CB–Note 1xx

LEAR Crystal Barrel Experiment, PS197

CBDISP
The Crystal Barrel Display Program

V1.05

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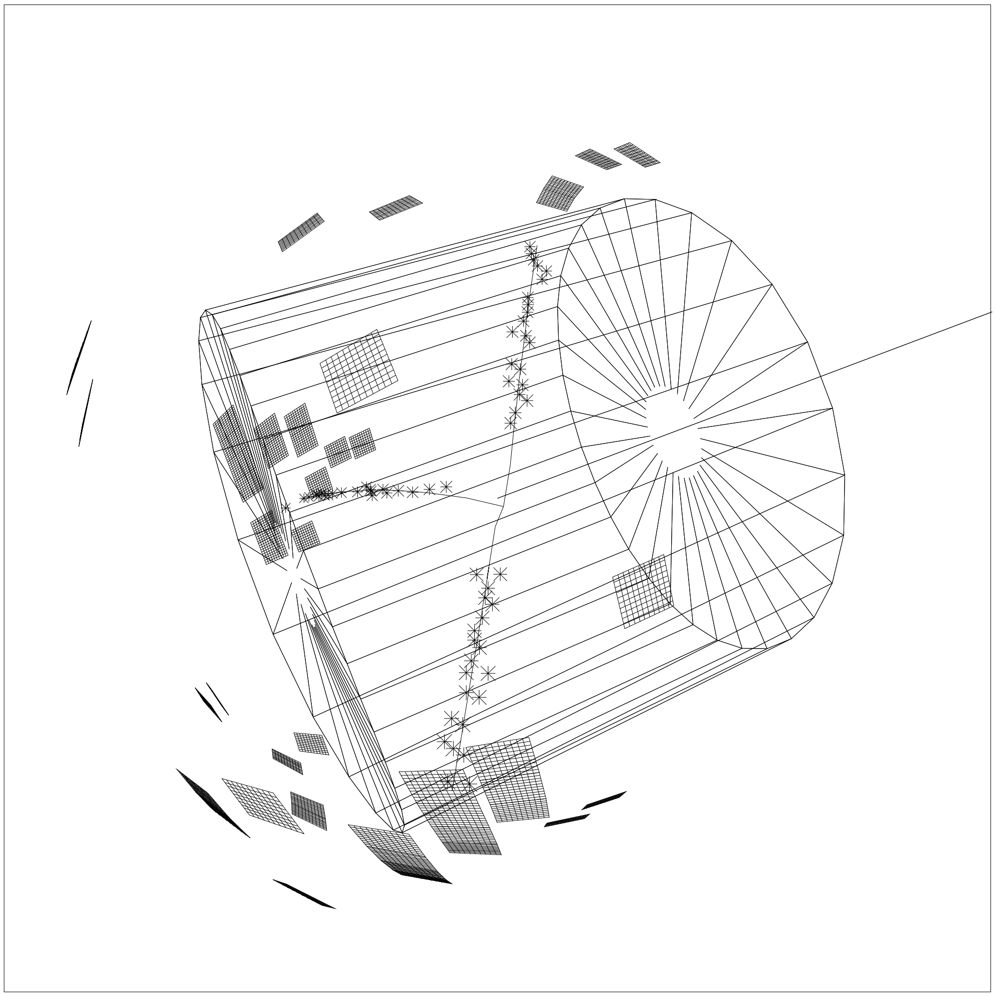

Contents

0.1 Changes from Version 1.04

- Program Flow
  1. CBDISP can be easily called from the standard user routines of CBDISP.
  2. Several routines were rewritten to improve readability and efficiency.
- Bug Fixes
  1. Fixed `SELECT` bug.
  2. Fixed the X11 window flushing bug.
  3. Fixed the bug in the crystal matrix plot, where end crystal depositions were plotted in the wrong place.
  4. Fixed the retrieval problem for `GLOB`, `NEUT` and `CHRG` data set types.
  5. Fixed the angular mismatch in the JDC.
  6. Fixed the PWC raw hits.
  7. Corrected spelling errors.
  8. Fixed ZOOM bug.
  9. Fixed other minor bugs.
- Graphical Display Enhancements
  1. 3D plotting is plotted in true perspective.
  2. JDC plotting is more attractive, tracks are better labelled.
  3. New JDC 3D detector view.
  4. Raw JDC signals are easier to read.
  5. Colours in the X11 version are more logical.
  6. Crystal tower plots are nicer and easier to read.
  7. Information window plots, GI CI JI and TI, look better.
  8. PED reconstructed plots look better.
  9. Energy towers are filled with colours.
  10. The RZ projection of the crystal towers conforms to the real positions of the crystals.
  11. Headers, both top and right, are easier to read and contain non- bogus information.
  12. New window legend, scale indicator in cm.
  13. Plotting is clipped to desired window.
  14. `CHAM`, `XTAL` and `GLBL` commands look nicer.
  15. The JS detector view has new options, including a double sector view and a skinny (real) view, and can be zoomed.
  16. Background is black in colour mode and white in black/white mode.
  17. `COLOR OFF` also sets FILLTYPE HATC.
- New and More User Friendly Features
  1. Several command line error checks, and new information messages when something fails.
  2. `AUTODO` option changed and `AUTOPLOT` option added, thereby removing `XXPLOT`

3. Graphics workstation setup is standardized.
4. `SETUP ?` works on UNIX and VAX machines.
5. `INFO/VERTEX` and `INFO/TRIGGER` commands.
6. Zooming is easier and interactive.
7. Printout of parameters when event is analyzed is disabled.
8. The KUIP Prompt gives current event and run number information.
9. The JS (JDC Sector) view will plot all the points of a track if at least one lies within the indicated sector.
10. `HARDCOPY` works for offline Unix machines.
11. `ASSIGN` is more user friendly.
12. Track reconstruction errors are printed.
13. Removed `INFO/CUTS` and `INFO/SWITCH` and combined them into `GENERAL/CUTS` and `GENERAL/SWITCH`.
14. Removed useless commands `SYSVAR` and `FILLAREA`.
15. New information window for Monte Carlo data, `MI`.
16. New mouse/menu driven mode, `MENU`.

Chapter 1

Introduction

CBDISP, the Crystal Barrel Display Program, allows the user to graphically look at the annihilation events produced in the Crystal Barrel Experiment. The three main detector parts, the Proportional Wire Chamber (PWC), the Jet Drift Chamber(JDC), and the Crystal Barrel Calorimeter, can be viewed either separately or combined, and the data associated with each can be viewed in many different forms.

The screen can be divided up into either one, two, three or four windows. Each window can show up to three data sets simultaneously. For example, the first window could show PWC raw hits, JDC raw hits and crystal energies. The second window could show JDC raw hits, pattern-recognized JDC hits, and the helical tracks fitted to the recognized JDC hits.

Most detectors can be shown in either ϕr (viewed parallel to the beam) or r/z (viewed perpendicular to the beam). A limited three dimensional perspective view can be had of the crystal barrel and JDC.

In order to quickly set up the screen with frequently used detector views, a number of setup macros exist. These macros set the number of windows, the zoom factor, and which detectors and associated data sets to show.

1.1 Running CBDISP

Frequent Used Commands

`DO`	Analyzes the next physics event. If AUTOPLOT is on, then the event will be plotted also.
`PLOT`	Plots the current physics event.
`SELECT` *n*	Selects a particular event number, `n`, and analyzes it.
`SETUP` *macroname*	Loads in a particular detector display setup. For example, `SETUP OVERALL` will load in the OVERALL macro, which gives a good overall view of all the data, in four windows. A list of macronames appears in the SETUP Macros Chapter, and is available with the command `SETUP ?`.
`HARDCOPY`	Makes a hardcopy on the local printer.
`MENU`	Goes into mouse menu mode.

CBDISP is actually a modification of the CBOFF program. Several FORTRAN Logical Unit Numbers must be assigned before running the program with environment variables or logicals, depending on the system.

	Logical	Typical File	Description
Input:	FOR017	cbbase.rz	CB database constants.
	FOR021	/dev/rmt4	Data
	FOR081	card_disp.jdc	Steers LOCATER for real data
	FOR081	card_mc.jdc	Steers LOCATER for Monte Carlo
	FOR082	jdc_gain_*.tbl	JDC gain table
	FOR099	card_disp.crd	Steers CBOFF
	CDMACRO *	cbdisp.kumac	`MACRO` definitions.
	CDLOGON *	cblogon.kumac	Graphics startup for CBDISP.
Output:	FOR004	cbdisp.log	Status of the run.
	FOR007	cbdisp.dbg	Possible debug output.
	FOR008	cbdisp.err	Errors encountered in running.
	FOR010	cbdisp.hist	Histogram output.
	FOR020	/dev/rst1	Output

Note: The spelling of the logicals varies by system. On SUNs, the format is `FORT`*nn*, while on VAXs, the format is `FOR`*nnn*.

* - These files are not pointed to by logical unit numbers, but with regular environment variables or logicals.

