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LaNSA Users Manual

H Habara

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LaNSA Users Manual

Hideaki Habara

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Contents

List of Tables

List of Figures

Chapter 1

Introduction

LaNSA(Large area Neutron Scintillator Array) detector is one of the largest neutron spectrometer for measuring laser-plasma neutrons in the world. The detector consists of 960 channels of BC505 liquid scintillator, each coupled with Thorn-EMI9902KB05 photo-multiplier-tube(PMT). The data acquisition system consists of CAMAC and fastbus modules that are controlled through IBM-PC base computer. The obtained signals from the detector are delivered to LeCroy 1879 Time-Digital-Converter (TDC), which records the arrival time of the signal via LeCroy 4413 discriminator. These timings are collected and then converted into a neutron spectrum through the time-of-flight (TOF) method. At the same time, the signals are also detected with LeCroy 1885F Analog-to-Digital Converter(ADC) to obtain accumulated current charge of the signal.

In order to measure the neutron angular distribution, these modules have been divided into three separate units. One unit is positioned in target area west (TAW) with 288 detectors. The other two units with 256 detectors are located in the target area PetaWatt (TAP). Figure 1.1 shows an schematic image of the neutron array for one spectrometer in TAP together with an overview of the setup for PW laser and the neutron spectrometers. An image of chamber and the module at TAW is also shown in Fig. 1.2. The yellow box represents the neutron detector module and the imaginary neutron flow is given by green gimlet area in both images. The distance between the two modules and the chamber centre in TAP are 12.9m and 5.1m. The distance in TAW is about 6m from the chamber centre.

The energy resolution of each module is about 100keV for 2.45MeV deuteron-deuteron (DD) neutron and 600keV for 14MeV deuteron-tritium (DT) neutron at 5m distances. On the other hand, at 12m distances, the energy resolution becomes much smaller (45keV for 2.45MeV neutron and 260keV for 14MeV neutron). The dynamic range for obtainable neutron

Figure 1.1: Left: TAP schematic image. Right: TAP overview.

Figure 1.2: TAW image

yield is estimated to be about 2 orders of magnitude. For more detail descriptions, see LaNSA reconstruction report.

This manual instructs you how to operate the LaNSA control system. In section 2, the basic operation processes on how to obtain the neutron data are described. In the next three sections, the important processes are examined and explained in detail: 'Set up the software', 'Initializing' and 'Acquisition'. Section 6 explains the functions of menu items in the main window. The last three sections are description for other utility windows: 'Setup', 'CAMAC test' and 'Fastbus test' windows.

Chapter 2

Getting start

LaNSA control system is located on the mezzanine floor above the 208 amplifiers of VULCAN near the south control room.

