03-Feb-94 .............. U300 DAMM - GENERAL - WTM

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Introduction and General Features

DAMM is a Display, Analysis and Manipulation Module which is configured to be used on DECstations, SPARCstations, and VAXstations. DAMM provides the features to be found in VAXPAK programs DAM, SAM, TDX and XAM. Some general features are listed below.

Display features ..............................................................
(1). Works with DECstations, SPARCstations & VAXstations running windows.
(2). Displays 1-D data from HIS- or SPK-files.
(3). Displays 2-D data from HIS-files.
(4). Hardcopy available via screen-copy to LNO3, LNO3 ScriptPrinter
(5). A dialog record may be saved on a Log-file.
(6). Supports Free-Form (Banana) gate construction.
(7). Provides for total number of counts within a Banana.
(9). Provides for peak sum, centroid and fwhm.
(10). Provides for spectrum analysis (fitting - see SEC# U300.400).

General features ..............................................................
(1). Reads 1-D histograms from either HIS-, SPK-files.
(2). Extracts GATES (on parameters 1 or 2) from 2-D histograms.
(3). Supports general projections of Bananas on arbitrary axis.
(4). Forms linear combinations, gain-shifts etc. of 1-D histograms.
(5). Forms linear combinations, gain-shifts etc. of 2-D histograms.
(6). Does linear gain and intercept transformations by rebinning.
(7). Does crunches (sums a specified number of channels together).
(8). Lists and plots 1-D histograms on the line printer.
(9). Shows directory (ID’S) contained in HIS-, SPK- & BAN-files.
(10). Shows count-sums for all ID’s in SPK- or HIS-files.

(continued on next page)
Program operation .................................................................

The program is controlled by a set of commands (alphabetic directives) and
associated data-lists (numbers): I call these command-lists. Input is
free-form. Command and list-element delimiters are BLANK , ( ) /

U300.020 GETTING STARTED

The steps given below outline how I would do it. Of course, you can do it
any way that you choose or not at all.

(1)....Log onto the workstation, Xterminal, etc. in the usual manner.

(2)....Open a window and move it to the lower left corner of screen.

(3)....Type:  damm ; to start program on any host
          ; where the path to the executable
          ; has been defined in your
          ; .cshrc, .login or login.com files
          ; otherwise,

          Type:  /usr/hhirf/damm ; to start on a HHIRF DECstation
           
          Type  /home/upak/damm ; to start on a HHIRF SPARCstation

(4)....Type:  H  ; for HELP directory

(5)....Type:  H ITEM  ; for help on directory ITEM

(6)....Type:  H FIG  ; for screen configurations

(7)....Try a few FIG commands to get a feel for how they work.

(8)....Note the fact that the display required for entering fitting
information (like peak positions, etc) is via the DS & DSX commands
rather than the general display commands D & DX.

(9)....Learn to use the HELP facility. That will usually be more
up-to-date than this document.

(10)....Filenames have been made case-sensitive for the UNIX version. Where
default extensions apply, upper case is assumed for VMS and lower
case is assumed for UNIX. Acceptable standard extensions now
include .spk, .SPK, .his, .HIS, .ban, .BAN, .cmd & .CMD. Note: If
the his-file extension is lower/upper case then the drr-file
extension must be lower/upper case. Also note:

/usr/users/directory/subdirectory/filename ; is an acceptable form but

../directory/subdirectory/filename ; is NOT! (at least for now)
U300.030 Commands for Assigning Input/Output Files

IN FIL.EXT - Open N-file (EXT = SPK or HIS)
OU FIL.EXT - Open O-file (EXT = SPK or HIS) - OUTPUT for SPK only
OU FIL.SPK,NEW - Create and open U-file (SPK-file for output)
QF FIL.EXT - Open Q-file (EXT = SPK or HIS) - for display only
RF FIL.EXT - Open R-file (EXT = SPK or HIS) - for display only
SF FIL.EXT - Open S-file (EXT = SPK or HIS) - for display only
BAN FIL - Open FIL.BAN for store, recall, proj, etc
BAN FIL,NEW - Create & open FIL.BAN for store, recall, etc
               (See below for how to specify variable FILENAMES)
CLO F - Closes F-file (where F = N, O, P, Q, R, S or BAN)
DFIL - Displays data files currently open

CMD FIL - 0pen and process commands from FIL.CMD
CMD FIL.EXT - 0pen and process commands from FIL.EXT

LON/LOF - Turn Log-output (to LU7) ON/OFF (default = OFF)

Explanation of variables in FILENAMES ........................................

One symbol (integer variable) may be incorporated in a FILENAME
specification as the following examples illustrate:

Example-1 .................................................................
SYM=3
OU FIL"SYM".SPK ;Opens FIL3.SPK

Example-2 .................................................................
I=0
LOOP 3
I=I+1
IN FIL"I".SPK ;Opens (in succession) FIL1.SPK, FIL2.SPK, FIL3.SPK
.
ENDLOOP

U300.040 Commands Related to Loop-Execution & Symbol-Definition

SYM = EXPRESSION - Define symbol (SYM) up to 100 symbols supported
               - symbols: UIND CIND ULOC CLOC FIX NONE FITS ALL and
               - COLR GREY DOTS LIVE BAN M N O P Q R S are reserved
               - expression syntax is same as in CHIL
               - no imbedded blanks are allowed in expressions
               - symbols may contain up to 4 characters (5-8 ignored)

DSYM - Displays list of currently defined symbols & values

LOOP N - Starts LOOP (executed N-times) N=SYM or CONST
CMD .... - Nesting supported
CMD .... - # lines between 1st LOOP & matching ENDL = 100
ENDL - Defines end-of-loop
       - KILL (entered before END) kills LOOP
       - Ctrl/C - aborts loop-in-progress
       - opening of CMD-file within a LOOP not allowed

(continued on next page)
LOOP suspension - the W0 command

A command W0 [means the same thing as WOA or WHOA - i.e the opposite of GIDDUP (my preferred spellings)] has been implemented to work within LOOPs. Whenever the WU command is encountered (within a LOOP only, otherwise it's illegal), the message:

Type [RETURN] to CONTINUE--->

will appear on the screen. This gives you an opportunity to look at the display etc. before it gets wiped out. When you are finished looking, press the [RETURN] key and it will continue.

U300.050 Log File - damm.log

The VMS version of DAMM always creates a new version of DAMM.LOG while the UNIX version creates a new damm.log or appends to an old version of damm.log if it exists. If you enter the command LON, almost all dialog to and from the host will be logged, otherwise, only certain "print commands" will produce output to the log-file or device. You may turn the log ON/OFF by entering LON/LOF.

U300.060 Comments on Hard Copy

As I have defined the default the color mapping, it is best to set up the Workstation to Print Screen in the negative image mode. If you are printing on something like a LNO3 ScriptPrinter, anything you chose to print will be scaled to fit on one page. If you are using an LNO3, it may come out on multiple pages (and you may miss some) unless you choose a "Portion of Screen" that it likes.

U300.070 File ID-directories and Count-Sums

<table>
<thead>
<tr>
<th>DIR</th>
<th>KF</th>
<th>Displays a list of all ID's in file-KF, where</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KF</td>
<td>left blank says input-file</td>
</tr>
<tr>
<td></td>
<td>KF</td>
<td>N denotes input-file</td>
</tr>
<tr>
<td></td>
<td>KF</td>
<td>0 denotes output-file</td>
</tr>
<tr>
<td></td>
<td>KF</td>
<td>Q denotes Q-file</td>
</tr>
<tr>
<td></td>
<td>KF</td>
<td>R denotes R-file</td>
</tr>
<tr>
<td></td>
<td>KF</td>
<td>S denotes S-file</td>
</tr>
<tr>
<td></td>
<td>KF</td>
<td>BAN denotes BAN-file</td>
</tr>
</tbody>
</table>

| LDIR | KF | Logs a list of all ID's in file-KF on DAMM.LOG |

<table>
<thead>
<tr>
<th>DDIR</th>
<th>KF</th>
<th>Displays ID's &amp; # of non-zero channels for SPK-files</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KF</td>
<td>Displays ID-directory in detail for HIS-files</td>
</tr>
<tr>
<td></td>
<td>KF</td>
<td>Also logs on DAMM.LOG if LON</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DSUM</th>
<th>KF</th>
<th>Displays count-sums of all ID's on file-KF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>KF</td>
<td>Also logs on DAMM.LOG if LON</td>
</tr>
</tbody>
</table>
U300.090 Cursor Tracking Problems With Xterminals

The software-generated full-window cursor displayed by DARM when in the "1-key cursor mode" requires a lot of real-time response from the host computer for live tracking of the mouse. This works fine when the host is a local workstation but does not work well for Xterminals hosted by a busy VAX. The following commands are intended to alleviate this problem. Type:

CURT LIVE ;for full-window cursor which tracks mouse "live" (default)
CURT X ;for new cursor display only for mouse-click or key-press ;(works better for Xterminals hosted by busy VAX, etc.)

Execute the desired CURT command and then FIG to make it take effect.

