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1 Introduction

1.1 Purpose and Scope

The purpose of the present document is to provide the information required to operate the Minicalorimeter Science Console (MCAL SC) in order to determine the parameters which characterise the CsI Bars of the AGILE Minicalorimeter SEM Model, as foreseen by the Test Plan document [1].

Its scope are the tests to be carried out at LABEN (Milano) using the Test Equipment procured by LABEN (MCAL CsI Bars TE), in the version which does not include the Gamma Source Positioning System (GSPS) for the positioning of the radioactive source commanded by the TE. This limitation has lead to arrange the MCAL SC software in order to allow the operator to control the measurement boundaries by driving the Measurement Control Signal to be provided to the Detector Front End and Read-Out Electronics.

Section 2 presents the test setup. The operations to be performed in order to startup-up the acquisition and the calibration software are given in Section 3. Section 4 and 5 present the GUI for the Electronic Chain Calibration and the Bar Calibration procedures, respectively. Section 6 details the steps to be carried out in order to create a permanent archive on CD-ROM containing all the archive data. Further details on the software configuration and the file format are given in Annex A and Annex B, respectively.

1.2 REFERENCE DOCUMENTS

[1] E.Celesti, C.Labanti, A.Mauri, E.Rossi, M.Trifoglio, J.B. Stephen, F.Gianotti, A.Bulgarelli, "Test Plan per la caratterizzazione delle barre CsI del Minicalorimetro di AGILE", AGILE-ITE-PR-001, Te.S.R.E. Report 333/02, 08/02/2002

[2] M.Trifoglio, F.Gianotti, J.B.Stephen, "AGILE Payload TE & EGSE Subsystem Specification, AGILE-ITE-SS-003, Issue 01, January 2001, CNR/ITESRE.

[3] M.Trifoglio, F.Gianotti, J.B.Stephen, "User Software Requirements for the Host Computer of the AGILE Minicalorimeter CAL-CsI Bars Test Equipment", AGILE-ITE-SR-001, Issue 03/B, January 2002, CNR IASF-Bologna.

[4] C. Labanti, "Agile MCAL subsystem specification", TESRE, AGILE-ITE-SS-002, Issue 2, January 2001

[5] "Packet Telemetry Standard", ESA PSS-04-106 Issue 1, January 1988.

[6] G.Forlanelli, "Gamma Ray Sources Positioning Stages Requirements Specification", TL 13350, IN-IB-LAB-RS-004, Laben

[7] F. Gianotti and M. Trifoglio, "DISCoS - a detector-independent software for the on-ground testing and calibration of scientic payloads using the ESA Packet Telemetry and

Telecommand Standards", Istituto TeSRE/CNR -Via P. Gobetti 101, 40129 Bologna, Italy, Astronomical Data Analysis Software and Systems X, Boston 12-15 November 2000, ASP Conference Series, Vol. 238, 2001

2   Test Set up

The test set-up for the SEM model is sketched in Figure 2-1.
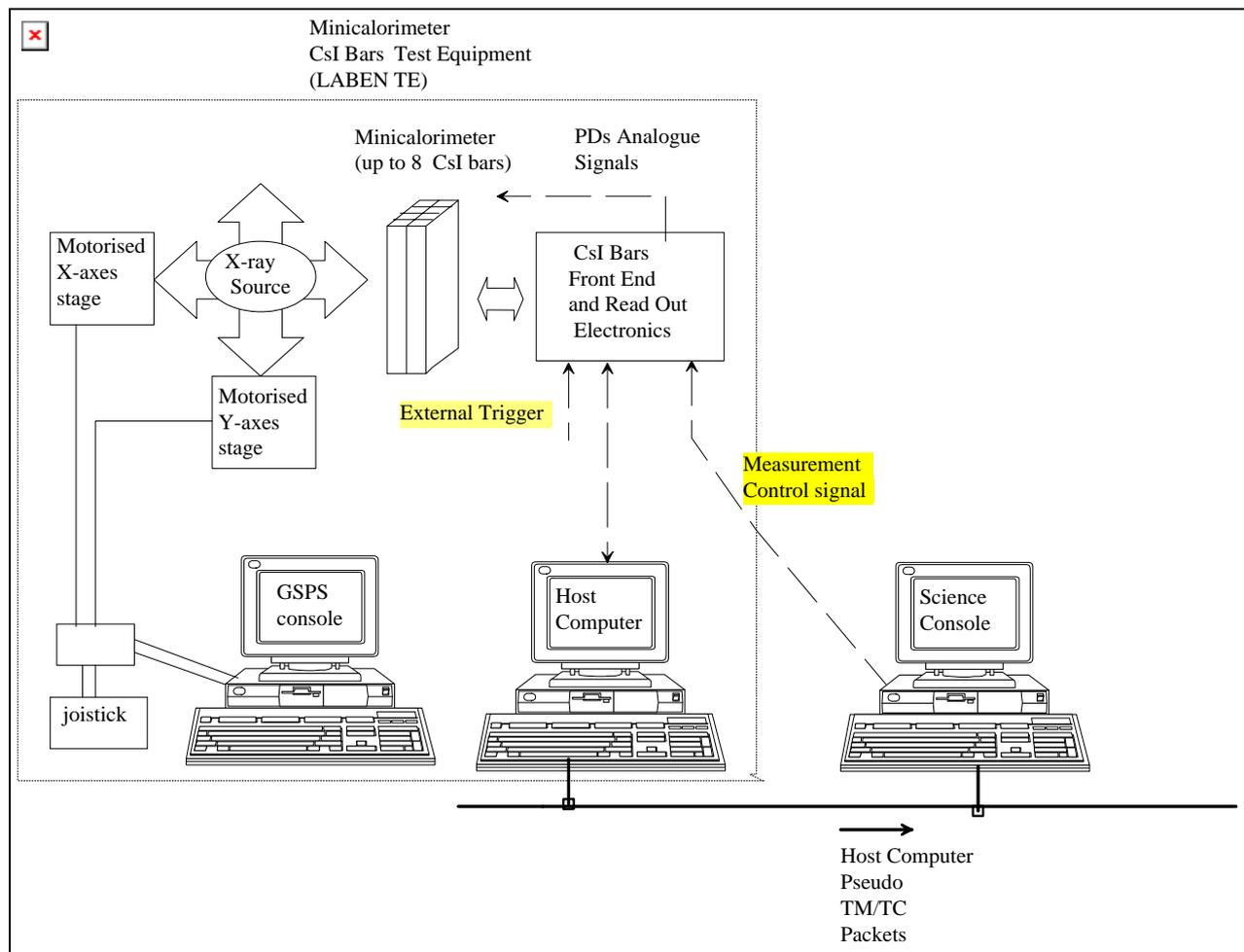
Figure 2-1 Set up configuration for CsI Bars Characterisation tests

The MCAL CsI Bars TE procured by LABEN consists of:

- the Gamma Source Positioning Stages (GSPS) (see [6]), which is controlled in manual mode using the Joystick. In this reduced mode of operations, the GSPS Console does not communicate with the Host Computer.

- the Host Computer, which:

    o interfaces the Front End Electronics in order to gather the amplitude values of the pulse signal produced by the two Photo Diodes that are coupled with each CsI Bar;

o   includes the acquired data in the TM packet format specified in [3].

o   forward in near real time the TM packet data to the Science Console.

The CsI Bars FEE is configured in order to operate in internal trigger mode (auto trigger mode). Through a dedicated I/F, the TE Host Computer is able to acquire the signals from the CsI Bars. The TE Host Computer:

−   acquires, for each detected event, the digital data generated by the ADC included in the CsI Bars FEE.

−   creates, with PHA digital values, a CsI Bars event data format (as detailed in Annex A of [3]).

−   prepares, with the CsI Bars event data format, a TM packet of fixed length having the structure complying with of the ESA Telemetry Standard [5]; each Data Packet shall be capable of containing a fixed number of event data; further details on the format are given in Annex A of [3].

−   sends the Data Packet (if not empty) to the MCAL Science Console through the TCP/IP link established on the LAN, as soon as a Data Packet is filled with the event data or the time-out is expired since the last packet has been sent.

The detector data are produced continuously since the power-on of the Front End Electronics.

In order to limit the acquisition to specific time periods (e.g.: after positioning of the source), the TE uses a TTL external signal (the Measurement Control Signal in Figure 2-1 which corresponds to one of the 32 bit (the Measurement Control flag) containing the event data:

o   the event data having the Measurement Control flag set to 1, are archived and/or forwarded to the SC,

o   the event data having this flag set to 0 are discarded by the TE.

The transitions of the MC flag are used by the TE in order to determine when to generate the start/stop TC to be forwarded to the SC in order to notify the measurement boundaries.

The Science Console is connected to the TE through the LAN and drives the Measurement Control Signal in order to control the boundaries of each measure. The MC signal is connected to one pin of the parallel port of the SC:

•   it is set to 5V upon a measurement period is started

•   it is reset to 0V once the measurement period is completed;

Summarising, for each measurement to be performed, the SC:

•   asks to the operator the parameters which characterise the test set-up and the measurement (e.g.: type of Radioactive Source, Source (X,Y) position information, detector configuration,

exposure time);

- provides to the operator the start/stop commands which drives Measurement Control Signal (MC signal);

- in near real time, acquires and archives in raw format the Pseudo TM/TC packets produced by the Host Computer and containing the CsI Bar data. A new set of raw files is created for each measurement (Level 0 Archive);

- accesses in near real time the raw file containing the incoming telemetry and produces the Level 1 Archive, containing the PD data in form of event list written using the binary table FITS format;

- accesses in near real time the Level 1 data file related to the running measurement and provides graphical interactive Quick Look tools to inspect the data

- provides the graphical interactive Analysis tools which allow the operator to perform all the operations foreseen by the mentioned test plan and to calculate the parameters which characterise the CsI Bars.

Summarising, for each measurement to be performed, the acquisition and filing operations on both the Host Computer and the SC are driven by the status of the Measurement Control Signal, as follows:

a) as long as MC signal is set to 0V, the MC flag in the event data is set to 0, and are discarded by the HC

b) once the MC signal changes to 5V, the MC flag in the next event data acquired changes to 1 and the HC:

  – increments the RUN ID and open the measurement file using the file naming defined in [3];

  – generates and sends on the TCP/IP link with the Science Console a **start** measurement TC packet; consequently the Science Console:

    – closes the *idle* files of the current RUN_ID;

    – opens the *measurement* files of the current RUN_ID, where shall be archived the forthcoming CsI TE packets which shall be sent by the TE Host Computer on the TCP/IP link.

c) Once the operator **stops** the current measurement (either from the Host Computer console or by resetting the Measurement Control signal to 0V), the MC flag in the next event data acquired changes to 0, and the HC:

  – closes the file of the current measurement;

- generates and send a **stop** measurement TC packet on the HBR_SCOE link with the SC;

d) consequently the SC:

- increments the RUN_ID for the next measurement;

- opens the *idle* files of the next measurement.

It is noted that, in order to allow the SC to complete the filing operations, a new start measurement could non occur before 20 s since the last stop command.

In addition, it is noted that MC Signal changes (and hence MC flag changes) are not detected until new event data are acquired.

The MCAL Science Console acquires and archives the Data Packets in one set of files for each measurement, by keeping separated the two packets streams.

By using local commands and without interfering with the Host Computers, at any time the Science Console operator will be able to close all the Science Console files related to the current measurement and to open a new set of Science Console files where all the forthcoming packets will be archived as a new measurement.

In the SEM test set-up the External Trigger signal is not used.

The Host Computers and the MCAL Science Console are connected to a 100BasetT LAN through a Mini HUB having at least 4 100BaseT RJ ports.

3   Software start-up and control

From the operative point of view, the SC software consists of two main subsystems:

- the Acquisition subsystem

- the Calibration subsystem

The former acquires the instrument data and archives them in raw format (stream file containing the TM/TC packets) and in FITS format (Binary table containing the event list). The latter, in near real time, reads the FITS file, accumulates and displays the event spectra.

The two subsystems interface the operator through separated user interfaces (GUI). The following subsections present how to operates these GUIs and details the operations to be performed in order:

- to start-up the SC software before starting the data acquisition software on the TE Host Computer

- to start/stop the data acquisition by means of the Measurement Control Signal controlled by the GUI of the Calibration subsystem

- to operate the Calibration subsystem in order to process and analyse the acquired data as required by the Test Plan operations given in [1].

3.1   Acquisition subsystem

The acquisition subsystem is based on the DISCoS architecture [7]. It consists of several programs which are controlled as follows.

3.1.1   Start-up

Once the system reboot is completed, the operator opens a new terminal window and enter the command:

   console

which creates the widget shown in Figure 3-1, displaying the status of the various acquisition programs. The Stop buttons are not activated as no program is running after system reboot.
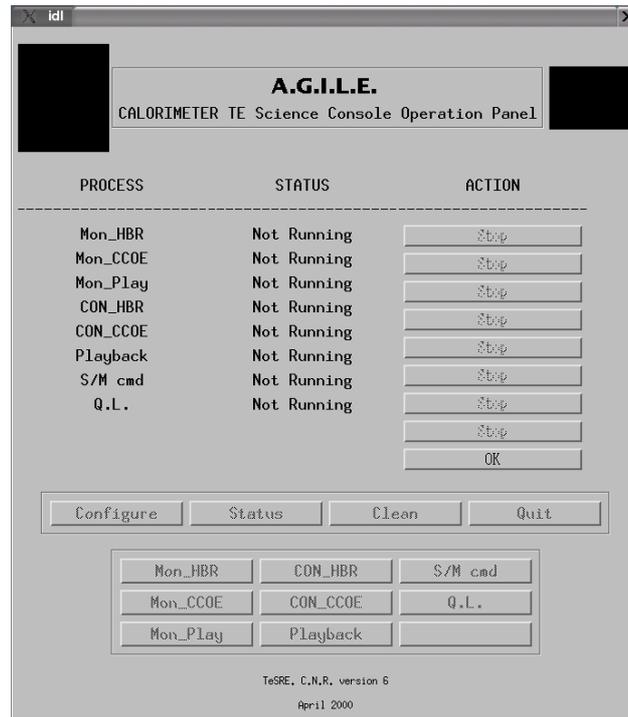
Figure 3-1 Acquisition Subsystem – Main Widget at start-up

3.1.2   Configuration

The selection of the OK button generates the configuration widget shown in Figure 3-2, which allows the operator to select the parameters to be included in the run string of the acquisition programs. In the present case, only the following parameters are used:

- *Campaign*, which corresponds to a specific string to be included in the file names
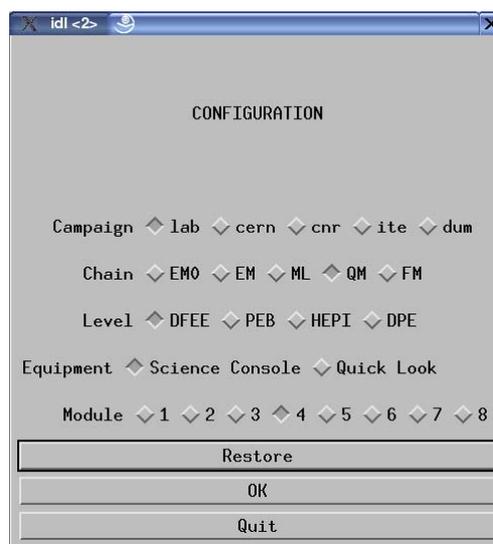
Figure 3-2 Acquisition Subsystem – Configuration widget

3.1.3 Acquisition chain start-up

Once the configuration is completed, the control returns to the Main Widget (Figure 3-3), which allows the operator to start-up the various programs.
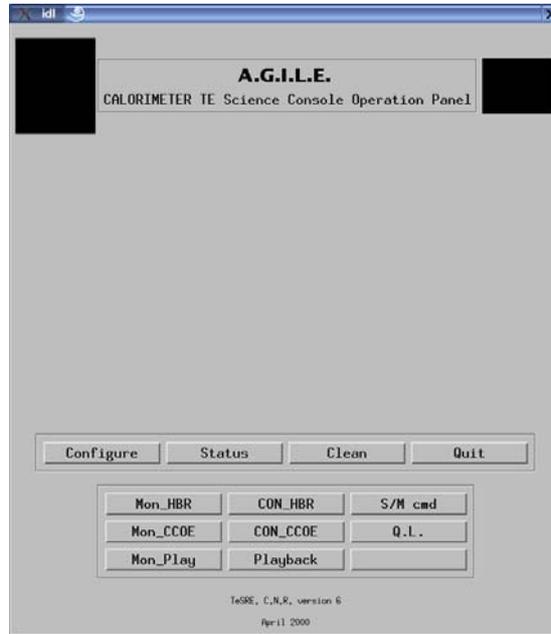
Figure 3-3 Acquisition Subsystem – Main Widget after configuration

In the present case, only the following buttons are used:

- *CON_HBR*: which starts the DISCoS acquisition chain, formed by:

    - The *Receiver* program, which acquires the TM/TC packets from the LAN

    - The *Archiver* program, which saves the packets on the local disk

    - The *Data Provider* program, which reads from disks the packets and writes them on a shared memory

    - The *Processor* program, which reads the packets from the shared memory and generates and archives the event list files in FITS format.

