NUS CORPORATION

NUS-397

Description of DRAW: A Code to CALCOMP Plot Gamma Photon Spectra

For

Goddard Space Flight Center
Greenbelt, Maryland

NASA Contract No.: NAS5-10337

By

Y. S. Kim
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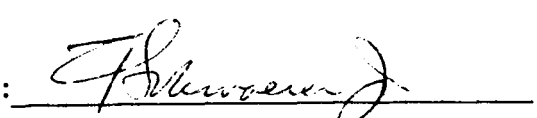
Approved: 

F. Schwoerer, Jr., Vice President
and Technical Director

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SUMMARY

A FORTRAN IV code for the IBM-7094 digital computer has been developed to CALCOMP plot histogram distributions. The code, specifically designed for multi-channel pulse-height analyzer spectra and calculated photon number and energy spectra, labels the Cartesian axes according to various options. It titles each plotted figure according to the user's input.

1. INTRODUCTION

This report presents the users requirements for code DRAW --- a code to CALCOMP plot gamma photon histogram spectra. Code DRAW, written in the FORTRAN-IV language for the IBM-7094 digital computer, has been developed for the National Aeronautics and Space Administrations, Goddard Space Flight Center, under contract NAS5-10337. It was designed to accept as input, the punch card output of code CUBED-II, reported in NUS-395[1].

The CALCOMP Digital Incremental Plotter may be used to plot from digital data stored on magnetic tape by an IBM-7094 digital computer code. Code DRAW has been developed for this purpose, namely: to plot histogram data such as arising in gamma photon pulse-height spectrometry. It is designed to specifically plot multi-channel pulse-height analyzer spectral output; and photon number and energy spectra such as determined during a computer analysis of analyzer spectra[1].

The code allows the user a number of options with respect to the figures to be plotted, namely:

Plot size --- may range from 8" x 8" to 8" x 20".

X-axis labelling --- may be either channel number or photon energy (MeV).

Y-axis labelling --- may be one of counts/channel-time, photon/sec, photons/cm^2-sec, MeV/cm^2-sec.

Figure title --- may be up to 60 alphanumeric characters in length.

Code DRAW and its required subprograms may be called as part of a larger code or instead used under the control and call of a specifically

designed main program --- the requirements for such a main program are presented in Section 2 of the present report; an example main program is presented in Appendix I.

Section 2 of this report describes the users requirements for code Draw.

Typical CALCOMP plots generated by code DRAW are presented in Figures 1 through 4.

2. Code Description

Code DRAW calls the NASA-GSFC CALCOMP subroutine package described in Reference (2), namely: CPLØTS, CCPLØT, LINE, NUMBER, SYMBØL. The FORTRAN listing of a typical main calling program and subroutines DRAW, LINE and NUMBER are presented in Appendix I. Subroutines CPLØTS/CCPLØT and SYMBØL, in MAP language are available on cards and system tape respectively at the Building 3 Computer Facility of NASA-GSFC.

A users description of code subroutine DRAW is presented as follows:

CALLING STATEMENT:

CALL DRAW (TITLE, NX, IDX, IDY, EMAX, PHI, XZ, PHMAX)

ARGUMENT DEFINITIONS:

TITLE - The title of plot to be drawn at the upper right-hand corner of each plot. 60 alphanumeric characters. First 20 characters on the first line, second 20 characters on the second line, and the third 20 characters on the third line. Format: 3(3A6, A2); DIMENSION: TITLE (12)

NX - Number of counting channels. It must be an integer number or variable, a multiple of 10, and must not be greater than 200.

IDX - X-axis labelling control word. An integer number or variable. When IDX = 1, the X axis is labelled by channel numbers; when IDX = 2, it is labelled by corresponding channel mean energies (Mev). For IDX = 2, EMAX must be greater than zero.

IDY - Y-axis labelling control word. An integer number or variable. When IDY = 1, the Y-axis is labelled by

photons/sec; when IDY = 2, by counts/(channel-time); when IDY = 3, by photons/(sq. cm-sec); when IDY = 4, by MeV/(sq. cm-sec).

EMAX - Maximum photon energy (MeV) in labelling the X-axis. It is a floating point number or variable, and must be in the range of 0.1 and 10.0 MeV. Set EMAX = 0.0 for IDX = 1.

PHI - Counts per channel in units specified by IDY. It is floating point number or variable. PHI (I) must be in the range of 0.01 and 999,999.0. Counts above 900,000.0 are regarded as negative and converted to zero count. DIMENSION: PHI (200).

XZ - Length of the X-axis in inches. A floating point member or variable, and must be in the range of 8.0 and 20.0. If XZ = 0.0, the routine interprets as XZ = 8.0. The Y-axis is always 8.0 inches long.

PHMAX - The maximum value of Y to be used for the uniform scaling of PHI (I)'s in different plots. It is a floating point number or variable and corresponds to the height of 7.0 inches above the X-axis. If PHMAX = 0.0, the routine will determine the maximum value (YMX) of PHI (I) for each plot and scale other PHI (I)'s. That is, if PHMAX = 0.0, each plot will have its own scaling factor and all other plots obtained with PHMAX = 0.0 may not have the same Y-axis scaling. If PHMAX is less than YMX, YMX will be used for the scaling.

OUTPUT:

For each CALL DRAW operation the data for one plot is generated on logical tape 16 (A6 at NASA-Goddard Center), with 200 BPI mode. The total number of plots on logical tape 16 will be determined by the number of CALL DRAW operations. The tape must be transferred to CALCOMP 570 to obtain actual plots. The print output which contains the input data for each plot is written on logical tape 3 (A3 at NASA-Goddard Center).

USAGE:

```
MAIN or Subroutine NAME
      -
      -
      -

DIMENSION TITLE (12), PHI (200), DATA (512)
      -
      -
      -

INDC = 0
CALL CPLOTS (DATA, 512, INDC)
      -
      -
      -

   IG = 1
   NCH = ---
11 TITLE = ---
   NX = ---
   IDX = ---
   IDY = ---
```

```
      EMAX = ---
      PHMAX = ---
      XZ = ---
  917 FORMAT ( 10F 7.1 )
      READ ( 2,917 ) (PHI (I), I = 1, NX)
      CALL DRAW (TITLE, NX, IDX, IDY, EMAX, PHI, XZ, PHMAX)
      IG = IG + 1
      IF (IG - NGH) 11, 11, 13
   13 END FILE 16
      END FILE 16
         -
         -
         -
      END
```

NOTE: ERROR RETURN, a statement, "INPUT DATA ERROR -- PLOT ABANDONED" will be written on the standard output tape (logical 3 or A3 at NASA-Goddard Center) and a message, "PLOT ABANDONED DUE TO INPUT ERROR -- NEXT PLOT WILL CONTINUE," will be plotted on the plot output when any of the following errors exist in the input data.

(1) NX > 200

(2) EMAX = 0.0 when IDX = 2

(3) IDX < 1 or IDX > 2

(4) IDY < 1 or IDY > 4

(5) EMAX < 0.1 or EMAX > 10.0 Mev

(6) PHI (I) > 1,000,000.0

(7) 0 < XZ < 8.0 or XZ > 20.0

A statement, "NUMBER OF CHANNELS NOT IN MULTIPLES

OF 10 --------- PLOT ABANDONED," will be written on the standard output tape when NX is not in multiples of 10.

SUBRPOGRAMS: CALCOMP plotting package at NASA-Goddard Space Flight Center: C/CCPLOT, SYMBOL, NUMBER, LINE

STORAGE:	DRAW	1947 Locations	(FORTRAN IV)
	CPLOTS/CCPLOT	364 Locations	(MAP)
	SYMBOL	343 Locations	(MAP)
	NUMBER	278 Locations	(FORTRAN IV)
	LINE	134 Locations	(FORTRAN)

MODIFICATION: If it is desired to increase the number of channels (NX) above 200, the following changes must be made in the calling program and DRAW:

eg. assume new NX = 400, then

Calling program,

```
DIMENSION PHI ( 400 )
```

DRAW,

```
DIMENSION PHI ( 400 ), X ( 400 ), Y ( 400 )
Statement No. 23 + 2
IF (NX - 400) 3, 3, 10
```

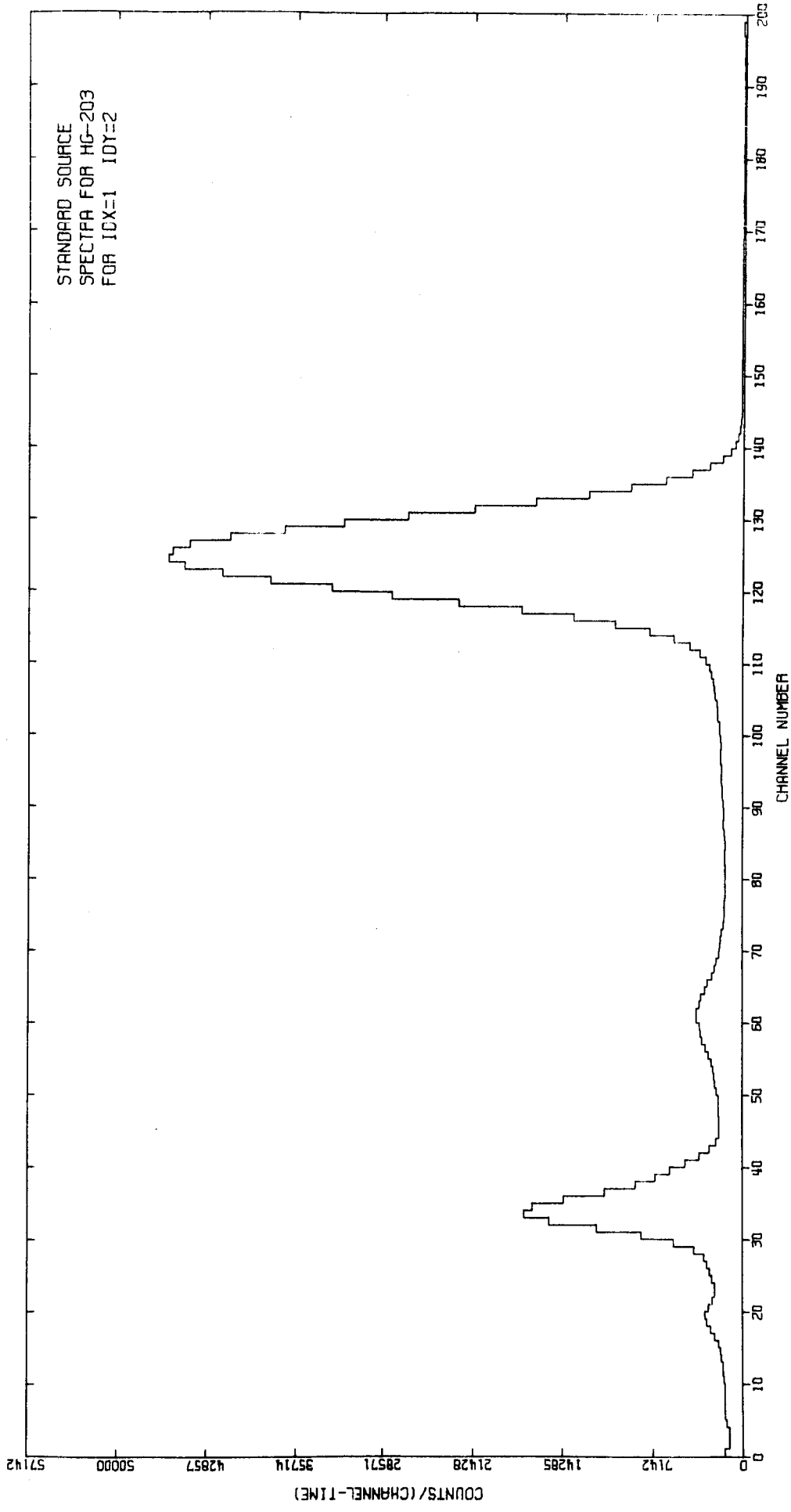
INPUT: Although input for code DRAW is defined above under the heating of 'ARGUMENT DEFINITIONS', a typical input card deck arrangement to plot one spectrum when the main program given in Appendix I is employed, is presented in Figure ›.