U300.100 Changes in Cursor-Mode Commands

I have eliminated the distinction between upper and lower case in all cursor-mode commands. The Shift- and Caps-lock keys have no effect. In order to do this and retain meaningful command names, it was necessary to use two keys for certain commands. These commands (UP, UX, UW, UL, UH, UG, and UB) are defined below:

P/UP Add/Delete peak to Library (pos specified by cursor)
X/UX Fix/Free peak position (for displayed peak nearest to cursor)
W/UW Fix/Free peak width (for displayed peak nearest to cursor)
L/UL Fix/Free Lo-Side ASYM (for displayed peak nearest to cursor)
H/UH Fix/Free Hi-Side ASYM (for displayed peak nearest to cursor)
G/UG Turn peak ON/OFF (for displayed peak nearest to cursor)
B/UB Add/Delete background point at cursor position

Read UP as Unset Peak, for example. As usual, no carriage return is used. There are also a few other changes in commands. These are listed below:

LF-ARROW Set expand-region lo-limit
RT-ARROW Set expand-region hi-limit
DN-ARROW Pan DOWN - move picture so cursor-chan at right-screen
UP-ARROW Pan UP - move picture so cursor-chan at left-screen
/
Display XCUR, YCUR, channel# & energy

U300.110 Mouse Button Customizing

The Mouse Buttons can be used in place of some key-strokes while in the 1-key cursor-mode. Different button definitions are provided for the three different types of displays (namely: the displays resulting from the commands D, DD & DS). The following customizing commands are supported:

BUD L,M,R ;Defines Left, Middle, Right buttons for cursor in D-window
BUDD L,M,R ;Defines Left, Middle, Right buttons for cursor in DD-window
BUDS L,M,R ;defines Left, Middle, Right buttons for cursor in DS-window
BUD L,H,S ;Example (cursor in 1-D) L-but sets sum-reg lo-limit,
;M-but sets sum-reg hi-limit, R-but requests S-sum
BUDD A,T,Z ;Example (cursor in 2-D) L-but adds banana points,
;M-but totals enclosed counts, R-but zots banana

Buttons can't be set to / or ; - set to ? or : instead
Screen configuration (placement of graphics windows on the screen) and color (or black & white) mapping is discussed in more detail in SEC# U300.550, U300.560 and U300.570 (if you have a B&W monitor, you will probably want to change the color mapping). Here we give the usual list of commands and a brief description of each.

**COMMANDS RELATED TO SCREEN SETUP & COLOR MAPPING .................................**

- **FIGI** ;Set screen configuration library to default
- **FIGF FILNAM** ;Read screen configuration library from FILNAM
- **FIG N** ;Set current screen configuration to type-N
- **WIN ID** ;Set subsequent displays to be in window-ID (dflt=1)
- **AXON ID** ;Enable the drawing of axis for window-ID (dflt)
- **AXOF ID** ;Disable the drawing of axis for window-ID
- **CMAP** ;Set color map to default ("takes" after next FIG)
- **CMAP FILNAM** ;Set color map from FILNAM ("takes" after next FIG)
- **REVV** ;Reverse all color specs ("takes" after next FIG)
- **DLNS N** ;Set # disp-lines = N - for HELP, DDIR & DSUM
- **CURT LIVE** ;Set full-wind cursor to track mouse LIVE (default)
- **CURT X** ;New full-wind cursor generated via mouse-click or key
 ;The CURT command takes effect only after next FIG
- **SSI** ;Set screen to initial - erase all graphic windows

Program damn has, by default, 16 pre-defined screen configurations available. Each is referenced (via the FIG command) by an ID-number. A list of the ID-numbers along with the associated configuration is given below. Try a few FIGs and observe the results or if you really want to get serious, see SEC# U300.550. In particular, if you have an Xterminal with less than 1024 x 860 pixels, you will probably need to modify the configuration table as described in SEC# U300.550.

```
1-[] 2-[] 3-[] 4-[] 5-[] 6-[] 7-[] 8-[]
   []   []   []   []   []   []   []   []
   []   []   []   []   []   []   []   []
   []   []   []   []   []   []   []   []
   []   []   []   []   []   []   []   []
 9-[] 10-[] 11-[--] 12-[--] 13-[--] 14-[--] 15-[2D] 16-[2d]
   []   []   [--]   [--]   [--]   [--]
   []   []   [--]   [--]   [--]   [--]
   []   []   [--]   [--]   [--]   [--]
   []   []   [--]   [--]   [--]   [--]
```
U300.130 Display Delay (hangup problems)

Some display devices (X-terminals for example) may require a delay between successive displays. If your device "hangs up" or produces "incomplete displays" when executing L0UPS, you might try increasing the appropriate delay. A range of 10 to 20000 milliseconds is accepted.

DLAF MS ;Set FIG-delay to MS milliseconds (default=1000)
DLAF ;Set FIG-delay to 1000 milliseconds
DLAD MS ;Set Display-delay to MS milliseconds (default=500)
DLAD ;Set Display-delay to 500 milliseconds

U300.150 Commands Related to 1-D Display

FIG NF ;Choose screen config-NF. See SEC# U300.120 & U300.550
;for screen configuration and color mapping commands
WIN NW ;Set subsequent displays to be in window-NW
LIN/LOG ;Set display to linear/log (default is linear)
PLON/PLOF ;Turn peak logging ON/OFF (dflt OFF) see SEC# U300.155
ST /OV ;Set to disp mult hist stacked/overlayed (dflt = 0V)
CAL A,B,C ;Define energy calibration (E=A+B*Chan+C*Chan**2)
COL I,J,K,... ;Defines color sequence for display
;For I,J... = 1 2 3 4 5 6 7
; COL= white,red,green,blue,yellow,magenta,cyan
GWID WID ;Define cursor-mode sum-region width (channels)
DNOR L0,HI ;Normalize displayed data to count-sum of chans L0,HI
DL L0,HI ;Set display limits (min,max chan#)
DMM L0,HI ;Set display limits (min,max counts)
;L0 or HI = X says use MIN or MAX data value
D IDLST ;Display histogram ID's contained in IDLST
DX IDLST ;Display IDLST (range defined by expand-region)
;IDLST format is  KF C ID, C ID.. KF C ID, C ID..
; C is an OPTIONAL floating-point norm-coeff (DFLT=1.0)
; KF = M,N,0,P,Q,R,S (default is N) and denotes:
; MEM-BUF, IN-FIL, OU-FIL, PROJ-FIL, Q-FIL, R-FIL, S-FIL
; If IDLST omitted, uses previously defined IDLST
SUML L0,HI ;Define sum region for SUM command below
SUM IDLST ;Sum counts (L0,HI) (IDLST same as D except C illegal)
C ;Enter cursor-mode
SSI ;Set screen to initial - erase graphic windows

(continued on next page)
U300.150 Commands Related to 1-D Display (continued)

1-KEY CURSOR COMMANDS FOR 1-D DISPLAY ............................... 

<-- (LF-ARROW) ;Set expand-region lo-limit
--> (RT-ARROW) ;Set expand-region hi-limit

V ;Make marker display visible/invisible (toggles)
E ;Expand display

M ;Turn marker display ON
K ;Turn marker display OFF (K is for kill)

UP-ARROW ;Pan up - move picture so cursor-chan at left-screen
DN-ARROW ;Pan down - move picture so cursor-chan at right-screen
 ;(you must be expanded to execute pan)

L ;Set sum-region lo-limit
H ;Set sum-region hi-limit
G ;Set sum-region limits (LO=XCUR, HI=XCUR+WID-1)

S ;Display sum, centroid, fwhm (2.35@*sigma) of sum region
 ;DATA(LO),DATA(HI) defines BGD for NETS

A ;Display sum, centroid, fwhm (2.35@*sigma) of sum region
 ;YCUR(LO),YCUR(HI) defines BGD for NETS

C ;Draw peak-marker and display chan# at cursor pos
P ;Draw peak-marker and display energy at cursor pos

/ or ? ;Display YCUR, YCUR, channel# & energy
' ;Same as ? except forces logging (see SEC# U300.155)

Q ;Quit cursor-mode (return to normal-mode)

See SEC# U300.110 or Type: h mous for use of Mouse Buttons.
The following commands control peak finding.

FIND BIAS,IFWHM ;Turn peak-find ON (see definitions below)
FIND ;Turn peak-find ON (with defaults - see below)
NOFI ;Turn peak-find OFF (default is OFF)

BIAS...is the number of standard deviations above background that a peak channel must be in order to be considered as part of a peak. Useful values of BIAS are in the range 3 to 10. The default value is 5.0.

IFWHM...is the approximate full-width at half-max (in channels) of peaks in the region of interest. This value is not very critical but should be within a factor of 2 or so of the correct value. The default value is 5.

All peaks found within the display region will be marked & labeled with the associated energy-calibration value (default is the same as channel number). Peak labels are integers (no decimals - to minimize screen space used) so if you want labels to be in units of keV, for example, you must enter CAL such that E(keV) is a whole number.

See SEC# U300.430 for how peak-finding is used in fitting operations.

