculated and an iterative unfolding method used. A result with $\chi^2 = 2.53$ was obtained after five iterations. The graphics output is shown in Figs. 8-12.

Figure 8 shows the input pulse height spectrum. Figure 9 illustrates the refold pulse height spectrum compared to the rebinned input data. At the bottom of this figure, a plot of residuals divided by the standard deviation can be used to assess the quality of the unfolded results. Figure 10 shows the unfolded results in linear-linear coordinates and Fig. 11 the same results in logarithmic-linear coordinates. The corresponding differential dose equivalent rate spectrum is shown in Fig. 12.

Example 3: Unfolding Data Obtained with Both an NE213 Scintillator and a Gas Proportional Counter

A neutron spectrum has been measured near a $^{238}\text{PuBe}$ source with an NE213 scintillator and a small hydrogen gas proportional counter. The scintillator pulse height data is contained in a file called 711JAO1HA. The interactions to unfold this set of measurements are:

u: NUTSPEC OUT4 BOX 072 SLAUGHTER 0 264
p/u: OK: DATA 711JAO1HA HIENER
p: 11JAN01 BARE PUBE HI ENERGY TAG = 1
p/u: OK: PROCESS 15

Tabular data is written to the file OUT4 and to microfiche. Graphics data is displayed on TMDS monitor 264 and also sent to microfiche. The high energy data file 711JAO1HA is unfolded first; the neutron spectrum is written to a file called HIENER for later use to correct the proportional counter data for high energy interactions. Unfolding of the high energy spectrum is carried out with the default parameter values with the exception that data below channel 15 is ignored. The results are plotted in Figs. 13-16.

Figure 13 shows the input pulse height data obtained with the NE213 scintillator. Figures 14 and 15 show the unfolded results above 1 MeV in linear-linear and logarithmic-linear coordinates, respectively. Figure 16

Fig. 8. Input pulse height spectrum of Example 2 obtained with a ^3He gas proportional counter exposed to 2.03 MeV neutrons.

Fig. 9. Final calculated refold spectrum (solid line) of Example 2 compared to experimental pulse height spectrum (x-line).

Fig. 10. Unfolded neutron spectrum, $\phi(E)$, of Example 2 in linear-linear coordinates.

Fig. 11. Unfolded neutron spectrum, $\phi(E)$, of Example 2 in logarithmic-linear coordinates.

Fig. 12. Differential dose equivalent rate spectrum, $D(E)$, of Example 2.

Fig. 13. Input pulse height spectrum of Example 3 obtained with an NE213 scintillation detector exposed to a bare $^{238}\text{PuBe}$ neutron source,

Fig. 14. Unfolded $^{238}\text{PuBe}$ neutron spectrum, $\phi(E)$, of Example 3 in linear-linear coordinates.

Fig. 15. Unfolded $^{238}\text{PuBe}$ neutron spectrum, $\phi(E)$, of Example 3 in logarithmic-linear coordinates.

Fig. 16. Differential dose equivalent rate spectrum, $D(E)$, of Example 3 near a bare $^{238}\text{PuBe}$ neutron source.

illustrates the differential dose equivalent rate spectrum for the ²³⁸PuBe source.

The low energy pulse height spectrum data obtained with the gas proportional counter is contained in a file called 608NOVO2A. The first few lines of the file look like:

```
8NOVO2/H2 PUBE BARE "    TAG = 09
    256          257    15227
-5.,102.,.606,201,
249852 174049 127063 97707 75646 59120 46415 37215 30288 25187
    21606    19682    17873 16711 15734 14851 14359 13815 13030 12916
```

The low energy pulse height data was obtained with detector number 201 during 15,227 seconds. Energy calibration is based on observation of a 0.606 MeV proton energy deposition at channel 102. A baseline offset implies that zero energy deposition would occur at channel -5.0. Continuing with the above user/program interactions:

```
p/u: OK: DATA 608NOVO2A LOENRG HIENER 0 0.5
p:      8NOVO2/H2 PUBE BARE "    TAG = 09
p/u: OK: PROCESS 10
p/u: OK: END
p:      ALL DONE
```

The unfolded spectrum is written to a file called LOENRG. Events due to energetic neutrons are compensated using the spectral data in the file HIENER, but multiplied by the scale factor 0.5 since the measurement positions were not the same. Unfolding is carried out using the default values with the exception that data below channel 10 in the pulse height data is ignored. The results are given in Figs. 17-22.