    Each of the above programs creates its log window on the screen.

- *Mon_HBR*: which starts the DISCoS Monitor program; this programs displays every seconds the status information written of the shared memories by the above programs (Figure 3-4).
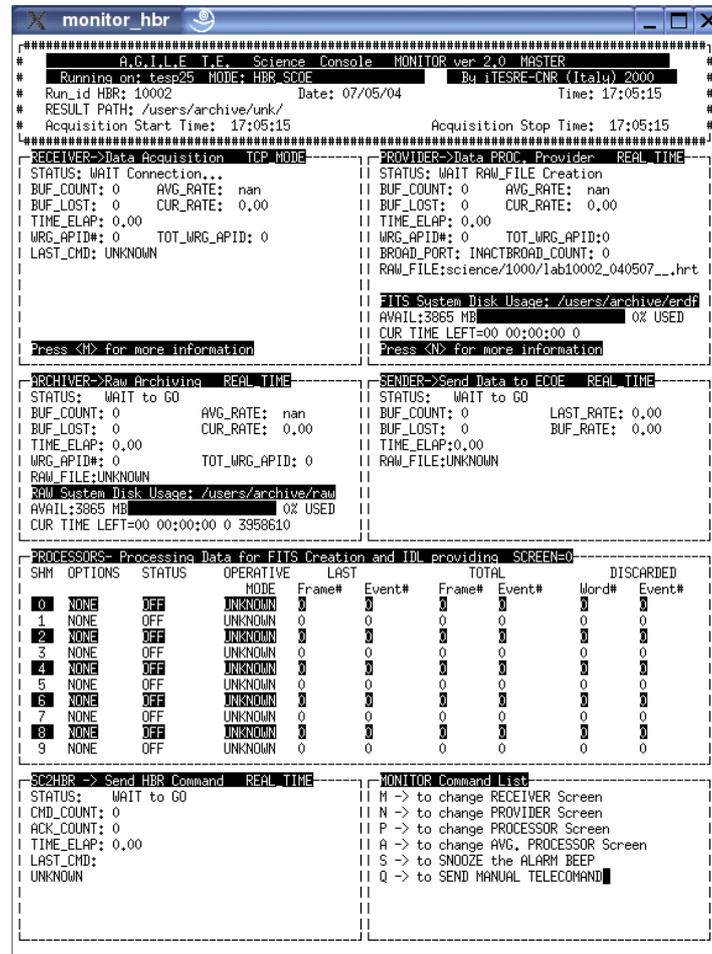
Figure 3-4 Monitor program display

Once started, the DISCoS Receiver program waits, as a Server, in order to establish the related TCP/IP connection, i.e. the *HBR_SCOE* link for the LABEN TE (port 9003).

In order to complete the start-up of the acquisition chain, the operator starts the Application software on the Host Computer TE, which:

- establishes (as Client) the TCP/IP connection (Data Link) with the SC; this link is kept along the whole test session;

- start acquiring the data from the FEE; the acquired data are either discarded or processed, archived and/or forwarded to the SC according to the status of the MC signal driven by the SC operator through the *Connect/Released* Button and the *Time* parameter entry of the Calibration Subsystem GUI (see 3.3).

In case the Data Link drops, automatically the Server on the SC restarts waiting for a new connection request from the Client running on the Host Computer.

Hence, in nominal condition, the DISCoS acquisition chain remains active (i.e. ready to acquire any data forwarded by the Host Computer through the TCP/IP link) as long as the test session is

running, without any operator intervention on the Acquisition Subsystem GUI.

3.2   On-line archiving and processing

In the DISCoS acquisition chain, all the acquired TM packets and the files generated by the Processor are automatically saved on the on-line Archive, which resides on the **/users/archive** directory tree located on a local magnetic disk.

As depicted below, this directory tree is structured in three main subdirectories (raw, erdf, , log) which are devoted to the raw data, the fits data, and the log data, respectively.

```
/users/archive
|-- erdf
|   |-- hk
|   |   `-- 0461
|   `-- science
|        `-- 0461
|-- log
`-- raw
    |-- hk
    |   `-- 0461
    `-- science
        `-- 0461
```

Fig. 4.1-1 The Science Console on-line Archive structure

As detailed below, the DISCoS software foresees different file name extensions in order to manage multiple acquisition chains in parallel. In the present case the HBR_SCOE link is used, as specified at start-up when the operator selects the con CON_HBR button (see 3.1.1).

3.2.1   Raw archiving

The Science Console provides the archiving of all the raw TC and TM packets of each measurement, which is identified by a ***run id*** number generated automatically by the software at the start of a new observation. The raw files contain the packet byte stream sequence as received by the Science Console during each measurement.

After verification of the APID and the SSC, each acquired packet is written into two files, one containing all the TC/TM packets, and the other containing only the TC and the HK packets.

These files are archived in the ***archive*** directory tree under the ***raw*** subdirectory tree, where a subdirectory is devoted to each decade of run IDs. The files are univocally associated to a given measurement by including in their names the campaign ID **ccc**, the run ID **nnnnn** and the date of creation **yymmdd**, i.e:

<div align="center">

cccnnnnn_yymmdd__.ext
cccnnnnn_yymmdd_.ext
cccnnnnn_yymmdd.ext

</div>

The campaign ID **ccc** has the value selected by the operator at start-up (see 3.1.2).

One underscore character appended to the name identifies the files related to the idle period between two consecutive measurements. Two of these characters are used for the first idle period in the test session.

In the **ext** suffix:

- the first character identifies the TCP/IP link from which the data are collected, namely:

  - **h** is for HBR_SCOE link;

  - **c** is for CCOE link;

  - **e** is for ECOE link [not used here];

- the second and the third characters identify:

  - either the file containing all the TC/TM packets (**rt**);

  - or the file containing only the TC and the HK packets (**hk**);

The SC software limits automatically each measurement to a maximum of 400000 TM packets (corresponding to the maximum size of ~ 600 Mbytes available on a CD-ROM). Indeed once this limit is reached, the software closes all the files related to the current measurement and opens a new set of files, after having incremented the measurement RUN ID.

3.2.2   Raw Data Processing

On each active TCP/IP link, as the packets are read from the *rt* file of the raw archive, they are sorted by APID and are made available to the related unpacking processor which operates on two different shared memories as follows:

- on the SHM shared memory, it receives the packets sorted by APID;

- on the SHMF shared memory, it writes the unpacked data to be analysed by the quick look program based on IDL;

Both shared memories are organised in channels which are assigned to the different APIDs.

Details on the raw data processing configuration are given in Annex A.

3.2.3   FITS Archiving

In near real time, the unpacking processor devoted to a given APID archives the information extracted from the raw packets on files written in FITS format. These files are located under the *erdf* subdirectory tree in the *archive* directory, where a subdirectory is devoted to each decade of run IDs., e.g.

```
/users/archive/erdf
|-- hk
|   `-- 0461
|   `-- 0462
|   `-- 0463
`-- science
    `-- 0461
|   `-- 0462
|   `-- 0463
```

Fig. 4.1-2 The Science Console FITS subdirectory tree structure

The **hk** subdirectory contains the hk files, while the **science** subdirectory contains the event lists.

The files in the erdf directory tree are univocally associated to a given measurement by a naming similar to the one used for the raw files, i.e.:

ccc_nnnnn_yymmdd_hhmmss__.ext
ccc_nnnnn_yymmdd_hhmmss_.ext
ccc_nnnnn_yymmdd_hhmmss.ext

In this case, the name includes also the time of creation of the file, in the format:

hhmmss   hours minutes seconds (2+2+2)

The campaign ID **ccc** has the value selected by the operator at start-up (see 3.1.2).

In the **ext** suffix:

- the first character identifies the TCP/IP link from which the data are collected, namely:

    - **h** is for HBR_SCOE link;

    - **c** is for CCOE link;

    - **e** is for ECOE link [not used here];

    - **g** is for the files reproduced in playback mode;

- the second and the third characters identifies the fits file (**ft**).

The Science erdf files are tabular files with one row per event. Details on the file format is given in Annex B.

It is noted that the present version foresees some header keywords where to save the information related to the Source, namely:

```
S_ENERGY=                      / Calibration Source Energy (KeV)
S_XOFF=                        / Calibration Source X offset position (mm)
S_XREL=                        / Calibration Source X relative position (mm)
S_YABS=                        / Calibration Source Y absolute position (mm)
```

In the present version, these keywords are not used as these information are not provided by the present version of the LABEN TE.

3.3   Calibration Subsystem start-up

Once the DISCoS acquisition chain has been activated, as detailed in the previous section, the operator uses the Calibration Subsystem GUI in order to start/stop the data acquisition and to process and analyses the acquired data.

The operator activates the Calibration GUI through the following steps:

a) Create a new terminal window from where to start *idlde* by entering the commands:

cd QL/v4

idlde

b) Open the procedure */home/agile/QL/v4/agical.pro* as shown in fig. Figure 3-5.
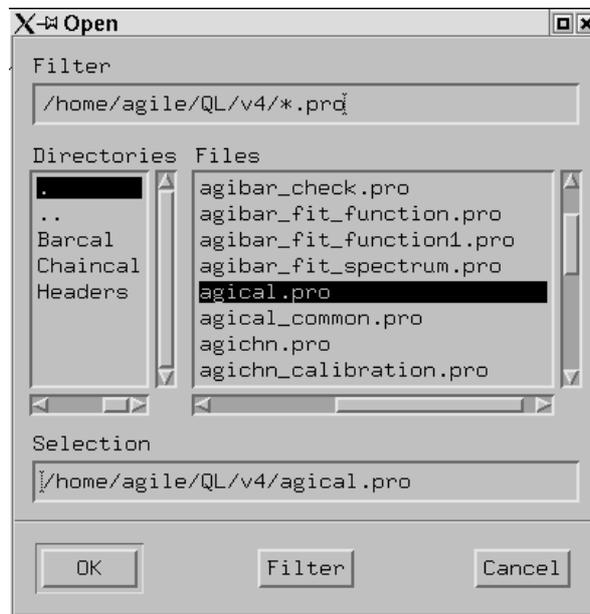
Figure 3-5 IDL File Open GUI

c) Run the procedure */home/agile/QL/v4/agical.pro*

agical.pro generates the Widget shown in Figure 3-6, which provides one button for each of the two procedures foreseen by the Test Plan document [1], namely

- Electrical Chain Calibration

- Bar Calibration
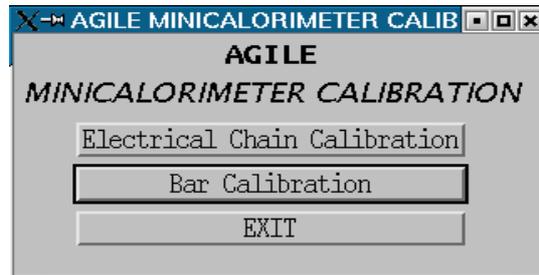
Figure 3-6 Calibration software - main widget

4   Electronic chain calibration

This section presents the steps to be followed in order to carry out the procedure defined in chapters 1 and 2 of [1] to calculate for each electronic chain:

a) offset in ch

b) gain in ch/mV)

c) gain in e-/ch.

First, for items a) and b), the operator performs:

- step 1-4 to acquire and archive one measurement and to analyse the peak for each of the 5 measurements with the Pulse Generator and one PD used as reference capacitance; the peak analysis results are archived in one ASCII file for each measurement;

- step 5, to calculate offset and gain in *mV/ch* using the results of the above peak analysis.

Hence, for items c), the operator performs:

- step 1-4 for the measurement with the AM-241 source manually positioned close to one PD

- step 5, to calculate the gain in e^-/ch using the results of the previous analysis.

4.1   Step 1: chain set-up

By selecting the "Electrical Chain Calibration" button of the widget shown in Figure 3-6, the Calibration software presents to the operator the Widget shown in Figure 4-1, which allows the operator to select the parameters which identifies the electronic chain under test and the other items under test.