Logging "found" and "marked" peaks on damm.log

Peaks which either found via the FIND command above or marked via the 1-key command (& or ? or ;) may be logged on damm.log. The following commands (independent of LON/LOF) turns said logging ON and OFF.

PLON ;Turns peak logging (to damm.log) ON
PLOF ;Turns peak logging (to damm.log) OFF (default)

For found peaks, damm.log may be read (skipping prog, date & time) as:

READ(LU,10)IFLG,ID,CH,HEFT,(FILNAM(I),I=1,16)
10 (29X,A4,I10,2F10.0,2X,16A4)

Where: IFLG = 'PEAK' for found peak log entry
ID = Spectrum ID number
CH = Peak location in channels
HEFT = Peak heftiness
FILNAM = First 64 characters of spk- or his-filename

For marked peaks, damm.log may be read (skipping prog, date & time) as:

READ(LU,10)IFLG,ID,ENER,(FILNAM(I),I=1,16)
10 (29X,A4,I10,2F10.0,2X,16A4)

Where: IFLG = 'MARK' for marked peak log entry
ID = Spectrum ID number
CH = Peak location in channels
ENER = Peak "energy" from calibration constants
FILNAM = First 64 characters of spk- or his-filename
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U300.160  Commands Related to 2-D Display

FIG  NF ;Choose screen config-NF. See SEC# U300.120 & U300.550
;for screen configuration and color mapping commands

WIN  NW ;Set subsequent displays to be in window-NW

ZLEV  N ;Set # of color/grey-scale intensity levels to N
ZLEV ;Set # of color/grey-scale intensity levels to 10 (dflt)

GRAS I,J,K... ;Set grey-scale values (range 0-100) & ZLEV (# entries)
;Must do after first FIG ("takes" after next FIG)

ZINT  COLR ;Set 2-D intensity mapping to Color (default)
ZINT  GREY ;Set 2-D intensity mapping to Grey-scale
ZINT  DOTS ;Set 2-D intensity mapping to Dot-matrix (3x3 or 5x5)

ZSON/ZSGF ;Z-scale ON/OFF - displays cnts vs colors legend (dflt)

ZLIN/ZLOG ;Set 2-D display to linear/log (default is log)

XC  L0,HI ;Set min & max X-channel numbers for display

YC  L0,HI ;Set min & max Y-channel numbers for display

ZMM L0,HI ;Set min & max counts/channel for display & count-sum

ZMM L0 ;Sets min & searches for max (semi-autoscale)

ZMM ;Searches for min & max (full-autoscale)

DD  ID ;Display 2-D histogram ID from IN-file

DD  KF,ID ;Display 2-D histogram ID from KF-file

DDX ID ;Display 2-D histogram ID from IN-file (expand region)

DDX KF,ID ;Display 2-D histogram ID from KF-file (expand region)
;Where KF = N,0,Q,R,S (default is N) and denotes:
;IN-FIL, OQ-FIL, Q-FIL, R-FIL, S-FIL
;ID (and KF) omitted says use previously defined spec

DDID ;Shows ID-number & Filename for current 2-D display

ZBL ;Zero in-core BAN-library

LBL ;List in-core BAN-ID numbers

C ;Enter cursor-mode

SSI ;Set screen to initial - erase graphic windows

(continued on next page)
U300.160  Commands Related to 2-D Display (continued)

1-KEY CURSOR COMMANDS FOR 2-D DISPLAY ..............................

<-- (LF-ARROW) ;Set expand-region lo-left-limit
---> (RT-ARROW) ;Set expand-region hi-right-limit

V ;Make expand markers visible/invisible (toggles)
E ;Expand
1 ;Move display such that cursor is at lo-left
2 ;Move display such that cursor is at hi-left
3 ;Move display such that cursor is at hi-right
4 ;Move display such that cursor is at lo-right

Z ;Zero (open) active X,Y-list
A ;Add point to active X,Y-list
D ;Delete nearest point in active X,Y-list
M ;Move nearest point in active X,Y-list to cursor pos
I ;Insert a point in active X,Y-list at cursor position

L ;List active X,Y-list (on VDT)
B ;Draw active BAN & BAN's in in-core library
G ;Prompt for ID & read into in-core BAN-library
O ;Open nearest in-core BAN for modification
S ;Prompt for ID & store in in-core library & on disk
R ;Store nearest BAN with original ID
F ;Remove nearest BAN from in-core library & erase
K ;Delete nearest BAN from in-core library and disk
T ;Totalize counts in nearest BAN (active or not)
P ;Totalize and save X- & Y-projections on DAMQ8Q.SPK

/ or ? ;Display/(log if PLON) X,Y-coordinates of cursor
\ ;Like ? but forces log (see X,Y-log format below)

Q ;Quit cursor-mode (return to normal-mode)

See SEC# U300.110 or Type: h mous for use of Mouse Buttons.

X,Y-log format- damm.log may be read (skipping prog, date & time) as:
  READ(LU,10)IFLG,ID,X,Y,(FILNAM(I),I=1,16)
   10 (29X,A4,I10,2F10.0,2X,16A4)

Where: IFLG = 'MAR2' for 2-D position mark entry
       ID = Histogram ID number
       X = X-position in channels
       Y = Y-position in channels
       FILNAM = First 64 characters of spk- or his-filename

--------------------------------------------------------------------------------
U300.170 Special XY-Line Display

DECstation damm provides for the display of one or more lists of concatenated vectors (lines) onto any of the FIGed windows. In order to use this feature, a ASCII file must be created of the following form:

```
XYDATA ID XLEN YLEN
X Y
X Y
.
.
XYDATA ID XLEN YLEN
X Y
X Y
.
.
END-OF-FILE Where:
```

XYDATA is the ASCII string "xydata" in upper or lower case (XYDA is enough).

ID.....is an integer ID-number by which the X,Y data set which follows will be referenced.

XLEN....is the X-length basis for the following X-values (optional).

YLEN....is the Y-length basis for the following y-values (optional).

X.....is a floating# (used as chan# for 1D & 2D displays).

(X is decoded via E-format & can contain up to 12 characters)

Y.....is a floating# (used as chan# for 2D and count for 1D displays).

(Y is decoded via E-format & can contain up to 12 characters)

If XLEN and YLEN are entered and "histogram lengths" are provided by the displayed histograms, the X,Y data will be appropriately scaled to match the histogram data contained in the window in which it is drawn. "Histogram lengths" are provided by all his-file directories and by spk-file entries which are copied from his-files. If either of these "length entries" are missing, no scaling will be done. For 1D displays, no attempt is made to scale Y.

(continued on next page)
U300.170 Special XY-Line Display (continued)

List of commands

XYF filename ;Opens XY-file and reads in all data

XYI ;Displays XY IDs which have been read in

XYD I J K L ... ;Displays XY data for IDs (I J K L ...) into active
window (default = window 1 or set by WIN command)

XYP I J K L ... ;Same as XYD except that XY-points are shown in
;addition to the connecting vectors
;XYD or XYP with no ID-list uses previous ID-list

XYC KOL ;Specifies the "color" for subsequent XY displays
;Legal values of KOL are:

;WHIT - white - CMAP entry 34
;RED - red - CMAP entry 35
;GREE - green - CMAP entry 36
;BLUE - blue - CMAP entry 37
;RG - red-green - CMAP entry 38
;RB - red-blue - CMAP entry 39
;GB - green-blue - CMAP entry 40

Note: Displays are done in "complement mode" so that displaying the same
ID a second time will erase it, displaying a third time will show it, etc.

Current Limits

Maximum number of IDs in a file = 2048
Maximum number of XY entries in a file = 256,000
Maximum number of XY points in a set = 500

These limits are rather arbitrary, and can easily be changed.

Comments

(1)....The XY display feature is for display only. The XY data file is not
another data type on a par with HIS-file or SPK-file data. It
cannot be analysed, summed, or combined with other data, etc.

(2)....If the XY data extend beyond the range of the display, it is
allowed to spill over into the "scale label" regions. It is easy
enough to prevent this but I am not sure if it would be more
desirable.

(3)....An ID label is drawn near to the XY-point which is "nearest" to the
center of the window. If multiple XY-lines are displayed, there may
be some confusion in identification. I will think about trying to
minimize this.

(4)....All commands and specifications are case insensitive.
U300.175 Label Generation and Annotation

damm provides a simple method for labeling and annotating graphical displays. The following features are provided:

(1)....Normal text labels may be generated either interactively or by the usual processing of command files.

(2)....The Label Generating Commands (LA7, LA8, LA9) described below are used to generate up to three blocks of "label text".

(3)....Each of the three "label blocks" can contain up to 10 lines of text with each line containing up to 76 characters (80 - 4 command characters).

(4)....Each damm window supports up to 3 independent, active (relocatable) label blocks.

(5)....By "locking" labels already displayed and re-defining label blocks, you can display as many labels as you like.

(6)....Labels are positioned within graphics windows using the 1-key Label Display Commands described below.

(7)....Label Pointer Commands, defined below, may be used to make close associations between labels and specific graphic features.