A shell script or command file is available that sets all these LUNs and calls CBDISP automatically. This file is usually `CBDISP_RUN` or CBDISP_RUN.COM. See the section below on compiling the program.

CBDISP executes the file pointed to by the logical CDLOGON at the beginning of the program and whenever the `RESET` command is issued. This file just contains KUIP and CBDISP commands. An example CDLOGON file is:

```
OPTION/COMMENT 'Photon Correlations'
OPTION/TEXTTYPE OFF
MESSAGE '* Started new CBDISP session...'
```

1.1.1 Prompt

The text prompt gives the event number and run number of the currently loaded and analyzed event.

```
(Event 000000,Run 003484) >
```

. If `AUTODO` is off, then the prompt will indicate whether or not the event has only been read (but not analyzed).

```
Event:     2 Run:  3484... read but not analyzed.
Read:(Event 000002,Run 003484) >
```

.

1.1.2 Menu Mode

By issuing the command `MENU`, CBDISP will go into menu mode. The menu is at the upper left corner of the screen and gives four options.

DO	Goes to the next event. Same as `DO` command.
SETUP	Select one of the `SETUP` macros.
PRINT	Makes a printout. Same as the `HARDCOPY` command.
EXIT	Exit CBDISP entirely.

To exit menu mode without exiting CBDISP, simple click anywhere outside the menu or press the right mouse button.

The setup macros are ready from the file pointed to by CDMACRO.

If one of the `JDCSEC*` setups is selected from the setup menu, then a second menu will be created near the middle of the top of the screen that allows the user to select the JDC sector number easily. The two arrow buttons increase or decrease the sector number, while the middle button gives a menu of all 30 sectors.

If menu mode is always desired, add the `MENU` command to the last line of the start-up kumac file (logical `CDLOGON`).

1.1.3 Screen Layout

The screen has a header, up to four graphics windows and information panels.

The header has three parts. The leftmost part gives the version number of CBDISP, a user defined message (see `MESSAGE`) and a message indicating online or offline analysis. The middle part gives the event type (e.g. real data, table event, etc. from IEHDCB(1)) and the number of neutral and charged particles the analysis has produced. The right part gives the run number, the event number, the date and time of the event, and some trigger information.

The hardware (HW) line gives the multiplicities for the JDC, FACE and PWC. The digits read as follows

`HW J=`*abcdef* **F=***gg* **P=***hhii*	a	JDC layer 2 multiplicity
	b	JDC layer 3 multiplicity
	c	JDC layer 4 multiplicity
	d	JDC layer 5 multiplicity
	e	JDC layer 20 multiplicity
	f	JDC layer 21 multiplicity
	gg	FACE multiplicity
	hh	PWC inner layer multiplicity
	ii	PWC outer layer multiplicity

The software (SW) line lists whether the software triggers (up to four) accepted (=1) or rejected (=0) the event.

The graphics windows are arranged via the `VIEW`,`ZOOM` and `ASSIGN` commands, or with the `SETUP` macros. Each window has a circled window number and a scale indicator giving a distance in centimeters (and a zoom factor if applicable).

The information panel on the right side of the screen gives a colour map of energies (MeV) (if applicable) and what projection, detector identifier and data set each window displays.

1.1.4 Data Sets

Each detector view can be associated with one of many available data sets. See `ASSIGN` for a description of how they are presented. These data sets are:

Data Set	Description
`FERA`	Crystal-TBEF bank data
`2282`	Crystal-TBEL bank data
`ENER`	Crystal-TBEN bank data
`CHRG`	Crystal-TTKS bank data,if (TTKS+4) not 0
`NEUT`	Crystal-TTKS bank data,if (TTKS+4) = 0
`GLOB`	Crystal-TTKS bank data
`PEDS`	Crystal-TBTK bank data
`RAWS`	JDC-TJDC bank data
`TRAR`	JDC-TCHT bank data, extracted with TCOORD(0,...) and TCOORD(1,...) routine data
`TRAK`	JDC-TCHT bank data, extracted with TCOORD(2,...) routine data
`HELX`	JDC-TCTR bank data, extracted with TCOORD(4,...) routine data
`VERT`	JDC-Same as `HELX` plus TCVT bank data
`RAWS`	PWC-TPWC bank data, -1 and -2 downlinks
`TRAK`	PWC-TPWC bank data, -3 and -4 downlinks
`CLST`	PWC-same as `TRAK`

1.2 Programming with CBDISP

1.2.1 Using CBDISP with CBOFF

For a stand alone version of CBDISP, simply use the dummy user routines provided with the CMZ file, i.e. `USER`, `USINIT`, `USEVNT`, `USRUN`, and `USLAST`.

To use ones own user routines, one must include the following calls in the appropriate user routine. (The mnemonic `CD` stands for Crystal Barrel Display Program.) The integer variable `IERR` gives a non-zero return value if the call failed. The integer variable `ICODE` must be the same variable that is passed to `USRUN` or `USEVNT`.

`CALL CDINIT(IERR)`	Insert at the first line of `USINIT`. *This call is required.* This routine sets up the graphics and KUIP. Note: `CDINIT` calls `HLIMIT` with a size of 350000 words. DO NOT call `MZPAW` or `HLIMIT` from one's `USINIT` routine, since this will interfer with the previous call to `HLIMIT.` If the current size of the `COMMON /PAWC/` block is too small for one's application, one will need to edit the `//CBDISP/GRPCOM/@MACROS` deck in `CBDISP.CMZ` and change `NPAWGN` to a higher number of words, and then recompile everything.
`CALL CDRUN(ICODE)`	Insert at the first line of `USRUN`. *This call is required.* This routine initializes things that change from run to run, such as detector position.
`CALL CDEVNT(ICODE)`	Insert at the first line of `USEVNT`. *This call is required.* This routine is used for the `SKIP`, `SELECT` and `RUN` CBDISP commands.
`CALL CDUSER(IERR)`	Insert somewhere inside `USER`. The call to `CDUSER` is optional and can selectively be called based on the user's own selection criteria coded into his `USER` routine. For example, the user might want to histogram all events above a certain cut and then display events with 3 or more tracks. The `USER` routine would contain a line such as `IF (NTRKS.GE.3) CALL CDUSER`

The calls to `CDINIT`, `CDRUN` and `CDEVNT` *must* be included at the proper place for CBDISP to work properly.

Warning: If the `RUN`, `SELECT` or `SKIP` features are used, then `CDUSER` should not be optionally called. Also, `CDUSER` should not be called more than once during each invocation of `USER`. Strange things might happen otherwise.

1.2.2 Compiling CBDISP

UNIX

The following commands should be entered into CMZ to create the code to automate compilation. The file `CBDISP.CAR` should be in the current directory. Substitute `DECS` or `ALT` for `SUN`, if necessary.

```
MAKE CBDISP
YTOC CBDISP.CAR
CD EXEC_SHELLS
SELECT SUN
SET make_it.com -F TEXT
CTOT -S @make_it
SHELL chmod +x make_it.com
SET cbdisp.compile.kumac -F TEXT
CTOT -S cbdisp_compile
EXIT
```

Compiling is down with the script file, `make_it.com`. It references `cbdisp.compile.kumac`. Many of the references within `make_it.com` are system dependent and must be tailored for the particular system. Consult the file directly for documentation. The script file makes a library, `libcbdisp.a`, which contains all the CBDISP routines, including dummy `USER`, `USINIT`, `USRUN`, `USEVNT` and `USLAST` routines. `cblogon.kumac` and `cbdisp.kumac` are also created, which are the logon and macro scripts for CBDISP. Finally, `run_it.com` is created, which is the c-shell script that sets the environment variables needed for CBDISP. This must be editted for the particular system.

To include private user routines, the compiled object files should reside in the directory `src` relative to the current directory where the executable version of CBDISP will be put. For example, if the workinging directory is `/user/work`, then put *all* five user object codes (`user.o usinit.o usrun.o usevnt.o uslast.o`) into `/usr/work/src`. (Put in dummy routines if necessary.) Then run `make_it` from `/user/work` and the CBDISP executable will be created in `/user/work`.

VAX

The following decks should be extracted from the CMZ file with the following CMZ commands.

```
MAKE CBDISP
YTOC CBDISP.CAR
CD EXEC_SHELLS
SELECT VAX
SET make_it.com -F TEXT
CTOT -S @make_vax
SET cbdisp_compile.kumac -F TEXT
CTOT -S cbdisp_compile
```

Compiling is down with the command file, `make_it.com`. It references `cbdisp_compile.kumac` and creates the file `cbdisp.opt`. `make_it.com` will have to be editted to suit the particular machine that CBDISP is compiled on. See the command file for further information. `CBLOGON.KUMAC` and `CBDISP.KUMAC` are also created, which are the logon and macro scripts for CBDISP. Finally, `RUN_IT.COM` is created, which is the c-shell script that sets the environment variables needed for CBDISP. This must be editted for the particular system.

Other machines

Good Luck! Look at the above two examples for hints, then fix this documentation once it is figured out.