For each measurement with the Pulse Generator, the following parameters are required:

a) *Pd Chain*: identifier of the Electronic chain
b) *Bar Id*: identifier of the Bar which the Electronic chain is assigned to
c) *PD*: identifier of the Bar side which the electronic chain is assigned to
d) *Voltage*: peak voltage setting for the Pulse Generator
e) *Attenuation*: attenuation factor applied by the Pulse Generator to the above "Voltage" value
f) *Capacitance*: value of the reference capacity in input to the Pre Amplifier (i.e. the capacitance of the PD)

For each measurement with the radioactive source (e.g. AM-241), the operator has to select the following parameters:

a) Pd Chain
b) Bar Id
c) PD

d) Source.
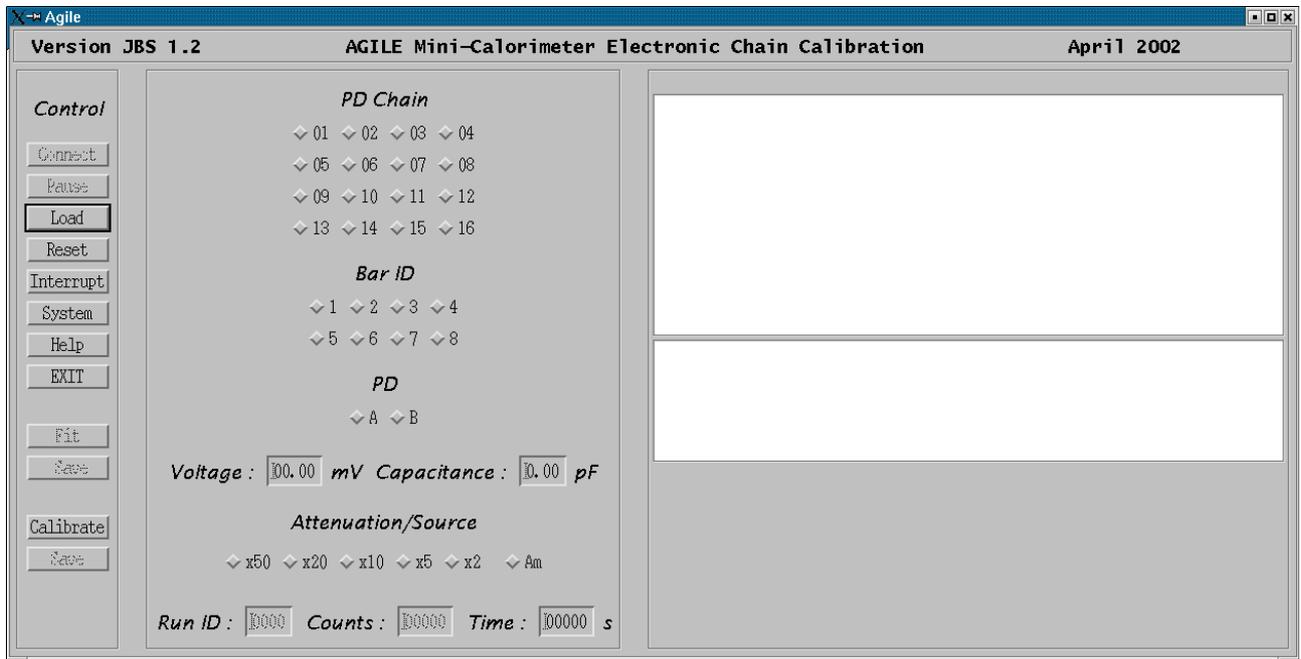
Figure 4-1 Calibration software - Electrical Chain Calibration widget

The Time parameter, defining the duration of the Measurement, is not mandatory. Once all the required parameters are set, the Connect button activates (Figure 4-2).
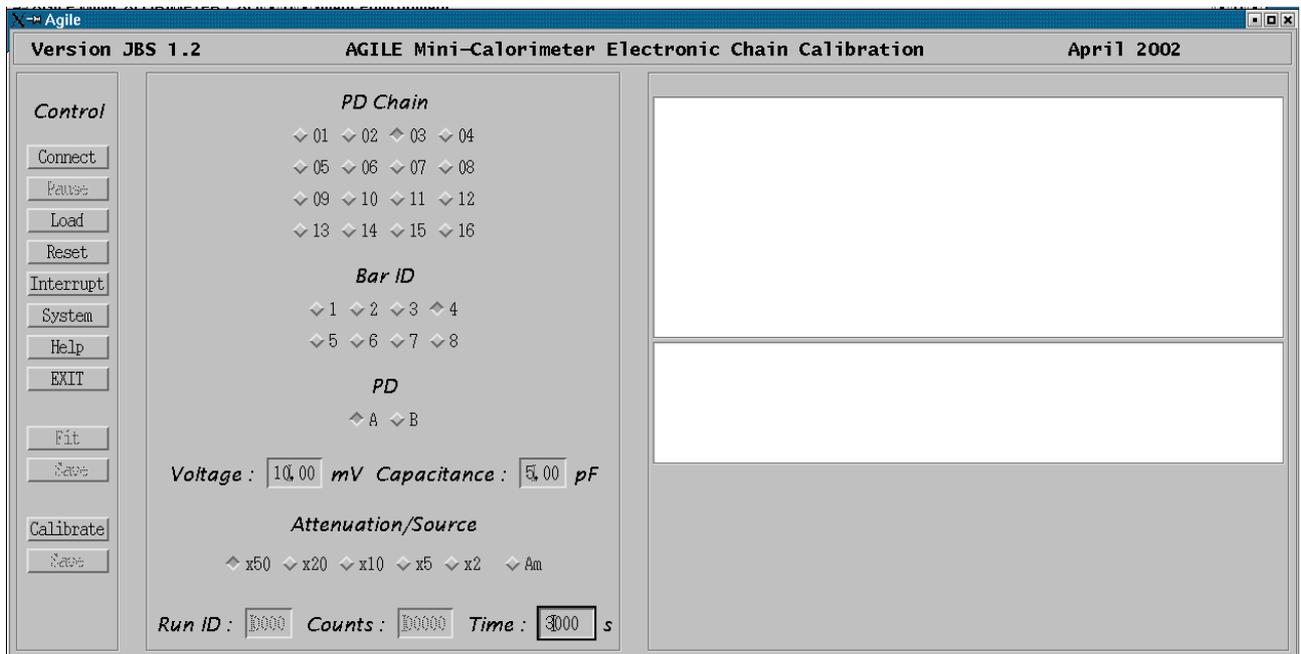
Figure 4-2 Electrical Chain Calibration widget –parameters selection for the data acquisition

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4.2   Step 2: Data Acquisition

When the *Connect* button is selected, the SC drives the Measurement Control Signal which commands the TE to start the measurement.

The SC Acquisition Subsystem provides to the processing and archiving forthcoming TM packet containing the event data, and communicates to the Calibration Subsystem the name of the event list file (FITS file) which is being created with these data using the format detailed in Annex B.

The communication mechanism is a file which is continuously updated with the number of events written in the FITS file.

This mechanism allows the Calibration software to access the event list data in near real time in order to accumulate and display the spectrum (counts/channel), as detailed in the next section.

The measurement completes when the *Time* parameter set by the operator in the Figure 4-2 widget is elapsed, or when the operator selects the "Release" button shown in Figure 4-3.

In both cases, upon completion of the current Run period, the Calibration software:

- Set the Measurement Control Signal to the level at which the HC stops the event data processing and the forwarding of the TM packets to the SC;
- reopens the FITS file of the current Run period and replaces in the Header some of the COMMENT keywords with the following Keywords:

        PD_CHAIN=   / Chain ID under Test
        BAR_IDEN=   / Bar Under Test
        BAR_END=   / Bar End Under Test
        VOLTAGE=   / Input Voltage (mV x100)
        CAPACIT=   / Capacitance (pF x 100)
        ATTENUAT=   / Attenuation factor
        ACC_TIME=   / Accumlation Time (s)

PD_CHAIN, BAR_IDEN, BAR_END are set to the ordinal number in the list presented by the widget, i.e:

        PD_CHAIN = (0,…, 15)
        BAR_IDEN = (0,…, 7)
        BAR_END = (0,1)

During the acquisition, the *Reset* button should not be used (to be disabled in the next version).
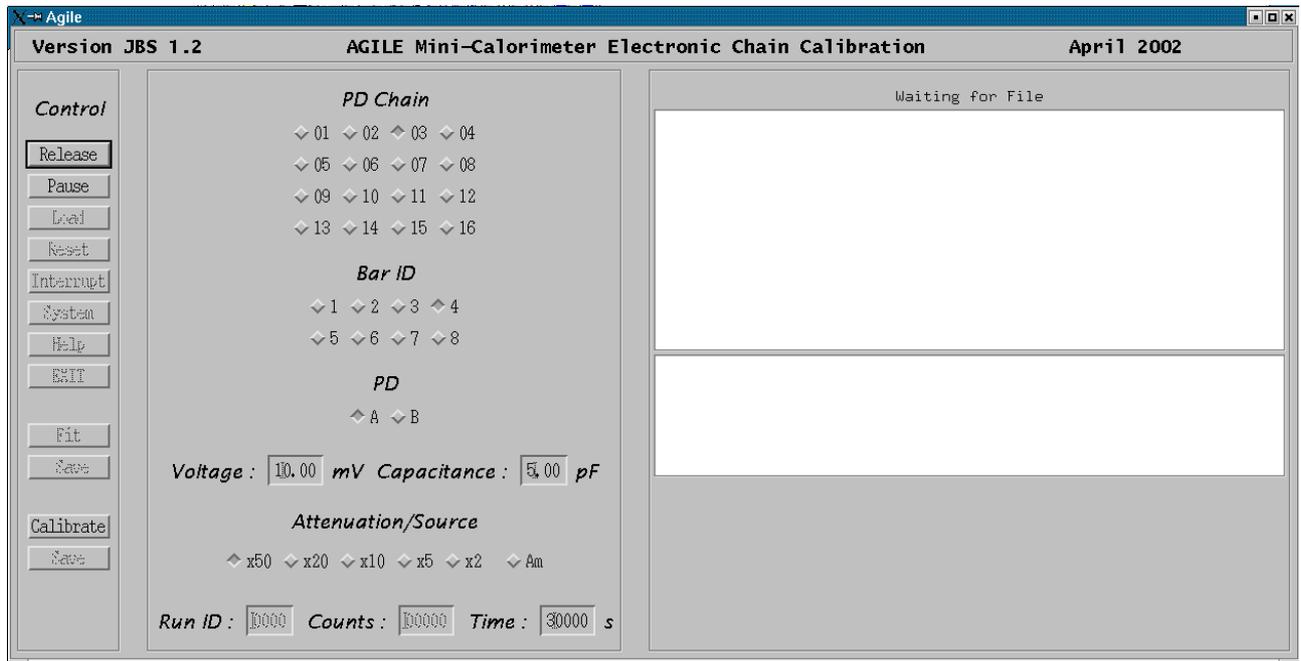
Figure 4-3 Electrical Chain Calibration widget after Connection

4.3   Step 3: Spectra accumulation and display

As long as the data are acquired, the SC software accumulates and displays the spectra of the PD PHA data which it reads from the FITS files.

Zoom operations on the Spectra are allowed by using the mouse, namely:

- using the left button, the area to be zoomed is selected by the graphical cursor;
- the right button generates a widget (see Figure 4-4) showing the current energy thresholds, modifiable by the operator.
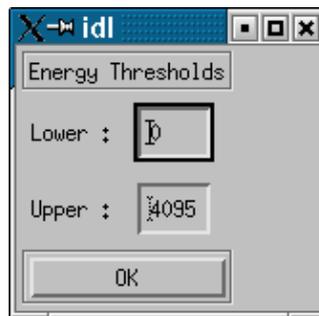
Figure 4-4 Zoom Spectra - Energy Thresholds selection

Since during the acquisition the whole accumulated spectrum is kept in memory, any time, and after zoom operations, the full spectrum can be redisplayed again by clicking on the spectrum area with the left button mouse.

Upon completion of the measurement, and until a new data acquisition is started, the accumulated

spectrum remains available for the peak analysis (see 4.4).

4.3.1   Spectra retrieving from the event list file

In case of need, it is possible to re-accumulate and display the spectrum in off-line mode (i.e. once the measurement has been closed and the accumulated spectrum is not available in memory anymore) by retrieving the event list file archived during the measurement.

To this purpose, the operator uses the *Load* button of the Electrical Chain Calibration widget shown in Figure 4-5.

The only parameter to be provided by the operator is the measurement RUN ID (e.g. 05155), followed by the *Enter* key.
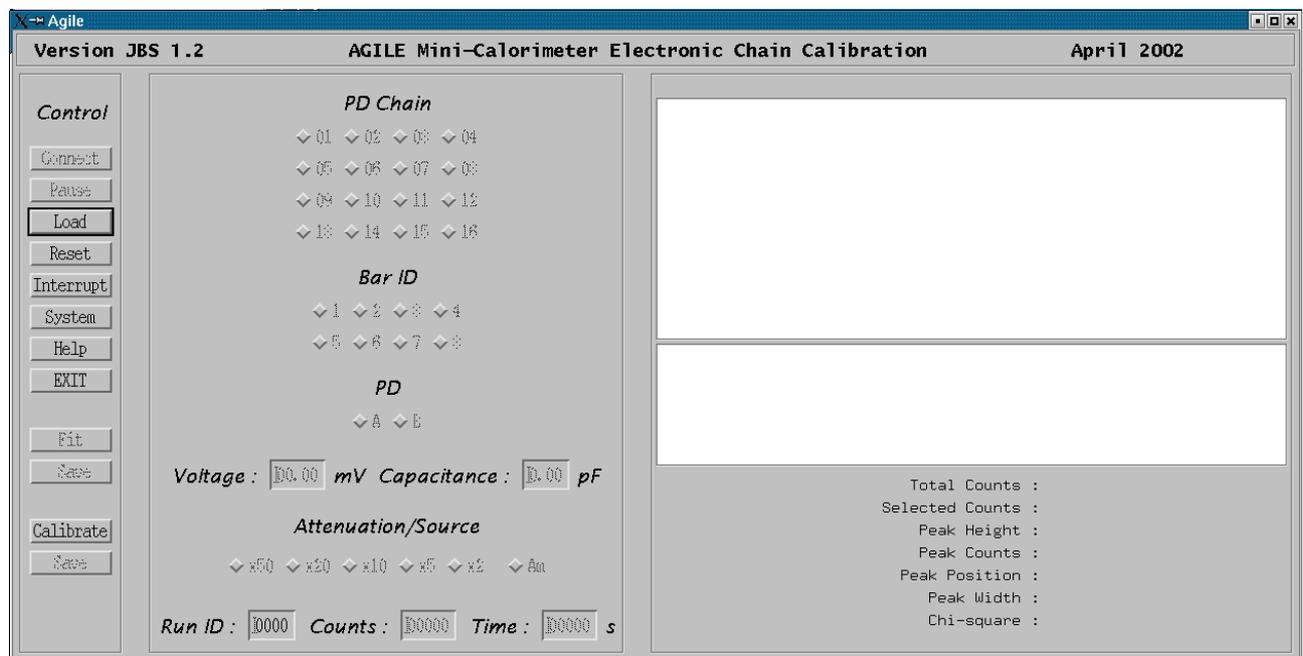
Figure 4-5 Electrical Chain Calibration – parameter selection for the Load button

The SC software derives automatically the name of the FITS file containing the event list of the RUNID measurement by searching in the DISCoS decade corresponding to the RUN ID, located under the directory tree specified in the agical.pro procedure by the variable fil_pth.

As at the time of writing the fil_pth is defined by:

$$fil\_pth='/users/archive/erdf/science/'$$

The search string is defined in the agichn.pro procedure defined by:

$$fil=fil\_pth+sm1+'/lab*'+smp+'*.hft'$$

In the example shown in Figure 4-6 the complete FITS file name was:

/home/agile/QL/BarCalibration/Data/0515/cer05155_011022_094346.hft

and the following setting was used:

fil_pth='/home/agile/QL/BarCalibration/Data/'

fil=fil_pth+sm1+'/*cer*'+smp+'*.hft*'

It is noted that in case more than one file matches the search string, only the first file name occurrence is used.

Once the file has been retrieved, the SC software, open the files and accumulate and display the spectrum on the widget, which looks like in the on-line case, included the widget parameters (PD Chain, Bar ID, PD, …) which are set automatically to the right values, as shown in the example of Figure 4-6.
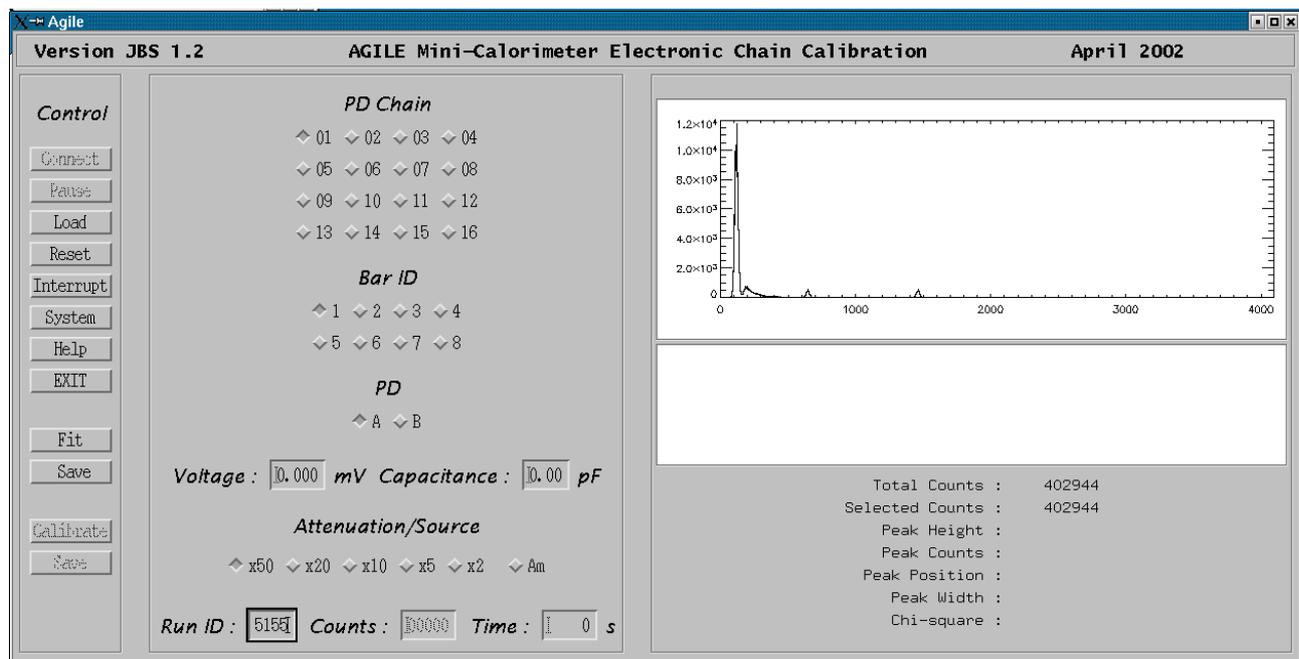
Figure 4-6 Electrical Chain Calibration - measurement retrieval

4.4   Step 4: Peak Analysis

This analysis is performed on the spectra which is obtained:

- either on-line, at completion of the measurement
- or off-line, by retrieving it from the event list file, as described in 4.3.1.