Note: LA7, LA8, LA9 label specifiers are used in order to make the association with the label display keys (7,8,9) easier.

Label Generating Commands -----------------------------------------------

LA7 text ;Adds line of "text" to LA7 label
LA8 text ;Adds line of "text" to LA8 label
LA9 text ;Adds line of "text" to LA9 label

LAZ7 ;Deletes all lines of LA7 label
LAZ8 ;Deletes all lines of LA8 label
LAZ9 ;Deleted all lines of LA9 label

LAL ;Displays current labels - LA7, LA8, LA9

LAC KOL ;Specifies label color for subsequent displays
            ;Legal values of KOL are:
            ;WHIT - white - CMAP entry 34
            ;RED - red - CMAP entry 35
            ;GREEN - green - CMAP entry 36
            ;BLUE - blue - CMAP entry 37
            ;RG - red-green - CMAP entry 38
            ;RB - red-blue - CMAP entry 39
            ;GB - green-blue - CMAP entry 40

(see next page for label display commands)
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U300.175  Label Generation and Annotation (continued)

Label Display Commands (1-key cursor-mode) ------------------------------

Key  Action

7    Displays LA7 at cursor location (complement mode)
8    Displays LA8 at cursor location (complement mode)
9    Displays LA9 at cursor location (complement mode)
0    Locks previously displayed labels against subsequent change
    (i.e. all labels displayed in a given window will be fixed)
    (enables the drawing of additional labels)

It goes like this:

(1)....The first strike of say key-7 displays LA7 with the upper-left
    corner of an unclosed box at the cursor location.

(2)....The next strike of key-7 will erase the LA7 label and the box.

(3)....The next strike of key-7 will display LA7 in any new cursor
    location. Etc, etc. and the same for key-8 and -9.

(4)....Finally, key-0 will close any open boxes and lock in all current
    labels within a given window. Additional labels are now enabled.

Label Pointer Commands (1-key cursor-mode) -----------------------------

The following 1-key commands provide for the interactive drawing of
concatenated straight-line segments. The idea is to provide a method of
associating a block of text with a very specific region in a display. The
following 1-key commands are used to draw and modify such lines.

Key  Action

=    Adds a vector point to current list and draws point or line
-
    Deletes last vector point in current list and erases line
;
    Locks current vector list against subsequent change and
    enables new list

Comments:

(1)....Each window supports an independent active vector list.

(2)....The active vector-list associated with any window can contain a
    maximum of 20 points.
U300.200 Command Syntax - General Definitions

B1 - Memory Buffer-1
B2 - Memory Buffer-2
ID - The ID-number of histogram to be read
NUID - Next ID-number to be assigned to output histogram
L0 - A first-channel-number (usually of a Gate)
HI - A last-channel-number (usually of a Gate)
FAC - A multiplication factor

Meaning of the individual command-characters

I  - Input or read
O  - Output or write
A  - Add or accumulate
S  - Shift (gain shift)
GX - Gate on X-parameter (i.e. parameter # 1)
GY - Gate on Y-parameter (i.e. parameter # 2)
1  - Buffer-1
2  - Buffer-2
M  - Multiply
C  - Crunch
D  - Divide

U300.210 Commands for Setup (no immediate action)

NUID IV   - Set next ID to be used to IV
IDST N   - Set ID-step to be used in implied I/O loops
           (remains active until changed - default=1)
CRUN IVAL - Sets standard crunch value to IVAL
GASP XI1,XI2,XF1,XF2,NCF - Standard gain shift specification
SIDA     - Says treat 16-bit HIS-file data as signed
USDA     - Says treat 16-bit HIS-file data as un-signed (default)
U300.220 Commands for Input/Output of 1-D Histograms

I  ID           Input to B1
IS ID          Input to B1, gain shift B1
IA ID,FAC      Input to B1, B2=B2+FAC*B1
ISA ID,FAC     Input to B1, shift B1, B2=B2+FAC*B1
I0 ID          Input to B1, output B1
ISO ID         Input to B1, shift B1, output B1
I0 ID,IDB      Input to B1, output B1 (for ID=IDA,IDB)
ISO ID,IDB     Input to B1, shift, output (for ID=IDA,IDB)
01             Output B1
02             Output B2

U300.230 Commands for Gating 2-D Histograms

GY ID,L0,HI    Y-gate to B1
GYS ID,L0,HI   Y-gate to B1, shift B1
GYO ID,L0,HI   Y-gate to B1, output B1
GYO IDA,IDB,L0,HI Y-gate to B1, output B1 (for ID=IDA,IDB)
GYS0 ID,L0,HI  Y-gate to B1, shift & output B1
GYS0 IDA,IDB,L0,HI Y-gate to B1, shift & output B1 (for ID=IDA,IDB)
GYA ID,L0,HI,FAC Y-gate to B1, B2=B2+FAC*B1
GYSB ID,L0,HI,FAC Y-gate to B1, shift B1, B2=B2+FAC*B1
GX ID,L0,HI    X-gate to B1
GXS ID,L0,HI   X-gate to B1, shift B1
GX0 ID,L0,HI   X-gate to B1, output B1
GX0 IDA,IDB,L0,HI X-gate to B1, output B1 (for ID=IDA,IDB)
GX50 ID,L0,HI  X-gate to B1, shift & output B1
GX50 IDA,IDB,L0,HI X-gate to B1, shift & output B1 (for ID=IDA,IDB)
GXA ID,L0,HI,FAC X-gate to B1, B2=B2+FAC*B1
GXSA ID,L0,HI,FAC X-gate to B1, shift B1, B2=B2+FAC*B1
01             Output B1
02             Output B2

U300.240 Commands for General 2-D Projections

PJ ID,BID,DEGR  PROJ TO B1
PJS ID,BID,DEGR  Proj to B1, shift B1
PJ0 ID,BID,DEGR  Proj to B1, output B1
PJ0 IDA,IDB,BIDA,BIDB,DEGR - Proj to B1, output B1
(outer loop on BID, inner loop on ID)
PJS0 ID,BID,DEGR  Proj to B1, shift & output B1
PJS0 IDA,IDB,BIDA,BIDB,DEGR - Proj, shift, output
(outer loop on BID, inner loop on ID)
PJA ID,BID,DEGR,FAC  Proj to B1, B2=B2+FAC*B1
PJSB ID,BID,DEGR,FAC  Proj to B1, shift B1, B2=B2+FAC*B1
PJAL              Project all bananas in currently open
BAN-file for HIS-files, ID’s & DEGR’S
contained therein
01             Output B1
02             Output B2

ID denotes histogram ID, BID denotes Banana ID

(DEGR = Projection-axis angle in degrees)
U300.250 Commands for Operations on Buffer-1 & Buffer-2

M1 XM    Multiply B1 by XM
M2 XM    Multiply B2 by XM
C1 ICRUN Crunch B1 by ICRUN (standard crunch unchanged)
C2 ICRUN Crunch B2 by ICRUN (standard crunch unchanged)
S1 Shift B1 by standard GASP
S2 Shift B2 by standard GASP
S1 XI1,XI2, XF1, XF2, NCF - Shift B1 as specified
       (standard GASP unchanged)
S2 XI1,XI2, XF1, XF2, NCF - Shift B2 as specified
       (standard GASP unchanged)
Z1 Zero B1
Z2 Zero B2
A12 FAC B2=B2+FAC*B1
A21 FAC B1=B1+FAC*B2
SWAP Swap B1 & B2
M2D1 FAC B2=(FAC*B2)/B1
O1 Output B1
O2 Output B2

U300.260 Commands which Show Data, Count-Sums etc (from Buvs-1 & -2)

PR1 Print Buffer-1
PR2 Print Buffer-2
D1 L0,H1 Display Buffer-1 (channels L0 thru H1)
D2 L0,H1 Display Buffer-2 (channels L0 thru H1)
SUM1 L0,H1 Display sum of counts L0-thru-H1 of B1
SUM2 L0,H1 Display sum of counts L0-thru-H1 of B2
COMP NCH Compare first NCH-channels of B1 & B2
       (gives # counts and # mis-matches)
GEN ID,K0,XX,NCH Generate test spectrum in B1 (NCH channels)
       Channel contents = K0+XX*(channel#+1)

U300.270 Commands which Modify Buffer Contents

SET1 ICN,YV Set channel ICN of B1 to YV
SET2 ICN,YV Set channel ICN of B2 to YV
SET1 L0,H1,YV Set channels L0-thru-H1 of B1 to YV
SET2 L0,H1,YV Set channels L0-thru-H1 of B2 to YV
SET1 L0,H1,YA,YB Set channels L0-thru-H1 of B1 to YA-thru-YB
SET2 L0,H1,YA,YB Set channels L0-thru-H1 of B2 to YA-thru-YB
ADD1 ICN,YV Add YV to channel ICN of B1
ADD2 ICN,YV Add YV to channel ICN of B2
ADD1 L0,H1,YV Add YV to channels L0-thru-H1 of B1
ADD2 L0,H1,YV Add YV to channels L0-thru-H1 of B2
ADD1 L0,H1,YA,YB Add YA-thru-YB to channels L0-thru-H1 of B1
ADD2 L0,H1,YA,YB Add YA-thru-YB to channels L0-thru-H1 of B2
       (i.e. a straight line)
U300.280 Commands Related to Printer Plots