REFERENCES

1. J. J. Steyn, NUS-395, Code CUBED-II: A Code to Unfold Bremsstrahlung Experimental Distributions (September 1967).

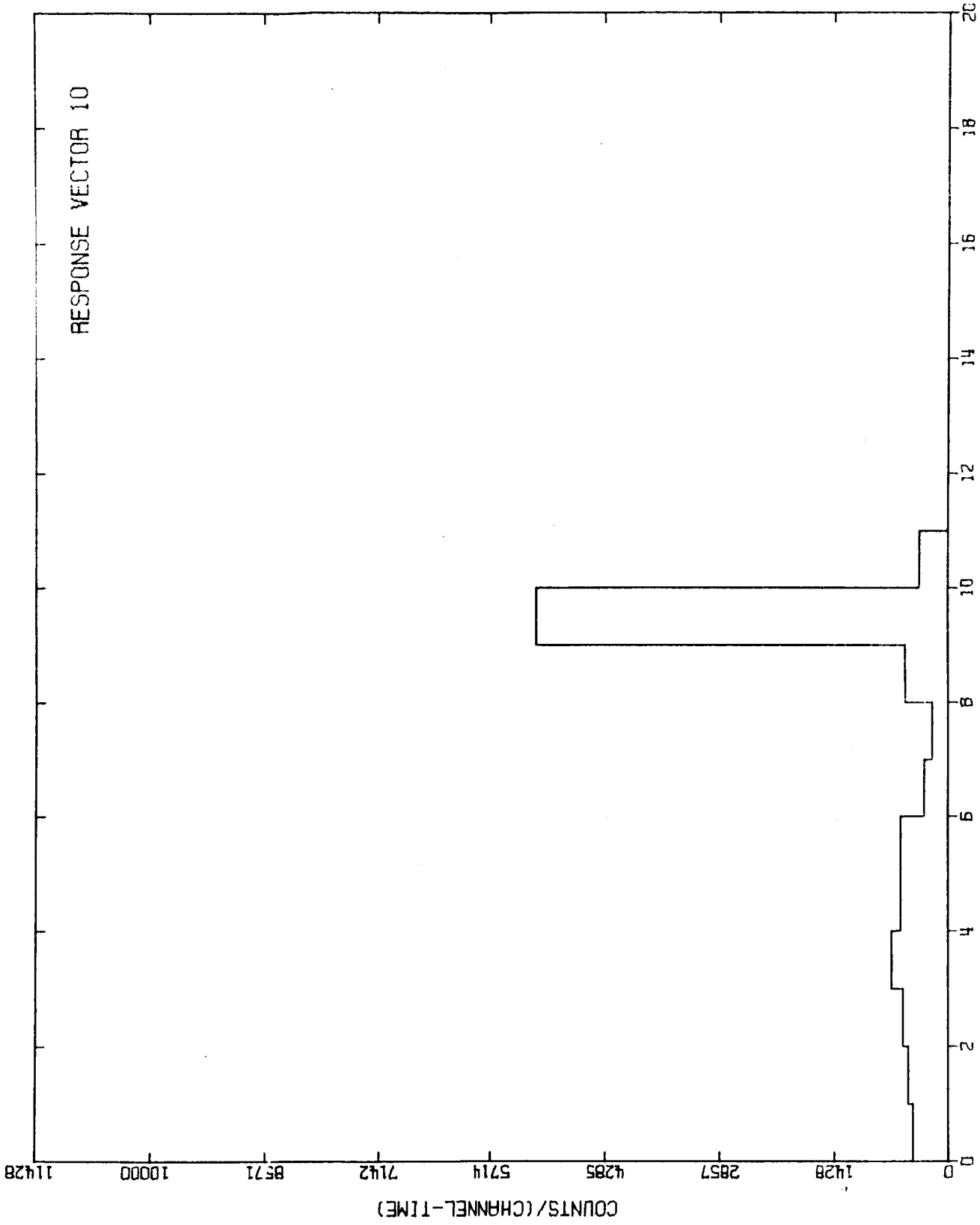
2. Report No. WD-9758-59-1, Calcomp Digital Recorder Users Manual, prepared for the Programming Methods Section Data Systems Division, NASA-GSFC by Computer Sciences Corporation, (January 1967).