After the spectrum has been loaded in memory, the SC software allows the operator:

- to isolate the peak to be analysed, by using the zoom functionality;
- to fit the peak
- to archive the accumulated spectra and the peak analysis results.

At any time, the *Reset* button terminates the current analysis and discards the accumulated spectra.

4.4.1   Fit analysis

In order to select the fitting area, the Calibration software allows the operator to perform on the displayed spectrum the same zoom operations described in 4.3.

The *FIT* button starts the FIT analysis, which plots the red curve fitting the peak and displays the values of the fit parameters. (see Figure 4-7).
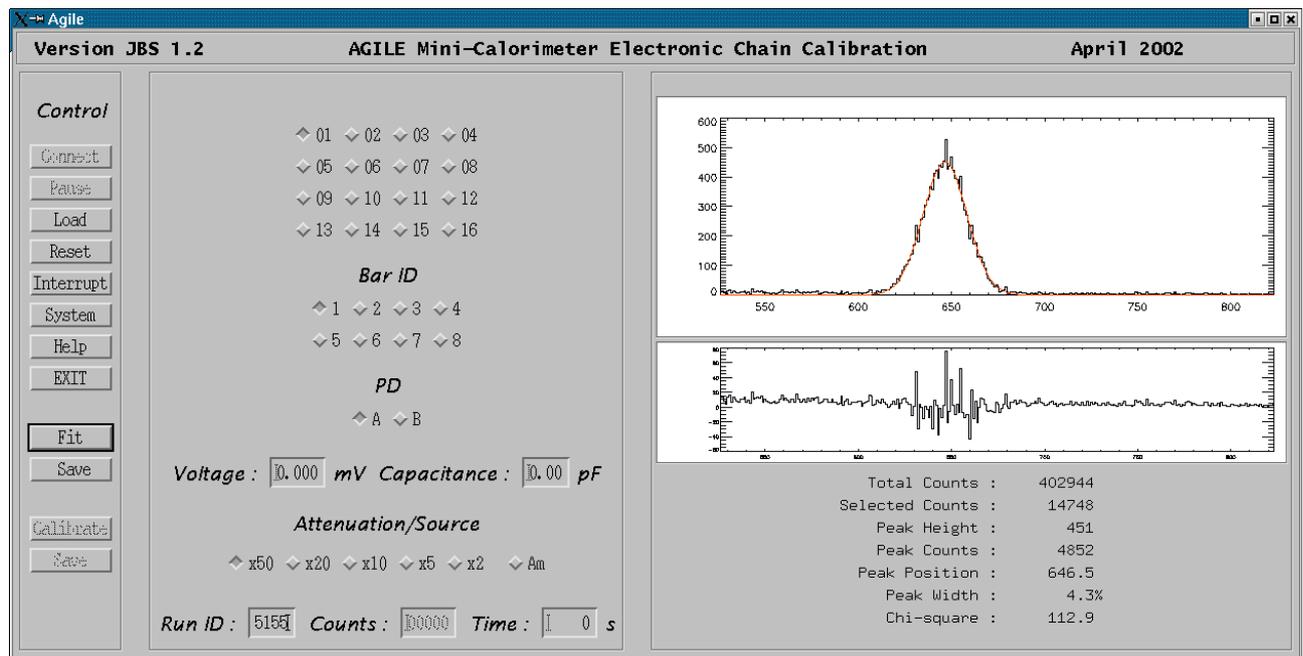
Figure 4-7 Electrical Chain Calibration – Fit Analysis

4.4.2   Spectra and peak parameters archiving

By selecting the *Save* button shown in Figure 4-7, the Calibration software creates the ASCII file containing the Spectrum and the results of the Peak Analysis.

The file directory tree above the decade is: /home/QL/v4/Chaincal/

The file name has the format: FIT_*xx_y_z_ww.nnn*

where:

xx: PD Chain (01, …, 16)

y: Bar ID (1, … , 8)

z: PD (A,B)

ww: Attenuation (1, … ,5) or Source (6)

nnn: progressive number (000, … , 999).

The file contains in the first row the results of the Fit Analysis (separated by blanks), namely:

Peak height, Peak Position, Peak Width, Peak Counts

followed by 4096 rows, each containing the PHA values of the spectrum channels (from channel 0 to channel 4095).

E.g., in the case shown in Figure 4-7, the file is named *FIT_01_1_A_01.003*, and it contains:

451.477   646.520   4.28795   4852.61

0

32

0

0

0

0

1

0

0

1

When the   spectra analysis have been carried out on the required set of Pulse Generator measurements and Radioactive Source measurements related to a given Electronic Chain, the corresponding files containing the spectra and the fit parameters are available on the directory specified in 4.4.2. An example of these files is given in Table 4-1.

FIT_01_1_A_01.003	FIT_03_1_B_05.001	FIT_03_2_A_03.002	FIT_03_2_B_00.000
FIT_03_1_A_05.000	FIT_03_1_B_05.002	FIT_03_2_A_03.003	FIT_03_2_B_02.000
FIT_03_1_B_00.000	FIT_03_2_A_00.000	FIT_03_2_A_03.004	FIT_03_2_B_03.000
FIT_03_1_B_00.001	FIT_03_2_A_00.001	FIT_03_2_A_03.005	FIT_03_2_B_04.000
FIT_03_1_B_00.002	FIT_03_2_A_00.002	FIT_03_2_A_04.000	FIT_03_2_B_05.000
FIT_03_1_B_00.003	FIT_03_2_A_00.003	FIT_03_2_A_04.001	FIT_03_3_A_00.000
FIT_03_1_B_02.000	FIT_03_2_A_00.004	FIT_03_2_A_04.002	FIT_03_3_A_02.000
FIT_03_1_B_02.001	FIT_03_2_A_00.005	FIT_03_2_A_04.003	FIT_03_3_A_03.000
FIT_03_1_B_02.002	FIT_03_2_A_02.000	FIT_03_2_A_04.004	FIT_03_3_A_04.000
FIT_03_1_B_03.000	FIT_03_2_A_02.001	FIT_03_2_A_04.005	FIT_03_3_A_05.000
FIT_03_1_B_03.001	FIT_03_2_A_02.002	FIT_03_2_A_05.000	FIT_03_4_A_00.000
FIT_03_1_B_03.002	FIT_03_2_A_02.003	FIT_03_2_A_05.001	FIT_03_4_A_02.000
FIT_03_1_B_04.000	FIT_03_2_A_02.004	FIT_03_2_A_05.002	FIT_03_4_A_03.000
FIT_01_1_A_01.000			
FIT_01_1_A_01.001			
FIT_01_1_A_01.002			

Table 4-1 El. Chain Calibration - Example of Spectra file archive

As detailed in 4.5.1.1 below, the Calibration software shall look in this directory in order to identify automatically, which set of measurements are available for the Gain and Offset calculation.

4.5 Step: 5 Offset and Gain calculation

Once the peak analysis has been completed on at least three Pulse Generator Peaks, this step allow to calculate the offset and the gain in ch/mV of the electronic chain.

The calculation of the gain in e-/ch requires that peak analysis includes also the Source measurement.

The procedure for the Gain and Offset Calculation is started by the *Calibrate* button of the Electronic Chain Calibration widget which activates the following actions:

- clears the plot area
- resets the current selection and waits for the selection of the parameters identifying the Electronic Chain to be calibrated, namely:
    - *PD Chain*
    - *Bar ID*
    - *PD*
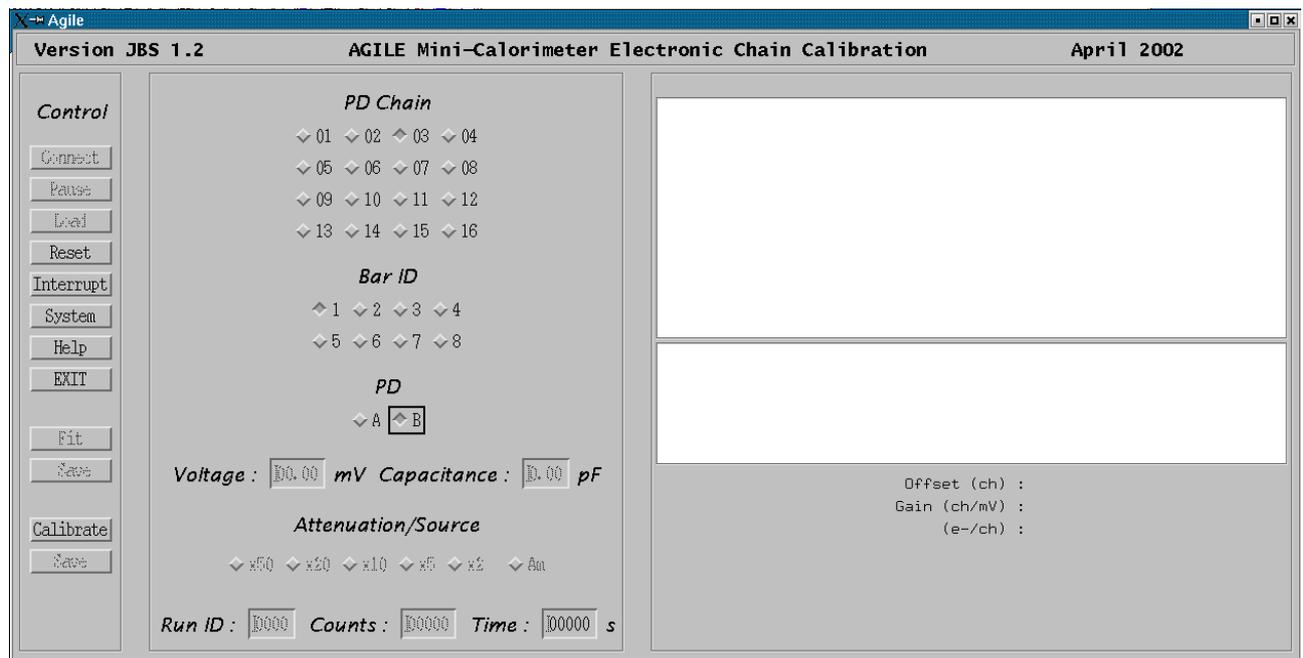
Figure 4-8 Electronic Chain Calibration – Calibrate button parameters

With the selection provided by the operator, the software looks in the Peak Analysis archive directory to determine which analysis have been completed. As result, it presents the *Attenuation/Source Selection Widget* (Figure 4-9).

As an example, Figure 4-9 shows the Attenuation/Source selection widget generated for the parameter selection given in Figure 4-8 and the Spectra files listed in Table 4-1.
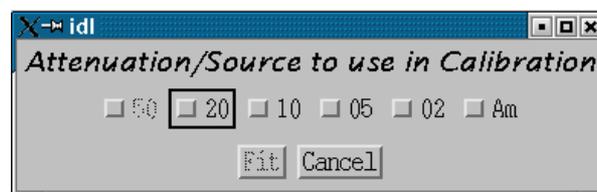
Figure 4-9 Electronic Chain Calibration – Attenuation/Source selection widget

As soon as the operator has selected at least 3 attenuation values, the *Fit* button shown in Figure 4-9 becomes available for the execution of the Calibration analysis, which:

- plots the linear fit of the *mV - ch* points (*Voltage on the Pulse Generator output - Peak Position*) related to the selected files;
- plots the residuals respects to the fit;
- calculates and displays the Gain (line slope) and Offset (intersection of the line with the X axes, which corresponds to an input signal of 0V) values.

The absolute Gain in *e⁻/ch* is calculated only in case the Source is selected.

It is noted that the *Calibrate* button does not allow any zoom operation on the plot area.

The example given in Figure 4-10 corresponds to the selection shown in Figure 4-11.
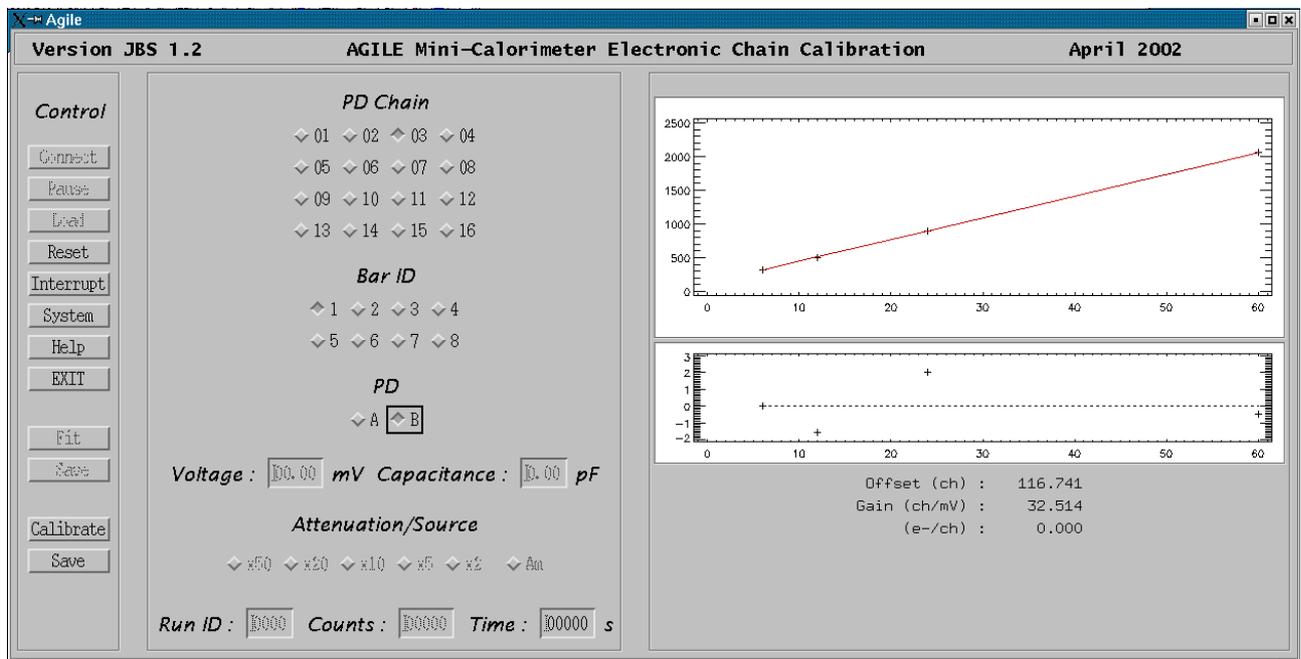
Figure 4-10 Electronic Chain Calibration – Offset and Gain calculation