SKRZ                      Set to skip repeated-zeros for printer plots
PLAZ                      Set to plot repeated-zeros for printer plots

PLG  ID,LO,HI,NCYC        - Input to B1 & LOG plot
PLN  ID,LO,HI,NCFS        - Input to B1 & LIN plot
PLG  IDA,IDA,LO,HI,NCYC   - Input to B1 & LOG plot (for ID=IDA,IDA)
PLN  IDA,IDA,LO,HI,NCFS   - Input to B1 & LIN plot (for ID=IDA,IDA)

PLG1 L0,HI,NCYC          Log Printer-plot of Buffer-1
PLG2 L0,HI,NCYC          Log Printer-plot of Buffer-2
PLN1 L0,HI,NCFS          Linear Printer-plot of Buffer-1
PLN2 L0,HI,NCYC          Linear Printer-plot of Buffer-2

(NCFS = # of counts full-scale for LIN plots)
(NCYC = # of cycles for LOG plots)

U300.290 Discussion of Gain-Shifts and Compressions

Gain shifts are specified by five parameters - XI1, XI2, XF1, XF2 and NCF. 
XI1 and XI2 represent two locations (in channel-# units) in the initial 
1-D histogram and XF1 and XF2 represent corresponding locations in the 
final histogram (i.e. after the transformation). That is:

\[ XF = A + B \times XI \]

where,
\[ B = (XF2 - XF1) / (XI2 - XI1) \]
and
\[ A = XF1 - B \times XI1 \]

NCF gives the number of channels in the histogram after the transformation.
If NCF=0, the final # of channels is determined by the initial 
# of channels NCI and the transformation specified. If NCF=-1 the final 
# of channels is set equal to NCI. Counts are redistributed into the final 
set of channels (bins) by assuming a uniform distribution of counts in the 
initial bins. Data shifted below channel-#=0 and above channel-#=NCF-1 are 
lost and gone forever.

Gain-shifts are always "in place"
CRUN IVAL (i.e. standard crunch) does it at "input time"
Data is kept internally as floating - is converted to fixed on output 
All output from DAMM is 32 bits/channel
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U300.300 Manipulation of HIS-files (Copy, Add, Gain-Shift, etc)

DAMM can copy, add (or subtract) and gain-shift 1-D or 2-D histograms from an input HIS-file to an output HIS-file.

(1)....All operations are from an INPUT-file and INPUT-ID (IDI) to an OUTPUT-file and OUTPUT-ID (IDO).

(2)....For HCOP and HADD operations, the output histogram must have the same dimensions and ranges as the input histogram.

(3)....For SHIF (gain-shift) and SHAD (gain-shift & add) operations, the dimensions of the output histogram need not match the input.

(4)....The number of bits-per-channel (16 or 32) need not be the same for input and output.

(5)....Gain-shifts are accomplished by converting the data to floating point, rebinning (with count fractionation) and finally converting back to integer.

(6)....Fractional copies and adds are also done in floating point.

(7)....Final conversion from floating point to integer involves the addition of a random number whose range is 0.0 to 1.0. This procedure results in slight differences in the total number of counts for the input and output histograms.

Use CHIL to create output DRR-file and allocate HIS-file as usual.

HOU  FIL.HIS - Opens HIS-file for output

SNEG OFF - Turn OFF reset of neg 16bit out data (default)
SNEG IV - Says set negative 16-bit output data to IV
- (you MUST use SIDA mode for this to work!!)

GSX XI1,XI2 XF1,XF2 - Defines X-gain-shift (described below)
GSY YI1,YI2 YF1,YF2 - Defines Y-gain-shift (described below)

GSXOF - Turns X-gain-shift OFF (GSX turns it ON)
GSYOF - Turns Y-gain-shift OFF (GSY turns it ON)

HSTA - Shows files open & gain-shift data

HCOP IDI,IDO <,F> - Copies F*IDI (input) to IDO (output)
(if F is not entered, F=1)

HADD IDI,IDO <,FI>,<,FO> - Adds FI*IDI to FO*IDO
(if FI is not entered, FI=1)
(if FO is not entered, FO=1)
(if FO is entered, FI must be entered)

(continued on next page)
U300.300 Manipulation of HIS-files (continued)

DIV IDI,ID0 <,FI> - Divides FI*IDI by ID0 & saves in ID0
SHIF IDI,ID0 <,FI> - Gain-shifts IDI & stores in ID0
SHAD IDI,ID0 <,FI>,<FO> - Gain-shifts IDI & adds to ID0
HSET ID0,IV - Sets ID0 on output-file to IV
HZOT ID0 - Sets ID0 on output-file to 0

X- and Y-Gain-shifts

X-gain-shifts are specified by the parameters - XI1, XI2, XF1 & XF2.
Y-gain-shifts are specified by the parameters - YI1, YI2, YF1 & YF2.

For an X-gain-shift, XI1 and XI2 represent two locations (in channel #
units) in the initial spectrum and XF1 and XF2 represent corresponding
locations in the final spectrum (i.e. after transformation). That is:

\[ XF = A + B \times XI \]
where: \[ B = (XF2-XF1)/(XI2-XI1) \]
and \[ A = XF1 - B \times XI1 \]

The "final" # of channels is determined by the "initial" # of channels and
the transformation specified. Counts are redistributed into the final set
of channels (bins) by assuming a uniform distribution of counts in the
initial bins. Data shifted out of the range of the final histogram are
lost and gone forever!

The rules and procedures are identical for Y-gain-shifts.

COMMATS

(1)....If gain-shift specifications are not given (or turned off),
bin-widths will be the same for output and input.

(2)....Any data which does not fall within the ranges of the output
histogram will be lost (without comment).

(3)....Data will be properly positioned in the output histogram even if
the ranges of the input and output are different. That is, data
will appear in that region of the output histogram which overlaps
the gain-shifted input histogram.
Free-form-gates (or Banana-gates - Bananas for short) are 2-D regions of arbitrary shape which are specified by a list of X,Y-points (channel-# coordinates). Each Banana on a given BAN-file is stored and recalled by means of an identification number (ID #). Attempts to store two Bananas with the same ID will be rejected. The rules for Bananas are listed below:

(1) Banana coordinates must be given in CLOCKWISE order.
(2) The Banana is formed by connecting X,Y-points with strait lines.
(3) The last point is connected to the first by the program.
(4) No line segment of the Banana should intersect another.
(5) A maximum of 63 points may be specified for any one Banana.
(6) A maximum of 880 Bananas may be stored on a given BAN-file.

Bananas may be displayed in two different forms (OPEN and CLOSED).

A CLOSED Banana is one which has just been recalled from or stored on a BAN-file (i.e. there is an exact image on disk). There may be up to 20 CLOSED Bananas displayed at once. You can do the following things with a CLOSED Banana:

GET - recall from disk (prompted for ID) by typing G
OPEN - for modification (change to OPEN) by typing O
FORGET - delete from display by typing F
KILL - delete from display and BAN-file by typing K
TOTALIZE - counts contained within Banana by typing T
PROJECT - (X & Y) and save on DAMQ8Q.SPK by typing P

An OPEN Banana is one which is open for creation or modification. If the Banana is being newly created there will be no corresponding image or partial image on a BAN-file. Only one such Banana can exist at a given time. You can do the following things with an OPEN Banana:

ADD - X,Y-point at cursor position by typing A
INSERT - X,Y-point at cursor position by typing I
MOVE - nearest X,Y-point to cursor position by typing M
SAVE - on BAN-file (prompted for ID) by typing S
REPLACE - on BAN-file (with old ID) by typing R
ZERO - all X,Y-points by typing Z
TOTALIZE - counts contained within Banana by typing T
PROJECT - (X & Y) and save on DAMQ8Q.SPK by typing P

All Banana references are made in cursor mode. ADD, INSERT, MOVE, SAVE, REPLACE and ZERO refer only to the OPEN Banana. Other references (except for GET) are made by moving the cursor such that it is closer to some point on the Banana of interest than it is to any point on any other Banana.

ALL BANANAS MUST BE CONSTRUCTED IN CLOCKWISE ORDER
Projections via the PJ-command

Data which fall within and on the boundaries of a Banana are projected onto the X-axis of a coordinate system which is rotated through an angle DEGR with respect to the system in which data channel-# (0,0) falls at the origin and the first and second indices of the histogram array define the X- and Y-axis, respectively. Channel-# XP in the projected histogram is calculated from channel-# X,Y in the 2-D histogram by an expression of the following form:

\[ XP = A + \cos(DEGR) \times X + \sin(DEGR) \times Y \]

where,

- \( A = 0.0 \) for DEGR = 0 - 90
- \( A = -\cos(DEGR) \times X_{\text{MAX}} \) for DEGR = 90 - 180
- \( A = -\cos(DEGR) \times X_{\text{MAX}} - \sin(DEGR) \times Y_{\text{MAX}} \) for DEGR = 180 - 270
- \( A = -\sin(DEGR) \times Y_{\text{MAX}} \) for DEGR = 270 - 360

\( X_{\text{MAX}} \) and \( Y_{\text{MAX}} \) are the "dimensions" of the 2-D histogram. The effect of this transformation is to make all channel numbers in the projected histogram positive.