FIGURES



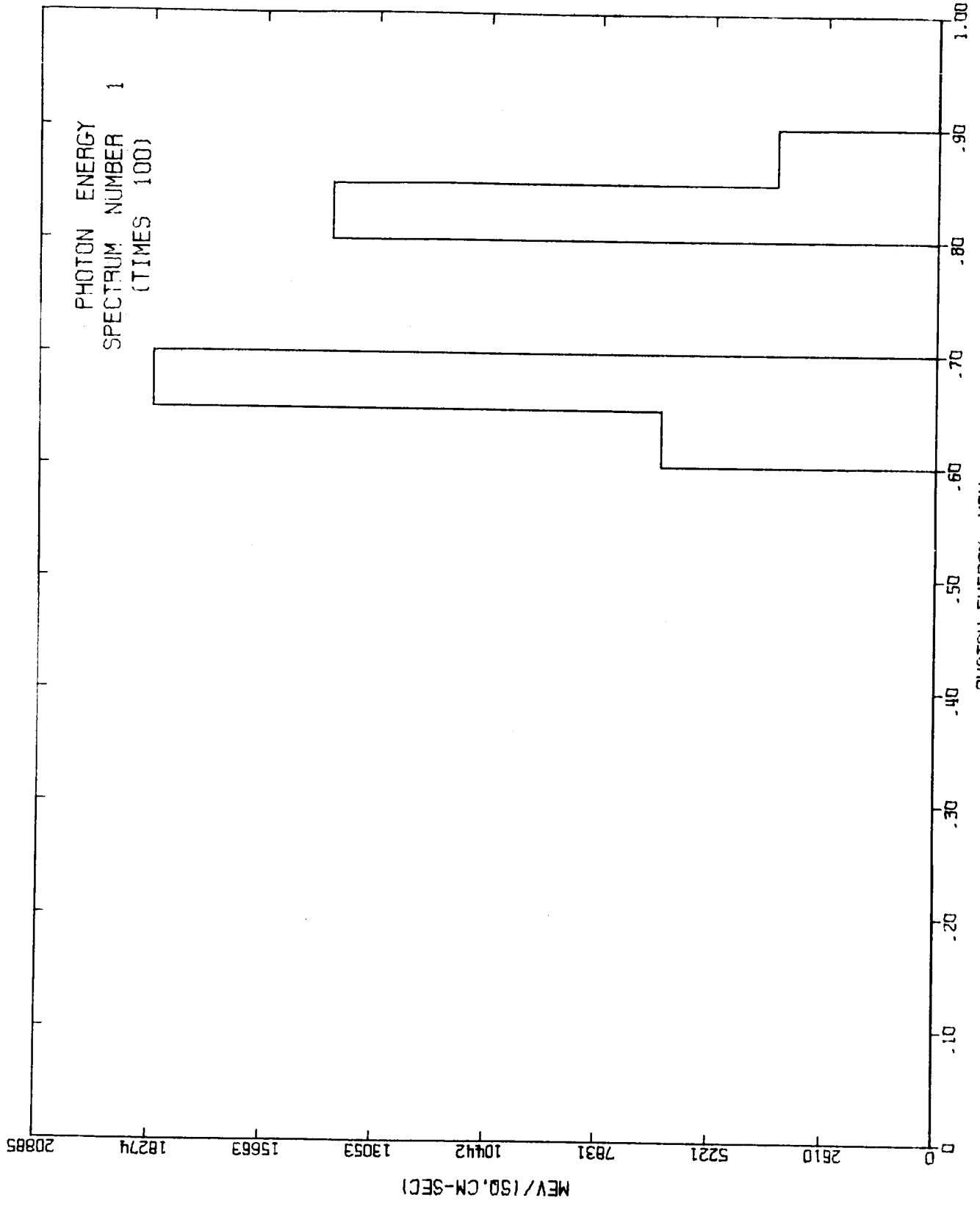
Plot of Pulse-Height-Analyzer Spectrum

FIGURE 1



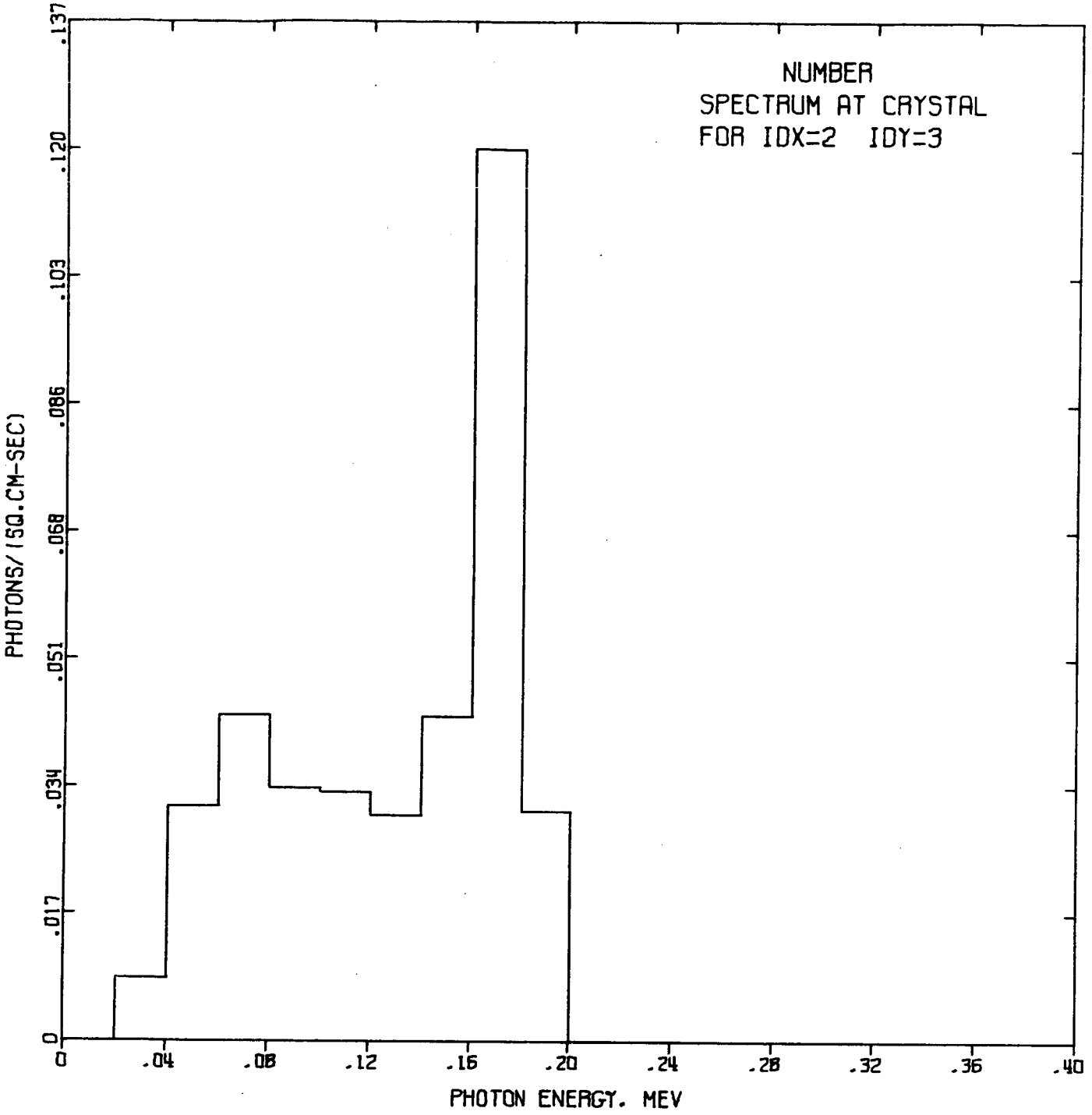
Plot of Response Matrix Spectrum

FIGURE 2



Plot of Photon Energy Spectrum

FIGURE 3



Plot of Photon Number Spectrum

FIGURE 4

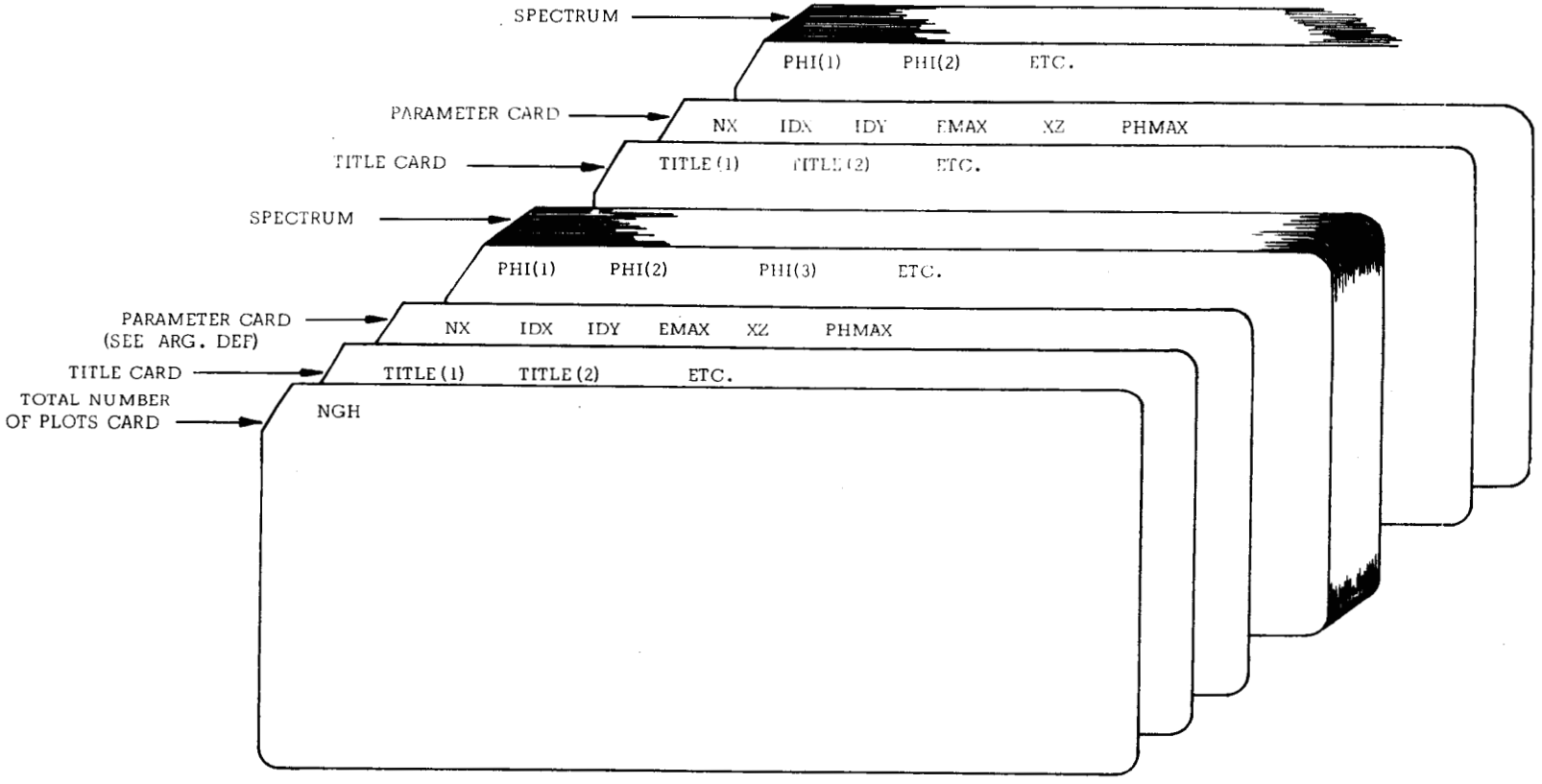


FIG. 5

INPUT CARD DECK ARRANGEMENT

APPENDIX I

FORTRAN LISTING OF SUBPROGRAM DRAW WITH MAIN, CALLED SUBPROGRAMS AND SAMPLE DATA

```
$JOB  5431      CUBED TWO - CALCOMP TEST
$EXECUTE        IBJOB
$IBJOB          GO,SOURCE,MAP
$IBFTC MAIN     DECK,REF,LIST
C         CONTROL PROGRAM FOR SUBPROGRAM *DRAW*, A PROGRAM TO PLOT PULSE-
C         HEIGHT ANALIZER SPECTRAL OUTPUT.
C         WRITTEN BY Y.S.KIM/NUS CORPORATION FEB. 1967
      DIMENSION TITL(12),PHI(200),DATA(512)
      INDC=0
      CALL CPLOTS(DATA,512,INDC)
      READ(2,911)NGH
      IG=1
   11 READ(2,913)(TITL(I),I=1,12),NX,IDX,IDY,EMAX,XZ,PHMAX,(PHI(I),I=1,
     1NX)
  911 FORMAT(I3)
  913 FORMAT(3A6,A2,3A6,A2,3A6,A2/1X,3I5,3E15.8/(1X,5E14.7))
      CALL DRAW(TITL,NX,IDX,IDY,EMAX,PHI,XZ,PHMAX)
      IG=IG+1
      IF(IG-NGH)11,11,99
   99 END FILE 16
      END FILE 16
      STOP
      END
$IBFTC DRAW     DECK,REF,LIST
      SUBROUTINE DRAW(TITL,NX,IDX,IDY,EMAX,PHI,XZ,PHMAX)
C     WRITTEN BY Y.S. KIM       FEB, 1967
C     HISTOGRAM PLOTTING ROUTINE (8X8 IN.)
C     TITL=TITLE OF DRAWING(ALPHANUMERIC) TO BE WRITTEN ON PLOT
C          FIRST 20 CHARACTERS ON FIRST LINE,3A6,A2
C         SECOND 20 CHARACTERS ON SECOND LINE,3A6,A2
C          THIRD 20 CHARACTERS ON THIRD LINE,3A6,A2
C     NX=NO. OF CHANNELS (MUST BE MULTIPLES OF 10) MAX NX=200
C     IDX=X AXIS LABEL SPEC.(1 OR 2)--=1 BY CHANNEL NO.--=2 BY ENERGY
C     IDY=Y AXIS LABEL SPEC.(1,2,OR 3)---=1 BY PHOTONS/SEC,
C        =2 BY COUNTS/(CHANNEL-TIME),---=3 BY PHOTONS/(SQ.CM-SEC)
C        =4 BY MEV/(SQ.CM-SEC)
C     EMAX=MAXIMUM PHOTON ENERGY IN MEV (0.1--10.0MEV)
C     PHI(I)=PHOTON COUNTS      MAX PHI(I) MUST BE  0.01--999999
C     PHMAX=MAX VALUE OF PHI FOR ALL CASES FOR UNIFORM Y AXIS
C     PHI GREATER THAN 900000 IS SET TO PHI-1000000
C     EMAX NOT REQUIRED FOR IDX=1
C     XZ=LENGTH OF X-AXIS(IN.)      MUST BE 8.0-20.0    XZ=0.0 MEANS 8.0
C     YAXIS IS ALWAYS 8.0 IN.
C     N=STANDARD OUTPUT TAPE LOGICAL NO.
      DIMENSION TITL(12),PHI(200),X(400),Y(400),XAX(21),YAX(21)
      N=3
```

```
      YZ=3.0
      IF(XZ)213,213,215
  213 XZ=8.0
  215 CONTINUE
      DO 15 I=1,NX
      IF(PHI(I)-900000.0)15,13,13
   13 PHI(I)=PHI(I)-1000000.0
   15 CONTINUE
C     FIND YMX=MAX PHI(I), SET NEGATIVE PHI(I)=0.0
      YMX=0.0
      DO 23 I=1,NX
      IF(PHI(I))17,23,19
   17 PHI(I)=0.0
      GO TO 23
   19 IF(PHI(I)-YMX)23,23,21
   21 YMX=PHI(I)
   23 CONTINUE
C     PRINT INPUT DATA
      WRITE(N,921)(TITL(I),I=1,12),NX,YMX,IDX,IDY,EMAX,(PHI(I),I=1,NX)
C     INPUT DATA CHECK
      IF(NX-200)3,3,10
    3 IF(IDX-1)10,4,4
    4 IF(IDX-2)5,5,10
    5 IF(IDY-1)10,6,6
    6 IF(IDY-4)7,7,10
    7 IF(YMX-0.00999)10,8,8
    8 IF(YMX-1000000.0)9,10,10
    9 IF(EMAX-0.1)11,201,201
   11 IF(IDX-1)10,201,10
  201 IF(EMAX-10.0)202,202,10
  202 IF(XZ-8.0)10,203,203
  203 IF(XZ-20.0)24,24,10
   10 WRITE(N,923)
      GO TO 60
  923 FORMAT(//5X42H ** INPUT DATA ERROR -- PLOT  ABANDONED **)
  921 FORMAT(1H1,3(5A6,A2)/3X,17H NO. OF CHANNELS=,I5,5X,12H PHI(I) MAX=
     1  ,E12.5,5H IDX=,I2,   5H IDY=,I2,6H EMAX=,E14.5/(7E14.5))
  931 FORMAT(//3X,49H **NUMBER OF CHANNELS NOT IN MULTIPLES OF 10, NX=,
     1I3,20H -- PLOT ABANDONED**)
   24 XNX=NX
      NX2=NX+NX
C     SET HISTOGRAM POINTS
      DO 25 I=2,NX2,2
      I2=I
      I2=I2/2
      X(I)=I2
```

```
      X(I-1)=X(I)-1.0
      Y(I)=PHI(I2)
   25 Y(I-1)=Y(I)
C     SET X-AXIS LABEL POINTS
C     TIC=LENGTH OF TIC MARK ON X,Y AXES
C     XC=X INTERVAL IN INCHES
      TIC=0.08
      GO TO(51,57),IDX
   51 I=1
      EN=XNX/XZ
      XC=1.0
   53 IEN=EN
      EN1=IEN
      IF(EN-EN1)55,61,55
   55 GO TO(57,59,259),I
   57 IF(XZ-15.0)259,259,257
  257 EN=XNX/20.0
      XC=XZ/20.0
      I=3
      GO TO 53
  259 EN=XNX/10.0
      XC=XZ/10.0
      I=2
      GO TO 53
   59 WRITE(N,931) NX
   60 CALL SYMBOL(2.0,4.0,0.10,61HPLOT ABANDONED DUE TO INPUT ERROR ----
     1NEXT PLOT WILL CONTINUE, 0.0,61)
      GO TO 155
   61 NINT=NX/IEN
      IXT=NINT+1
      XAX(1)=0.0
      GO TO (63,62),IDX
   62 EM=NINT
      EN=EMAX/EM
   63 DO 65 IT=2,IXT
      IT1=IT-1
   65 XAX(IT)=EN+XAX(IT1)
      GO TO 69
C     SET Y-AXIS LABEL POINTS
   69 YAX(1)=0.0
      IF(PHMAX-YMX)70,70,169
  169 YMX=PHMAX
   70 DVY=YMX/(YZ-1.0)
      NY=YZ
      NY=NY+1
      DO 71 IT=2,NY
```

```
      IT1=IT-1
   71 YAX(IT)=DVY+YAX(IT1)
C     SCALE X AND Y AXES
      EX=XZ/X(NX2)
      EY=(YZ-1.0)/YMX
      DO 72 I=1,NX2
      X(I)=X(I)*EX
   72 Y(I)=Y(I)*EY
      DO 73 I=1,NX2
      X(I)=X(I)+1.0
   73 Y(I)=Y(I)+1.0
      CALL LINE(X,Y,NX2,1)
      XX=1.0+XZ
      CALL CCPLOT(XX ,1.0,3)
      CALL CCPLOT(1.0,1.0,2)
      YY=1.0+YZ
      CALL CCPLOT(1.0,YY ,2)
      CALL CCPLOT(XX ,YY ,2)
      CALL CCPLOT(XX ,1.0,2)
C     X-AXIS LABEL START
      XS=1.0+XZ
      YS=1.0
      IT=IXT
      GO TO(93,91),IDX
   91 N=2
      DX=0.16
      GO TO 95
   93 N=-1
   95 YS=YS-TIC
      CALL CCPLOT(XS,YS,2)
      GO TO(97,110),IDX
   97 IF(XAX(IT)-10.0)103,105,105
  103 DX=0.03
      GO TO 110
  105 IF(XAX(IT)-100.0)107,109,109
  107 DX=0.07
      GO TO 110
  109 DX=0.11
  110 YN=YS-0.13
      IF(XAX(IT))112,111,112
  111 XN=XS-0.03
      CALL SYMBOL(XN,YN,0.10,1H0,0.0,1)
      GO TO 113
  112 XN=XS-DX
      CALL NUMBER(XN,YN,0.10,XAX(IT),0.0,N)
  113 IF(IT-1)115,115,114
```

```
  114 YS=YS+TIC
      XS=XS-XC
      IT=IT-1
      CALL CCPLOT(XS,YS,3)
      GO TO 95
  115 GO TO(117,119),IDX
  117 XX=1.0+XZ/2.0-0.72
      CALL SYMBOL(XX    ,0.50 ,0.12, 14HCHANNEL NUMBER, 0.0,14)
      GO TO 121
  119 XX=1.0+XZ/2.0-0.92
      CALL SYMBOL(XX    ,0.50 ,0.12, 18HPHOTON ENERGY, MEV, 0.0,18)
C     Y AXIS LABEL START
  121 XS=1.0
      YS=1.0
      IT=1
      IF(YMX-100000.0)222,221,221
  221 DY=0.24
      GO TO 127
  222 IF(YMX-10000.0)123,122,122
  122 DY=0.20
      GO TO 127
  123 IF(YMX-1000.0)125,124,124
  124 DY=0.16
      GO TO 127
  125 IF(YMX-100.0)128,126,126
  126 DY=0.11
  127 N=-1
      GO TO 131
  128 IF(YMX-10.0)229,129,129
  129 DY=0.16
      N=1
      GO TO 131
  229 IF(YMX-1.0)130,230,230
  230 DY=0.18
      N=2
      GO TO 131
  130 DY=0.20
      N=3
  131 CALL CCPLOT(XS,YS,3)
      XS=XS+TIC
      CALL CCPLOT(XS,YS,2)
      XN=XS-TIC-0.04
      YN=YS-DY
      IF(YAX(IT))133,132,133
  132 YN=YS-0.03
      CALL SYMBOL(XN,YN,0.10,1H0,90.0,1)
```

```
      GO TO 134
  133 CALL NUMBER(XN,YN,0.10,YAX(IT),90.0,N)
  134 IF(YS-1.0-YZ)135,137,137
  135 XS=XS-TIC
      YS=YS+1.0
      IT=IT+1
      GO TO 131
  137 GO TO(139,141,142,146),IDY
  139 YY=1.0+YZ/2.0-0.5
      CALL SYMBOL(0.65 , YY  ,0.12, 11HPHOTONS/SEC, 90.0,11)
      GO TO 143
  141 YY=1.0+YZ/2.0-1.10
      CALL SYMBOL(0.65 , YY  ,0.12, 21HCOUNTS/(CHANNEL-TIME),90.0,21)
      GO TO 143
  142 YY=1.0+YZ/2.0-1.0
      CALL SYMBOL(0.65 , YY  ,0.12, 19HPHOTONS/(SQ.CM-SEC),  90.0,19)
      GO TO 143
  146 YY=1.0+YZ/2.0-0.6
      CALL SYMBOL(0.65 , YY  ,0.12, 15HMEV/(SQ.CM-SEC),90.0,15)
C     UPPER X-AXIS MARK
  143 XS=1.0+XC
      YS=1.0+YZ
      IT=2
  145 CALL CCPLOT(XS,YS,3)
      YS=YS-TIC
      CALL CCPLOT(XS,YS,2)
      IF(IT-NINT)147,149,149
  147 XS=XS+XC
      YS=YS+TIC
      IT=IT+1
      GO TO 145
  149 XX=XZ-2.0
      CALL SYMBOL(XX  ,8.55,0.14,TITL(1),0.0,20)