1.3 Sample Sessions

1.3.1 General Use

The user simply wants to look at a few physics events in general to get the flavor of the run. The user looks at six events and makes a hardcopy printout of the fifth event.

```
> SETUP OVERALL
> PLOT
> DO
> DO
```

```
> DO
> DO
> HARDCOPY
> DO
```

1.3.2 JDC tracking check

The user wants to look at JDC tracking in general and then examine certain sectors of the JDC more closely for event 587. Sector 24 seems peculiar, so the user looks at the raw wire signals. Since there are more signal plots that can fit on one screen, the user must issue several `PLOT` commands to page through them.

```
> SELECT 587
> SETUP JDCALL
> PLOT
> SETUP JDCSEC
> JDC_SECTOR 23
> PLOT
> JDC_SECTOR 24
> PLOT
> SETUP JDCRAW
> JDC_RAWSECTOR 24
> JDC_RAWSUM OFF
> PLOT
> PLOT
```

Chapter 2

Commands

2.1 KUIP Commands

The Command Processor commands are all standard KUIP commands. Most, except for HELP, will not be needed for most uses. Therefore, in the interest of space, most KUIP commands are not included here. One should consult the latest KUIP manual[1] , or use the on-line HELP command from within CBDISP, for documentation on the complete set of KUIP commands.

2.1.1 HELP *[item option]*

ITEM	(C)	Command or menu path	`D='␣'`
OPTION	(C)	View mode	`D='N'`

option	Description
`EDIT`	The help text is written to a file and the editor is invoked,
`E`	Same as 'EDIT'.
`NOEDIT`	The help text is output on the terminal output.
`N`	Same as 'NOEDIT'

Give the help of a command. If ITEM is a command its full explanation is given: syntax (as given by the command USAGE), functionality, list of parameters with their attributes (prompt, type, default, range, etc.). If ITEM='/' the help for all commands is given.

If HELP is entered without parameters or ITEM is a submenu, the dialogue style is switched to 'AN', guiding the user in traversing the tree command structure.

'HELP -EDIT' (or just 'HELP -E') switches to edit mode: instead of writing the help text to the terminal output, it is written into a temporary file and the pager or editor defined by the command HOST_PAGER is invoked. (On Unix workstations the pager can be defined to display the help text asynchronously in a separated window.) 'HELP -NOEDIT' (or just 'HELP -N') switches back to standard mode. The startup value is system dependent.

[1] CERN Program Library Long Writeup I102, KUIP Version 2.0

2.1.2 `USAGE` *item*

ITEM	(C)	Command name

Give the syntax of a command. If ITEM='/' the syntax of all commands is given.

2.1.3 `MANUAL` *item [output option]*

ITEM	(C)	Command or menu path	
OUTPUT	(C)	Output file name	`D='␣'`
OPTION	(C)	Text formatting system	`D='␣'`

option	Description
`'␣'`	plain text format
`LATEX`	LaTeX format (encapsulated)
`TEX`	LaTeX format (without header)

Write on a file the text formatted help of a command. If ITEM is a menu path the help for all commands linked to that menu is written. If ITEM='/' the help for the complete command tree is written. If OUTPUT=' ' the text is written to the terminal.

The output file produced with option LATEX can be processed directly by LaTeX , i.e. it contains a standard header defining the meta commands used for formatting the document body. With option TEX only the document body is written into the output file which can be included by a driver file containing customized definitions of the standard meta commands. Example:

```
MANUAL / MAN.TEX LATEX
```

will produce the file MAN.TEX containing the documentation of all available commands in LaTeX format.

2.2 ZEBRA Commands

Some useful zebra logging and debugging commands.

2.2.1 `IO` *[ierr ilog]*

IERR	(I)	Zebra I/O error unit	`D=6 R=-1:100`
ILOG	(I)	Zebra I/O logging unit	`D=6 R=-1:100`

Defines the ZEBRA I/O units. The first parameter defines the error unit, the second one specifies the logging unit. (-1 specifies system wide default log). If no parameters are given, the current values are printed.

2.2.2 `BANK` *[fcn name inum]*

FCN	(C)	Function	`D='*'`
NAME	(C)	Name of dump/survey link	`D='*'`
INUM	(I)	Index number	`D=0`

Prints information about certain or all ZEBRA data banks.

fcn	Description
`DUMP`	prints a zebra bank with the given name.
`SURV`	prints a survey of the structure.
`VERI`	verifies a bank (not implemented).
`FORM`	prints the format of the bank (not implemented).
`STOR`	prints the general store parameters.
`*`	prints all available ZEBRA banks.

2.2.3 `FZLOG` *[ilun ilog]*

ILUN	(I)	FZ log level unit	`D=21`
ILOG	(I)	FZ log level	`D=0 R=-3:4`

Defines the logging level for FZ messages and error logs. Please refer to the ZEBRA manual for the meaning of the log levels. If no parameters are given, the current values are printed.

2.2.4 `MZLOG` *[ilog]*

ILOG	(I)	MZ log level	`D=0 R=-3:2`

Defines the logging level for MZ messages and error logs. Please refer to the ZEBRA manual for the meaning of the log levels. If no parameters are given, the current values are printed.

2.3 GENERAL Commands

Commands to select and analyze physics events.

2.3.1 `DO`

Analyzes the next event to be ready for display. If AUTODO is off, then each subsequent `DO` command will alternately either read in just the next header or analyze the event associated with the header just read.

2.3.2 `REDO`

Starts reanalyzing the same event. See `DO`.

2.3.3 `RUN` *irun*

IRUN	(I)	RUN number to analyze	`D=0`

Defines the next run to analyze and display. If AUTODO is ON, then the first event in the selected run will be read and analyzed automatically.

Since the data tapes or files are read sequentially, it is not possible to skip *backwards* from the current run. The ZEBRA file format does not have an index available for random access; all event headers between the current run and the desired run must be sequentially read. This can take a fair amount of time, especially when reading tape.

2.3.4 SELECT *ievt*

IEVT	(I)	EVENT number to select	`D=0`

Selects the next event to be analyzed by a subsequent DO command. If AUTODO is ON, then the selected event will be read and analyzed automatically.

Since the data tapes or files are read sequentially, it is not possible to skip *backwards* from the current event. The ZEBRA file format does not have an index available for random access; all event headers between the current event and the desired event must be sequentially read. This can take a fair amount of time, especially when reading tape.

2.3.5 SKIP *iskp*

ISKP	(I)	Number of events to skip	`D=0`

Selects the number of events to skip when a DO command is issued. If AUTODO is ON, then the (*ISKP*-1) number of events will be skipped, and the *ISKP*th event will be read and analyzed. See also `SELECT` for more information.

2.3.6 BATCH

Declares the job to be in batch mode (irreversible). One `BATCH` command is equivalent to an infinite number of `DO` commands, without any further user interaction. If `AUTOPLOT` is on, then the events will be plotted.

2.3.7 CUTS *[name cuts rcut icut]*

NAME	(C)	Detector identifier	`D='*'`
CUTS	(C)	Cut to set	`D='*'`
RCUT	(R)	Cut value	
ICUT	(I)	Second identifier	`D=1`

Sets/resets cuts for the off-line analysis of crystals, JDC tracking and the global pattern recognition. Note that display cuts are set with the command `XTL_CUT`.

name	Description
`XTAL`	Crystal Calorimeter
`CHAM`	Jet Drift Chamber
`GLBL`	Global Tracking
`*`	All of the above

If only the detector name is given, then information on that detector will be printed out, giving a list of allowable cuts.

Crystal Cuts	Description
`MAXLBC`	Maximum counts in LeCroy 2282
`MINFBC`	Minimum counts in the FERAs
`EMINBC`	Min. energy of crystal for analysis
`EXTLBC`	Min. energy of crystal in cluster
`ECLUBC`	Min. energy of one cluster
`EPEDBC`	Min. energy of central crystal in PED
`QSUBBC`	Pedestal subtraction 1=on/0=off

JDC *Cuts*	Description
`IAMPTJ`	Min. accepted amplitude
`IGAPTJ`	Largest gap in layers, one segment
`TMINTJ`	Min. time a hit can have
`YCUTTJ`	Resolution border around sector
`DMINTJ`	Minimum allowed delta time
`DMAXTJ`	Maximum allowed delta time
`CLMBTC`	χ^2 cut for $\tan(\lambda)$
`XSQRTC`	χ^2 cut for connecting points
`NITRTC`	Nominal number of iterations
`CCUTTC`	Convergence criteria in TCITER
`CHDSTC`	Cut parameter in TCITER
`CHLXTC`	Convergence criteria in TCHELX
`NVTXTC`	Max. number of iterations in TCVRTX
`CVXCTC`	Convergence criteria in TCVRT
`RSLVTC`	Decision par. to add points to tracks

2.3.8 SWITCH *[name switch option]*

NAME	(C)	Detector identifier	`D='*'`
SWITCH	(C)	Switch name	`D='*'`
OPTION	(C)	Switch	`D='ON'`

Sets/resets switches for the off-line analysis of crystals, JDC tracking and the global pattern recognition.

name	Description
`XTAL`	Crystal Calorimeter
`CHAM`	Jet Drift Chamber
`GLBL`	Global Tracking
`*`	All of the above

option	Description
`ON`	Turns on switch
`OFF`	Turns off switch

If only the detector name is given, then information on that detector will be printed out, giving a list of allowable switches.