Figure 17 contains the low energy pulse height data. Figure 18 illustrates the calculated pulse height spectrum due to energetic neutrons which is subtracted from the input pulse height spectrum. Figure 19 shows the refold pulse height spectrum (calculated from the final estimate of $\phi(E)$ and the detector response matrix) and compares it to the input pulse height spectrum after correction for energetic events. At the bottom of this

Fig. 17. Input pulse height spectrum of Example 3 obtained with a hydrogen proportional counter near a $^{238}\text{PuBe}$ neutron source.

Fig. 18. Input pulse height spectrum of Example 3 obtained with a hydrogen proportional counter. The solid line shows the calculated response to high energy neutrons; the x-line shows the experimental pulse height spectrum, including both high and low energy neutrons.

Fig. 19. Final calculated refold spectrum (solid line) of Example 3 compared to experimental pulse height spectrum (x-line).

Fig. 20. Unfolded neutron spectrum, $\phi(E)$, of Example 3 in linear-linear coordinates. Note that the steep tail below 1.5 MeV is due to δ ray interactions.

figure, a plot of residuals divided by the standard deviation can be used to assess the quality of the unfolded results. Figures 20 and 21 show the final estimate of $\phi(E)$ in linear-linear and logarithmic-linear coordinates, respectively. Figure 22 shows the low energy differential dose equivalent rate spectrum.

The neutron spectrum segments obtained using several different detectors can be merged into a single summary tabular and graphical display using the RESULTS program. A complete neutron spectrum and differential dose equivalent rate spectrum is then presented over the energy range 0.01-20 MeV. Data presented there is also integrated over the 30 energy groups used by MORSE-L for comparison with neutron transport calculations.

Fig. 21. Unfolded neutron spectrum, $\phi(E)$, of Example 3 in logarithmic-linear coordinates.

Fig. 22. Differential dose equivalent rate spectrum, $D(E)$, of Example 3 corresponding to neutron intensities given in Figs. 20 and 21.

REFERENCE

1. D. R. Slaughter, D. W. Rueppel, and D. A. Fuess, *Neutron Spectrum Measurements for Radiation Protection Purposes*, Lawrence Livermore Laboratory, Rept. UCRL-52415 (1978).

Appendix A
Tabular Output for Example 1 (OUT1)

Detector parameters, calibration data, and input file parameters are reproduced.

```

1 CODEWORD
  DATA      INOV08      FLUX1
  INPUT PULSE HEIGHT DATA FILENAME:      INOV08
  TITLE ON INPUT FILE IS:
    INOV08 NE213 1.5X3 D.D CHANGED BIAS TAG 21

  PULSE HEIGHT DATA MULTIPLIED BY 1.000E+00 BEFORE ANALYSIS
  OUTPUT FLUX WILL BE WRITTEN INTO FILENAME:      FLUX1

DETECTOR ID NUMBER= 103

DETECTOR USED IS NE213 1.5 X 3 INCH SCINTILLATOR

  R= 1.90E+00 CM L= 7.30E+00 CM
  PRIMARY GAS= 0. ATM OF HYDROGEN WITH DENSITY= 4.787E+22 AT/CM3
  STOPPING GAS= 0. AT/CM3 OF HYDROGEN
  QVALUE= -0. LIO DENSITY= 8.740E-01

  ANODE VOLTS= 0. X0= 0. CALCHAN= 1.84E+02 CCAL= -1.06E+00
DETECTOR PARAMETERS AND PHYSICS LIMITS
  EMIN= 4.000E-01 EMAX= 2.000E+01 ANAL 0. OUTPUT
  CAP= 0. GAIN COEF= 0. 0. 0.
  RESOLUTION PARAMS= 5.000E-02 0.

  4-FEP PARAMS          4-RECOIL PARAMS
  0. 0. 0. 0. 0. 0.
  3-RECOIL ENERGY PARAMS  5-RECOIL HEIGHT
  0. 0. 0. 0. 0. 0.
  16- CONTINUUM PARAMS
  0. 0. 0. 0. 0. 0.
  0. 0. 0. 0. 0. 0.
  REMAINING PARAMS
  0. 0. 0. 0. 0. 0.
  0. 0. 0. 0. 0. 0.

CALIBRATION IS BASED ON ELECTRON LIGHT OUTPUT OR TEST PULSER INPUT

ELAPSED TIME= 2.000E+03 SEC

LIGHT RESPONSE CALCULATED FROM P.P. POLYNOMIAL REPRESENTATION
DATA BASE LABEL IS--
  NE213 LIGHT OUTPUT VS. PHOTON ENERGY

SYSTEM GAIN= 2.082E+02 CHANNELS/LIGHT UNIT

TOTAL NUMBER OF EVENTS= 6.11E+05

```

Parameters for the first case are processed.