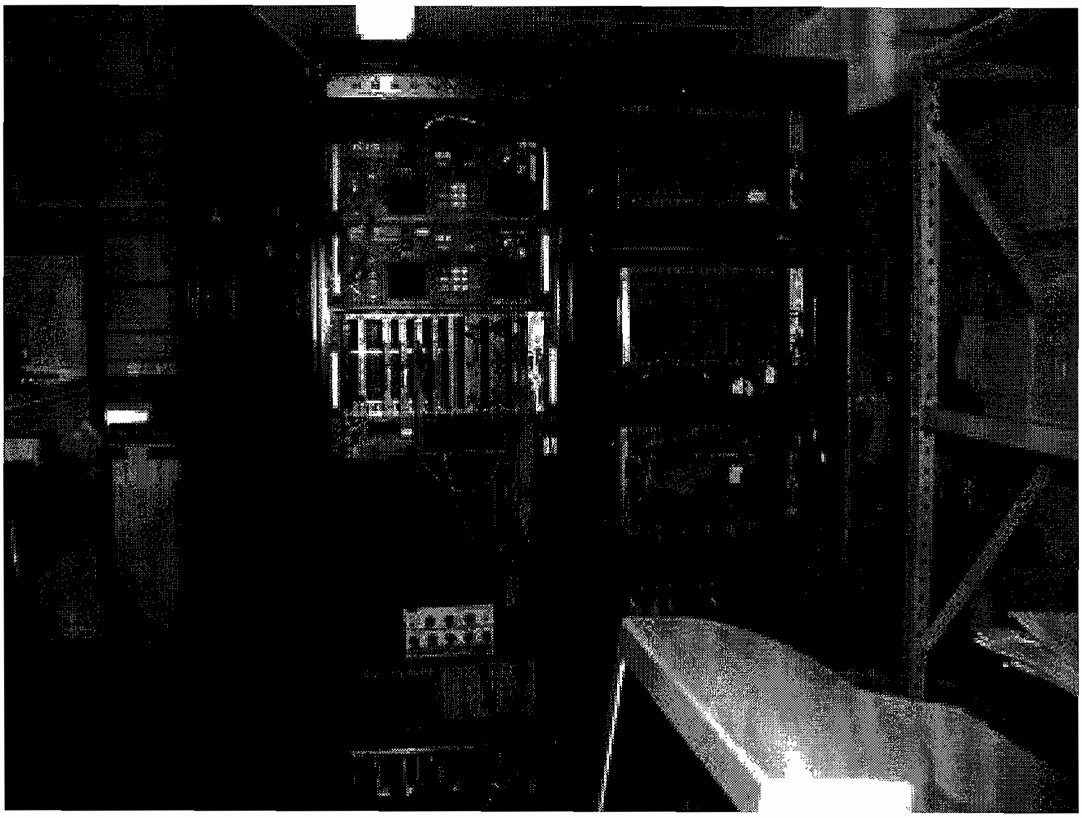


Figure 2.1: LaNSA electronics located on the mezzanine floor. The control electronics are divided into two isolation towers.

Let's start the system by switching on the power!

2.1 Power on

2.1.1 Main Power

Turn on the main power of the system. The switches are located beside the electrical noise isolation towers. You can access them from rear side of the towers (See figure 2.2).

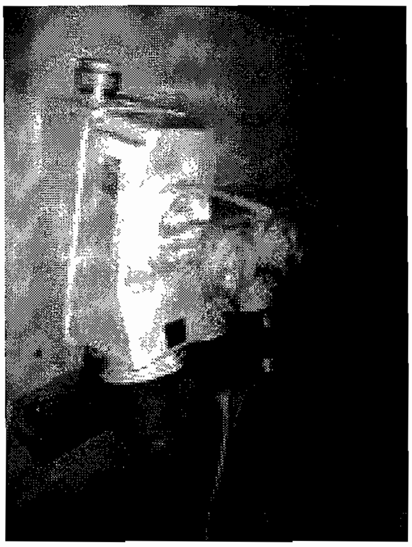


Figure 2.2: Main Power knob beside the control tower.

The larger knob is for the fastbus power supply and other two are for each of the towers. Turn clockwise all knobs to turn on the system. Then you should hear the sound of the fans.

2.1.2 Crate Power

Turn on the supply to CAMAC and the fastbus crates. The switches are on face of the each crate manager below the inserted modules. There are 4 CAMAC crates, 2 high voltage units, and 1 fastbus crate to turn on. The CAMAC crates in right-hand tower are the discriminator for each detector unit, therefore you can turn on the crate that you will use (top 2 are for TAP units and bottom module is for TAW).

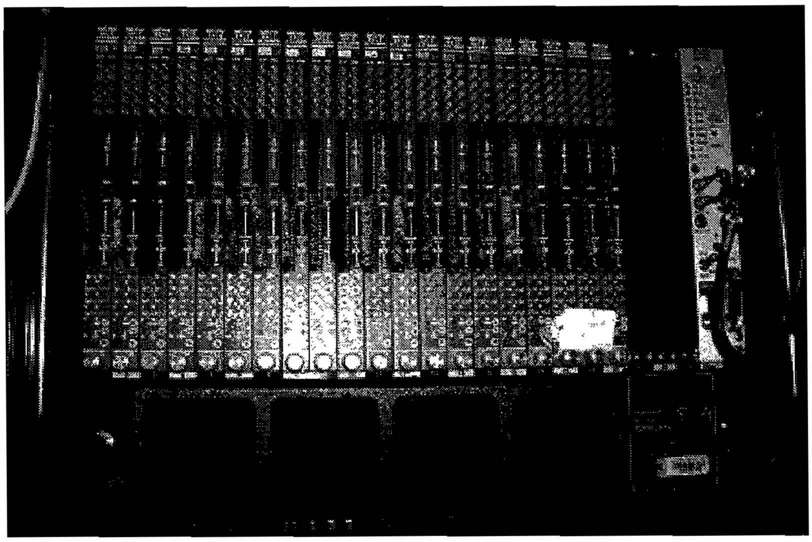


Figure 2.3: CAMAC crate with 4413 Discriminators. The power switch is next to the fan cover at the bottom of the crate.