JDC *Switches*	Description
`TRAK`	Chamber tracking enabled
`PWC`	PWC tracking enabled
`RAWS`	Do TJDCGT
`PATT`	Do TCPATT
`CIRC`	Do TCCIRC
`HELX`	Do TCHELX
`VERT`	Do TCVERT

Crystal Switches	Description
`TRAK`	Crystal analysis enabled
`ALCE`	Calculate energies from ADCs
`PEDS`	Search peds
`CLST`	Find clusters
`DECF`	Decode FERA data
`DECL`	Decode LeCroy 2282 data

2.3.9 `AUTODO` *option*

OPTION (C) Autoplot switch `D='ON'`

Sets the auto-do option.

option	Description
`ON`	Analyzes the event automatically after being read, and also after SELECT, SKIP, RUN and BATCH.
`OFF`	Enters command interpreter before and after analysis, doesn't analyze after SELECT, SKIP, RUN and BATCH.

2.3.10 `AUTOPLOT` *option*

OPTION (C) Autoplot switch `D='ON'`

Sets the auto-plot option. This works with `DO`, `REDO`, `SELECT`, `RUN`, `SKIP` and `BATCH`.

option	Description
`ON`	Calls PLOT after event is analyzed.
`OFF`	Never calls PLOT automatically.

2.4 INFO Commands

Prints some useful informations on the off-line analysis results.

2.4.1 `TRIGGER` *[option]*

OPTION (C) Info options `D='A'`

option	Description
`J`	Prints JDC trigger information.
`X`	Prints X-tal trigger information.
`A`	Prints All of the above.

Prints on-line trigger information.

2.4.2 `DEPOSIT`

Prints the energy deposited in each crystal above the cut value. The cut value is defined with `OPTION/XTL_CUT`. The data set is equivalent to the `ENER` data set used in `ASSIGN`.

2.4.3 `CALIBRATION` *[name]*

NAME (C) Detector name for the cuts `D='*'`

Prints all information on the calibration data.

name	Description
`XTAL`	Crystal Calorimeter
`CHAM`	Jet Drift Chamber
`GLBL`	Global Tracking
`*`	All of the above

2.4.4 `CHAM`

Prints a list of all the JDC tracks, including track number, charge, particle type, opening angle (in degrees), total momentum and vector momentum (x, y, z).

2.4.5 `XTAL`

Prints a list of all the Crystal Barrel reconstructed PEDs, including PED number, PED center expressed in Phi and Theta indices, energy and vector momentum (x, y, z).

2.4.6 `GLBL`

Prints a list of all the reconstructed particles, including particle number, PED number, track number, charge, total momentum, starting vertex number, reconstruction probability, JDC hits on the track, crystal hits in the cluster and the track quality word.

2.5 DISPLAY Commands

CB graphical event display. The program can be used both on-line and off-line. Several windows can display information on different detectors and their corresponding data.

2.5.1 `PLOT`

Plots the current event. The number of windows is set with `VIEW`, the detectors in each window are set with `ASSIGN`, and the zoom factor is set with `ZOOM`. To speed things up, the `SETUP` command is used in place of the above three commands.

2.5.2 `SETUP` *macnam*

MACNAM (C) Name of macro to execute `D='?'`

Executes macros to load predefined setups. The macros are read from the default macro file, which is CBDISP.KUMAC initially, but may be changed with the DEFAULT_SETUP command below. See the SETUP Macros Chapter for a list of standard macros.

macnam	Description
?	Show all available setups available from the default macro file.[2]
XYZ	Equivalent to **`EXECUTE CBDISP#`***XYZ*.

2.5.3 `DEFAULT_SETUP` *defnam*

DEFNAM (C) Name of default macro file name to use `D='?'`

Sets the new default file name for the setup macros. Initially the default macro file is CBDISP.KUMAC. The SETUP command above reads this file for KUIP MACRO commands.

defnam	Description
?	List all available KUMAC and/or macro files.
XYZ	Sets the macro file to *XYZ*, used by SETUP.

2.5.4 `VIEW` *iview*

IVIEW (C) View type `D='S'`

Defines the window arrangement. Each window must be assigned a detector with the **`ASSIGN`** command.

iview		Description
`S`	1	Single display
`D.1`	1 2	Double display
`D.2`	1 2	Double display
`T.1`	1 2 3	Triple display
`T.2`	1 2 3	Triple display
`T.3`	1 2 3	Triple display
`T.4`	1 2 3	Triple display
`Q`	1 2 3 4	Quadruple display

2.5.5 `ZOOM` *[elem iwind]*

ELEM (C) Screen element `D='S'`
IWIND (I) Window identifier `D=1 R=1:4`

Zooms (magnifies) a window. The two modes of zooming are Direct Specification of what part of the window one wants zoomed, or Cursor Specification using the mouse or graphics cursor.

Direction Specification has the following syntax: *x.yy*

x	Description
`S`	Normal Size ("Single")
`Q`	2X Magnification, y ranges from 0 to 3 ("Quarter")
`N`	3X Magnification, y ranges from 0 to 8 ("Ninth")
`H`	4X Magnification, y ranges from 0 to 15 ("Hexadec")

The value yy selects which part of the screen to zoom, where the upper-left corner is `0` and subsequent sections of the screen are increasing left-to- right, top-to-bottom. For example, the center subwindow when in the "Ninth" subdivision mode is 4. To zoom that particular subwindow of window 2, use `ZOOM N.04 2`.

inth"

0	1	2
3	4	5
6	7	8

Cursor Specification has the following syntax: `C` or `C.`yy or `C-`yy

An interactive graphics cursor must be available for this option, such as a mouse. If there is more than one window, one must first move the mouse into the desired window and click the left mouse button. The program will prompt the user for this if it is necessary. There are three things one can do from here:

- Select a zoom box with mouse, by clicking once with the left mouse button at each opposing corner. The region within the box will be enlarged to fill the window. Some graphics systems will display an interactive rubber-band box, while others won't.
- Select a point and double-click the left mouse button. The region centered at the mouse pointer will zoom by a factor of yy. If yy is negative, then the zoom will be a "shrink" and the window will be reduced by a factor of $|yy|$. If yy is not given, a value of 2 is used. For example, entering `ZOOM C.3` and double-clicking somewhere inside the correct window will enlarge the detector by a factor of three.
- Click the middle or right mouse button, which will unzoom the selected window back to normal size. Which button to press will depend of course on the mouse and computer. If a right or middle mouse button is not available, then the command `ZOOM S` n should be used, where n is the window number.

2.5.6 ASSIGN *[iwind iprec proj det1 det2 det3]*

IWIND	(I)	Window identifier	`R=1:4`
IPREC	(I)	Precision identifier	`D=1 R=1:14`
PROJ	(C)	Projection type	`D='PR'`
DET1...	(C)	Detector identifiers	`D='CB:ENER'`

Assigns detectors and data sets to a window, or prints out the current assignment.

With no arguments, ASSIGN will list the current window assignment, giving the precision, projection and detectors assigned to each window. Otherwise, at least 3 arguments must be given.

An example of the command is

```
ASSIGN 1 13 PR JD:HELX CB:ENER
```

The "`1`" specifies the window number that the detectors will be plotted in. The "`13`" specifies what precision to use. In this case, 13 will plot JDC sector boundaries and sector labels. The "`PR`" sets the ϕr projection. The "`JD:HELX`" selects the JDC detector and the associated helix fitted tracks data. The "`CB:ENER`" selects the Crystal Barrel calorimeter detector and the associated raw energy data.

The larger the precision number is, the more detail there will be in the picture. Odd precisions will draw in sector or crystal boundaries. Precision values greater than 10 will label sectors and crystals. The usable values of *prec* are usually 1,2,3,4 and 11,12,13,14.

Detector	IPREC values	Description
JD	1,3,11,13	draw sector boundaries
	11,12,13,14	label sectors (not in 3D)
		and inner/outer sector boundary (new JDC)
	3 and up	tracks have unique markers for hits
JS	1,2	fat single sector, 2:1 aspect ratio.
	3,4	skinny single sector, 1:1 aspect ratio.
	11,12,13,14	two outer sectors and one inner sector,
		1:1 aspect ratio (new JDC)
CB,CX	1,2,11,12	coloured-coded energies
	3,4,13,14	label energies
	11,12,13,14	label crystals
CR	11,12,13,14	label energies and PEDs
CT	11,12,13,14	label energies

proj	Description
`PR`	ϕr projection. The view is against the beam (looking upstream).
`RZ`	r/z projection. For individual hits, if the y-position is greater than 0, then the hits are plotted in the upper chamber, otherwise they are plotted in the lower chamber. For tracks, if most of the track has y-position greater than zero, then the entire track is plotted in the upper chamber, otherwise the entire track is plotted in the lower chamber. The beam moves from left to right. N.B. The `JS` view is not drawn to scale in the z direction, and cannot be zoomed in the z direction.
`3D`	Viewed in 3D perspective. The viewing angles are set with `3D_ANGLE`. The incoming beam line is drawn in cyan colour.