1 GOODWORD
PROCESS 30

INPUT PARAMETERS:

STARTING CHANNEL 30 END CHANNEL 256
CHANNELS IN OUTPUT TABLE 64 BINNED IN GROUPS OF 3

OUTPUT RESET TO 64 CHANNELS LINEAR IN ENERGY FROM CH 30 TO 256 IN BINS OF ABOUT 4

POLYNOMIAL USED TO CALCULATE LIGHT OUTPUT FROM PROTON ENERGY

LOWER BOUND, MEV	FOLLOWED BY ASCENDING COEFFICIENTS				
1.000E-01	6.370E-03	6.316E-02	2.351E-01	-9.391E-02	
1.092E+00	1.674E-01	2.481E-01	1.419E-01	-5.788E-02	
3.170E+00	9.029E-01	4.181E-01	2.104E-02	-9.543E-04	

Unfolded results for the first case are processed.

DATA UNFOLDED 10:45:44R 02/27/78
CODE VERSION 02/09/78R 16.26.55

UNFOLDED RESULTS BASED ON PULSE HEIGHT DATA ACCUMULATED FOR 2.000E+03 SEC
USING DETECTOR NO. 103

DATA LABEL IS:

1NOV08 NE213 1.5X3 D.O CHANGED BIAS TAG 21

DIFFERENTIAL RESULTS *****

RESULTS INTEGRATED FROM E TO INF. *****

MID CHANNEL	ENERGY (MEV)	FLUX DENSITY (NEUTRONS/CM2-SEC-MEV)	KERMA (ERG/CM2-SEC-MEV)	DOSE EQUIV. (MREM/HR-MEV)	INTED FLUX (NEUTRONS/CM2-SEC) ABOVE E	INTED KERMA (ERG/CM2-SEC) ABOVE E	INT DOSE (MREM/HR) ABOVE E	
1	31	1.023E+00	-8.104E+00 (3.2E+00)	-1.069E-06	-9.690E-01	4.645E+01	1.393E-05	6.784E+00
2	33	1.053E+00	-8.115E+00 (3.5E+00)	-1.062E-06	-9.682E-01	4.677E+01	1.401E-05	6.823E+00
3	36	1.119E+00	-1.534E+01 (4.1E+00)	-3.732E-06	-1.091E+00	4.743E+01	1.417E-05	6.902E+00
4	39	1.156E+00	-3.075E+00 (4.3E+00)	-9.474E-07	-4.712E-01	4.779E+01	1.426E-05	6.946E+00
5	41	1.215E+00	-1.267E+00 (4.8E+00)	-3.110E-07	-1.558E-01	4.784E+01	1.430E-05	6.944E+00
6	43	1.251E+00	-3.675E+00 (5.2E+00)	-9.094E-07	-4.551E-01	4.803E+01	1.432E-05	6.975E+00
7	46	1.305E+00	-1.306E+01 (5.8E+00)	-3.248E-06	-1.634E+00	4.843E+01	1.443E-05	7.031E+00
8	48	1.340E+00	-2.483E+01 (6.3E+00)	-6.153E-06	-3.103E+00	4.914E+01	1.459E+05	7.114E+00
9	51	1.391E+00	1.554E+01 (6.8E+00)	3.905E-06	1.677E+00	4.937E+01	1.465E+05	7.143E+00
10	54	1.441E+00	-1.504E+01 (7.3E+00)	-3.287E-06	-1.670E+00	4.931E+01	1.464E+05	7.135E+00
11	56	1.474E+00	-1.747E+01 (7.7E+00)	-4.421E-06	-2.251E+00	4.981E+01	1.476E+05	7.200E+00
12	59	1.522E+00	-7.075E+00 (8.4E+00)	-2.010E-06	-1.027E+00	5.042E+01	1.482E+05	7.270E+00
13	62	1.570E+00	-7.507E+00 (9.0E+00)	-1.927E-06	-9.893E-01	5.079E+01	1.501E+05	7.327E+00
14	65	1.616E+00	-3.185E+01 (9.8E+00)	-8.141E-06	-4.190E+00	5.169E+01	1.524E+05	7.447E+00