      CALL SYMBOL(XX  ,8.30,0.14,TITL(5),0.0,20)
      CALL SYMBOL(XX  ,8.05,0.14,TITL(9),0.0,20)
C     RIGHT Y-AXIS MARK
      XS=1.0+XZ
      YS=YZ
  151 CALL CCPLOT(XS,YS,3)
      XS=XS-TIC
      CALL CCPLOT(XS,YS,2)
      IF(YS-2.0)155,155,153
  153 XS=XS+TIC
      YS=YS-1.0
      GO TO 151
  155 XX=XZ+5.0
```

```
      CALL CCPLOT(XX   ,0.0,-3)
C     END OF ONE PLOT
      RETURN
$IBFTC NUMBER  DECK,REF,LIST
      SUBROUTINE NUMBER (X,Y,HGHT,FPN,THETA,N)                          NMBR0040
C                                                                       NMBR0050
C  WHERE-  X,Y    IS THE COORDINATE OF LOWER LEFT CORNER OF THE FIRST    NMBR0060
C                 DIGIT OF OUTPUT.(X,Y) IS IN FLOATIN POINT PAGE INCHES. NMBR0070
C          HGHT   IS THE HEIGHT OF THE PLOTTED NUMBER. (FLOATING INCHES) NMBR0080
C          FPN    IS THE FLOATING POINT NUMBER TO BE PLOTTED.            NMBR0090
C          THETA  IS THE ANGLE ON THE PAGE FOR THE NUMBER.               NMBR0100
C          N      IS THE NUMBER DECIMAL DIGITS FOR OUTPUT. A (-1) VALUE  NMBR0110
C                 WILL SUPPRESS THE DECIMAL POINT.                       NMBR0120
C                                                                       NMBR0130
      TFPN =ABS (FPN) * 1.0000002                                       NMBR0140
      TH = THETA * .017455                                              NMBR0150
      CTH = HGHT * 6.0 / 7.0                                            NMBR0160
      STH = CTH * SIN (TH)                                              NMBR0170
      CTH = CTH * COS (TH)                                              NMBR0180
      XT = X                                                            NMBR0190
      YT = Y                                                            NMBR0200
      IF (FPN) 10,90,20                                                 NMBR0210
   10 CALL SYMBOL (XT,YT,HGHT,1H-,THETA,1)                              NMBR0220
      XT = XT + CTH                                                     NMBR0230
      YT = YT + STH                                                     NMBR0240
   20 I = 0.4343 *ALOG (TFPN) + 1.0                                     NMBR0250
      IF (I) 50,50,30                                                   NMBR0260
   30 DO 40 J = 1,I                                                     NMBR0270
        K = TFPN * 10.0 ** (J-I)                                        NMBR0280
      CALL SYMBOL (XT,YT,HGHT,(K    )*2**30,THETA,1)                    NMBR0290
        TFPN = TFPN - FLOAT  (K * 10 ** (I-J))                          NMBR0300
        XT = XT + CTH                                                   NMBR0310
   40   YT= YT+ STH                                                     NMBR0320
      IF (N+1) 60,60,50                                                 NMBR0330
   50 CALL SYMBOL (XT,YT,HGHT,1H.,THETA,1)                              NMBR0340
      IF (N) 80,80,60                                                   NMBR0350
   60 DO 70 I = 1,N                                                     NMBR0360
        XT = XT + CTH                                                   NMBR0370
        YT = YT + STH                                                   NMBR0380
        K = TFPN * 10.0                                                 NMBR0390
      CALL SYMBOL (XT,YT,HGHT,(K    )*2**30,THETA,1)                    NMBR0400
   70 TFPN = TFPN * 10.0 - FLOAT (K)                                    NMBR0410
   80 RETURN                                                            NMBR0420
   90 CALL SYMBOL (XT,YT,HGHT,13H0.0000000000 ,THETA,2+N)               NMBR0430
      RETURN                                                            NMBR0440
      END                                                               NMBR0450
```

```
$IBFTC LINE     DECK,REF,LIST
      SUBROUTINE LINE (X,Y,N,K)                                          LINE5030
C LINE                                                                   LINE5030
      DIMENSION X(1),Y(1)                                                LINE5040
      I3=3                                                               LINE5050
      KK =IABS  (K)                                                      LINE5060
      J = 1. * KK - KK + 1                                               LINE5070
      CALL WHERE (XN,YN)                                                 LINE5080
      DX1 = ABS  (X(1)-XN)                                               LINE5090
      DY1 = ABS  (Y(1)-YN)                                               LINE5100
      DX2 = ABS  (X(J )-XN)                                              LINE5110
      DY2 = ABS  (Y(J )-YN)                                              LINE5120
      DX1 =AMAX1 (DX1,DY1)                                               LINE5130
      DX2 =AMAX1 (DX2,DY2)                                               LINE5140
      IF (DX1-DX2) 8,8,9                                                 LINE5150
    8 J = 1                                                              LINE5160
      KK = - KK                                                          LINE5170
      IF (K) 5,9,9                                                       LINE5180
    5 I3 = 2                                                             LINE5190
    9 DO 10 I=1,N                                                        LINE5200
      CALL CCPLOT (X(J),Y(J),I3)                                         LINE5210
      J = J+ KK                                                          LINE5220
   10 I3 = 2                                                             LINE5230
   11 RETURN                                                             LINE5240
      END                                                                LINE5250
$IBMAP CPLTS    DECK,REF,LIST
*PLT470/1   COPYRIGHT 1965     *1     CALIFORNIA COMPUTER PRODUCTS        P4700030
       ENTRY   CCPLOT
       ENTRY   CPLOTS                                                GSFC1P4700090
       ENTRY   WHERE                                                      P4700100
       ENTRY   FACTOR                                                     P4700110
       ENTRY   OFFSET                                                     P4700120
       ENTRY   ZIP                                                        P4700130
       ENTRY   .UNIT.                                                     P4700144
UNIT10 FILE    ,A(2),OUTPUT,BIN,BLK=1024,LOW,DEFER
.UNIT. PZE     UNIT10                                                     P4700164
       REM                                                               P4700170
       REM FORTRAN LINKAGE                                               P4700180
       REM                                                               P4700190
       REM CALL PLOTS (DATA , N , K )                                    P4700200
       REM                                                               P4700210
       REM       DATA     IS THE LOCATION OF A WORK REGION FOR PLOT ROUTNP4700220
       REM      N IS THE NUMBER OF WORDS IN THIS WORK REGION              P4700230
       REM       K        IS THE LOGICAL TAPE UNIT FOR PLOT OUTPUT.      P4700240
       REM                                                               P4700250
       REM CALL PLOT (X,Y,IC)                                            P4700260
```