2.1.3 High Voltage

Turn on the high voltage for PMTs. There are 2 LeCroy high voltage units: the upper one is assigned as frame 1 and lower one is frame 2. Turn clockwise the two key switches to power on the frames.

If High Voltage mode is in manual operation, you should adjust the HV by hand according to the procedures described below:

1. Select a channel. Push the arrow button while holding down the C button.
2. Set the voltage. Push the arrow button while holding down the V button.
3. Continue 1-2 for all channels you will use.
4. Push the "HV on" button.

If HV is set to remote mode, these procedure can be operated on the operation software. See next section in detail.

The original voltage for each channel is listed in Table 2.1 [1].

[1]These voltages are calibrated to obtain same output level using characteristic X-ray of ^{60}Co radioactive source.

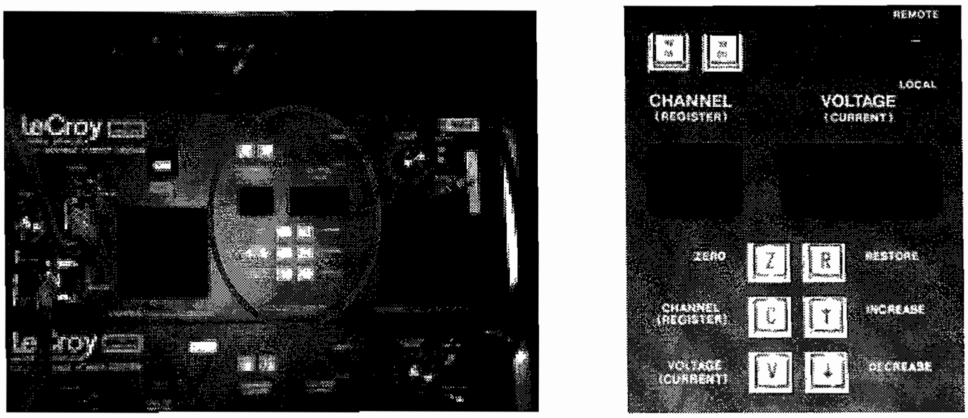


Figure 2.4: Left: high voltage supplier. Right: extended view surrounded by the red circle in the left figure. The high voltage can be set using the six keys on the bottom of the figure. Top two buttons are HV on and off button. The top right switch selects either the remote or the manual mode of HV operation.

LaNSA	TAW			TAPN			TAPW		
Module	Frame	Channel	Voltage	Frame	Channel	Voltage	Frame	Channel	Voltage
1	1	00	1000	2	00	1000	2	16	800
2	1	01	880	2	01	1000	2	17	1000
3	1	02	1000	2	02	1000	2	18	1120
4	1	03	800	2	03	1000	2	19	1000
5	1	04	1000	2	04	1300	2	20	1160
6	1	05	1050	2	05	1060	2	21	1110
7	1	06	950	2	06	1070	2	22	1090
8	1	07	940	2	07	1000	2	23	1150
9	1	08	915	2	08	1270	2	24	1100
10	1	09	1000	2	09	1160	2	25	1010
11	1	10	1120	2	10	1140	2	26	1050
12	1	11	950	2	11	1070	2	27	1170
13	1	12	950	2	12	1180	2	28	1160
14	1	13	1047	2	13	1170	2	29	1170
15	1	14	920	2	14	1100	2	30	1020
16	1	15	700	2	15	1140	2	31	1020
17	1	16	1070						
18	1	17	1010						

Table 2.1: High voltage level for each module.

2.2 Software Operation

The operation and data acquisition of the LaNSA can be only performed from the HOST PC. The PC is now located in TAP control room.

2.2.1 Login

The operating system of the host computer is Windows NT4(TM). You can login using below ID.

ID : LANSA
DOMAIN : LANSAPC01

To login the PC you also need password. Contact LaNSA administrator. Note : Windows NT user authorization is case sensitive.

2.2.2 Running CAMAC Driver

Double click the shortcut for "ECC_HOST.exe" on the desktop to activate the CAMAC driver. If the opening window says only

hytec_memstart = a60000
hytec_memend = a73dff

then ECC_HOST is successfully running, otherwise you must close the window and repeat this procedure.