15	68	1.662E+00	1.690E+01 (1.0E+01)	4.388E-06	2.265E+00	5.202E+01	1.533E+05	7.491E+00
16	71	1.706E+00	-4.590E+00 (6.5E+00)	-1.197E-06	-6.203E-01	5.175E+01	1.526E+05	7.454E+00
17	74	1.747E+00	-1.683E+01 (7.0E+00)	-4.358E-06	-2.269E+00	5.218E+01	1.537E+05	7.513E+00
18	77	1.795E+00	-1.005E+01 (7.4E+00)	-2.648E-06	-1.391E+00	5.262E+01	1.554E+05	7.601E+00
19	81	1.853E+00	5.756E+00 (7.9E+00)	1.527E-06	8.001E-01	5.295E+01	1.557E+05	7.618E+00
20	84	1.896E+00	-4.811E+01 (8.3E+00)	-1.310E-07	-6.893E-02	5.284E+01	1.554E+05	7.602E+00
21	87	1.936E+00	-1.481E+01 (8.7E+00)	-3.971E-06	-2.093E+00	5.316E+01	1.563E+05	7.646E+00
22	90	1.980E+00	3.547E+00 (9.1E+00)	9.554E-07	5.052E-01	5.339E+01	1.568E+05	7.681E+00
23	94	2.035E+00	3.888E+00 (9.7E+00)	1.082E-06	5.704E-01	5.319E+01	1.564E+05	7.651E+00
24	97	2.075E+00	1.941E+01 (1.0E+01)	5.294E-06	2.778E+00	5.271E+01	1.551E+05	7.593E+00
25	101	2.129E+00	3.018E+01 (1.0E+01)	8.289E-06	4.322E+00	5.138E+01	1.514E+05	7.392E+00
26	104	2.169E+00	2.490E+01 (1.1E+01)	6.873E-06	3.586E+00	5.028E+01	1.484E+05	7.235E+00
27	107	2.209E+00	3.828E+01 (1.1E+01)	1.082E-06	5.485E+00	4.903E+01	1.449E+05	7.056E+00
28	111	2.261E+00	2.752E+01 (7.6E+00)	7.688E-06	3.944E+00	4.732E+01	1.402E+05	6.811E+00
29	115	2.312E+00	2.292E+01 (7.9E+00)	6.447E-06	3.287E+00	4.602E+01	1.365E+05	6.624E+00
30	116	2.350E+00	2.333E+01 (8.0E+00)	5.959E-06	3.347E+00	4.513E+01	1.340E+05	6.497E+00
31	122	2.401E+00	2.848E+01 (8.2E+00)	7.537E-06	3.801E+00	4.388E+01	1.305E+05	6.317E+00
32	125	2.439E+00	2.220E+01 (8.3E+00)	6.348E-06	3.187E+00	4.296E+01	1.278E+05	6.185E+00
33	129	2.480E+00	2.543E+01 (8.4E+00)	7.324E-06	3.653E+00	4.176E+01	1.245E+05	6.015E+00
34	133	2.535E+00	5.049E+01 (8.9E+00)	1.482E-05	7.258E+00	3.999E+01	1.193E+05	5.798E+00
35	136	2.574E+00	4.084E+01 (8.7E+00)	1.188E-05	5.871E+00	3.824E+01	1.142E+05	5.507E+00
36	140	2.620E+00	9.315E+01 (9.7E+00)	2.728E-05	1.340E+01	3.512E+01	1.051E+05	5.058E+00
37	144	2.672E+00	1.212E+02 (1.0E+01)	3.572E-05	1.743E+01	2.957E+01	0.880E+05	4.261E+00
38	148	2.720E+00	1.253E+02 (1.0E+01)	3.716E-05	1.803E+01	2.361E+01	7.117E-05	3.403E+00
39	152	2.768E+00	1.220E+02 (8.4E+00)	3.642E-05	1.797E+01	1.787E+01	5.347E-06	2.947E+00
40	155	2.804E+00	1.113E+02 (7.6E+00)	3.340E-05	1.604E+01	1.343E+01	4.093E-06	1.843E+00

Unfold results for the first case are processed (continued).