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        REM                                                                 P4700270
        REM       X IS THE LOCATION OF THE FLOATING POINT DATA POINT THAT   P4700280
        REM              PLOTTER IS TO MOVE TO.                             P4700290
        REM       Y IS THE LOCATION OF THE FLOATING POINT DATA POINT THAT   P4700300
        REM              PLOTTER IS TO MOVE TO.                             P4700310
        REM       IC IS A SIGNED FIXED POINT INTEGER. A POSITIVE IC IS      P4700320
        REM            NORMAL. A NEGATIVE IC MEANS - ESTABLISH A NEW        P4700330
        REM            REFERENCE POINT. OR STORE ZERO IN CURRENT PEN        P4700340
        REM             POSITION AFTER MOVING TO (X,Y) IN LINKAGE.          P4700350
        REM            IC  IS  EQUAL TO N+K-WHERE N = 3 FOR PEN UP          P4700360
        REM            AND N = 2 FOR PEN DOWN. -WHERE K =0  TO INDICATE     P4700370
        REM           THE VALUES IN (X,Y) ARE PHYSICAL PAGE DIMENSIONS.     P4700380
        REM            WHEN  K = 10 , THIS INDICATES SCALE FACTORS          P4700390
        REM             PROVIDED THROUGH OFFSET ENTRY ARE TO BE USED TO     P4700400
        REM            COMPUTE  PLOTTER MOVE. IF IC EXCEEDS  13 THIS        P4700410
        REM            MEANS TO EMPTY WORK REGION AND WRITE BLOCK            P4700420
        REM            ADDRESS OF  999. TWO  END OF FILES ARE WRITTEN       P4700430
        REM                                                                 P4700440
        REM   CALL OFFSET (XOFF, XFAC,YOFF,YFAC)                            P4700450
        REM                                                                 P4700460
        REM       XOFF IS LOCATION OF FLOATING POINT X OFFSET.(XMIN)        P4700470
        REM       XFAC IS LOCATION OF FLOATING POINT X SCALE FACTOR.(DX)    P4700480
        REM       YOFF IS LOCATION OF FLOATING POINT Y OFFSET.(YMIN)        P4700490
        REM       YFAC IS LOCATION OF FLOATING POINT Y SCALE FACTOR.(DY)    P4700500
        REM                                                                 P4700510
        REM CALL FACTOR (FCTR)                                              P4700520
        REM     FCTR IS THE CURRENT FACTOR ALL COORDINATES ARE MULTIPLIEDP4700530
        REM                                                                 P4700540
        REM CALL WHERE (X,Y)                                                P4700550
        REM                                                                 P4700560
        REM       X AND Y ARE CURRENT PLOTTER POSITION SUPPLIED BY PLOT     P4700570
        REM       ROUTINE TO SUBROUTINE MAKING THE CALL.                    P4700580
        REM                                                                 P4700590
        REM CALL ZIP (MAX,MIN,NUP,NDOWN)                                    P4700600
        REM                                                                 P4700610
        REM      MAX     IS THE MAXIMUM ZIP LEVEL                           P4700620
        REM      MIN     IS THE SAFE ZIP LEVEL TO LEAVE ZIP MODE            P4700630
        REM      NUP     IS THE UP PEN DELAY COUNT                          P4700640
        REM      NDOWN   IS THE PEN DOWN DELAY COUNT                        P4700650
        REM                                                                 P4700660
OFFSET  CLA*     5,4              PICK UP X OFFSET (XMIN)                   P4700684
        STO XOFF                                                            P4700690
        REM                                                                 P4700700
        CLA*     4,4             PICK UP DX (XFACTOR)                      P4700724
        TNZ *+2                    TRANSFER IF DX IS NON ZERO               P4700730
        CLA FONE                   SET FACTOR TO 1.0 IF ZERO ENCOUNTEREDP4700740
```