NOTE: The "length" of the projected histogram may be as large as \( \sqrt{X_{\text{MAX}}^2 + Y_{\text{MAX}}^2} \).

Projections via the P-command

Each time DAMM is executed, it will create a new version of the file DAMQ8Q.SPK for the storage of projections. The file is only created if projections are actually made.

When you project a Banana, both X- and Y-projections are stored on DAMQ8Q.SPK under the ID-numbers displayed. These 1-D histograms may be displayed (or otherwise used) in the normal manner for a SPK-file. Use the P-qualifier to display spectra from DAMQ8Q.SPK without explicitly opening it. For example, to display ID numbers 1,3,5 from DAMQ8Q.SPK, type:

\[ \text{DP 1,3,5} \]
U300.400 FITTING - Introduction & General Features

You specify how fitting is to be carried out by supplying a number of Fit Specification Data Sets which may be given in any order. Many of these have default values (see SEC# U300.450). After the fitting process is specified, one or more Fit Requests are entered. Subsequently, some or all of the Fit Specifications may be changed and more Fit Requests entered etc. etc.

GENERAL FEATURES

(1)...Fit specifications may be entered interactively or read from a file or a combination of the two methods may be used.

(2)...Peak and background intensities are determined in a weighted linear least-squares fit while peak positions, widths, and asymmetry parameters are determined by a non-linear least-squares search (either Gradient search or Gauss method - See SEC#s U300.490 and U300.500).

(3)...Peak positions may be typed in or selected interactively or found automatically.

(4)...Spectra are fitted one section at a time and can be no more than 512 channels in length.

(5)...In the gradient search mode (FIT command), each section may contain a total of 16 peaks and background terms. That is, the number of linear coefficients to be determined in the linear least squares fit (# of peaks plus # of background terms) may not exceed 16. In the Gauss mode, only 5 peaks are allowed and asymmetry is not supported.

(6)...Initial values of peak positions, widths and asymmetry parameters must be specified by the user. Different values of width and asymmetry may be assigned to each peak or all peaks may be assigned the same values.

(7)...The FWHM for peaks in a section may vary independently, conditionally, or be held fixed. All peaks in a section may be forced to have the same width or fixed relative widths.

(8)...Peak positions may be adjusted or held fixed.

(9)...Peaks may be gaussian or asymmetric (see SEC# U300.480 & U300.540

(10)...The background may be specified (by up to 50 X,Y-points) or be determined in the fit. If determined in the fit, the background takes the form, \( Y = A + B\times X + C\times X^2 + D\times X^3 + X + . . . . . \) with the number of terms in the power series specified by the user.

(11)...The output includes the Fit Specification Data, peak positions, widths, energies, areas and uncertainties (in percent) as well as a printer plot of the fit on a 0.5 to 5 cycle plot.
U300.410 Commands for 1-key (cursor mode)

One-Key cursor commands (valid following a DS or DSX command)

Type: C - To enter cursor-mode

P/UP Add/Delete peak to Library (pos specified by cursor)
M/M Move nearest displayed peak to cursor pos (FW, ASYM unchanged)
X/UX Fix/Free peak position (for displayed peak nearest to cursor)
W/UW Fix/Free peak width (for displayed peak nearest to cursor)
L/UL Fix/Free Lo-Side ASYM (for displayed peak nearest to cursor)
H/UH Fix/Free Hi-Side ASYM (for displayed peak nearest to cursor)
O/UO Turn peak ON/OFF (for displayed peak nearest to cursor)
B/UB Add/Delete background point at cursor position

<-- Set Expand Region Lo-Limit
---> Set Expand Region Hi-Limit
[ Set Fit Region Lo-Limit
] Set Fit Region Hi-Limit
/
or ? Display chan#, cursor Y-value, chan contents
S Disp sum, cent & fwhm of Fit-Reg - DAT(,)DAT() defines BGD
A Disp sum, cent & fwhm of Fit-Reg - CUR(,)CUR() defines BGD
Q Return from cursor control routine
E Expand display (region defined by <-- -->)

See SEC# U300.110 or Type: h mous for use of Mouse Buttons.
03-Feb-94 ............ U300  DAMM - FITTING - WTM ............ PAGE 27

U300.420 Setup Commands

Commands for entry of peak, background & skip-regions ------------------------

PZOT - Zero the Peak Library
PK X,W,ASLO,ASHI - List of complete peak specifications
BZOT - Delete Fixed Background array
BACK X1,Y1 X2,Y2 .. - X,Y-points for fixed background
SKIP I1,I2 J1,J2 .. - Without List turns SKIP OFF
SKIP I1,I2 J1,J2 .. - Up to 4 regions to omit from Fit

Commands for defining FWHM, ASYM, WLIM, ALIM, NBC, WOOD, ECAL ------------

FW FWA,FWB,FWC - Coefficients for standard width function
WLIM FWL0,FWHI - Variation limit factors for peak widths
ASYM ASLO,ASHI - Standard Lo-Side and Hi-Side asymmetries
ALIM FALO,FAHI - Variation limit factors for peak asymmetries
NBC NBC - Number of power series terms in variable BGD
WOOD ON/OFF - Turn Woods-Saxon BGD term ON/OFF (default OFF)
- ON creates an additional background component
- with a Woods-Saxon "jog" under each peak which
- is proportional to the peak intensity.

ECAL ECO,ECA,ECB - Coefficients for standard energy calibration

Commands for control of non-linear parameter variation ----------------------

DPX XSTEP,DXMAX - Initial step size and limit for peak pos
DEL DEL,Delfac,NDEL - Initial step size, step size multiplier and
- number of DEL-values to use

VB - Use Variable Background (the default)
FB - Use Fixed Background if available

VX KVAR - Kind of variation for peak positions
VW KVAR - Kind of variation for peak widths
VALO KVAR - Kind of variation for Lo-Side asymmetries
VAHI KVAR - Kind of variation for Hi-Side asymmetries

KVAR = UIND - says vary Unconditionally, Independently
= CIND - says vary Conditionally, Independently
= ULOC - says vary Unconditionally, Locked
= CLOC - says vary Conditionally, Locked
= FIX - says keep Fixed - this the default assignment

Conditional says hold Fixed if peak so specified.

Unconditional says vary regardless of peak specifications.

Independent says given parameter-types are varied independently.

Locked says given parameter-types (width for example) are varied together
(multiplied by the same factor) in the non-linear search.
03-Feb-94 ............... U300  DASS - FITTING - WTM ............... PAGE 28

U300.430 Display of Data, Fits and Printer-plots

Commands for general display control -------------------------------

FIG  N - Select screen configuration number-N
WIN  N - Select window-N for subsequent displays
LIN/LOG - Set graphic display to LIN (default) or LOG
DMM  YMIN,YMAX - Set display-range (YMIN & YMAX)
DL  IL0,IHI - Set display-range (channel# limits)
DS  ID - Display spectrum ID (range defined by DL)
DS  I0,I0,IHI - Display spectrum ID (DL values replaced)
(MAX value of IHI-IL0 = 4095)
DSX  ID - Display Data defined by Expand Region
C - Enters 1-key cursor-mode

Commands related to display of FITS -------------------------------

MON/MOF - Peak Markers ON/OFF for DF (default = ON)
DFI - Set to display (DF ) DATA,FIT,BGD (default)
DPK - Set to display (DF ) DATA,FIT,PEAKS,BGD
DPBP - Set to display (DF ) DATA,FIT,(PEAKS+BGD),BGD
DF - Display Fit (channel-limits given by Fit-range)
DF  I0,IHI - Display Fit (channel-limits given by I0,IHI)
DC  NPK - Display Calculated peak # NPK+ RESIDUAL

PRP  X0,XHI - Display peaks from Library in range X0 thru XHI
PRP - Display all peaks from Library
PRB - Display all fixed Bgd-points
FSTAT - Display current fit-parameters
DR - List results of last Fit on VDT (terminal)

Commands related to printer-plots of results -------------------------------

KPPL  NONE - Says do no printer plots
KPPL  FITS - Says plot FITS only (the default)
KPPL  ALL - Says plot FITS, COMPONENTS and RESIDUALS

PR - Print and Plot results of last Fit on printer

Commands related to peak-finding -------------------------------

FIND  BIAS,FWHM - Enables peak-finding (see SEC# U300.155)
FIND - Enables peak-finding with (BIAS=5, FWHM=5)
NOFI - Disables peak-finding

If FIND is enabled (see SEC# U300.155 for general details), DASS will do a
peak find within the display region each time a DS (or DSX) command is
given. An attempt will then be made to add the newly found peaks to the
internal peak library. If a newly found peak is closer than 0.5*FWHM
channels to an existing library peak, it will not be added. Finally, all
library peaks will be marked on the display in the usual manner. No
distinction is made between "found peaks" and "manually entered peaks".
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U300.440 FIT Execution Commands