The following detectors do not use a projection, and their detector identifier should be used in place of the projection identifier: `GI TI JI CI MI CX PR` The information panels and JDC raw signal screens should be supplied with a dummy precision (of 1 for instance).

The detector identifier is a two letter symbol for the detector view type, a colon and a four letter symbol for the data set type. For example, `JD:RAWS CB:ENER PW:CLST` are all valid detector identifiers.

Crystal Barrel Calorimeter Detectors and Data Sets:

Detector Views	Description
`CB`	Expanded view showing all crystals.
`CT`	Energy towers.
`CR`	Plots an asterisk where the reconstructed PED is. Only used with `PEDS` data set.
`CX`	Flat crystal matrix.
`CI`	Prints out crystal information.

Data Sets	Description
`FERA`	TBEF bank data.
`ENER`	TBEN bank data, Standard energy values.
`2282`	TBEL bank data.
`CHRG`	TTKS bank data. Crystals closest to PED center, associated with a charged track.
`NEUT`	TTKS bank data. Crystals closest to PED centers, not associated with a track, presumably caused by neutral particles.
`GLOB`	TTKS bank data. Crystals closest to PED centers.
`PEDS`	TBTK bank data. Exact PED centers, only used with `CR`.

`CB`, `CT` and `CX` use `FERA`, `ENER`, `2282`, `CHRG`, `NEUT` and `GLOB` data. `CR` uses only `PEDS` data. `CI` uses none.

JDC Detectors and Data Sets:

Detector Views	Description
`JD`	The entire JDC.
`JS`	A single JDC sector. The stagger of the wires is exaggerated by a factor of 4. The sector is chosen with `JDC_SECTOR`.
`JI`	Prints out JDC information.
`JR`	Plot raw JDC wire signals vs time

Data Sets	Description
`RAWS`	TJDC bank data. Left/right unresolved data points. Drawn as red and green points.
`TRAR`	TCHT bank data, extracted with calls to TCOORD(0,...) and TCOORD(1,...). Left/right unresolved data points, associated with a track. Drawn as various symbols in `JD` and `JS` views.
`TRAK`	TCHT bank data, extracted with calls to TCOORD(2,...). Pattern recognized data points, associated with a track. Drawn as various symbols in `JD` view, circles in `JS` view.
`HELX`	TCTR bank data, extracted with calls to TCOORD(4,...). Recognized helical tracks. Drawn as line segments connecting the position-corrected hits.
`VERT`	`HELX` data plus TCVT bank data. Recognized helical tracks, connected to a found vertex. Drawn as line segments connecting the position-corrected hits.

`JD` and `JS` use `RAWS`, `TRAK`, `HELX` and `VERT` data. `JI` and `JR` use none.

PWC Detectors and Data Sets:

Detector Views	Description
`PW`	Draws the PWC

Data Sets	Description
`RAWS`	All PWC hits
`TRAK`	PWC clusters connected to a JDC track
`CLST`	PWC clusters (not necessarily connected to a JDC track)

`PW` uses `RAWS`, `TRAK` and `CLST` data-sets.

Other Views	Description
`GI`	prints out global tracking and PED information
`TI`	prints out trigger information
`MI`	prints out RMCB GEANT Monte Carlo info

`GI`, `MI` and `TI` require no data-set specification.

2.5.7 `RESET`

Resets all parameters to the default and then reads cblogon or cblogon.kumac for CBDISP commands. See introduction.

2.6 OPTION Commands

Defines various graphics options for the event display. Main features are the control over colours, marker sizes and other line/marker options for the different detector sets.

2.6.1 `HEADER` *[option]*

OPTION	(C)	Switch header plot on/off	`D='ON'`

Enables/disables the plot of the event-display header for each plot, which speeds up plotting on slow terminals (like FALCO). *option* = `ON` or `OFF`.

2.6.2 `PRINT`

Prints information on the graphic options.

2.6.3 `ERASE`

Clears the graphics screen.

2.6.4 `COORDINATES` *[iwind option]*

IWIND	(I)	Window number	`D=0 R=0,4`
OPTION	(C)	Coordinates switch	`D='OFF'`

Sets the flag for an additional plot of a coordinate system for the given window. (IWIND=0 means all windows). *option* = `ON` or `OFF`.

2.6.5 `3D_ANGLE` *[alpha beta]*

ALPHA	(R)	First view angle	`D=30`
BETA	(R)	Second view angle	`D=15`

Defines the two projection view angles (in degrees) for the 3-dimensional plot. If no parameters are given, the current values are printed out.

2.6.6 `COMMENT` *[title]*

TITLE	(C)	Comment title	`D=''`

Defines a global comment title for the picture.

2.6.7 `HARDCOPY` *[filename]*

FILENAME	(C)	Postscript Filename

Makes a hardcopy. The SUN version sends output to the local default printer. The on-line version send output to the GKS3812 printer in building 6. See the **`COLOR`** command for setting the colour mode of the hardcopy.

If *filename* is given, then the postscript is written to that file and NOT printed out.

The SUN version modifies the postscript slightly so that the printout will fit on a normal piece of letter paper, whether or not a filename is given. The problem seems to be in HIGZ, in that it assumes the paper is 28 cm x 28 cm. To fix this, the postscript `scale .25 .25` command is changed to `scale .18 .18`.

The command is not fully implemented for other platforms unfortunately. One should specify a filename with the **`HARDCOPY`** command, and then issue the required print command in a subshell, i.e.

```
HARDCOPY PIC1.PS
SHELL PRINT/PRINTER=AP1 PIC1.PS
```

Alternatively, one could fix the `GR3812` routine in the CBDISP source code to print it out automatically.

2.6.8 `COLORMAP` *index red green blue*

INDEX	(C)	Colour Index
RED	(C)	Red Colour value
GREEN	(C)	Green Colour value
BLUE	(C)	Blue Colour value

Redefines the global colour map for the screen. The indices 11 through 17 are the colour indices for the crystal energies. The indices 21 through 37 are the colour indices for the tracks. The RGB values are given as real values between 0.0 and 1.0. For example, to set the lowest energy colour to yellow, use `COLORMAP 11 1. 1. 0.` This command is best used in the `cblogon.kumac` startup script. Note that colour indices 0 and 1 are automatically changed with the **`COLOR`** command.

2.6.9 `COLOR` *[screen_option hardcopy_option]*

OPTION	(C)	Screen Colour indicator	`D='ON'`
OPTION	(C)	Hardcopy Colour indicator	`D='OFF'`

Set/resets COLOR mode for the screen and/or the hardcopy. The default is a colour screen and a black and white hardcopy.

option	Description
ON	Colour. Background is black, foreground is coloured.
OFF	Black and White. Background is white, foreground is black, and hatching rather than solid fill is used when energy levels of the crystal detector are plotted.

2.6.10 FILLTYPE *[option]*

OPTION (C) Fill style type D='SOLI'

Defines the fill pattern style type.

option	Description
SOLI	Solid Fill
HOLL	Hollow Fill
HATC	Hatched Fill

2.6.11 TEXTTYPE *[option]*

OPTION (C) Text type switch D='ON'

Enables and disables the change of font and precision of the text printed via GKS ITX calls. If OFF, a machine independent vector mapped font is used (0,2). *option* = ON or OFF.

2.6.12 PICTUREFILE *[option name]*

OPTION (C) I/O option D='OPEN'
NAME (C) Name of picturefile D='CBPICT.ZFL'

Opens (closes) a HIGZ picture file for further use. Autosave is enabled when opening and disabled after closing the file. *option* = OPEN or CLOS.

2.6.13 METAFILE *[lunm wktyp]*

LUNM (I) Metafile unit D=50
WKTYP (I) Workstation type D=0

Handles GKS metafile i/o. Possible values for the unit LUN are:

num	Description
=0	the active metafile is closed.
>0	the output will be written to screen and to the file.
<0	the output will be written only to the file.

The default is close a currently opened metafile.

2.6.14 `JDC_RAWTIMES` *[option]*

OPTION (C) Fit time switch for raw pulses `D='OFF'`

option	Description
`ON`	Turns on fit time flag.
`OFF`	Turns off fit time flag.

Enables/disables plotting of raw fit times onto the raw JDC pulse plot.

2.6.15 `JDC_RAWSECTOR` *[isec]*

ISEC (I) Sector for raw data pulses `D=0 R=0:30`

Defines the sector which should be used for raw JDC pulses. For ISEC=0 all pulses are plotted (default).

2.6.16 `JDC_RAWRESET`

Resets the graphics page number of the raw JDC pulses to 1.