```
        STO XFACT                                                       P4700750
        REM                                                             P4700760
        REM                                                             P4700770
        CLA*    5,4         PICK UP Y OFFSET (YMIN)                     P4700794
        STO YOFF                                                        P4700800
        REM                                                             P4700810
        CLA*    6,4         PICK UP DY (Y FACTOR)                       P4700834
        TNZ **+2              TRANSFER IF DX IS NON ZERO                P4700840
        CLA FONE              SET FACTOR TO 1.0 IF ZERO ENCOUNTEREDP4700850
        STO YFACT                                                       P4700860
        REM                                                             P4700870
        TRA     1,4         RETURN FROM OFFSET ENTRY.                   P4700894
FONE    DEC 1.0                                                         P4700900
        REM                                                             P4700910
ZIP     CLA*    5,4       PICK UP NEW PEN UP DELAY COUNT                P4700934
        ALS     18          MOVE DELAY COUNT INTO DECREMENT             P4700944
        STO     PUD                                                     P4700950
        CLA*    6,4       PICK UP NEW PEN DOWN DELAY COUNT.             P4700974
        ALS     18          MOVE DELAY COUNT INTO DECREMENT             P4700984
        STO     PDD                                                     P4700990
        TRA     1,4       RETURN-IGNORE FIRST TWO ZIP ARGUMENTS.        P4701014
WHERE   CLA PENX              PICK UP FIXED PEN X * 100                 P4701020
        ORA FKF               MASK ON FLOATING CHARACTERISTIC           P4701030
        FAD FKF               NORMALIZE PEN X                           P4701040
        FDP K100              COMPUTE PAGE COORDINATE                   P4701050
        STO*    3,4         PUT CURRENT X VALUE INTO LINKAGE.           P4701074
        REM                                                             P4701080
        CLA PENY              PICK UP FIXED PEN Y  * 100                P4701090
        ORA FKF               MASK ON FLOATING CHARACTERISTIC           P4701100
        FAD FKF               NORMALIZE PEN Y                           P4701110
        FDP K100              COMPUTE PAGE COORDINATE                   P4701120
        STO*    4,4         PUT CURRENT Y VALUE INTO LINKAGE.           P4701144
        CLA FCTR              PICK UP CURRENT FACTOR USED BY PLOT       P4701150
        STO*    5,4         PUT CURRENT FACTOR INTO LINKAGE.            P4701174
        REM                                                             P4701180
        TRA     1,4         RETURN FROM WHERE ENTRY.                    P4701204
        REM                                                             P4701210
FACTOR LDQ*     5,4         PICK UP FACTOR.                             P4701234
        STO FCTR              SAVE FACTOR FOR WHERE ENTRY               P4701240
        FMP RF100             MULTIPLY FACTOR BY 100.0                  P4701250
        STO K100              STORE FOR USE IN CALCULATING INTEGER      P4701260
        TRA     1,4         RETURN FROM FACTOR ENTRY.                   P4701284
        REM                                                             P4701290
CPLOTS  SXD X4,4              SAVE INDEX FOR RETURN FROM INITIGSFC1P4701300
        SXD X2,2                                                        P4701310
        STZ*    5,5                                                GSFC1P4701325
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         CLA      3,4              PICK UP LOCATION OF BUFFER AREA.        P4701334
         STA BUF1                    SET UP FIRST DATA BUFER              P4701340
         CLA*     4,4              PICK UP COUNT OF BUFER REGION           P4701364
         LRS      35               CLEAR ACCUM AND LOAD Q WITH COUNT.      P4701384
         DVP      DENSE            DENSE = 2,3,4 FOR FULL,HALF,THIRD       P4701390
         LLS      35               PUT BACK INTO ACCUMULATOR.              P4701400
         PAX 8135,4                  SAVE COUNT FOR EACH BUFER            P4701410
         ADD BUF1                    COMPUTE LOCATION OF SECOND BUFER     P4701420
         STA      BUF2             INITIALIZE UNPACK BUFER STORE LOCATION.P4701430
         STA      IOPI          INITIALIZE TAPE WRITE INFO.             P4701440
         TXI      *+1,4,-1      ADJUST COUNT FOR END OF BUFER TEST.     P4701450
         PXD 0,4                     PUT ADJUSTED COUNT IN DECREMENT      P4701460
         COM                         COMPUTE BUFER FULL TEST COUNT        P4701470
         STO FLTST                   STORE IN FIRST FULL TEST             P4701480
         STO FLT                     STORE IN SECOND FULL TEST DECREMENT  P4701490
         CLA      .UNIB.           PICK UP TAPE FILE DATA.                 P4701544
         STA      L                INITIALIZE TAPE LINKAGE. (WRITE)        P4701554
         STA      M                INITIALIZE TAPE LINKAGE. (OPEN)         P4701564
         STA      P                INITIALIZE TAPE LINKAGE. (CLOSE)        P4701574
         ADD      ONE                                                      P4701584
         STA      ORS                                                      P4701594
         CAL      KONK                                                     P4701604
ORS      ORS      **                                                       P4701614
         TSX      .OPEN,4          OPEN TAPE FILE.                         P4701624
M        PZE      **,0,0                                                   P4701634
         SDLA     6                                                  GSFC1
         TSX TRW,4                   TRANSFER TO TAPE WRITE               P4701640
         IOCD     START,0,NBS      BLOCK ADDRESS TAPE WRITE DATA.          P4701650
         TSX TRW,4                   TRANSFER TO TAPE WRITE               P4701660
         IOCD     DAD-1,0,3        NO-INFO RECORD FOR SPACE AFTER BLOCK    P4701670
 X2      TXI EXIT+1,0,**             GO TO EXIT FOR RETURN FROM INITIALIZEP4701740
         REM                                                              P4701770
CCPLOT   SXD X4,4                    SAVE INDEX 4 FOR RETURN        GSFC1P4701780
         SXD X2,2                    SAVE INDEX 2 FOR RETURN              P4701790
         SXD X1,1                    SAVE INDEX 1 FOR RETURN              P4701800
         REM                                                              P4701810
         CLA*     3,4             PICK UP NEW X VALUE.                    P4701834
         STO LX                                                           P4701840
         CLA*     4,4             PICK UP NEW Y VALUE.                    P4701864
         STO LY                                                           P4701870
         CLA*     5,4             PICK UP PEN,PICTUR,OFFSET,BLOCK INDICATP4701894
         ALS      18              MOVE INTO DECREMENT.                    P4701904
         STO EPE                     SAVE FOR END OF PICTURE TEST         P4701910
         PDX 7,4                     SET INDEX EQUAL TO IC                P4701920
         TIX SC,4,10                 TRANSFER IF INDICATOR GREATER 3      P4701930
RSC      AXT 2,4                                                          P4701940
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        LDQ  LX+2,4                 DIVIDE NEW X BY PLOTTER STEP SIZE    P4701950
        FMP  K100                                                        P4701960
        STO  YPLTC                  SAVE SIGN OF NEW X (OR Y) TEMPORARY  P4701970
        SSP                                                              P4701980
        FAD  P005                   FIX AT B34 AND ROUND                 P4701990
        ARS  1                      TRUNCATE ROUNDED NO. NOW B35.        P4702000
        ANA  MASK                   ELIMINATE CHARACTERISTIC             P4702010
        LDQ  YPLTC                  BRING SIGN INTO MQ                   P4702020
        LLS  0                      RESTORE ORIGINAL SIGN TO NEW X (OR Y)P4702030
        STO  YPLTC                  SAVE NEW X (OR Y)                    P4702040
        SUB  PENX+2,4               COMPUTE DELTA X AND DELTA Y          P4702050
        SLW  DX+2,4                 SAVE DX AND DY                       P4702060
        LDQ  PX+2,4                 PICK UP PLUS X CHAR (OR Y)           P4702070
        TPL  *+2                    SKIP NEXT INSTRUCTION IF DX PLUS (/RYP4702080
        LDQ  MX+2,4                 PICK UP MINUS X PLOT CHAR (OR Y)     P4702090
        CLA  YPLTC                  SET PENX TO NEW X AND PENY TO NEW Y  P4702100
        STQ  XPLTC+2,4              STORE CORRECT X PLOT CHAR (OR Y)     P4702110
        STO  PENX+2,4                                                    P4702120
        TIX  RSC+1,4,1              RETURN FOR Y CALCULATION             P4702130
        REM                                                              P4702140
        CLA  XPLTC                  PICK UP X PLOT CHARACTER             P4702150
        ADD  YPLTC                  ADD Y PLOT CHARACTER TO GET COMBINED P4702160
        LXD  XPLTC,4                PICK UP X PLOT CHAR FOR TEST         P4702170
        TXL     E1,4,12288      TRANSFER IF  X IS EQUAL TO 2             P4702180
        LXD  YPLTC,4                PICK UP Y PLOT CHAR FOR TEST         P4702190
        TXH     E1,4,0            SKIP DIVISION WHEN X=6 AND Y=0.        P4702200
E3      ADD     B5                                                       P4702210
PUD     TXI     E2,0,1          PEN UP DELAY IN DECREMENT                P4702220
 E1     ARS  1                      DIVIDE X + Y PLOT CHAR BY TWO        P4702230
 E2     STO  XYPLTC                 SAVE COMBINED XY PLOT CHARACTER      P4702240
        REM                                                              P4702250
        CLA  DX                     COMPARE ABSOLUTE DX TO ABS.DY        P4702260
        SUB  DY                                                          P4702270
        TPL  SKIP                   SKIP IF ABSOLUTE DX IS BIGGEST       P4702280
        CLA  DX                     INTERCHANGE DX  AND DY               P4702290
        LDQ  DY                                                          P4702300
        STQ  DX                                                          P4702310
        STO  DY                                                          P4702320
        REM                                                              P4702330
        CLA  YPLTC                  SUBSTITUTE Y PLOT CHAR.FOR X         P4702340
        STO  XPLTC                                                       P4702350
        REM                                                              P4702360