41	159	2.852E+00	**	8.124E+01	(5.0E+00)	2.453E-05	1.171E+01	**	8.886E+00	2.712E+08	1.282E+00
42	163	2.899E+00	**	6.100E+01	(4.0E+00)	1.853E-05	8.799E+00	**	5.511E+00	1.680E+06	7.551E+01
43	167	2.947E+00	**	4.087E+01	(3.4E+00)	1.248E-05	5.899E+00	**	3.194E+00	9.572E+07	4.480E+01
44	171	2.994E+00	**	2.180E+01	(2.0E+00)	6.703E-06	3.146E+00	**	1.529E+00	5.956E+07	2.333E+01
45	175	3.041E+00	**	1.266E+01	(1.4E+00)	3.918E-06	1.828E+00	**	8.216E-01	2.566E+07	1.197E+01
46	179	3.087E+00	**	5.852E+00	(9.0E+01)	1.822E-06	8.453E-01	**	3.990E-01	1.224E+07	5.622E+02
47	183	3.134E+00	**	2.657E+00	(6.3E+01)	8.950E-07	4.128E-01	**	1.862E-01	5.816E+06	2.683E+02
48	187	3.180E+00	**	9.934E+01	(4.8E+01)	3.605E-07	1.378E-01	**	9.832E-02	3.160E+06	1.423E+02
49	191	3.226E+00	**	3.947E+01	(5.0E+01)	1.251E-07	5.708E-02	**	6.710E-02	2.175E+06	8.718E+03
50	194	3.261E+00	**	9.989E+01	(3.3E+01)	3.156E-07	1.433E-01	**	4.308E-02	1.410E+06	8.244E+03
51	198	3.307E+00	**	1.621E+01	(2.6E+01)	5.184E-08	2.346E-03	**	1.649E-02	5.627E+09	2.396E+03
52	202	3.353E+00	**	8.712E+02	(2.5E+01)	2.184E+08	9.716E+03	**	1.121E+02	3.824E+08	1.833E+03
53	206	3.399E+00	**	-1.599E-01	(2.6E+01)	-5.172E+08	-2.310E+02	**	1.333E+02	4.629E+09	1.940E+03
54	210	3.445E+00	**	-8.629E+02	(2.5E+01)	-2.814E+08	-1.290E+02	**	1.896E+02	6.453E+09	2.765E+03
55	214	3.491E+00	**	-3.659E+02	(2.7E+01)	-1.200E+08	-5.301E+03	**	3.178E+02	7.370E+09	3.162E+03
56	218	3.536E+00	**	3.255E+01	(2.7E+01)	1.075E+07	4.721E+02	**	1.318E+02	5.195E+09	2.877E+03
57	222	3.582E+00	**	-1.546E+01	(3.1E+01)	-5.143E+09	-2.247E+02	**	1.130E+02	3.921E+09	1.644E+03
58	226	3.627E+00	**	-1.316E+01	(3.0E+01)	-4.384E+08	-1.884E+02	**	1.779E+02	6.081E+09	2.886E+03
59	231	3.684E+00	**	1.422E+01	(2.1E+01)	4.787E+08	2.089E+02	**	1.747E+02	5.967E+09	2.840E+03
60	235	3.728E+00	**	2.119E+01	(2.6E+01)	7.177E+08	3.879E+02	**	9.484E+03	3.268E+09	1.380E+03
61	239	3.771E+00	**	-2.321E+01	(2.1E+01)	-7.905E+08	-3.374E+02	**	9.913E+03	3.423E+09	1.442E+03
62	243	3.818E+00	**	1.691E+01	(1.9E+01)	5.794E+08	2.459E+02	**	1.138E+02	3.914E+09	1.855E+03
63	247	3.863E+00	**	1.731E+01	(3.6E+01)	5.965E+08	2.518E+02	**	3.684E+03	1.270E+09	5.350E+04
64	251	3.906E+00	**	-1.392E+03	(2.3E+00)	-4.825E+10	-2.026E+04	**	-1.765E+13	-1.158E+19	-2.154E+14

Parameters for the second case are processed.