Figure 4-11 Attenuation/Source selection for the example of Figure 4-10

An example of the calibration which uses also the Source in order to calculate the absolute gain, is given in Figure 4-12.
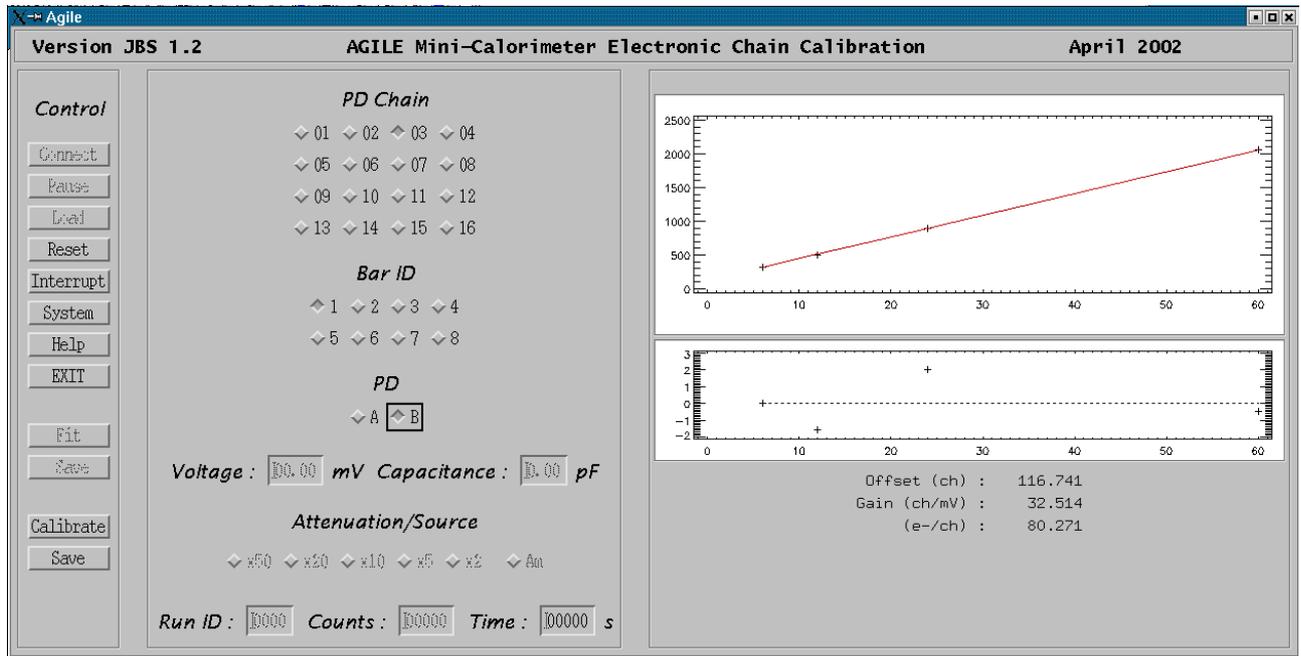
Figure 4-12 Electronic Chain Calibration – Offset and absolute Gain calculation

4.5.1.1   Gain and offset archiving

By selecting the *Save* button shown in Figure 4-12, the Calibration software creates the ASCII file containing the results of the Gain and Offset calculation.

The file directory tree above the decade is: /home/QL/v4/Chaincal/

The file name has the format: CAL_*xx_y_z_w.nnn*   (e.g.: CAL_03_1_B_F.000)

where:

xx: PD Chain (01, …, 16)

y: Bar ID (1, … , 8)

z: PD (A,B)

w: F: Full calibration, P: Partial calibration.

nnn: progressive number (000, … , 999).

The file consists of one row containing the Gain and Offset values (separated by blanks).

The *Full* (*w*=F) file contains:

$$Offset\ (ch),\ Gain\ (ch/mV),\ Gain\ (e^{-}/ch)$$

The *Partial* (*w*=P) file does not contain the *Gain (e⁻/ch)* value.

5   Bar attenuation calibration

The present version of the software is limited to the calculation for each CsI Bars of:

a) light output in e-/KeV

To this purpose, the operator shall perform:

- step 1-3 to acquire and archive one measurement for each of the different positions of the radioactive source along the bar; the analysis results shall be archived in one ASCII file for each measurement;

- step 4 to calculate the light output.

5.1   Step 1: chain set-up

By selecting the "Bar Calibration" shown in Figure 3-6, the Calibration software presents to the operator the Widget shown in Figure 5-1, which has to select the following parameters.

a) Pd Chain
b) Bar Id
c) PD
d) Position: identifier of the position where the radioactive source is located along the bar

The Time parameter, defining the duration of the Measurement, is not mandatory.

Once all the required parameters are set, the Connect button is activated (Figure 4-2).

5.2   Step 2: Data Acquisition

When the *Connect* button is selected, the SC commands the TE to start the measurement.

To this purpose, the SC:

- sets the Measurement Control Signal to the level which starts the TE instrument data processing and the forwarding of the TM packets to the SC;
- looks for the file where the Discos software writes the name of the FITS file which is being created with the event data acquired by the Host Computer.

The latter file allows the Calibration software to access the event list data contained in the FITS file which is being written.
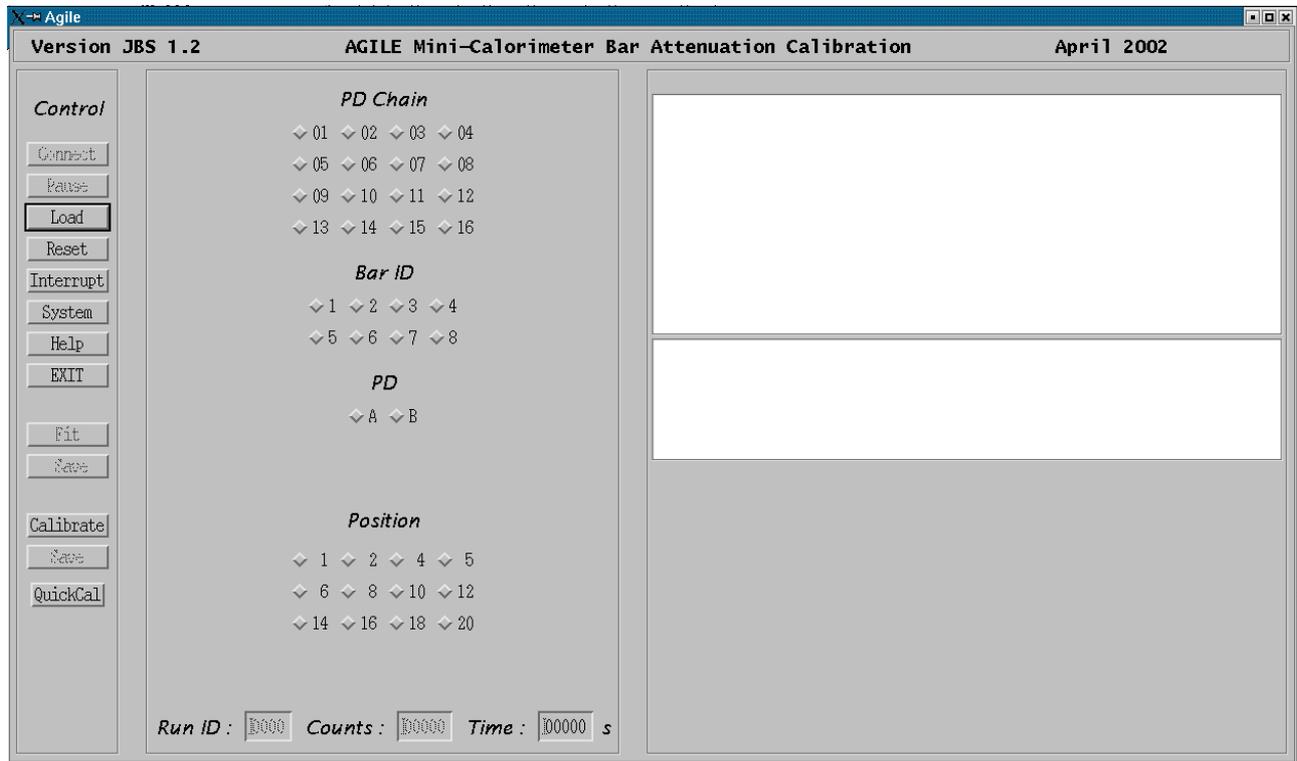
Figure 5-1 Bar Calibration widget: parameter selection for the data acquisition

The measurement completes when the *Time* parameter set by the operator in the Figure 5-1 widget is elapsed, or when the operator selects the "Release" button shown in Figure 5-1. In both cases, upon completion of the current Run period, the Calibration software:

- Set the Measurement Control Signal to the level which stops the TE instrument data processing and the forwarding of the TM packets to the SC;
- reopens the FITS file of the current Run period and replaces in the Header some of the COMMENT keywords with the same Keywords used for the Electronic chain calibration, where the keyword not used are set to -1, i.e.:

PD_CHAIN=	/ Chain ID under Test
BAR_IDEN=	/ Bar Under Test
BAR_END=	/ Bar End Under Test
VOLTAGE= -1	/ Input Voltage (mV x100)
CAPACIT= -1	/ Capacitance (pF x 100)
ATTENUAT=	/ Attenuation factor
ACC_TIME=	/ Accumlation Time (s)

ATTENUAT is used for the ID of the position of the Source, and it is set to the ordinal number in the list presented by the widget. E.g., in the case shown in Figure 5-2, they have the following values:

PD_CHAIN=	2 / Chain ID under Test
BAR_IDEN=	2 / Bar Under Test
BAR_END=	0 / Bar End Under Test

VOLTAGE= -1   -1 / Input Voltage (mV x100)
CAPACIT= -1   -1 / Capacitance (pF x 100)
ATTENUAT=   9 / Attenuation factor
ACC_TIME=   900 / Accumlation Time (s)

During the acquisition, the *Reset* button should not be used (to be disabled in the next version).

5.3   Step 3: Spectra accumulation and display

As long as the data are acquired, the SC software accumulates and displays the spectra of the PD PHA data which it reads from the FITS files. The display and zoom modalities are the same presented in 4.3.

5.3.1   Spectra retrieving from the event list file

In case of need, it is possible to re-accumulate and display the spectrum in off-line mode (i.e. once the measurement has been closed and the accumulated spectrum is not available in memory anymore) by retrieving the event list file archived during the measurement.

To this purpose, the operator uses the *Load* button of the Bar Attenuation Calibration widget shown in Figure 5-1.

The only parameter to be provided by the operator is the measurement RUN ID (e.g. 07410), followed by the *Enter* key.

Figure 5-2 Bar Attenuation Calibration – parameter selection for the Load button

The SC software derives automatically the name of the FITS file containing the event list of the RUNID measurement by searching in the DISCoS decade corresponding to the RUN ID, located under the directory tree specified in the *agical.pro* procedure by the variable *fil_pth*. As at the time of writing the *fil_pth* is defined by:

fil_pth='/users/archive/erdf/science/'

The search string is defined in the agibar.pro procedure defined by:

fil=fil_pth+sm1+'/*lab**'+smp+'*.*hft*'

In the example shown in Figure 4-6 the complete FITS file name is:

/users/archive/erdf/science/0714/lab07410_040203_122750.hft

It is noted that in case more than one file matches the search string, only the first file name occurrence is used.

Once the file has been retrieved, the SC software, opens the files and accumulates and displays the spectrum on the widget, which looks like in the on-line case, included the widget parameters (PD Chain, Bar ID, PD, …) which are set automatically to the right values, as shown in the example of Figure 5-2.

5.4   Step 4: Peak Analysis

This analysis is performed on the spectra which is obtained:

- either on-line, at completion of the measurement
- or off-line, by retrieving it from the event list file, as described in 5.3.1.

After the spectrum has been loaded in memory, the SC software allows the operator:

- to isolate the peak to be analysed, by using the zoom functionality;
- to fit the peak
- to archive the accumulated spectra and the peak analysis results.

At any time, the *Reset* button terminates the current analysis and discards the accumulated spectra.

5.4.1   Fit analysis

In order to select the fitting area, the Calibration software allows the operator to perform on the displayed spectrum the same zoom operations described in 4.3.

The *FIT* button starts the FIT analysis, which plots the red curve fitting the peak and displays the values of the fit parameters. (see Figure 5-3).
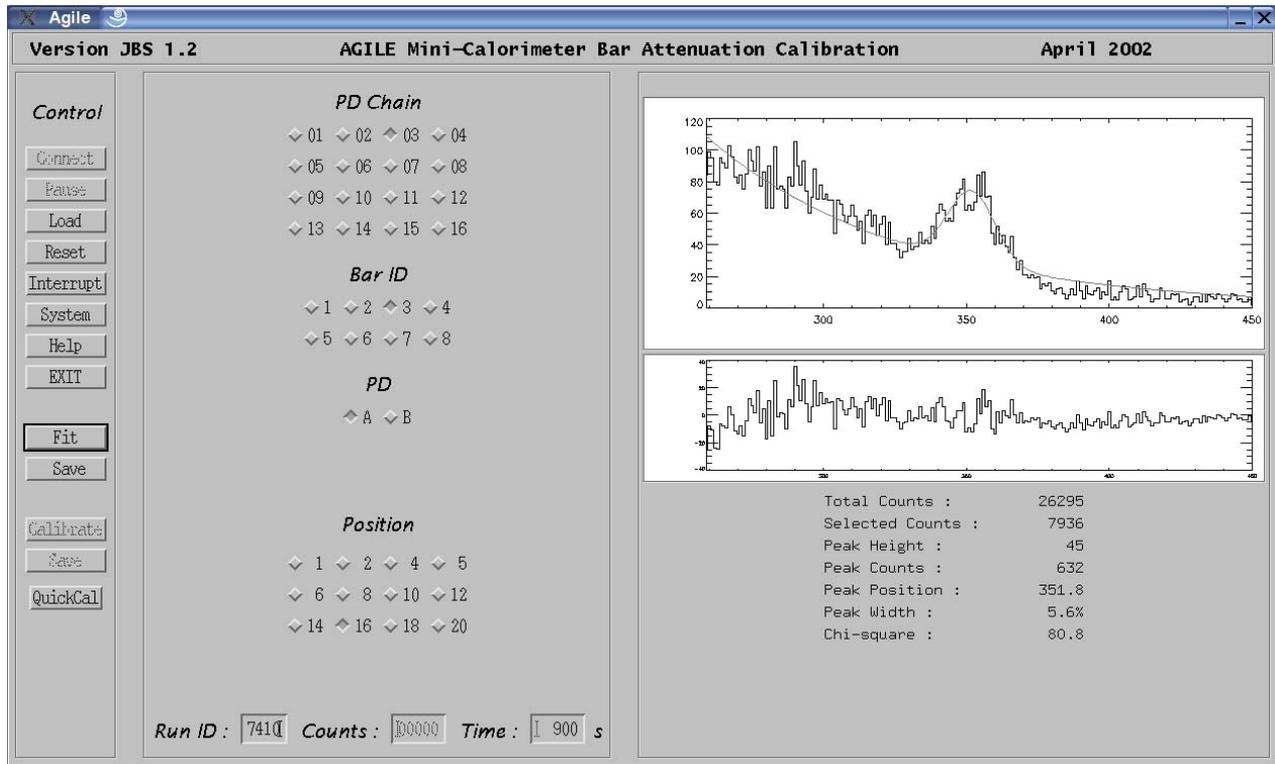
Figure 5-3 Bar Attenuation Calibration – Fit Analysis

5.4.2   Spectra and peak parameters archiving

By selecting the *Save* button shown in Figure 5-3, the Calibration software creates the ASCII file containing the Spectrum and the results of the Peak Analysis.