SKIP    LXA  DX,4                   INDEX  4  IS COUNT  FOR  LOOP        P4702370
        TXL  TPIC,4,0               EXIT IF NO MOVE REQUIRED             P4702380
        REM                                                              P4702390
        CLA  DY                     PICK UP SMALL MOVEMENT COUNT         P4702400
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        ALS 19                      DOUBLE DY AND PLACE IN DECREMENT     P4702410
        STO RATIO                   SET UP RATIO IN INCREMENT LOOP       P4702420
        CLA DX                      PICK UP DX                           P4702430
        ALS 19                      DOUBLE DX AND PUT IN DECREMENT       P4702440
        STO TEST                    SET UP DECREMENT ON COMBINED TEST    P4702450
        REM                                                              P4702460
        LXD EPE,2                   PICK UP PEN MOVE COMMAND(IC)         P4702470
        PXD     0,2             PUT CURRENT PEN REQUEST INTO ACCUMULATOR P4702480
        SUB     IP              COMPARE TO CURRENT PEN POSITION          P4702490
        TZE     AL2             TRANSFER  AROUND PEN MOVE ALREADY THERE  P4702500
        TXH PENUP,2,2               TRANSFER ON PEN UP COMMAND.          P4702510
        LXD     PDD,4           PICK PEN DOWN DELAY COUNT                P4702520
        LDQ PNDN                    PICK UP PEN DOWN PLOT CHARACTER      P4702530
RTRN    SXD     IP,2                RESET PEN POSITON INDICATOR          P4702540
        STQ PMOVE                   SAVE PEN MOVE CHARACTER              P4702550
        CLA PART                    PICK UP PARTIAL 670 WORD FOR PEN CHARP4702560
        LXD SS2,1                   PICK UP SHIFT IN COUNTER             P4702570
        LDQ PMOVE                   PUT PEN MOVE COMMANDS IN MQ          P4702580
        LGL 6                       SHIFT IN ONE PEN COMMAND             P4702590
        TNX STR,1,1                 TRANSFER WHEN WORD FULL              P4702600
GBK     TIX *-3,4,1                 GO BACK FOR DELAY COUNT              P4702610
        SXD SS2,1                   SAVE PARTIAL WORD SHIFT COUNT        P4702620
        STO PART                    SAVE NEW PARTIAL WORD                P4702630
SS2     TXI AL2,0,6                 GO TO OUTPUT OF INCREMENTS           P4702640
STR     LXD SVX2,2                  PICK UP STORE COUNT                  P4702650
        STO* BUF1                   SAVE FULL 570 WORD IN BUFER          P4702660
        TXI **+1,2,-1               INCREMENT STORE COUNT                P4702670
        SXD SVX2,2                  SAVE STORE COUNT                     P4702680
        PXD 0,0                     CLEAR ACCUMULATOR TO PREVENT OVERFLOWP4702690
        LXA K6,1                    SET INDEX TO SHIFT IN COUNT          P4702700
FLT     TXH GBK,2,**                GO BACK AS LONG AS BUFER NOT FULL    P4702710
        TSX TRW,4                   WRITE FULL BUFER. DO NOT GO BACK FOR P4702720
        IOCP    DAD,0,NS          SYNC DATA FOR PLOT DATA RECORD.        P4702730
AL2     LXA DX,1                    PICK UP INITIAL SETTING OF ACCUM(NA) P4702740
        LXA DX,4                    PICK UP INCREMENT COUNT              P4702750
        LXD SS2,2                   SET INDEX TO SHIFT COUNT             P4702760
        CLA PART                    PICK UP PARTIAL 670 WORD             P4702770
RATIO   TXI **+1,1,**               NA=NA+NR                             P4702780
        LDQ XPLTC                   PUT X PLOT CHARACTER IN MQ           P4702790
TEST    TNX **+2,1,**               TRANSFER IF NA GREATER NT OR NA=NA-NTP4702800
        LDQ XYPLTC                  PUT XY PLOT CHARACTER INTO MQ        P4702810
        LGL 6                       SHIFT CORRECT CHARACTER INTO PARTIAL  P4702820
        TIX TXRAT,2,1               TRANSFER UNTIL SHIFT COUNT GONE      P4702830
        LXD SVX2,2                  PICK UP STORE COUNT                  P4702840
BUF1    SLW     **,2              STORE 770-5/1 WORD INTO BUFFER.        P4702850
        TXI **+1,2,-1               INCREMENT STORE COUNT                P4702860
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        SXD SVX2,2                     SAVE STORE COUNT                        P4702870
 FLTST  TXH LX6,2,**                   TRANSFER IF BUFER NOT FULL              P4702880
        SXD TS4,4                      TEMPORARY SAVE INCREMENT COUNT          P4702890
        TSX TRW,4                      WRITE FULL BUFER                        P4702900
        IOCP     DAD,0,NS           SYNC DATA FOR PLOT DATA RECORD.            P4702910
        LXD TS4,4                      RESTORE INDEX TO REMAINING COUNT        P4702920
 LX6    LXA K6,2                       REFRESH SHIFT COUNT                     P4702930
 K6     PXD 6,0                        CLEAR ACCUMULATOR TO PREVENT OVERFLOWP4702940
 TXRAT  TIX RATIO,4,1                  GO BACK FOR REST OF INCREMENTS          P4702950
        STO PART                       SAVE PARTIAL 670 WORD FOR NEXT TIME     P4702960
        SXD SS2,2                      SAVE SHIFT COUNT FOR NEXT TIME H  E     P4702970
TPIC    CLA  EPE                       PICK UP END OF PICTURE INDICATOR        P4702980
        TMI      ENDP               TRANSFER IF END OF PICTURE ASKED FOR       P4702990
        CLA      RFIND              PICK UP REREFER INDICATOR                  P4702995
        TZE      EXIT               EXIT IF NO REREFER REQUIRED                P4703000
        STZ      RFIND              RESET REFERENCE INDICATOR                  P4703010
        TXI      RFR,0,0            SKIP DUMPING OF BUFFER                     P4703020
ENDP    LXD SVX2,2                     PICK UP STORE COUNT FOR TAPE WRITE      P4703030
        LXD SS2,1                      PICK UP SHIFT COUNT                     P4703040
        TXL      *+2,1,5            SKIP NEXT INSTRUCTION IF SOMETHING IN      P4703050
        TXL      SLUM,2,0           NOTHING IS IN BUFFER IF WE TAKE THIS TRP4703060
        TXH      SLM,1,5          SKIP IF NOTHING IS IN PARTIAL WORD.          P4703070
        CLA PART                       PICK UP PARTIAL 670 WORD IF ANY         P4703080
        LDQ PMOVE                      PICK UP DUMMY PEN COMMANDS              P4703090
 LGL    LGL 6                          SHIFT IN DUMMY PEN CODE TO FILL PARTIP4703100
        TIX      LGL-1,1,1             USE ALL OF SHIFT COUNT                  P4703110
        SLW*     BUF1             STORE 770-5/1 WORD INTO BUFFER.              P4703120
        TXI *+1,2,-1                   INCREASE STORE COUNT                    P4703130
SLM     TSX TRW,4                      TRANSFER TO TAPE WRITE                  P4703140
        IOCP     DAD,0,NS           SYNC DATA FOR PLOT DATA RECORD.      )     P4703150
 SLUM   CLA      N                  PICK UP LAST BLOCK NUMBER                  P4703160
        ADD      ONE                INCREMENT BY ONE.                          P4703170
        STO      N                  SAVE FOR NEXT BLOCK NUMBER.                P4703180
        LXA L36,4                *1    SET INDEX FOR BLOCK ADDRESS COMPUTE     P4703190
        CLA FOURS                      PICK UP BCD WORD OF ALL FOURS           P4703220
        STO ABS                        INITIALIZE BLOCK ADDRESS CELL           P4703230
        LDQ N                          PICK UP BLOCK NO. FOR DIVISION          P4703260
 L36    PXD 36,0                       CLEAR ACCUM.                            P4703270
        DVP TEN                        DIVIDE BY TEN                           P4703280
        STQ YPLTC                      SAVE QUOTIENT FOR NEXT DIVISION         P4703290
        LRS 2                          SHIFT 2 BITS OF REMAINDER INTO MQ       P4703300
        ALS      4               *1    INSERT 4 ZERO BITS BETWEEN 8,4 AND 2,P4703310
        LLS 38,4                 *1    SHIFT 2 BITS BACK AND INTO CORRECT POP4703340
        ORS ABS                  *1    PUT FUNNY 2 CHANNEL BITS INTO BLOCK     P4703370
        LDQ YPLTC                      PICK UP QUOTIENT TO GET NEXT ORDEROF P4703400
        TIX L36,4,12             *1    CHANGE SHIFT COUNT AND GO BACK FOR NEP4703410
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BAXIT   TSX     TRW,4           TRANSFER TO WRITE BLOCK ADDRESS.          P4703570
 BIO    IOCD    START,0,NBS       BLOCK ADDRESS TAPE WRITE DATA.(         P4703580
        TSX TRW,4                   TRANSFER TO TAPE WRITE                P4703590
NIO     IOCD    DAD-1,0,3         NO-INFO RECORD TO PROVIDE SPACE AFTER   P4703600
REN     STZ PENX                    SET NEW REFERENCE POINT(X).           P4703605
        STZ PENY                    SET NEW REFERENCE POINT(Y).           P4703610
        STZ     IP              RESET PEN POSITION INDICATOR FOR NEXT PLOTP4703615
 EXIT   LXD X1,1                                                          P4703620
        LXD X2,2                                                          P4703630
        LXD X4,4                                                          P4703640
        TRA     1,4                                                       P4703664
        REM                                                               P4703670
 TRW    SXD X42,4                   SAVE INDEX FOR RETURN                 P4703680
        SXD KXK,1                   SAVE INDEX FOR RETURN                 P4703690
        CLA 1,4                     PICK UP LOCATION OF CURRENT BUFER     P4703740
        STC     IO              PICK TAPE WRITE DATA FIRST WORDS.         P4703750
        TPL     WRS               SKIP THIS IS BLOCK OR NO INFO.          P4703760
        SXD     UNP,2             SAVE X 2 FOR TEST OF EMPTY UNPACK BUFFERP4703770
        AXT     0,2               LOAD INDEX FOR PACKED DATA PICK UP.     P4703780
        AXT     0,4             LOAD INDEX TO STORE UNPACKED DATA.        P4703790
 UN1    LDQ*    BUF1              PICK UP PACKED WORDS.                   P4703800
        CRQ     CODE,0,6          BRING IN TAPE CODES FOR 470 PLOT SYSTEMP4703810
        SXD     SVX2,2            SAVE INDEX TEMPORARILY.                 P4703820
        AXT     3,2             *1 LOAD INDEX FOR ALL OF PACKED WORD.     P4703830
 UN2    AXT     6,1             *1 LOAD INDEX FOR 2 FULL PLOTTER COMMANDS.P4703860
        PXD     0,0               CLEAR ACCUM TO PREVENT OVERFLOW         P4703890
 UN3    ALS     4                 SHIFT IN ZERO S BETWEEN BITS.           P4703900
        LGL     2                 SHIFT IN PLOTTER BITS.                  P4703910
        TIX     UN3,1,1           GO BACK UNTIL UNPACK WORD IN AC COMPLETP4703940
        ORA     START             ADD COMMON BITS TO FINISH WORD.         P4703950
        SLW*    BUF2              STORE FINISHED UNPACKED WORD.           P4703960
        TXI     *+1,4,-1          INCREASE STORE COUNT                    P4703970
        TIX     UN2,2,1           GO BACK FOR COMPLETE PACKED WORD.       P4703980