1 CODEWORD
PROCESS 25 0 20

INPUT PARAMETERS:
STARTING CHANNEL 25 END CHANNEL 256
CHANNELS IN OUTPUT TABLE 64 BINNED IN GROUPS OF 3

OUTPUT RESET TO 64 CHANNELS LINEAR IN ENERGY FROM CH 25 TO 256 IN BINS OF ABOUT 4

SLOPE DETERMINED BY 20 POINT DIGITAL FILTER

POLYNOMIAL USED TO CALCULATE LIGHT OUTPUT FROM PROTON ENERGY

LOWER BOUND, MEV	FOLLOWED BY ASCENDING COEFFICIENTS			
1.000E-01	5.370E-03	5.115E-02	2.351E-01	-9.391E-02
1.092E+00	1.674E-01	2.401E-01	1.419E-01	-5.788E-02
3.170E+00	9.025E-01	4.181E-01	2.184E-02	-9.543E-04

Unfolded results for the second case are processed.

DATA UNFOLDED 10:45:56R D2/27/79
CODE VERSION 02/06/78R 18.26.95

UNFOLDED RESULTS BASED ON PULSE HEIGHT DATA ACCUMULATED FOR 2.000E+03 SEC
USING DETECTOR NO. 103

DATA LABEL IS:

(NOV09 NE213 1.5KJ 0.0 CHANGED BIAS TAG 21

DIFFERENTIAL RESULTS					RESULTS INTEGRATED FROM E TO INF.		
*****					*****		
MID CHANNEL	ENERGY (MEV)	FLUX DENSITY (NEUTRONS/CM2-SEC-NEV)	KERMA (EROS/CM2-SAL-NEV)	DOSE EQUIV. (MREM/HR-NEV)	INTEG FLUX (NEUTRONS/CM2-SEC) ABOVE E	INTEG KERMA (EROS/CM2-SEC) ABOVE E	INT DOSE (MREM/HR) ABOVE E
1	26 9.170E-01	** -4.814E-01 (5.3E+00)	-1.035E-07	-5.008E-02	** 4.663E+01	1.402E-05	6.820E+00
2	29 9.603E-01	** -9.337E-01 (1.6E+00)	-1.984E-07	-9.679E-02	** 4.688E+01	1.403E-05	6.824E+00
3	31 1.023E+00	** -4.351E+00 (7.9E-01)	-1.047E-06	-5.158E-01	** 4.702E+01	1.407E-05	6.834E+00
4	33 1.063E+00	** -5.156E+00 (6.3E-01)	-1.247E-06	-6.197E-01	** 4.721E+01	1.411E-05	6.855E+00
5	35 1.097E+00	** -5.060E+00 (5.9E-01)	-1.228E-06	-6.093E-01	** 4.739E+01	1.416E-05	6.866E+00
6	38 1.133E+00	** -5.490E+00 (6.5E-01)	-1.342E-06	-6.876E-01	** 4.770E+01	1.423E-05	6.924E+00
7	40 1.166E+00	** -5.704E+00 (7.0E-01)	-1.401E-06	-6.969E-01	** 4.792E+01	1.428E-05	6.951E+00
8	43 1.201E+00	** -5.094E+00 (7.6E-01)	-1.237E-06	-6.296E-01	** 4.822E+01	1.436E-05	6.968E+00
9	46 1.305E+00	** -3.751E+00 (8.1E-01)	-8.330E-07	-4.683E-01	** 4.848E+01	1.442E-05	7.017E+00
10	48 1.340E+00	** -5.306E+00 (8.8E-01)	-1.330E-06	-6.683E-01	** 4.881E+01	1.448E-05	7.037E+00
11	51 1.391E+00	** -6.022E+00 (9.6E-01)	-1.515E-06	-7.657E-01	** 4.890E+01	1.453E-05	7.074E+00
12	54 1.441E+00	** -6.028E+00 (1.0E+00)	-1.524E-06	-7.743E-01	** 4.921E+01	1.461E-05	7.113E+00
13	57 1.490E+00	** -6.432E+00 (1.1E+00)	-1.639E-06	-8.340E-01	** 4.951E+01	1.468E-05	7.152E+00
14	60 1.538E+00	** -1.012E+01 (1.3E+00)	-2.587E-06	-1.324E+00	** 4.991E+01	1.479E-05	7.204E+00
15	63 1.585E+00	** -8.015E+00 (1.3E+00)	-2.661E-06	-1.056E+00	** 5.034E+01	1.490E-05	7.260E+00
16	66 1.631E+00	** -6.015E+00 (1.4E+00)	-1.553E-06	-8.013E-01	** 5.068E+01	1.498E-05	7.303E+00
17	69 1.673E+00	** -8.528E+00 (1.5E+00)	-2.215E-06	-1.145E+00	** 5.098E+01	1.505E-05	7.343E+00
18	72 1.720E+00	** -8.410E+00 (1.5E+00)	-2.197E-06	-1.140E+00	** 5.135E+01	1.516E-05	7.397E+00
19	75 1.765E+00	** -6.674E+00 (1.6E+00)	-1.608E-06	-9.397E-01	** 5.171E+01	1.525E-05	7.445E+00
20	79 1.804E+00	** -7.250E+00 (1.7E+00)	-1.917E-06	-1.008E+00	** 5.212E+01	1.536E-05	7.501E+00
21	82 1.867E+00	** -6.181E+00 (1.8E+00)	-1.643E-06	-2.616E-01	** 5.241E+01	1.544E-05	7.541E+00
22	85 1.919E+00	** -2.256E+00 (1.9E+00)	-6.025E-07	-3.178E-01	** 5.268E+01	1.549E-05	7.585E+00
23	89 1.966E+00	** -3.156E+00 (2.0E+00)	-9.498E-07	-4.493E-01	** 5.274E+01	1.553E-05	7.589E+00
24	92 2.007E+00	** 2.484E+00 (2.1E+00)	6.714E-07	3.253E-01	** 5.276E+01	1.553E-05	7.590E+00
25	96 2.082E+00	** 1.345E+01 (2.4E+00)	3.665E-06	1.927E+00	** 5.282E+01	1.541E-05	7.527E+00
26	99 2.102E+00	** 1.851E+01 (2.6E+00)	5.085E-06	2.649E+00	** 5.187E+01	1.583E-05	7.435E+00
27	103 2.196E+00	** 2.565E+01 (2.8E+00)	7.089E-06	3.674E+00	** 5.049E+01	1.481E-05	7.266E+00
28	106 2.199E+00	** 2.765E+01 (3.1E+00)	7.717E-06	3.591E+00	** 4.943E+01	1.462E-05	7.114E+00
29	110 2.249E+00	** 2.633E+01 (3.1E+00)	7.337E-06	3.781E+00	** 4.882E+01	1.422E-05	6.911E+00
30	114 2.299E+00	** 2.385E+01 (3.1E+00)	6.485E-06	3.301E+00	** 4.674E+01	1.387E-05	6.729E+00
31	117 2.339E+00	** 2.314E+01 (3.1E+00)	6.528E-06	3.313E+00	** 4.586E+01	1.363E-05	6.601E+00
32	121 2.368E+00	** 2.061E+01 (3.1E+00)	5.891E-06	2.957E+00	** 4.475E+01	1.330E-05	6.442E+00
33	125 2.433E+00	** 2.433E+01 (3.3E+00)	8.865E-06	3.493E+00	** 4.362E+01	1.290E-05	6.268E+00
34	129 2.488E+00	** 3.259E+01 (3.3E+00)	9.495E-06	4.739E+00	** 4.219E+01	1.257E-05	6.076E+00
35	132 2.523E+00	** 4.101E+01 (3.3E+00)	1.186E-05	5.892E+00	** 4.095E+01	1.221E-05	5.897E+00
36	136 2.574E+00	** 6.471E+01 (4.5E+00)	1.683E-05	9.302E+00	** 3.881E+01	1.142E-05	5.503E+00
37	140 2.626E+00	** 8.727E+01 (5.9E+00)	2.552E-05	1.455E+01	** 3.463E+01	1.033E-05	4.995E+00
38	144 2.679E+00	** 1.095E+02 (6.9E+00)	3.220E-05	1.578E+01	** 2.888E+01	8.869E-06	4.262E+00
39	148 2.729E+00	** 1.238E+02 (7.5E+00)	3.687E-05	1.779E+01	** 2.392E+01	7.221E-06	3.451E+00
40	152 2.786E+00	** 1.181E+02 (7.1E+00)	3.523E-05	1.700E+01	** 1.813E+01	5.491E-06	2.614E+00

Unfolded results for the second case are processed (continued).