Commands for FIT execution -----------------------------------------------

FIT  ID,IL0,IHI  - Fit Request - (non-linear gradient search)
GFIT ID,IL0,IHI  - Fit request - (gaussian method)
RFIT ID,IL0,IHI  - Resume FIT/GFIT start withParms from last Fit
LFIT ID,IL0,IHI  - Linear Fit - no non-linear search
  - (Fit-range specified by IL0,IHI)
FIT ID X        - Fit Range specified by cursors (Fit Region)
GFIT ID X      - Fit Range specified by cursors (Fit Region)
RFIT ID X      - Fit Range specified by cursors (Fit Region)
LFIT ID X      - Fit Range specified by cursors (Fit Region)

Ctrl/C          - Terminates Fit-in-progress

U300.450 FIT Parameters - Saving, Setting, Default

Commands which save FIT parameters in memory library---------------------

SAV  I,J         - Save allParms from peaks I thru J of last Fit in PK-LIB
SAX  I,J         - Save X-Parms for peaks I thru J of last Fit
SAW  I,J         - Save W-Parms for peaks I thru J of last Fit
SAL  I,J         - Save ASL-Parms for peaks I thru J of last Fit
SAH  I,J         - Save ASH-Parms for peaks I thru J of last Fit
(If I,J omitted, indicatedParms from ALL peaks are saved)

Commands which set FIT parameters----------------------------------------

SET- X1,X2      - Set STD WIDTH and ASYM for peaks in range X1-X2
  values (defined by FWA, FWB, FWC, ASLO, ASHI)
SETW X1,X2      - Set WIDTH for peaks in range X1-X2 to STD value
SETW X1,X2,WA,WB,WC - Set WIDTH for peaks in range X1-X2 to value
   defined by WA,WB,WC (FWA,FWB,FWC unchanged)
SETL X1,X2      - Set ASLO for peaks in range X1-X2 to STD value
SETL X1,X2,ASLO - Set ASLO=ASL0 for peaks in range X1-X2
SETH X1,X2      - Set ASHI for peaks in range X1-X2 to STD value
SETH X1,X2,ASHI - Set ASHI=ASHI for peaks in range X1-X2
(If X1,X2,.. omitted, indicatedParms for ALL peaks are set)

List of default FIT parameters-------------------------------------------

    DEL  = 0.05   FWLO = 0.5     VX  =  CIND     NBC  = 2
    DELFAC=0.25  FWHI = 2.0     VW  =  CLDC     WOOD  = 0FF
    NDEL  = 1     FALO = 0.5    VAL0 =  FIX     KPPL = FITS
    XSTEP  = 0.5   FAHI = 2.0    VAHI =  FIX
    DXMAX  = 5.0     ASLO = 0.0
               ASHI = 0.0
U300.460 Commands to Control Relative Peak-intensities

The following commands may be used to fix the intensity of two or more peaks relative to each other within a section being fitted:

RELI X,R Sets relative intensity of library-peak nearest chan-X to be R
RELI ZOT Deletes all relative intensity entries
RELI OFF Disables relative intensity control but saves previous entries
RELI ON Enables relative intensity control (default)

NOTE: RELI specifications must be entered AFTER the associated peak library entries are completed. RELI has no effect unless there are two or more peaks with specified relative intensities within the region being fitting. R may be in any units however there is an 8 character limit on the number entered! Peak-areas will be in the same ratios as the relative intensities specified ONLY if width & asymmetry parameters are the same for each peak.

U300.470 FIT Specification Details

PK Data Set - Complete Peak Specifications

The PK Data Set accommodates a full specification of the characteristics of each individual peak. Up to 100 peaks may be included in the list. Each peak is specified by the following parameters.

X......Gives the initial peak position in channels.

W......Specifies the initial peak FWHM in channels. If not entered, FWHM is set to the value specified by FWA, FWB & FWC.

ASLO....Specifies the Lo-Side asymmetry parameter.

ASHI....Specifies the Hi-Side asymmetry parameter.

Other Specifications

ECO,ECA,ECB...Defines the spectrum energy calibration (not required for fitting) through the relation;

\[ E = ECO + ECA \times (CHAN \#) + ECB \times (CHAN \#)^2 \]

FWA,FWB,FWC...Defines the peak WIDTH as a function of channel number through the relation;

\[ FWHM(CHANNELS) = FWA + FWB \times SQRT(CHAN \#) + FWC \times (CHAN \#) \]

ASLO,ASHI...Are the initial values of the Lo-Side and Hi-Side asymmetry parameters. If this specification is used, the initial values will be the same for all peaks.

FWLO...Is the minimum fraction of the initially specified value by which any peak width may be reduced.

FWHI...Is the maximum fraction of the initially specified value by which any peak width may be increased.

(continued on next page)
FALO...Is the minimum fraction of the initially specified value by which any peak asymmetry parameter may be reduced.

FAHI...Is the maximum fraction of the initially specified value by which any peak asymmetry parameter may be increased.

DEL....Specifies the fraction by which the peak width and the peak asymmetry parameters are to be changed in each step of the non-linear search. For example,

$ \text{(NEW WIDTH) = (OLD WIDTH) \times (1.0 - \text{DEL})} $ 

DELFAC-Is a factor by which the current value of DEL is multiplied in order to obtain a new (smaller) value. Typically one starts with a fairly large value of DEL (say 0.02 to 0.05) and subsequently makes one or more reductions in order to achieve a greater convergence speed.

NDEL....Is the number of DEL-values to be used

XSTEP...Is the maximum amount (in channels) that a peak may be moved in any one step in the non-linear search for the best fit. XSTEP is reduced at the same time and by the same factor (DELFAC) that DEL is reduced.

DXMAX..Is the maximum number of channels (either + or -) that any peak is allowed to be moved from its original position.

SKIP...Defines up to four regions within the Fit Range which are to be ignored in doing the fit.

KPPL=..NONE says do no printer plots.

KPPL=..FITS says plot the FIT (experimental and calculated spectrum on the same graph).

KPPL=..ALL says plot the FIT (as in KPPL=..FITS) and in addition, plot each component (calculated peak) together with the corresponding "residual component". What do you mean by residual component, you ask. When plotting the Ith peak we calculate the Ith residual component by subtracting any background (specified or calculated) as well as all calculated peaks other than the Ith from the experimental spectrum.

NBC....Denotes the number of background components to be included in the power series. NBC=2 Says use the form $ Y=A+B \times X $ and NBC=4 says use $ Y=A + B \times X + C \times X \times X + D \times X \times X \times X $. The number of peaks in a section plus NBC must not exceed 16.

(continued on next page)
FIT Specification Details (continued)

WOOD...ON/OFF says turn Woods-Saxon background term ON/OFF. The default is OFF. If WOOD is ON, an additional background component is included which has a Woods-Saxon type "jog" under each peak which is proportinal to the peak intensity. The jog form is given by:

\[ Y = \frac{1.0}{(1.0 + \exp(\text{ARG}))} \]
\[ \text{ARG} = 4.714 \times (X_0 - X) / \text{FWHM} \]
\[ X_0 = \text{peak-position}, \quad X = \text{channel-of-interest}, \quad \text{and FWHM}=\text{peak-FWHM}. \]

The use of such a background form could be helpful in the analysis of weak peaks which are located on the low-energy side of strong peaks. You will have to be the judge.

Discussion of Peak Shapes

The most general peak shape allowed is given by

\[ \text{YL} = \exp(-(X-X_0)^2 / (2 \times \text{FWHM})^2) \times (1 + \text{ASLO} \times (X - X_0) / A) \]
\[ \text{YH} = \exp(-(X-X_0)^2 / (2 \times \text{AFWHM})^2) \times (1 + \text{ASHI} \times (X - X_0) / A) \]

Where \( A \) is the gaussian Half-Width at 1/e max and YL and YH describe the curve on the Lo- and Hi-Sides, respectively. If all asymmetry parameters are held to zero, the shape is gaussian. The ASLO/ASHI parameters broaden the Lo/Hi sides of the peak and result in an exponential fall-off (like \( \exp(-(X-X_0)/(A \times \text{ASLO}) \)) for example) As you move far away from the peak maximum (i.e. channel X0). To get some idea of what size asymmetry parameters to use see Fig 1.

Gradient-search Method (FIT request)

Each time the program encounters a Fit Request, it searches the complete Library and includes in the Fit all peaks which are ON and whose positions lie within the Range of Fit (i.e. between ILO and IHI).

GENERAL PROCEDURE FOR THE NON-LINEAR SEARCH

1. ...The initial values of all parameters which are to vary in a non-linear way are set to the initial values specified by the user.

2. ...Each individual parameter is changed (both increased and decreased) by an amount determined by DEL or XSTEP in order to establish a "direction" (increase or decrease) for each parameter.

3. ...All parameters are changed in the direction determined in step (2) and in step sizes determined by DEL and XSTEP until the Quality of Fit is no longer improved.