The file path is :   /home/QL/v4/Barcal/

The file name has the format: FIT_*xx_y_z_ww.nnn*

where:

xx: PD Chain (01, …, 16)

y: Bar ID (1, … , 8)

z: PD (A,B)

ww: Position ID (1,..., 12) (i.e. ordinal number of the Position in the list presented by the widget)

nnn: progressive number (000, … , 999).

The file contains in the first row the results of the Fit Analysis (separated by blanks), namely:

Peak height, Peak Position, Peak Width, Peak Counts

followed by 4096 rows, each containing the PHA values of the spectrum channels (from channel

0 to channel 4095).

E.g., in the case shown in Figure 5-3, the file is named *FIT_03_3_A_10.005*, and it contains:

```
45.4486        351.765      5.55557        632.905
        0
        0
        0
```

When the   spectra analysis have been carried out on the measurements corresponding to the required set of Source positions related to a given Bar, the corresponding files containing the spectra and the fit parameters are available on the directory specified in 4.4.2. An example of these files is given in Table 5-1.

FIT_03_1_A_01.000	FIT_03_1_A_01.001	FIT_03_1_A_01.002	FIT_03_1_A_01.003
FIT_03_1_A_01.004	FIT_03_1_A_01.005	FIT_03_1_A_01.006	FIT_03_1_A_02.000
FIT_03_1_A_02.001	FIT_03_1_A_02.002	FIT_03_1_A_02.003	FIT_03_1_A_02.004
FIT_03_1_A_02.005	FIT_03_1_A_02.006	FIT_03_1_A_02.007	FIT_03_1_A_03.000
FIT_03_1_A_03.001	FIT_03_1_A_03.002	FIT_03_1_A_03.003	FIT_03_1_A_03.004
FIT_03_1_A_03.005	FIT_03_1_A_03.006	FIT_03_1_A_03.007	FIT_03_1_A_04.000
FIT_03_1_A_04.001	FIT_03_1_A_04.002	FIT_03_1_A_04.003	FIT_03_1_A_04.004
FIT_03_1_A_04.005	FIT_03_1_A_04.006	FIT_03_1_A_04.007	FIT_03_1_A_05.000
FIT_03_1_A_05.001	FIT_03_1_A_06.000	FIT_03_1_A_06.001	FIT_03_1_A_06.002
FIT_03_1_A_06.003	FIT_03_1_A_06.004	FIT_03_1_A_06.005	FIT_03_1_A_06.006
FIT_03_1_A_07.000	FIT_03_1_A_07.001	FIT_03_1_A_07.002	FIT_03_1_A_08.000
FIT_03_1_A_08.001	FIT_03_1_A_08.002	FIT_03_1_A_08.003	FIT_03_1_A_08.004
FIT_03_1_A_08.005	FIT_03_1_A_08.006	FIT_03_1_A_09.000	FIT_03_1_A_09.001
FIT_03_1_A_10.000	FIT_03_1_A_10.001	FIT_03_1_A_10.002	FIT_03_1_A_10.003
FIT_03_1_A_10.004	FIT_03_1_A_10.005	FIT_03_1_A_10.006	FIT_03_1_A_12.000
FIT_03_1_A_12.001	FIT_03_1_A_12.002	FIT_03_1_A_12.003	FIT_03_1_A_12.004
FIT_03_1_A_12.005	FIT_03_1_B_01.000	FIT_03_1_B_01.001	FIT_03_1_B_01.002

Table 5-1 Bar Attenuation - Example of Spectra File Archive

5.5   Step 3: Light output calculation

The software calculates the light output using the following formulae:

$$1)\ LO = \frac{(ctr_{Na} - offset)}{1275} gain_{Am} \qquad \text{or} \qquad 2)\ LO = \frac{(ctr_{Y} - offset)}{1836} gain_{Am}$$

LO   = Light Output of the Bar measured in the current position

ctr_{Na} =peak position (Centroide) of the Na-22 source at 1275 keV;

ctr_{Y} = peak position (Centroide) of the Y-88 source at 1836 keV.

To this purpose, for each position of the source, after having obtained the spectrum, the operator selects the *QuickCal* button of the widget in Figure 5-3 and obtains the widget shown in Figure 5-4.
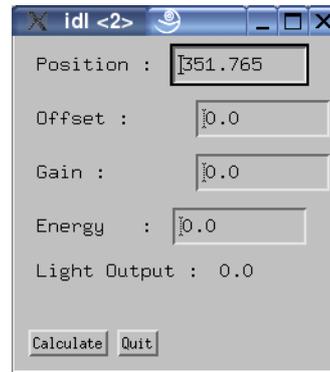
Figure 5-4 Bar Attenuation –light output calculation

The peak position is already provided by the software. The operator has to provide the Offset and Gain of the electronic chain and the source energy (1275 or 1836).

The resulting light output is saved by the software in the header of the FITS file related to the measure (not implemented yet).

6   Permanent archiving on CD-ROM

Purpose of this archive is to save on CD-ROM all the relevant data archived on the on-line Archive by the Science Console during a given test campaign.

This is accomplished in different steps:

1. initialisation:

    -   the current on-line Archive directory tree (i.e.: /users/archive) is renamed to the *setpro* subdirectory of the **off-line Archive** directory tree */users/archive_offline*;

    -   in the *Report* directory, an auxiliary directory, a new *setpro* subdirectory is initialised in order to host the summary information which shall be produced during the archiving of the off-line Archive files;

    -   in the *CD Area,* a temporary disc area, a new *setpro* subdirectory is initialised in order to host the off-line Archive files organised in a directory tree suitable for the creation of the CD-ROMs;

    -   a new on-line Archive directory tree is initialised for the forthcoming measurements;

2. cleaning and copy the off-line Archive *setpro* subdirectory tree on a temporary area (the CD Area):

    -   meaningless measurement files are removed;

    -   the measurement files are copied on the CD Area, which consists of a directory tree capable of containing the whole off-line Archive and where the measurements file are saved into subdirectories having a maximum size of about 600MB;

    -   the copy operations are verified;

3. close the off-line Archive:

    –   the *setpro* subdirectory of the off-line Archive directory is renamed to *set***xxx**;

    –   the *setpro* subdirectory of the Report directory is renamed to *set***xxx**;

    –   the *setpro* subdirectory of the CD Area is renamed to *set***xxx**;

4. burning the CD-ROMs:

    -   for each subdirectory contained in the *set***xxx** subdirectory of the CD Area:

        -   the CD image is created;

        -   the master copy of the CD is burned;

        -   the master copy is verified against the CD image;

        -   a second copy of the CD is burned;

        -   the CD image is removed.

The above steps shall be iterated until all the data produced during the Test Campaign are saved on the CD-ROMs.

As shown in fig. 4.2-1 below, the Report directory tree shall contain a subdirectory tree for each Test Campaign, plus a *conf* subdirectory devoted to some configuration information.

For each Test Campaign, the Report directory tree shall contain:

– the *doc* subdirectory, where to save the Test Campaign log file;

– the *setpro* directory related to the current off-line Archive,

– the *setxxx* directories, created by renaming the setpro subdirectory of the previous off-line Archives, which have been already closed by the operator.

```
/users/agile_report
|-- cernnov2000
|   |-- doc
|   |-- set000
|   `-- setpro
`-- conf
```

Fig. 4.2-1 The Report directory tree structure

As shown in fig. 4.2-2 below, the CD Area directory tree shall consist of:

- the *setpro* subdirectory, where the current off-line Archive files shall be copied by splitting the *archive* tree in one subdirectory *cdyyyy*, for each CD-ROM to be created;

- the *setxxx* subdirectories, created by renaming the setpro subdirectory of the previous off-line Archives, which have been already closed by the operator, but have not been burned yet on CD ROM.

The CD Area must be located on a computer equipped with a CD writer, and it must be capable of containing the files of the whole off-line Archive.

This area could either be hosted on a local Science Console disk (e.g. */data1/cd_area/setpro),* or located on a remote computer and mounted on the Science Console through NFS (e.g.: */data1/remote_cdarchive/setpro*).

```
/data1/remote_cdarchive/
`-- set000
   |-- cd0007
   |  `-- archive
   |-- cd0008
   |  `-- archive
   `-- setpro
```

Fig. 4.2-2 The CD-Area directory tree structure

The off-line Archive directory tree shall consist of:

- the *setpro* subdirectory, where are located all the files of the off-line Archive which is being processed;

- the *setxxx* subdirectories, created by renaming the *setpro* subdirectory of the previous off-line Archives, which have been already closed by the operator, but have not been backed up on DAT yet.

As detailed in the following sections, most of the above operations are automated by means of shell scripts which are executed by the operator on the Science Console through the Archive Control widget shown below, which is obtained by typing *archive* to run Idl, and then typing *arc* to run the required Idl procedure.
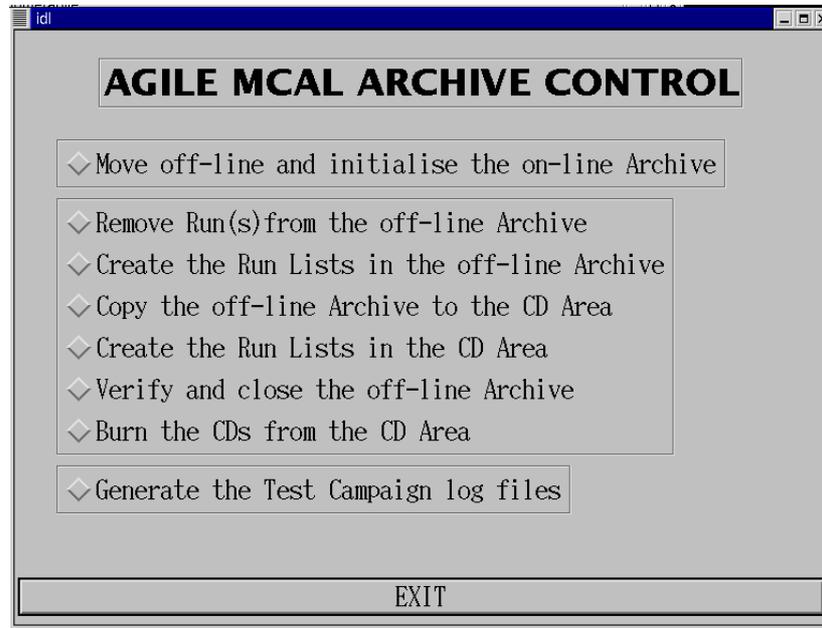
Fig. 4.2-3 AGILE Archive Control widget on the Science Console.

6.1.1 Move off-line and initialise the on-line Archive

This is the first step to be performed in order to start the archiving operations of the measurement already performed without interfering with the data acquisition of the forthcoming measurements.

To this purpose, the operator selects the "*Move off-line and initialise the on-line Archive*" widget list item (see fig 4.2-3 above), which:

1. checks whether the archiving operations on the current off-line Archive has been completed and the off-line Archive has been closed (see below), and in the negative case terminates;

2. renames the current directory tree of the on-line Archive, which becomes the off-line Archive tree to be saved on CD ROM;

3. in the Report directory, creates a new *setpro* subdirectory *(e.g.: /users/agile_report/cernnov2000/setpro),* where to save the summary information of the off-line Archive, which shall be produced in the next steps;

4. in the CD Area, creates a new *setpro* subdirectory, where to copy the off-line Archive files organised in a directory tree which is suitable for the creation of the CD ROM;

5. creates and initialise a new directory tree for the on-line Archive.

E.g.:

The /data1/archive subdir will be renamed to: /data1/archive_offline/setpro
and a new setpro subdirectory shall be created in both
the Report directory and in the CD Area

Would you like to continue ? (y/n) [n] y

... renaming the directory which was linked to /users/archive

/data1/archive moved to /data1/archive_offline/setpro

… creating the Report setpro subdirectory
/users/agile_report/cernnov2000/setpro created

... creating the CD Area setpro subdirectory
/data1/remote_cdarchive/setpro created

... re-creating an empty on-line Archive directory /data1/archive for the link /users/archive

/data1/archive created

... initialising the on-line Archive directory /data1/archive

 ... /data1/archive/raw created
 ... /data1/archive/erdf created
 ... /data1/archive/log created

The required operation has been successfully completed

As shown above, a default value is proposed by the script for each parameter. Some of these defaults can be changed by the user, while others require the modification of the script, in the default setting section listed below.

```
# Main
#
#
#--- site default setting (start)
#
  filesys_link=/users/archive
  topdir=/data1
  subdir=archive
  topsubdir_offline=archive_offline
  subdir_new_name=${topsubdir_offline}/setpro
  reportdir=/users/agile_report/cernnov2000/setpro
  destfilesys=/data1
  destsubdir=remote_cdarchive/setpro

#
#--- site default setting (end)
#
```

As shown above, a default value is proposed by the script for each parameter. Some of these defaults can be changed by the user, while others require the modification of the script, in the default setting section listed below.

6.1.2   Remove Runs from the off-line Archive

This step is performed in order to remove from the off-line Archive any file related to measurements which are meaningless;

To this purpose, the operator selects the "*Remove Run(s) from the off-line Archive*" widget list item (see fig 4.2-3 above) and provides the minimum and maximum Run ID of the set of measurements to be removed, e.g.:

```
Campaign id ?  [cer]:
the Campaign id is set to: cer
Would you like to continue ? (y/n) [n]: y

Data archive top directory ? [/data1/archive_offline/setpro]:
the Data archive top directory is set to: /data1/archive_offline/setpro
Would you like to continue ? (y/n) [n]: y

the scoeids are set to HBRS, OLD
Would you like to continue ? (y/n) [n]: y

Prompt the user before removing each file (y/n) ? [y]: y
the user will be prompt before removing each file
Would you like to continue ? (y/n) [n]: y
first runid to be removed ?  1
last runid to be removed ?  10

All files found in /data1/archive_saved for runids from 1 to 10 will be removed
Would you like to continue ? (y/n) [n]:
```

It is noted that the *Data archive top directory* must be set to the directory path of the off-line Archive directory being saved on CD ROM.

As shown above, a default value is proposed by the script for each parameter. Some of these defaults can be changed by the user, while others require the modification of the script, in the default setting section listed below.

```
# Main
#
#
#--- site default setting (start)
#
  camp=cer
  source_top_dir=/data1/archive_offline/setpro
#
################################################################
#               Playback    ECOE   CCOE   HBR_SCOE OLD #
# -------------------------------------------------------- #
# scoeid          [not used]  ECOE   CCOE   HBRS     OLD #
################################################################
#
  scoeid1=HBRS
  scoeid2=OLD
#
#--- site default setting (end)
```

6.1.3   Create the Run List in the off-line Archive

With this step the whole off-line Archive is processed in order:

1. to identify the run which total size does not fit into a CDROM (600 Mbytes); in this case the script:

    - creates a file consisting of the copy of the header of the FITS elf file containing the data;

    - compresses the elf file, and if necessary, compresses the raw file.

2. to create the *Run List* file containing a list of summary information related to all the run contained in the archive.