2.6.17 `JDC_RAWLIN` *[option]*

OPTION (C) Raw data linearization switch `D='OFF'`

Enables/disables linearization of the raw data pulses. *option* = `ON` or `OFF`.

2.6.18 `JDC_RAWSUM` *[option]*

OPTION (C) Raw data right+left sum `D='ON'`

Enables/disables addition of left and right signal.

option	Description
`ON`	Displays only the sum of the left and right signals.
`OFF`	Displays both the left and right signals separately.

2.6.19 `JDC_COLOR` *icol*

ICOL (I) Colour index for JDC

Defines the colour index for text dealing with the JDC.

2.6.20 `JDC_MARKER` *[ismk size]*

ISMK (I) Marker index for JDC points `D=31 R=20:31`
SIZE (R) Marker size for JDC points `D=1`

Defines the marker type and marker size for the JDC points.

2.6.21 `JDC_SECTOR` *isec*

ISEC	(I)	Sector identifier	`D=1 R=1:30`

Defines the current sector to plot for a single JDC sector plot.

2.6.22 `PWC_COLOR` *icol*

ICOL	(I)	Colour index for PWC

Defines the colour index for text dealing with the PWC.

2.6.23 `PWC_MARKER` *[ismk size]*

ISMK	(I)	Marker index for PWC points	`D=31 R=20:31`
SIZE	(R)	Marker size for PWC points	`D=1`

Defines the marker type and marker size for the PWC points.

2.6.24 `XTL_CUT` *[ecut]*

ECUT	(R)	Energy cut	`D=0`

Minimum energy threshold to print and plot crystal energy deposits.

2.6.25 `XTL_LOGTOWER` *[option]*

OPTION	(C)	Logarithmic tower scale flag	`D='OFF'`

Defines whether or not the energy towers should be scaled logarithmically. *option* = `ON` or `OFF`.

2.6.26 `XTL_SCALE` *iscal [scale]*

ISCAL	(I)	Energy shift for CB plots (LOG2)	`D=2 R=0:3`
SCALE	(R)	Data scaling factor for CB plots	`D=1`

Defines the index offset of the Colour Scale used in energy plots, in powers of two. For instance, 0 represents a minimum of 4 MeV, 1 represents 8 MeV. The second factor scales the energy towers relative to the default.

2.6.27 `XTL_COLOR` *icol*

ICOL	(I)	Colour index for CB

Defines the colour index for text dealing with the Crystal Barrel.

Chapter 3

SETUP Macros

The following macros have been created for use with the on-line program. The are obtained using the setup command.

3.1 CBDISP.KUMAC Macros

3.1.1 $\boxed{\texttt{SETUP CRYSTAL}}$

This is a four–window overview of the crystal information. Window 1 is an ϕr view with all crystals visible. Window 2 is an rz view with all crystals visible. Window 3 is the crystal matrix, and window 4 contains crystal information. See figure 3.1.

```
MACRO CRYSTAL
DISPLAY/VIEW Q
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1  2 PR JD:RAWS CB:ENER
DISPLAY/ZOOM S 2
DISPLAY/ASSIGN 2  2 RZ JD:RAWS CB:ENER
DISPLAY/ZOOM S 3
DISPLAY/ASSIGN 3  2 CX:ENER
DISPLAY/ZOOM S 4
DISPLAY/ASSIGN 4  2 CI
RETURN
```

3.1.2 $\boxed{\texttt{SETUP INFO}}$

This is a four–window view of just text panels, with information on PEDS, JDC tracks, global tracks and triggers.

```
MACRO INFO
DISPLAY/VIEW Q
DISPLAY/ASSIGN 1 1 CI
DISPLAY/ASSIGN 2 1 JI
```

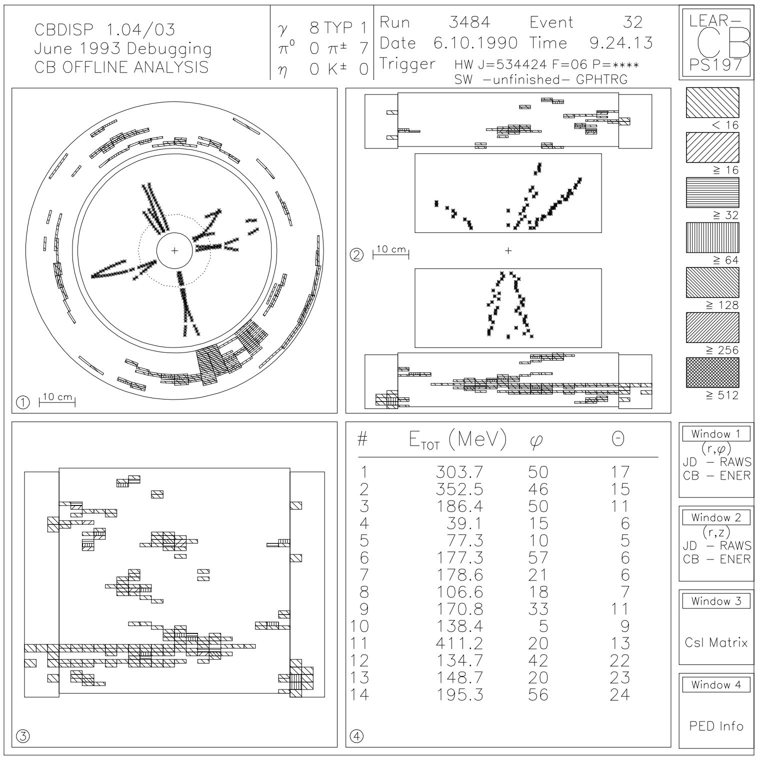

Figure 3.1: `SETUP CRYSTAL`

```
DISPLAY/ASSIGN 3 1 GI
DISPLAY/ASSIGN 4 1 TI
RETURN
```

3.1.3 SETUP JDC

This draws a four–window view of the ϕr projection of the JDC containing the raw data, (left–right not resolved).

```
MACRO JDC
DISPLAY/VIEW Q
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 13 PR JD:RAWS PW:RAWS
DISPLAY/ZOOM S 2
DISPLAY/ASSIGN 2 13 RZ JD:RAWS
DISPLAY/ZOOM S 3
DISPLAY/ASSIGN 3 13 PR JD:TRAK JD:VERT PW:CLST
DISPLAY/ZOOM S 4
DISPLAY/ASSIGN 4 13 RZ JD:TRAK JD:HELX
RETURN
```

3.1.4 SETUP JDCALL

This draws a four–window view of the JDC. Window 1 is an ϕr view containing the raw, (left–right unresolved) data. Window 2 is the JDC track information. Window 3 is an ϕr view containing the tracked JDC information. Window 4 is an rz view of the tracked JDC information.

```
MACRO JDCALL
DISPLAY/VIEW Q
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 11 PR JD:RAWS JD:HELX
DISPLAY/ZOOM S 2
DISPLAY/ASSIGN 2  1 JI
DISPLAY/ZOOM S 3
DISPLAY/ASSIGN 3 12 PR JD:TRAK JD:VERT
DISPLAY/ZOOM S 4
DISPLAY/ASSIGN 4  1 RZ JD:TRAK JD:VERT
RETURN
```

3.1.5 SETUP JDCSEC

This is a two–window view of data in one sector of the JDC. The raw JDC hits are drawn as asterisks, and the hits recognized on a track as drawn as coloured hollow circles. All recognized hits that belong to a track that passes through the selected sector will be plotted, even if they do not themselves lie in the sector. It is necessary to specify the sector number using the command `OPTION/JDC_SECTOR`, otherwise sector one will always be shown.

```
MACRO JDCSEC
DISPLAY/VIEW D.2
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 1 PR JS:RAWS JS:TRAK
DISPLAY/ZOOM S 2
DISPLAY/ASSIGN 2 1 RZ JS:RAWS JS:TRAK
RETURN
```

3.1.6 SETUP JDCSEC_H

The display is the same as `SETUP JDCSEC`, but the helix tracks are also drawn.

```
MACRO JDCSEC_H
DISPLAY/VIEW D.2
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 1 PR JS:RAWS JS:HELX JS:TRAK
DISPLAY/ZOOM S 2
DISPLAY/ASSIGN 2 1 RZ JS:RAWS JS:HELX JS:TRAK
RETURN
```