41	155	2.616E+00	**	1.009E+02	(6.0E+00)	3.028E-03	1.452E+01	**	1.299E+01	3.922E-06	1.059E+00
42	160	2.664E+00	**	9.271E+01	(4.8E+00)	2.501E-03	1.132E+01	**	9.532E+00	2.803E-06	1.210E+00
43	164	2.911E+00	**	5.689E+01	(3.5E+00)	1.731E-03	9.204E+00	**	5.217E+00	1.853E-06	7.585E-01
44	168	2.959E+00	**	3.945E+01	(2.4E+00)	1.177E-03	5.547E+00	**	2.987E+00	9.763E-07	4.293E-01
45	172	3.006E+00	**	2.080E+01	(1.4E+00)	6.408E-04	3.002E+00	**	1.574E+00	4.852E-07	2.273E-01
46	176	3.052E+00	**	1.139E+01	(9.4E-01)	3.527E-04	1.643E+00	**	8.208E-01	2.965E-07	1.185E-01
47	180	3.099E+00	**	6.131E+00	(5.5E-01)	1.912E-04	9.857E-01	**	4.112E-01	1.295E-07	5.943E-02
48	184	3.146E+00	**	2.648E+00	(3.5E-01)	9.934E-05	4.115E-01	**	2.022E-01	6.423E-08	2.924E-02
49	188	3.192E+00	**	1.317E+00	(2.5E-01)	4.156E-05	1.804E-01	**	1.022E-01	3.409E-03	1.538E-02
50	192	3.238E+00	**	6.587E-01	(1.6E-01)	2.082E-05	9.526E-02	**	6.031E-02	1.953E-08	8.785E-03
51	196	3.284E+00	**	4.291E-01	(1.0E-01)	1.342E-05	6.078E-02	**	3.590E-02	1.170E-09	5.161E-03
52	201	3.342E+00	**	1.871E-01	(3.4E-01)	5.656E-06	2.274E-02	**	1.898E-02	2.382E-09	2.757E-03
53	205	3.388E+00	**	1.766E-03	(1.6E-01)	5.720E-10	2.558E-04	**	1.534E-02	5.208E-09	2.229E-03
54	209	3.434E+00	**	-5.283E-02	(1.4E-01)	-1.715E-08	-7.626E-03	**	1.650E-02	5.587E-09	2.396E-03
55	213	3.479E+00	**	1.978E-02	(1.4E-01)	6.482E-09	2.687E-03	**	1.725E-02	5.831E-09	2.546E-03
56	217	3.525E+00	**	1.485E-01	(1.4E-01)	4.699E-08	2.087E-02	**	1.355E-02	4.512E-08	1.970E-03
57	221	3.570E+00	**	-1.015E-01	(1.0E-01)	-3.358E-08	-1.473E-02	**	1.262E-02	4.308E-09	1.835E-03
58	225	3.616E+00	**	-3.250E-03	(1.5E-01)	-1.094E-09	-4.717E-04	**	1.500E-02	5.096E-09	2.180E-03
59	230	3.672E+00	**	3.258E-02	(1.4E-01)	1.095E-08	4.732E-03	**	1.417E-02	4.919E-09	2.089E-03
60	234	3.717E+00	**	1.188E-01	(1.7E-01)	4.810E-08	1.723E-02	**	1.076E-02	3.666E-09	1.963E-03
61	238	3.760E+00	**	1.239E-01	(1.6E-01)	4.213E-08	1.881E-02	**	5.650E-03	1.935E-09	9.216E-04
62	242	3.806E+00	**	-9.699E-03	(1.6E-01)	-3.303E-09	-1.404E-03	**	2.983E-03	1.032E-09	4.354E-04
63	247	3.863E+00	**	8.623E-02	(1.5E-01)	2.282E-08	8.834E-03	**	1.382E-03	4.757E-10	2.022E-04
64	251	3.906E+00	**	-1.349E-03	(3.3E-01)	-4.675E-10	-1.883E-04	**	-6.603E-14	-9.966E-20	1.183E-15

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