To this purpose, the operator selects the "*Create Run List in the off-line Archive*" widget list item (see fig 4-1 above), and answers to the script prompt, e.g.:

```
Archive Type ? (mo|cd|hd) [hd]:
The Archive Type  is set to: hd
Would you like to continue ? (y/n) [n]: y


Source File System for HD? [/data1]:
Archive ID is fixed to: 0000
The Source File System Subdir is set to: archive_off-line/setpro
Would you like to continue ? (y/n) [n]: y

   –    The list of all runs contained in /data1/archive_offline/setpro
will be written on file /data1/archive_saved/summary/hd0000list.create
Would you like to continue ? (y/n) [n]: y
```

As shown above, a default value is proposed by the script for each parameter. Some of these defaults can be changed by the user, while others require the modification of the script, in the default setting section listed below.

```
# Main
#
#
#--- site default setting (start)
#
  tmpdir="users/agile/tmp"
  arctype=hd
  hdsourcefilesys=/data1
  hdsourcesubdir=archive_offline/setpro
  cd_dir=/data1/remote_cdarchive/setpro
  reportdir=/users/agile_report/cernnov2000/setpro
  compressdir=/data1/gzdir
  minimum=20
  arcid=0
  cdmaxsize_mb=600
  empty_name="empty"
#
#--- site default setting (end)
```

Once the parameters setting is completed, the script analyses the whole off-line Archive and

generates the ASCII files containing the related summary information:

–   under the *summary* subdirectory of the off-line Archive, the script creates the *Run List* file (e.g. /data1/archive_offline/setpro/summary/hd00001list.create)

–   the script copies the *Run List* file into the Report *setpro* subdirectory.

e.g:

> Verifying /data1 status ...
> ... /data1 is mounted
> ... /data1/archive_offline/setpro/summary exists
>
> creating run list file /data1/archive_offline/setpro/summary/hd0000list.create
> 04289 (95040 bytes)
> elf file name= ./erdf/science/0428/ite04289_001204_143128__.hft
> keyword value is LABEN T.E.
> keyword value is 4289
> keyword value is 2000-12-04
> keyword value is 14:31:30
> keyword value is 14:34:25
> keyword value is 1560
>
> ……….
> ... /users/agile_report/cernnov2000/setpro exists

The *Run List* file is an ASCII file containing one line for each measurement. Each line consists of the following fields (separated by "*;*"):

-    Archive ID (always set to 0 for the HD tytpe)
-    Host Computer ID
-    Run ID;
-    Measurement Date;
-    Measurement start time;
-    Measurement end time;
-    Measurement total number of events;
-    the total size in bytes of the files (Log, Raw, Erdf) related to the measurement

Host Computer, Run ID, Date, times, total number of events and packet type are copied from the header of the FITS file and are set to "unknown" in case this file is missing.

A zero value for the "Measurement total number of events" means that the measurement has been terminated abnormally and the NAXIS2 header keyword has not been updated to the correct value. In this case, if necessary, the FITS files can be reproduced in playback from the raw files.

6.1.4   Copy the off-line Archive to the CD Area

This step is performed in order to copy all the files contained in the off-line Archive *setpro* subdirectory on the *setpro* subdirectory of the CD Area, organised as a directory tree having subdirectories smaller than the capacity of one CDROM (600MB), namely:

- the subdirectories will be named cd*xxxx*, where *xxxx* is an incremental number which will identify the CDs. This numbering has been started from 1 with the May 2000 CERN campaign and will be incremented for all the remaining Agile campaigns;

- in each subdirectory a maximum of 600 MB of measurement files will be copied having care of keeping on the same subdirectory all the files related to a given measurement (i.e. the files related to one measurement cannot be split among CDs).

By selecting the "*Copy the off-line Archive to the CD Area*" list item (see fig. 4.2-3 above), on the Science Console the operator runs the shell script which performs the above operations, i.e.:

- determines the ID of the next CD subdirectory to be created, i.e.:

    - gets the ID found in the *lastcdid_file* configuration file and checks whether the *setpro* subdirectory of the CD Area contains any subdirectory;

        - if not, it assumes that the CD corresponding to that ID has already been burned, and continues with the next step;

        - if yes, it checks whether the highest subdirectory found in the CD Area corresponds to that ID;

            - if yes, continues with the next step;

            - if not, terminates with an error message;

- checks whether the file system hosting the CD Area does contain the *setpro* subdirectory, and is capable of containing the whole off-line Archive:

    - if yes, continues with the next step;

    - if not, terminates with an error message;

- by iterating the following steps, the script copies the whole *setpro* subdirectory of the off-line Archive to the *setpro* subdirectory of the CD Area*:*

    - based on the ID number *xxxx* determined in the previous steps, the script evaluates whether in the subdirectory *cdxxxx* there is enough space to host at least the files related to the first run to be copied. If there is not space left, or the subdirectory *cdxxxx* does not exist at all, the scripts increments the ID number *xxxx* and creates a new subdirectory *cdxxxx.*

    - the script copies the off-line Archive data to the *cdxxxx* subdirectory up to the maximum of 600 MB, having care of keeping together all the files related to a given measurement.

    - the script writes on the *summary* subdirectory of the *sourcedir* directory, the file *cdxxxxlist.copy*, containing the lists of the runs copied on the *cdxxxx* directory.

    - increments the CD ID until the whole on-line Archive has been copied.

e.g.:

The CD ID to be assigned to the data to be copied is: 8
 where 550 MB are available
Would you like to continue ? (y/n) [n]: y
The Source File System Subdir is set to: archive_offline/setpro
Would you like to continue ? (y/n) [n]: y
Verifying /data1 status ...
 ... /data1 exists
 ... /data1/archive_offline/setpro exists
Verifying /data1 status ...
... /data1 exists
Verifying /data1/remote_cdarchive/setpro status ...
… /data1/remote_cdarchive/setpro exists
 ... /data1/remote_cdarchive/setpro/cd0008 created
 ... /data1/remote_cdarchive/setpro/cd0008/archive created
 ... /data1/remote_cdarchive/setpro/cd0008/archive/raw created
 ... /data1/remote_cdarchive/setpro/cd0008/archive/erdf created
 ... /data1/remote_cdarchive/setpro/cd0008/archive/log created
 ... /data1/remote_cdarchive/setpro/cd0008/archive/summary created

The list of all runs which will be copied from /data1/archive_offline/setpro to
/data1/remote_cdarchive/setpro/cd0008/archive
will be written on /data1/archive_14_feb_01/summary
Would you like to continue ? (y/n) [n]:

As they fit in the required space, all the files for run 04383 will be copied ....

copying file labccoe04383.log to /data1/remote_cdarchive/setpro/cd0008/archive/log .... copied
sleeping 2 seconds before continuing ...

 ... /data1/remote_cdarchive/setpro/cd0008/archive/raw/science/0438 created
 ... /data1/remote_cdarchive/setpro/cd0008/archive/raw/hk/0438 created
 ... /data1/remote_cdarchive/setpro/cd0008/archive/erdf/science/0438 created
 ... /data1/remote_cdarchive/setpro/cd0008/archive/erdf/hk/0438 created

The above steps lead to generate in the CD Area a number of subdirectories where the whole *setpro* subdirectory of the off-line Archive is copied, e.g.:

```
$ ls /data1/remote_cdarchive/setpro
cd0007 cd0009 cd0011 cd0013 cd0015 cd0017 cd0019 cd0021
cd0008 cd0010 cd0012 cd0014 cd0016 cd0018 cd0020
```

The related Run_list files are added to the same summary directory containing the Run List file created at the previous step for the whole *setpro* subdirectory of the off-line Archive, e.g.:

```
$ ls /data1/archive_offline/setpro/summary
cd0007list.copy    cd0011list.copy    cd0015list.copy    cd0019list.copy
cd0008list.copy    cd0012list.copy    cd0016list.copy    cd0020list.copy
cd0009list.copy    cd0013list.copy    cd0017list.copy    cd0021list.copy
cd0010list.copy    cd0014list.copy    cd0018list.copy    hd00000list.create
```

The default setting section of the script is listed below.

```
#################################
#
# Main
#
#
#--- site default setting (start)
#
..tmpdir="/users/agile/tmp"
  sourcefilesys=/data1
..sourcesubdir=archive_offline/setpro
  sourcearctype=data1
  destfilesys=/data1
  destsubdir=remote_cdarchive/setpro
  destarctype=cd
  cdmaxsize_mb=550
  minimum_mb=20
  empty_name="empty"
  confdir=/users/agile_report/conf
# file containing the ID of the last CD, to be used in case no cdxxxx dir has been left
# on destsubdir
  lastcdid_file=${confdir}/lastcdid
#
#--- site default setting (end)
```

6.1.5   Create the Run Lists in the CD Area

Once the previous step has been completed, the list of the Runs contained in the CD Area could be obtained by running, on all the *cdxxxx* subdirectories of the CD Area, the same scripts which has been run on the off-line Archive.

To this purpose, on the Science Console the operator selects the "*Create all the Run Lists in the CD Area*" list item (see fig. 4.2-3 above) in order to run the shell script which performs the required operations, i.e.:

-   runs the script *create_all_cds_run_lists*, which in turn runs the *Create Run List* in order to

perform on each *cdxxxx* subdirectory found in the CD Area the same processing of the script which created the *hdnnnnlist.create* file in the off-line Archive.

This time, after having removed any previous version of *Run List* files, the script produces in each *cdxxxx/summary* subdirectory the file *cdnnnnlist.create* containing the same kind of information produced for the off-line Archive case.

The *cdnnnnlist.create* files are also copied to the Report *setpro* subdirectory.

E.g.:

```
The CD Archive directory is set to: /data1/remote_cdarchive/setpro
Would you like to continue ? (y/n) [n]:y
The Archive Type  is set to: cd
CD ID is set to: 0007
The Source File System Subdir is set to: cd0007/archive
The list of all runs contained in /data1/remote_cdarchive/setpro/cd0007/archive
will be written on file /data1/remote_cdarchive/setpro/cd0007/archive/summary/cd0007list.create
Verifying /data1/remote_cdarchive status ...
 ... /data1/remote_cdarchive is mounted
…….
... /users/agile_report/cernnov2000/setpro exists

Type the Return key to return to the main window
```

The default setting section of the script is listed below.

```
#
# Main
#
# for each CD directory in cddir
#
#--- site default setting (start)
#
  cd_dir=/data1/remote_cdarchive/setpro
  script_dir=/users/agile/Archive
  report_dir=/users/agile_report/cernnov2000/setpro
#
#--- site default setting (end)
```

6.1.6   Verify and close the off-line Archive

This is the last step to be performed before starting with the burning of the CD ROM. This step:

1. verifies that the whole off-line Archive has been copied successfully to the CD Area; this is accomplished by comparing the Run Lists created with the above steps.

2. closes the current off-line Archive.

To this purpose, on the Science Console the operator selects the "*Verify and close the off-line Archive*" list item (see fig. 4.2-3 above) in order to run the shell script which performs the required

operations, i.e.:

- runs the script *verify_run_lists_and_close,* which:

    - compares the Run Lists (on-line Archive vs CD Area), i.e.:

        - copies in the file *hd.db* the hd*0000list.create* file*;*

        - creates the file *hd.merge* by copying the file *hd.db* without the first column;

        - merges in the file *cd.db* all the *cdnnnlist.create* files*;*

        - creates the file *cd.merge* by copying the file *cd.db* without the first column;

        - presents to the user any difference found by comparing byte to byte the content of the files *mo.merge* and *cd.merge;*

        as already detailed in the previous section, one of the fields in the run lists gives the total size in bytes of the files related to each measurement; hence in case the *.merge* files are identical, the copy was successful;

        all the above ASCII files are copied to the Report *setpro* subdirectory.

    – asks the operator whether the off-line Archive can be closed by:

        – renaming the *setpro* subdirectory of off-line Archive directory tree

        – renaming the *setpro* subdirectory of Report directory tree;

        – renaming the *setpro* subdirectory of CD Area directory tree.

    It is noted that until the off-line Archive has not been closed, the operator shall **not** be able to start the archiving operations on the current On-line Archive.

E.g.:

    The Report Dir is set to: /users/agile_report/cernnov2000/setpro
    Would you like to continue ? (y/n) [n]: y

    The hd and the cd merged files are identical

    Close the off-line Archive ? (y/n): y

    The /data1/remote_cdarchive/setpro dir shall be renamed to: /data1/remote_cdarchive/set000

    Would you like to continue ? (y/n) [n] y
    /data1/remote_cdarchive/setpro moved to /data1/remote_cdarchive/set000

    The /users/agile_report/cernnov2000/setpro dir shall be renamed to: /users/agile_report/cernnov2000/set000

    Would you like to continue ? (y/n) [n] y

/users/agile_report/cernnov2000/setpro moved to /users/agile_report/cernnov2000/set000

Type the Return key to return to the main window

The default setting section of the script is listed below.

```
#
# Main
#
#
#--- site default setting (start)
#
  tmpdir="/users/agile/tmp"
  topdir=/data1
  topsubdir_offline=archive_offline
  offline_dir=${topdir}/${topsubdir_offline}
  cd_dir=/data1/remote_cdarchive/setpro
  reportdir=/users/agile_report/cernnov2000/setpro
  hd_merged_file=${reportdir}/hd.merged
  hd_db_file=${reportdir}/hd.db
  cd_merged_file=${reportdir}/cd.merged
  cd_db_file=${reportdir}/cd.db
  diff_file=${reportdir}/hd_cd.diff
#
#--- site default setting (end)
#
```

6.1.7   Burn the CDs from the CD Area

Once the off-line Archive has been verified and closed as detailed in the previous sections, the corresponding CD Area   subdirectory tree (e.g. */data1/remote_cdarchive/set000*) contains a subdirectory *cdxxxx* for each of the CDROM which is ready to be burned.

The instructions to be followed in order to burn the CDROM are obtained by selecting the "*Burn the CDs from the CD Area* " list item (see fig. 4.2-3 above), i.e.:

```
On the PC equipped with the CD writer,login as root, and perform the following
operations for each cdxxxx subdirectory:
1) open a first terminal and execute the commands:
   - cd /data1/cd_area
   - ./create_agile_cd <xxxx>   where xxxx identifies the CD to be burned
       this runs the scripts which:
       - ask you to confirm/change set setxxx CD Area subdirectory
       - creates the raw image /cd_area/picsitcdxxxx.raw corresponding
          to the subdirectory cdxxxx;
       - burns the image on the CD; assigning  the volume name agilexxxx;
2) open a second terminal from which verify the burned CD against the image,
   by using the xcdroast package; this CD will be kept as master copy.
3) on the first terminal, run again the above script:
   - ./create_agilet_cd <xxxx>
       this time the scripts finds the raw image and only burns a second CD
       to be kept as working copy.
   - remove the raw image;
   - remove the subdirectory cdxxxx.
```

Type the Return key to return to the main window

The *create_agile_cd* script creates the raw image by using the command */usr/bin/mkisofs* (Version 1.12b5, 17 Feb 1998), and burns the image on the CD by using the command */usr/bin/cdrecord* (AUTHOR: Joerg Schilling, Seestr. 110 D-13353 Berlin Germany).

The default setting section of the *create_agile_cd* script is listed below.

```
#
##################################
#  Main
#
#
#--- site default setting (start)
#
  cd_area=/data1/cd_area
  agile_topdir=${cd_area}/agile
  agile_subdir=set000
  raw_pref="agilecd"
  raw_ext="raw"
  cd_pref="cd"
  vol_pref="agile"
#
#--- site default setting (end)
```

The labels for the CDs are produced using the Fujifilm CD-Labeling System by Labelle™.

The setxxx subdirectory of the CD Area shall be removed by the operator once all the data contained in the subdirectory have been burned on CD-ROMs.

5.2.5   Backing up the off-line Archive

Before removal, the *setxxx* subdirectories of the off-line Archive directory tree must be backed up on DAT tape by using tar.