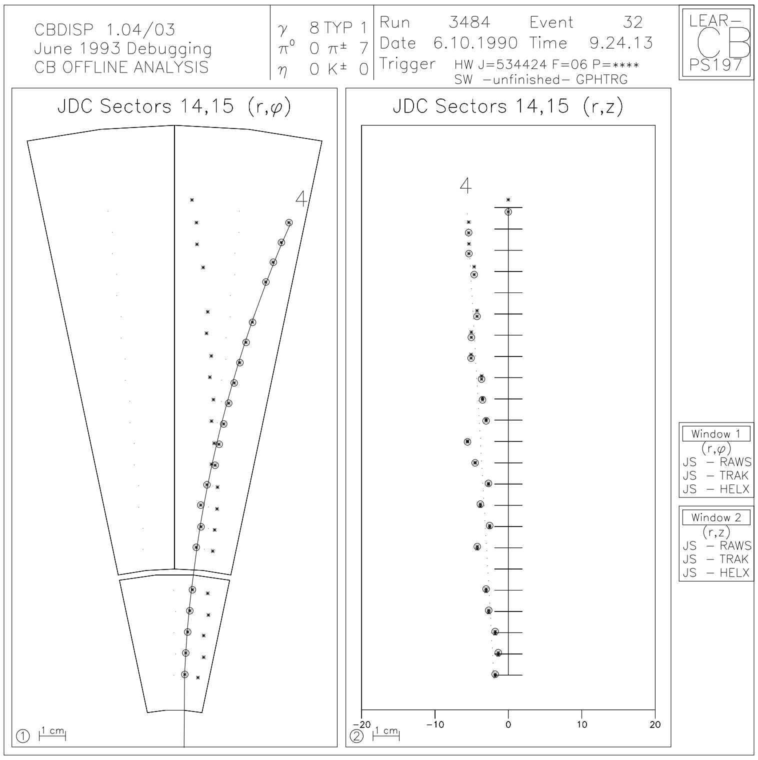

Figure 3.2: `SETUP JDCSEC_2`

3.1.7 `SETUP JDCSEC_2`

The display is the same as `SETUP JDCSEC_H`, but two outer sectors and one inner sector are drawn. (Not implemented for old JDC geometry) See figure 3.2.

```
MACRO JDCSEC_2
DISPLAY/VIEW D.2
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 11 PR JS:RAWS JS:HELX JS:TRAK
DISPLAY/ZOOM S 2
DISPLAY/ASSIGN 2 11 RZ JS:RAWS JS:HELX JS:TRAK
RETURN
```

3.1.8 `SETUP JDCRAW`

This draws the raw pulses seen on each wire of the JDC. One should also set options with the `JDC_RAWSUM`,`JDC_RAWTIMES`, `JDC_RAWSECTOR`, etc. commands. Several `PLOT` commands will probably be necessary to plot all the wire signals. Note the Page Number displayed in the upper-right corner of the window. See figure 3.3.

```
MACRO JDCRAW
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1  1 JR
RETURN
```

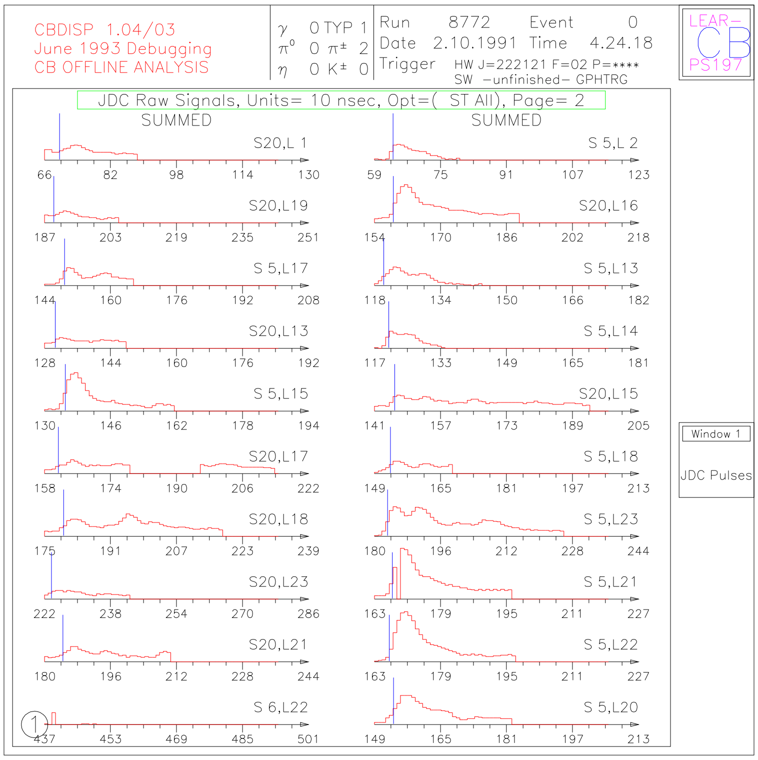

Figure 3.3: `SETUP JDCRAW`

3.1.9 SETUP JDC_TEST

This is a four–window view that draws the global tracking PEDS in their nearest crystal, and shows how the tracks line up with PEDS. The top two windows display unmatch PEDS, while the bottom two windows display track–matched PEDS.

```
MACRO JDC_TEST
DISPLAY/VIEW Q
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 12 PR JD:TRAK CT:NEUT
DISPLAY/ZOOM S 2
DISPLAY/ASSIGN 2 13 RZ JD:TRAK CT:NEUT
DISPLAY/ZOOM S 3
DISPLAY/ASSIGN 3 12 PR JD:VERT CT:CHRG
DISPLAY/ZOOM S 4
DISPLAY/ASSIGN 4 13 RZ JD:HELX CT:CHRG
RETURN
```

3.1.10 SETUP MC

A four–window view of PWC and Crystal Tower data (in two projections) along with a global tracking information window and a Monte Carlo information window.

```
MACRO MC
```

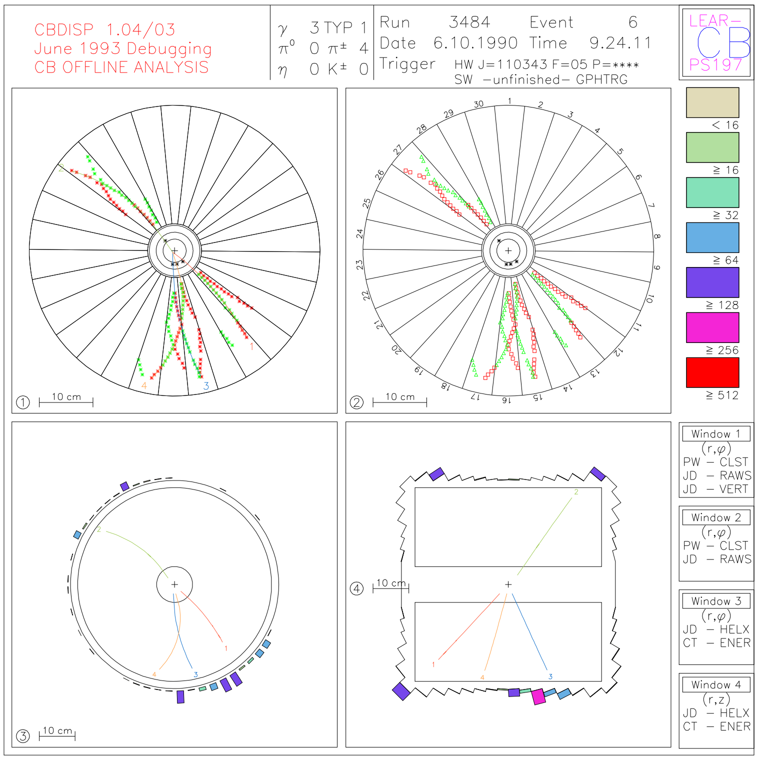

Figure 3.4: `SETUP OVERALL`

```
DISPLAY/VIEW Q
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 11 PR JD:RAWS JD:HELX CT:ENER
DISPLAY/ZOOM S 2
DISPLAY/ASSIGN 2 11 RZ JD:RAWS JD:HELX CT:ENER
DISPLAY/ASSIGN 3 1  GI
DISPLAY/ASSIGN 4 1  MI
RETURN
```

3.1.11 `SETUP OVERALL`

A four–window view of the PWC up close, the raw hits of the PWC and JDC, and the helix tracks and energy towers from ϕr and rz projections. See figure 3.4.

```
MACRO OVERALL
DISPLAY/VIEW Q
DISPLAY/ZOOM S
DISPLAY/ZOOM N.04 1
DISPLAY/ASSIGN 1  1 PR PW:CLST JD:RAWS JD:VERT
DISPLAY/ZOOM S 2
DISPLAY/ASSIGN 2 13 PR PW:CLST JD:RAWS
DISPLAY/ZOOM S 3
DISPLAY/ASSIGN 3  2 PR JD:HELX CT:ENER
DISPLAY/ZOOM S 4
```