4. ...Steps (2) and (3) are repeated until no improvement in the Fit can be made.

5. ...DEL and XSTEP are multiplied by DELFAC and steps (2) and (3) are repeated until no improvement in the Fit can be made.

6. ...Step (5) is repeated (NDEL-1) times.
The GFIT (Gauss-method) fit request initiates an alternate non-linear procedure. Commands are:

GFIT ID,IL0,IHI 
or GFIT ID X

This command initiates a nonlinear least-squares search by Gauss' method as modified by Marquardt. (See, for example, P.R. Bevington's book, "Data Reduction and Error Analysis for the Physical Sciences", p. 235 ff. The routines used in GFIT are not Bevington's, but are those of M.J. Saltmarsh from the SEL 840-A program PKFT.)

The search continues until chi-squared per degree of freedom (QFN) has changed by less than 0.0001 or until 25 iterations have occurred. The search may be resumed by the RFIT command. The iteration number and QFN appear on the right side of the screen.

The printer output from GFIT includes absolute error estimates for the peak positions, widths, and areas which are derived from the correlation matrix of the fit. The percentage error in the area is printed in the column labeled PCE.

The DAMM commands VW ULOC or VW CLOC (the default option) are interpreted to mean that the widths of the peaks are to be the same and vary together. Widths may be varied independently by VW UIND or VW CIND. Individual widths or positions may be frozen or released by the standard cursor commands of DAMM. If one or more widths are to be kept fixed while others are varied, the command VW CIND or VW CLOC should be given; if UIND or ULOC is given, the instruction to fix is ignored.

If GFIT is chosen, the program attempts to estimate the width of the tallest peak for its initial guess of width. If unsuccessful it reverts to the standard DAMM procedure of using whatever was stored from the last previous FW, SETW commands (or the default option, which is FW = 5).

At present The GFIT request is limited to fitting a sum of up to 5 Gaussian peaks with a linear background. The parameters ASLO and ASHI for asymmetric peaks are ignored.
Estimated uncertainties should always be viewed with considerable skepticism, especially when non-linear as well as linear fitting processes are involved, as it is here. The uncertainties in the peak areas estimated by both the FIT and GFIT procedures are rather "standard" and involve CHISQ (of the overall fit) as well the diagonal element of the inverse matrix corresponding to the peak intensity in question. This inverse matrix is found in the standard linear least-squares fitting process. See a book like "Bewington" or Cziffra et. al. UCRL-8523, 1958 for a real discussion of this subject. I have used:

\[ D(J) = \text{SQRT}(\text{AINV}(J,J) \times \text{QFN}) \]  
where;

\[ D(J) \] = the estimated uncertainty in the J-th fit parameter B(J)  
(there is a B(J) for each peak-area(J))

\[ \text{QFN} = \text{CHISQ}/(\#\text{data-points} - \#\text{adjustable-parameters}) \]

\[ \text{AINV}(J,J) \] = the J-th diagonal element of the inverse matrix found in the linear least-squares fitting process.

\[ \text{PCE}(J) = 100 \times D(J)/B(J) \] = percent uncertainty in J-th peak-area.

Reading Fit Results from damm.log

The table of fit-results recorded on damm.log, as a result of a PR command, includes flags of the form LAB$ to facillitate the location and decoding of relevant data by other programs. Formats associated with the different line-labels are listed below.

<table>
<thead>
<tr>
<th>Label</th>
<th>Format</th>
</tr>
</thead>
<tbody>
<tr>
<td>TIT$</td>
<td>(1X,15X,2I6,6X,20A4)</td>
</tr>
<tr>
<td>DEL$</td>
<td>(1X,2F10.0,1I0,6F10.0)</td>
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<tr>
<td>SKP$</td>
<td>(1X,8I10)</td>
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<td>CAL$</td>
<td>(1X,6F10.0,1I0)</td>
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<td>VAR$</td>
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<tr>
<td>GFI$</td>
<td>(1X,5F10.0,3F8.0,4F7.0,15,I7)</td>
</tr>
<tr>
<td>BDG$</td>
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</tr>
<tr>
<td>QFN</td>
<td>(1X,6X,F10.0,11X,F10.0)</td>
</tr>
</tbody>
</table>

Alternatively, one may make use of the routines contained in the internally documented demonstration program samred. The source of this program is in /usr/users/milner/Ddamm/samred.f.

Common Problems

(1)....If you define the standard FWHM (via command: FW FWA,FWB,FWC) or standard asymmetry parameters (via command: ASYM ASL0,ASHI), this does not re-define such parameters for previously defined peaks. You must use SETW to do this (see SEC# U300.450).
U300.540 Peak Shape vs Asymmetry (Log plot)

Y_L = EXP((-X-X_0)**2/(A**2*(1+ASLO*(X0-X)/A))
Y_H = EXP((-X-X_0)**2/(A**2))

Y = 100

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FWHM = 12

Y = 10

| 1 6   | 0  |
| 1 8   | 4 2|
| 1 8   | 4  |
| 1 8 6 | 2  |
| 1 8 6 | 0  |

Y = 1

Figure 1
U300.550 Screen Configurations

The sizes and locations of display windows are controlled by one or more of the commands - FIG, FIGF or FIG1.

FIG ID - Sets the number and size of display windows to that specified by configuration number ID. A given configuration ID number may specify up to 20 display windows. The default configuration library contains ID-numbers 1 thru 16. Type: H FIG for a display indicating the default screen configurations or just Type: FIG 1, FIG 2 ... FIG 16 and see what you get.

FIGF FILENAME - Requests that a new configuration library be read from a file named FILENAME. The file /usr/htirf/fig.dat (or the file /home/uptk/fig.dat) which contains the default configuration is listed on the next two pages. The **** in col-1 of the table denote comment lines and are ignored in processing.

****DEFAULT SCREEN-CONFIGURATION TABLE

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FIG-Id = Configuration ID number to be associated with window.
XO(PIX) = X-coordinate of upper left corner of window in pixels.
YO(PIX) = Y-coordinate of upper left corner of window in pixels.
W(PIX) = Width of window in pixels.
H(PIX) = Height of window in pixels.

---

FIGI Restores the configuration library to the default state.
U300.560 Graphic Screen Color Mapping

The colors (or grey scale) is controlled by means of a color map which has 40 entries that specify (red, green, blue) intensities in the range 0-65535. The default table contained in /usr/hhirf/cmap.dat or in /home/upak/cmap.dat is listed below:

<table>
<thead>
<tr>
<th>RED</th>
<th>GREEN</th>
<th>BLUE</th>
<th>ENTRY# - NORMAL USE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
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<td>01 - BLACK</td>
</tr>
<tr>
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<td>65535</td>
<td>02 - 1-D DISPLAY - COL(1) - FIT DATA</td>
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<tr>
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<td>0</td>
<td>03 - 1-D DISPLAY - COL(2)</td>
</tr>
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<td>04 - 1-D DISPLAY - COL(3) - FIT CALC</td>
</tr>
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<td>05 - 1-D DISPLAY - COL(4)</td>
</tr>
<tr>
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<td>0</td>
<td>06 - 1-D DISPLAY - COL(5) - FIT BACK</td>
</tr>
<tr>
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<td>07 - 1-D DISPLAY - COL(6)</td>
</tr>
<tr>
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<td>08 - 1-D DISPLAY - COL(7)</td>
</tr>
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<td>0</td>
<td>09 - 1-D DISPLAY - COL(8)</td>
</tr>
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<td>10 - NOT USED FOR NOW</td>
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<td>11 - 2-D COLOR DISPLAY</td>
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<td>33 - NOT USED FOR NOW</td>
</tr>
<tr>
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<td>34 - GCOR(1)</td>
</tr>
<tr>
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<td>35 - GCOR(2), SAM PK MARK, FIT VAR MARK</td>
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<td>36 - GCOR(3), 1-D PK LAB, 2-D BAN &amp; EX-MARK</td>
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</tr>
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<td>38 - GCOR(5), CURSOR</td>
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Different color mapping is accomplished by the CMAP command as shown below:

CMAP FILENAME ;Processes a file FILENAME of the structure shown above ;and maps as specified therein. The new mapping only ;takes place subsequent to the next FIG command.
U300.570  Graphic Screen Black & White Mapping

When using black & white monitors, the table /usr/hhirf/bmap.dat, (or /home/upak/bmap.dat) listed below, may be more useful. If you are using the REVV mode, then table /usr/hhirf/bmap.dat or /home/upak/bmap.dat, not listed here, should be used as a template. You will probably need to make other adjustments in order to achieve semi-satisfactory results.

Note: that table entries are labeled with their uses.

RED  GREEN  BLUE  ;ENTRY# - NORMAL USE -----------------------------

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<tr>
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</table>
U300.600 Implementation

The SUNPAK or UPAK tape that you receive will contain all of the files that I have on the SPARCstation (or DECstation), whether you want them or not - it is just a lot easier for me to do that.

Please read the SUNPAK or UPAK document, supplied in hardcopy form with the tape, for a discussion of file organization, implementation of run-time help-files, etc.

Good Luck,

W. T. Milner