The following command are required (logged in as root):

- *cd <off-line Archive top directory>*   *e.g. cd /data1/archived_saved*
- *tar cvf /dev/rmt/0mn ./*

It is noted that the tape is not rewound by the tar command.

5.2.6   Generate the Test Campaign log files

As already mentioned, the Report *doc* subdirectory is used to collect the ancillary files related to the whole campaign.

Once the last set of CDROM of campaign has been burned, the following steps are required in order to create in the *doc* subdirectory the ASCII files containing the complete directory of the CDROMs to be included in the Test Report document.

To this purpose, on the Science Console the operator selects the "*Generate the Test Campaign log*" list item (see fig. 4.2-3 above) in order to run the shell script which performs the required operations, i.e.:

- runs the *create_docs* script which in the above *doc* directory:

  - merges in the file *all_hd.db* all the hd.*db* files found under all the *setnnn* directories;

  - merges in the file *all_cd.db* all the *cd.db* files found under all the *setnnn* directories;

E.g.:

> The Report Dir top is set to: /users/agile_report/cernnov2000
> Would you like to continue ? (y/n) [n]: y
> The file /users/agile_report/cernnov2000/doc/all_hd.db has been created
> The file /users/agile_report/cernnov2000/doc/all_cd.db has been created
>
> Type the Return key to return to the main window

The default setting section of the script is listed below.

```
#
# Main
#
#
#--- site default setting (start)
#
 tmpdir="/users/agile/tmp"
 reportdirtop=/users/agile_report/cernnov2000
 setid="set"
 hd_db_file=hd.db
 cd_db_file=cd.db
 docdir=${reportdirtop}/doc
 all_hd_db_file=${docdir}/all_hd.db
 all_cd_db_file=${docdir}/all_cd.db
#
#--- site default setting (end)
#
```

Eventually, in the Report *doc* subdirectory, the operator creates by hand the ASCII file *doc/all_hd_tar.db* which contains, for each Off-line Archive backed up as given in the previous section*;* the Off-line Archive ID, the DAT #, the File # within the DAT (separated by semicolon).

Annex A   Science Console Raw data processing configuration

The present version is version 6, (*fai_v6*), having the configuration summarized below.

* VERSION

```
# * 1    -> CERN MAY 2000 Prototype Model
# * 2    -> CERN NOV 2000 added time in each event
# * 3    -> versione Agosto 2001
# * 4    -> versione Ottobre 2001 (dopo correzioni LABEN)
# * 5    -> versione Gennaio 2001 (test CSRC)
# * 6    -> versione Febbraio 2002 Sincronizzazione
# *         con file = ver 4 cambia il Processor

# *******************************************


#
     CONSOLEDIR=/users/agile/Console
     TESTDIR=/users/agile/Test/New
     SYSDIR=/users/agile/Sys/New
     QLDIR=/users/agile/QL
     PROCDIR=/users/agile/Proc/bin
#
###################################################################
#                     VERSION definition                         #
###################################################################
#
     VERSION=6
     version_file="AAAVERSION"
#
     CONSVER=2
     TESTVER=2
     SYSVER=2
     PROCVER=5
     QLVER=2
#
```

With respect the previous release, the only changes concern the Processor and the Quick Look, namely:

- the Quick Look identified by the fai_v6 file is not used anymore; it has been replaced by the Calibration software having its own start-up GUI (see 3.3);

- the Calibration Software does not use the DISCoS SHMF shared memory, but reads the data from the FITS file which name and status are provided by the synchronization file created by the Processor.

A.1   Processor and shared memory channel assignment

The processor *proc_5_lnx* has the general features of the previous version, namely:

- it is able to process the TM packet data coming from one or both the LABEN TE and

the INFN-TE.

- one copy of the program can be run on each of the two possible active TCP/IP link (HBR_SCOE link, CCOE link).

- on each active link, the Science Console is able to receive the packet stream having the APID assigned to the TE connected on that link, and on the basis of the APID, performs the different processing required for that TE.

The assignment of the various APIDs to the different DISCoS shared memory channels is shown in the table below.

APID Nominal/ Redundant	Packet type/ subtype	Function name	SHM channel	Unpacking processor on the Science Console	SHMF Channel
1348 , 1476			0		0
1352 , 1480			1		1
1356 , 1484			2		2
1357 , 1485			3		3
1360 , 1488			4		4
1361 , 1489			5		5
1364 , 1492			6		6
1368 , 1496			7		7
1372 , 1500			8		8
1373 , 1501			9		9
1376 , 1504			10		10
1293 , 1421			11		11
1280 , 1408			12		12
1281 , 1409			13		13
1285 , 1413		INFN TE	14		14
1286 , 1414			15		15
1397 , 1525			16		16
1398 , 1526		(TESRE TE in version 2)	17		17
1399 , 1527			18		18
1293		LABEN TE	18	proc_5_lnx	18

Table A-1 APID and shared memories channels mapping

In the present case:

- only the LABEN TE is used, and it is connected to the SC through HBR_SCOE TCP/IP link (see 3.1.3)

- the *proc_5_lnx* does not use the SHMF shared memory anymore, but it generates the synchronization file (ASCII file):

/home/agile/Conf/New/qlf_file_hbr_scoe.sync

which is used by the Calibration software to identify, in near real time, the status and the name of the FITS file containing the event list which is being written by the processor with the incoming data.

The synchronization file is an ASCII file consisting of four lines:

- file status (QLF_OPEN/QLF_CLOSE)

- total number contained in the file (NAXIS2 keyword)

- RUN ID

- Complete FITS file name

e.g.:

```
QLF_CLOSE
1000
5318
/users/archive/erdf/science/0531/lab05318_020306_113638.hft
```

Annex B   Science Console FITS file formats

B.1   LABEN TE

Each TM packet produced by the LABEN TE shall contain in its Data Field the number of trigger data blocks specified by the field *Nblocks* contained in its Data Field header. Each trigger data block shall contain the number of PD data specified by the field *Blsize*.

For each forthcoming TM packet, the Science Console shall extract each trigger data block in order to write them on the FITS binary table; using the format detailed in the following subheadings.

Each trigger data block shall be saved on one row of the binary table, namely:

−   one column for the time given in the Header of the Data Field containing the block;

−   one column for each of the PD PHA;

B.1.1   FITS format for the LABEN TE Data

B.1.1.1   Primary Header

```
SIMPLE  =               T / file does conform to FITS standard
BITPIX  =              16 / number of bits per data pixel
NAXIS   =               0 / number of data axes
EXTEND  =               T / FITS dataset may contain extensions
COMMENT   FITS (Flexible Image Transport System) format defined in Astronomy and
COMMENT   Astrophysics Supplement Series v44/p363, v44/p371, v73/p359, v73/p365.
COMMENT   Contact the NASA Science Office of Standards and Technology for the
COMMENT   FITS Definition document #100 and other FITS information.
END
```

B.1.1.2   Extension Header

```
XTENSION= 'BINTABLE'          / binary table extension
BITPIX  =               8 / 8-bit bytes
NAXIS   =               2 / 2-dimensional binary table
NAXIS1  =              40 / width of table in bytes
NAXIS2  =           26295 / number of rows in table
PCOUNT  =               0 / size of special data area
GCOUNT  =               1 / one data group (required keyword)
TFIELDS =              17 / number of fields in each row
TTYPE1  = 'TIME    '        / label for field   1
TFORM1  = '1D      '         / data format of field: 8-byte DOUBLE
TUNIT1  = 's       '        / physical unit of field
TTYPE2  = 'MC_SIGNAL0'       / label for field   2
TFORM2  = '1I      '         / data format of field: 2-byte INTEGER
TZERO2  =           32768 / offset for unsigned integers
TSCAL2  =               1 / data are not scaled
TUNIT2  = 'PHA     '         / physical unit of field
TTYPE3  = 'MC_SIGNAL1'       / label for field   3
TFORM3  = '1I      '         / data format of field: 2-byte INTEGER
TZERO3  =           32768 / offset for unsigned integers
```

```
TSCAL3  =                1 / data are not scaled
TUNIT3  = 'PHA     '         / physical unit of field
TTYPE4  = 'MC_SIGNAL2'       / label for field   4
TFORM4  = '1I      '         / data format of field: 2-byte INTEGER
TZERO4  =            32768 / offset for unsigned integers
TSCAL4  =                1 / data are not scaled
TUNIT4  = 'PHA     '         / physical unit of field
TTYPE5  = 'MC_SIGNAL3'       / label for field   5
TFORM5  = '1I      '         / data format of field: 2-byte INTEGER
TZERO5  =            32768 / offset for unsigned integers
TSCAL5  =                1 / data are not scaled
TUNIT5  = 'PHA     '         / physical unit of field
TTYPE6  = 'MC_SIGNAL4'       / label for field   6
TFORM6  = '1I      '         / data format of field: 2-byte INTEGER
TZERO6  =            32768 / offset for unsigned integers
TSCAL6  =                1 / data are not scaled
TUNIT6  = 'PHA     '         / physical unit of field
TTYPE7  = 'MC_SIGNAL5'       / label for field   7
TFORM7  = '1I      '         / data format of field: 2-byte INTEGER
TZERO7  =            32768 / offset for unsigned integers
TSCAL7  =                1 / data are not scaled
TUNIT7  = 'PHA     '         / physical unit of field
TTYPE8  = 'MC_SIGNAL6'       / label for field   8
TFORM8  = '1I      '         / data format of field: 2-byte INTEGER
TZERO8  =            32768 / offset for unsigned integers
TSCAL8  =                1 / data are not scaled
TUNIT8  = 'PHA     '         / physical unit of field
TTYPE9  = 'MC_SIGNAL7'       / label for field   9
TFORM9  = '1I      '         / data format of field: 2-byte INTEGER
TZERO9  =            32768 / offset for unsigned integers
TSCAL9  =                1 / data are not scaled
TUNIT9  = 'PHA     '         / physical unit of field
TTYPE10 = 'MC_SIGNAL8'       / label for field  10
TFORM10 = '1I      '         / data format of field: 2-byte INTEGER
TZERO10 =            32768 / offset for unsigned integers
TSCAL10 =                1 / data are not scaled
TUNIT10 = 'PHA     '         / physical unit of field
TTYPE11 = 'MC_SIGNAL9'       / label for field  11
TFORM11 = '1I      '         / data format of field: 2-byte INTEGER
TZERO11 =            32768 / offset for unsigned integers
TSCAL11 =                1 / data are not scaled
TUNIT11 = 'PHA     '         / physical unit of field
TTYPE12 = 'MC_SIGNAL10'      / label for field  12
TFORM12 = '1I      '         / data format of field: 2-byte INTEGER
TZERO12 =            32768 / offset for unsigned integers
TSCAL12 =                1 / data are not scaled
TUNIT12 = 'PHA     '         / physical unit of field
TTYPE13 = 'MC_SIGNAL11'      / label for field  13
TFORM13 = '1I      '         / data format of field: 2-byte INTEGER
TZERO13 =            32768 / offset for unsigned integers
TSCAL13 =                1 / data are not scaled
TUNIT13 = 'PHA     '         / physical unit of field
TTYPE14 = 'MC_SIGNAL12'      / label for field  14
TFORM14 = '1I      '         / data format of field: 2-byte INTEGER
TZERO14 =            32768 / offset for unsigned integers
TSCAL14 =                1 / data are not scaled
```

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TUNIT14 = 'PHA    '        / physical unit of field
TTYPE15 = 'MC_SIGNAL13'     / label for field  15
TFORM15 = '1I     '        / data format of field: 2-byte INTEGER
TZERO15 =          32768 / offset for unsigned integers
TSCAL15 =              1 / data are not scaled
TUNIT15 = 'PHA    '         / physical unit of field
TTYPE16 = 'MC_SIGNAL14'     / label for field  16
TFORM16 = '1I     '         / data format of field: 2-byte INTEGER
TZERO16 =          32768 / offset for unsigned integers
TSCAL16 =              1 / data are not scaled
TUNIT16 = 'PHA    '         / physical unit of field
TTYPE17 = 'MC_SIGNAL15'     / label for field  17
TFORM17 = '1I     '         / data format of field: 2-byte INTEGER
TZERO17 =          32768 / offset for unsigned integers
TSCAL17 =              1 / data are not scaled
TUNIT17 = 'PHA    '         / physical unit of field
EXTNAME = 'AGILE_Binary'    / name of this binary table extension
ORIGIN  = 'TESRE Science Console V.4'
TELESCOP= 'Agile  '
INSTRUME= 'Grid    '
MODEL   = 'October 2001'
DETNAM  = 'MCAL   '
NBARS   =              / Bar Total Number from the HK Conf Packet Data Field Header
MCF=                   / MCF from the HK Conf Packet Data Field Header
HKTYPE=                / HKTYPE from the HK Conf Packet Data Field Header
HOSTCOMP= 'LABEN T.E.'
APID    =          1293
TESTLEVE= 'FEE    '
DATATYPE= 'Diagnostic'
SOURCETY=              / Source Type from word. 1) of the HK Conf Packet Data Field Header
PDA01=                 / from word. 2) of the HK Conf Packet Data Field Header
CHA01=                 / from word. 2) of the HK Conf Packet Data Field Header
PDB01=          / from word. 3) of the HK Conf Packet Data Field Header
CHB01=                 / from word. 3) of the HK Conf Packet Data Field Header
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PDA08=                 / from word. 16) of the HK Conf Packet Data Field Header
CHA08=                 / from word. 16) of the HK Conf Packet Data Field Header
PDB08=                 / from word. 17) of the HK Conf Packet Data Field Header
CHA08=                 / from word. 17) of the HK Conf Packet Data Field Header
BAR01=                 / from word 18) of the HK Conf Packet Data Field Header
BAR02=                 / from word 19) of the HK Conf Packet Data Field Header
BAR03=                 / from word 20) of the HK Conf Packet Data Field Header
BAR04=                 / from word 21) of the HK Conf Packet Data Field Header
BAR05=                 / from word 22) of the HK Conf Packet Data Field Header
BAR06=                 / from word 23) of the HK Conf Packet Data Field Header
BAR07=                 / from word 24) of the HK Conf Packet Data Field Header
BAR08=                 / from word 25) of the HK Conf Packet Data Field Header
S_POSX=                / from word 26) of the HK Conf Packet Data Field Header
OFFX=                  / from word 27) of the HK Conf Packet Data Field Header
S_POSX=                / from word 28) of the HK Conf Packet Data Field Header
OFFX=                  / from word 29) of the HK Conf Packet Data Field Header
DURATION=              / from word 30) of the HK Conf Packet Data Field Header
CHAINID=               / from word 31) of the HK Conf Packet Data Field Header
VOLTAGE=               / from word 32) of the HK Conf Packet Data Field Header
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CAPACITY=                / from word 33) of the HK Conf Packet Data Field Header
ATTENUAT=                / from word 33) of the HK Conf Packet Data Field Header
SPARE1=                  / from word 33) of the HK Conf Packet Data Field Header
SPARE2=                  / from word 33) of the HK Conf Packet Data Field Header
SPARE3=                  / from word 33) of the HK Conf Packet Data Field Header
SPARE4=                  / from word 33) of the HK Conf Packet Data Field Header
RUNID   =         7410
CAMPAIGN= 'lab    '
FILENAME= '/users/archive/erdf/science/0741/lab07410_040203_122750.hft'
TRIGGERS=                 / Total number of triggers
DISCARD =                 / Total number of discarded triggers
DATE-OBS= '2004-02-03'
TIME-OBS= '12:27:45'
DATE-END=
TIME-END=
COMMENT
COMMENT
COMMENT
COMMENT
COMMENT
COMMENT
COMMENT
COMMENT
COMMENT
COMMENT
END
```