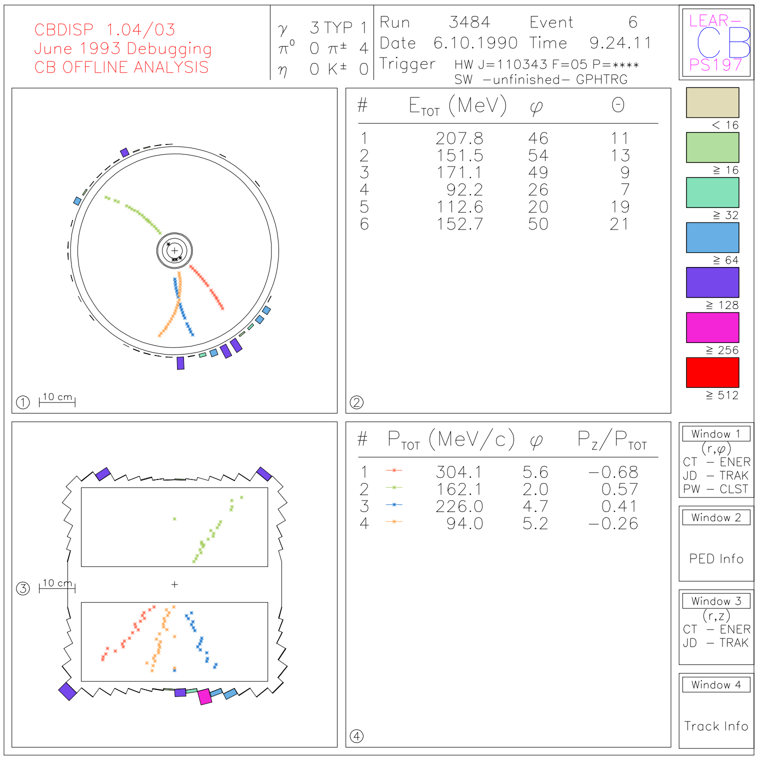

Figure 3.5: `SETUP OVERVIEW`

```
DISPLAY/ASSIGN 4  2 RZ JD:HELX CT:ENER
RETURN
```

3.1.12 `SETUP OVERVIEW`

Draws a four–window overview of the detector. Window 1 is the ϕr view of the JDC with energy towers. Window 2 contains crystal information. Window three is the rz view of the JDC with energy towers, and window 4 is the JDC track information. See figure 3.5.

```
MACRO OVERVIEW
DISPLAY/ZOOM S.00 1
DISPLAY/VIEW Q
DISPLAY/ASSIGN 1  2 PR CT:ENER JD:TRAK PW:CLST
DISPLAY/ASSIGN 2 11 CI
DISPLAY/ASSIGN 3  2 RZ CT:ENER JD:TRAK
DISPLAY/ASSIGN 4 11 JI
RETURN
```

3.1.13 `SETUP PR`

This draws a one–window ϕr view of the JDC with all crystals drawn around the JDC. The hit crystals are coloured.

```
MACRO PR
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 1 PR CB:ENER JD:TRAK
RETURN
```

3.1.14 SETUP PR_N

This draws a 1 window ϕr view of the JDC with all crystals drawn around the JDC. The hits crystals have their energy put in as a number.

```
MACRO PR_N
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 14 PR CB:ENER JD:TRAK
RETURN
```

3.1.15 SETUP PWC

This draws four different views of the PWC. The first view is of the PWC and its hit clusters and of the inner five layers of the JDC and its raw hits and helix tracks. The second view is of PWC raw hits, the third view is of PWC clusters, and the fourth view is of PWC clusters that are connected to tracks.

```
MACRO PWC
DISPLAY/VIEW Q
DISPLAY/ZOOM N.04 1
DISPLAY/ASSIGN 1  1 PR PW:CLST JD:RAWS JD:HELX
DISPLAY/ZOOM S.00 2
DISPLAY/ASSIGN 2  1 PR PW:RAWS
DISPLAY/ZOOM S.00 3
DISPLAY/ASSIGN 3  2 PR PW:CLST
DISPLAY/ZOOM S.00 4
DISPLAY/ASSIGN 4  2 PR PW:TRAK
RETURN
```

3.1.16 SETUP PWCFIT

Draws one window with PWC clusters and JDC hits that are connected to tracks.

```
MACRO PWCFIT
DISPLAY/VIEW S
DISPLAY/ZOOM N.04 1
DISPLAY/ASSIGN 1  1 PR PW:TRAK JD:TRAK JD:HELX
RETURN
```

3.1.17 SETUP PWCRAW

Draws one window with raw PWC and JDC hits, and the tracks that go through them.

```
MACRO PWCRAW
DISPLAY/VIEW S
DISPLAY/ZOOM N.04 1
DISPLAY/ASSIGN 1  1 PR PW:RAWS JD:RAWS JD:HELX
RETURN
```

3.1.18 SETUP RTOWER_PR

This is a one–window view of the ϕ projection of the JDC. Raw JDC data, (left–right unresolved) is plotted as well as energy towers, and the energy.

```
MACRO RTOWER_PR
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 11 PR CT:ENER JD:RAWS CR:PEDS
RETURN
```

3.1.19 SETUP RTOWER_RZ

This is a one–window view of the rz projection of the JDC. Raw JDC data and labeled energy towers are plotted.

```
MACRO RTOWER_RZ
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 12 RZ CT:ENER JD:RAWS CR:PEDS
RETURN
```

3.1.20 SETUP RZ

This draws a one–window rz view of the JDC with all crystals drawn around the JDC. The hit crystals are shaded.

```
MACRO RZ
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 1 RZ CB:ENER JD:TRAK
RETURN
```

3.1.21 SETUP RZ_N

This draws a one–window rz view of the JDC with all crystals drawn around the JDC. The hits have their energy put in as a number.

```
MACRO RZ_N
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 14 RZ CB:ENER JD:TRAK
RETURN
```

3.1.22 SETUP STANDARD

A four–window view of the PWC, JDC and CB from both projections, with both raw and analyzed data.

```
MACRO STANDARD
DISPLAY/ZOOM S 1
DISPLAY/VIEW Q
DISPLAY/ASSIGN 1 12 PR JD:TRAK CB:ENER PW:CLST
DISPLAY/ASSIGN 2 12 RZ JD:TRAK CB:ENER
DISPLAY/ASSIGN 3  2 PR CT:ENER JD:HELX PW:CLST
DISPLAY/ASSIGN 4  2 RZ CT:ENER JD:HELX
RETURN
```

3.1.23 SETUP TOWER_PR

This draws a one–window ϕr view of the JDC with energy towers.

```
MACRO TOWER_PR
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 13 PR CT:ENER JD:TRAK JD:VERT
RETURN
```

3.1.24 SETUP TOWER_RZ

This draws a one–window rz view of the JDC with energy towers.

```
MACRO TOWER_RZ
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 13 RZ CT:ENER JD:TRAK JD:HELX
RETURN
```

3.1.25 SETUP XTAL

This draws a one–window crystal matrix. The hit crystals are shaded.

```
MACRO XTAL
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 1 ! CX:ENER
RETURN
```

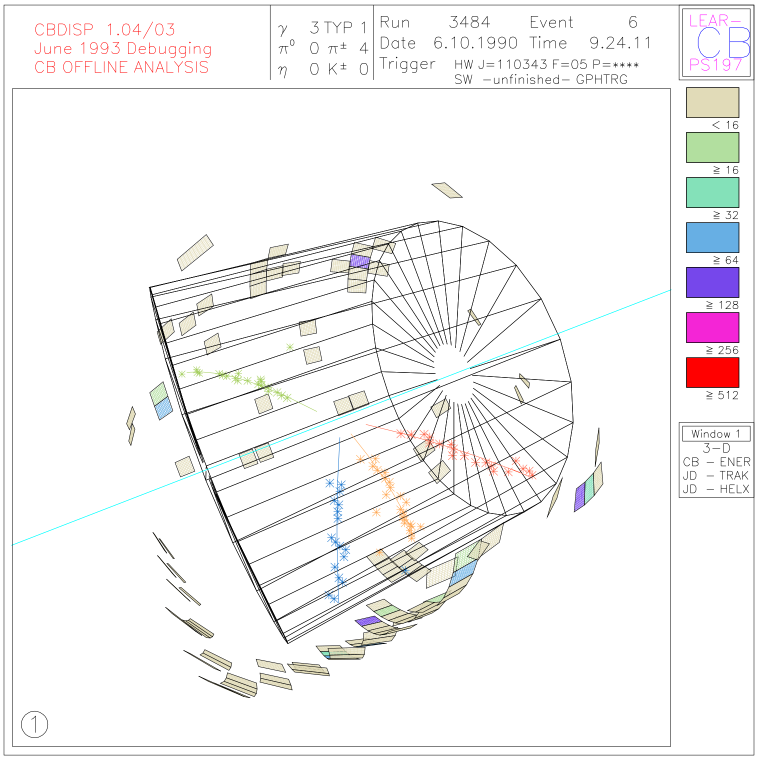

Figure 3.6: `SETUP 3D`

3.1.26 SETUP XTAL_N

This draws a one–window crystal matrix. The energy of each hit crystal is drawn in the crystal as a number.

```
MACRO XTAL_N
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1 14 ! CX:ENER
RETURN
```

3.1.27 SETUP 3D

This draws a one–window, three dimensional view of the event, including the crystal energies (drawn as floating colour panels positioned in space where the crystal faces are) and JDC tracks. See figure 3.6.

```
MACRO 3D
DISPLAY/VIEW S
DISPLAY/ZOOM S 1
DISPLAY/ASSIGN 1  1 3D CB:ENER JD:TRAK JD:HELX
RETURN
```