        LXD     SVX2,2            RESET PICK UP INDEX.                    P4703990
        TXI     *+1,2,-1          INCREMENT FOR NEXT WORD.                P4704000
 UNP    TXH     UN1,2,**          HAVE WE EVERYTHING OUT OF BUFFER.       P4704010
        TXI     *+1,4,-1          CORRECT COUNT.                          P4704020
        PXD     0,4               PUT NEGATIVE COUNT INTO AC.             P4704030
        COM                       COMPUTE CORRECT COUNT OF DATA IN BUFER.P4704040
        STD     IOP1              SAVE IN OUTPUT LINKAGE.                 P4704050
WRS     TSX     .WRITE,4          CALL IOCS TO WRITE DATA.                P4704074
L       PZE     **,0,0                                                    P4704084
        TCH     IO                GET IO LIST FROM CONSTANTS REGION.      P4704104
        LXA K6,2                    RELOAD SHIFT COUNT TO 6               P4704110
        SXD SS2,2                   RESET SHIFT COUNT CELL                P4704120
        AXT     0,2             RESTORE STORE INDEX                       P4704130
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         SXD  SVX2,2                SET UP INDEX FOR NEXT PLOT ENTRY      P4704140
         STZ  PART                  INITIALIZE 670 PARTIAL WORD           P4704150
         LXD  KXK,1                 RESTORE NA TO INDEX 1                 P4704160
         LXD      X42,4           RESTORE INDEX IN CASE WE DESTROYED IT   P4704170
         TRA  2,4                   RETURN TO BASIC PLOT ROUTINE          P4704180
         REM                                                              P4704190
         REM                                                              P4704480
         REM                                                              P4704540
PENUP    LXD      PUD,4           PICK UP PEN UP DELAY COUNT              P4704550
         LDQ  PNUP                  PICK UP PEN UP MOVE CHARACTER         P4704560
 KXK     TXI  RTRN,0,**             GO BACK FOR STORING PEN UP CODES      P4704570
SC       SXD  EPE,4                 SAVE INDEX FOR PEN MOTION             P4704580
         TIX      REFER,4,10        TRANSFER IF GREATER THAN 3 F          P4704590
         CLA  LX                    PICK X VALUE TO BE SCALED             P4704600
         FSB  XOFF                  SUBTRACT XOFFSET (XMIN)               P4704610
         FDP  XFACT                 DIVIDE BY SCALE FACTOR (DX)           P4704620
         STQ  LX                    SAVE FOR INCREMENT CALCULATION        P4704630
         REM                                                              P4704640
         CLA  LY                    PICK Y VALUE TO BE SCALED             P4704650
         FSB  YOFF                  SUBTRACT Y OFFSET (YMIN)              P4704660
         FDP  YFACT                 DIVIDE BY SCALE FACTOR (DY)           P4704670
         STQ  LY                    SAVE FOR INCREMENT CALCULATION        P4704680
X4       TXI  RSC,0,**              GO BACK TO MAIN PROBLEM FLOW          P4704700
REFER    TIX      B999,4,10       TRANSFER IF GREATER THAN 13             P4704705
         SXD      EPE,4           RESET PEN COMMAND JUST IN CASE          P4704710
         SXD      RFIND,4         SET RE-REFER INDICATOR                  P4704715
         TXI      RSC,0,**        GO BACK TO MAIN FLOW OF ROUTINE         P4704716
RFIND    PZE      0               REREFER INDICATOR CELL                  P4704717
B999     AXT      NB,1            LOAD INDEX WITH NUMBER WDS IN BLOCK     P4704724
         CLA      K999+NB,1       PICK UP FIRST WORD OF BLOCK 999         P4704734
         STO      ABS+NB,1        STORE IN BLOCK SYNC CODES.              P4704744
         TIX      *-2,1,1         GO BACK FOR ALL OF BLOCK NUMBER.        P4704754
         TSX      TRW,4                                                   P4704764
         IOCD     START,0,NBS                                             P4704774
         TSX      .CLOSE,4                                                P4704784
P        PZE      **,0,0                                                  P4704794
X1       TXI      EXIT,0,**                                               P4704804
 KM3     MZE      0,0,3           END OF PICTURE CONSTANT FOR SPECIAL BLOP4704860
         REM                                                              P4704870
PDD      PZE      0,0,15        PEN DOWN DELAY CONSTANT                   P4704880
XOFF     PZE  0                     X SCALE OFFSET                        P4704890
XFACT    DEC  1.0                   X SCALE FACTOR                        P4704900
FOURS    OCT      040404040404
YOFF     PZE  0                     Y SCALE OFFSET                        P4704910
YFACT    DEC  1.0                   Y SCALE FACTOR                        P4704920
PENX     PZE  0                     CURRENT PEN X                         P4704930
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PENY    PZE 0                          CURRENT PEN Y                                P4704940
 PNDN   BCI     1,900000                670 PEN DOWN CHARACTERS (6)                  P4704950
 PNUP   BCI     1,800000                670 PEN UP CHARACTERS (6)                    P4704960
XYPLTC  OCT 740000000000                POSITION TABLE FOR STORING PACK INCR.P4704970
 XPLTC  OCT 740000000000                POSITION TABLE FOR STORING CONDENSED P4704980
 YPLTC  OCT 036000000000                PLOT CHARACTER.                              P4704990
FKF     OCT 233000000000                FLOATING CONVERSION CONSTANT                 P4705000
P005    OCT 232400000001                FLOATING TO FIX AND ROUND CONSTANT           P4705010
MASK    PZE -1,0,0                      MASK FOR FLOAT TO FIX                        P4705020
DX      PZE 0                           DELTA X VALUE                                P4705030
DY      PZE 0                           DELTA Y VALUE                                P4705040
 DFE    PZE 0                                                                        P4705050
IP      PZE 0                        THIS IS CELL USED TO KEEP TACK OF PEN           P4705060
 ONE    PZE 1                                                                        P4705070
 N      PZE 1                           BLOCK ADDRESS NUMBER.                        P4705080
 TEN    PZE 10                          CONSTANT FOR USE IN BLOCK COMPUTE            P4705090
 PMOVE  PZE 0                           TEMPORARY STORE FOR PEN MOVE CODE            P4705100
 LX     PZE 0                           STOREAGE FOR NEW X VALUE                     P4705110
 LY     PZE 0                           STOREAGE FOR NEW Y VALUE                     P4705120
 PART   PZE 0                           PARTIAL 670 PLOT WORD                        P4705180
FCTR    DEC 1.0                         NORMAL FACTOR IN PLOT                        P4705190
PX      BCI     1,200000                                                             P4705200
PY      BCI     1,000000                                                             P4705210
DX      BCI     1,600000                                                             P4705220
MY      BCI     1,400000                                                             P4705230
55      BCI     1,100000                                                             P4705240
 RF100  DEC 100.0                       NOTE THIS IS 200.0 FOR 564,566               P4705250
K100    DEC 100.0                       RECIPRICAL OF PLOTTER RESOLUTION.            P4705260
IO      IOCP    **,0,**              VARIABLE IO DATA CAN BE IOCP OR IOCD            P4705270
IOF1    IOCP    **,0,**                                                              P4705280
        IOCD    ENPLT,0,2                                                            P4705290
 BUFZ   PZE     **,4                    LOCATION OF UNPACK BUFER.                    P4705300
 NB     EQU     2               *1   NUMBER OF WORDS IN BLOCK ADDRESS.               P4705310
 NS     EQU     3               *1                                                   P4705340
 NBS    EQU     8               *1                                                   P4705370
K999    BCI     1,666666        *1 BLOCK ADDRESS NUMBER 999 AND REFLECTED.P4705400
START   BCI     2,444444444433  *1 START OF BLOCK ADDRESS SYNC. CODES.               P4705440
        BCI     1,333331        *1                                                   P4705450
ABS     BCI     1,444445        *1                                                   P4705460
        BCI     2,133333334444  *1 BLOCK ADDRESS NUMBER ONE AND SO ON.               P4705470
DAU     BCI     2,444444444433  *1 START OF PLOT DATA SYNC CODES.                    P4705480
        BCI     1,333332        *1                                                   P4705490
ENPLT   BCI     2,4--6--3--4--     END OF PLOT CODE.                                 P4705730
 CODE   MON     CODE,0,6*4096         +Y      PLOT CODE FOR 570/1 676                P4705740
        MTH     CODE,0,6*4096      +X,+Y      PLOT CODE FOR 570/1 776                P4705750
        MTH     CODE,0,2*4096      +X         PLOT CODE FOR 570/1 766                P4705760
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        MTW     CODE,0,6*4096      +X,-Y     PLOT CODE FOR 570/1 756      P4705770
        MZE     CODE,0,6*4096        -Y      PLOT CODE FOR 570/1 656      P4705780
        PTW     CODE,0,6*4096      -X,-Y     PLOT CODE FOR 570/1 556      P4705790
        PTH     CODE,0,2*4096      -X,       PLOT CODE FOR 570/1 566      P4705800
        PTH     CODE,0,6*4096      -X,+Y     PLOT CODE FOR 570/1 576      P4705810
        MON     CODE,0,1*4096      PEN UP    PLOT CODE FOR 570/1 665      P4705820
        MON     CODE,0,3*4096      PEN DOWN  PLOT CODE FOR 570/1 667      P4705830
 DENSE  PZE     4                *1                                       P4705840
X42     PZE     0,0,**                                                    P4705874
SVX2    PZE     0,0,**                                                    P4705884
TS4     PZE     0,0,**                                                    P4705894
KONK    OCT     001000000000                                              P4705904
        END                                                               P4705910
$DATA
  2
   PHOTON ENERGY   SPECTRUM  NUMBER   1     (TIMES  100)
    20    2     4 0.09999999E 01 0.09999999E 02 0.99999997E 04
  0.4336359E 01 0.5208983E 01 0.5309920E 01 0.1066452E 02 0.8175346E 01
  0.1330111E 02 0.1437233E 02 0.1483322E 02 0.2235549E 02 0.1468612E 02
  0.2010409E 01 0.1842255E 02 0.6397278E 04 0.1827464E 05 0.1487654E 03
  0.2168624E 03 0.1413064E 05 0.3761968E 04 0.3512093E 02 0.3466013E 02
  RESPONSE VECTOR 10
    20    1     2 0.              0.09999999E 02 0.99999997E 04
  0.4370039E 03 0.5071111E 03 0.5710201E 03 0.7194396E 03 0.5945137E 03
  0.6019468E 03 0.3058752E 03 0.2036741E 03 0.5496490E 03 0.5157218E 04
  0.3525469E 03 0.
*
*       END TAPE
```