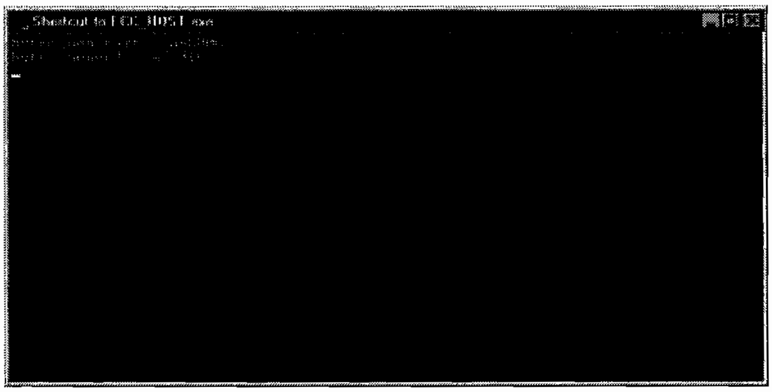


Figure 2.5: ECC_HOST.exe window.

2.2.3 Running LaNSA OPERATION PROGRAM

Double click the shortcut for "LaNSA.exe" on the PC's desktop. Following the title window, the main window will appear on the centre of screen.

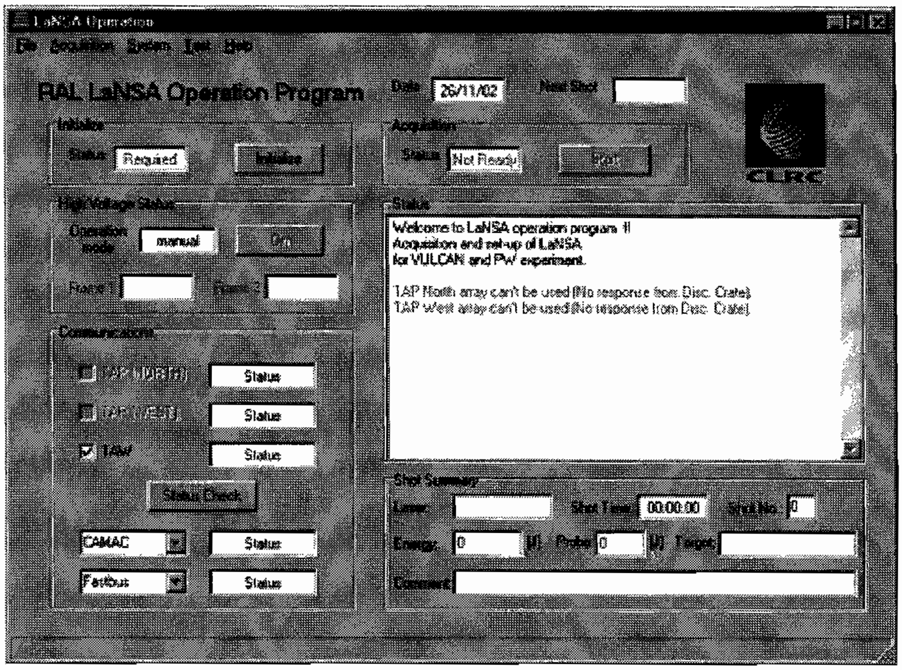


Figure 2.6: LaNSA operation program main window.

The main window contains following boxes:

Initializing : Initializing the system.

High Voltage : Display and initialize the high voltage status.

Communication : Display CAMAC and fastbus module status.

Acquisition : Start acquisition process.

Status : Show all status and log of the processes.

Shot summary : Edit and show the shot summary.

See more details for the first 4 boxes are in an each independent section.

After displaying the main window, if the CAMAC crates are on correct status and the ECC_HOST.exe has already been running, then no caution appears in the status box. If either or both are not on correct status, check the power of CAMAC crates and ECC_HOST.exe along with the statement in the status box.

If some of CAMAC crates are not working, corresponding messages are displayed in the status box, e.g., if the Crate 1 doesn't work then the message says "TAW array can't be used (No response from Disc. Crate). ". At the same time the caption named "TAW" in the communication box changes grey and one is no longer able to select TAW array for the initialization process.

2.2.4 Initializing system

If the colour of the caption of "Initialize" button is black, you are ready for initializing the system. If it is grey, you can't operate the system and you need to check the electronics and whether ECC_HOST is correctly running.

Check the appropriate active check box named each array in the communications box you will use, then click the "Initialize" button to initialize the system.

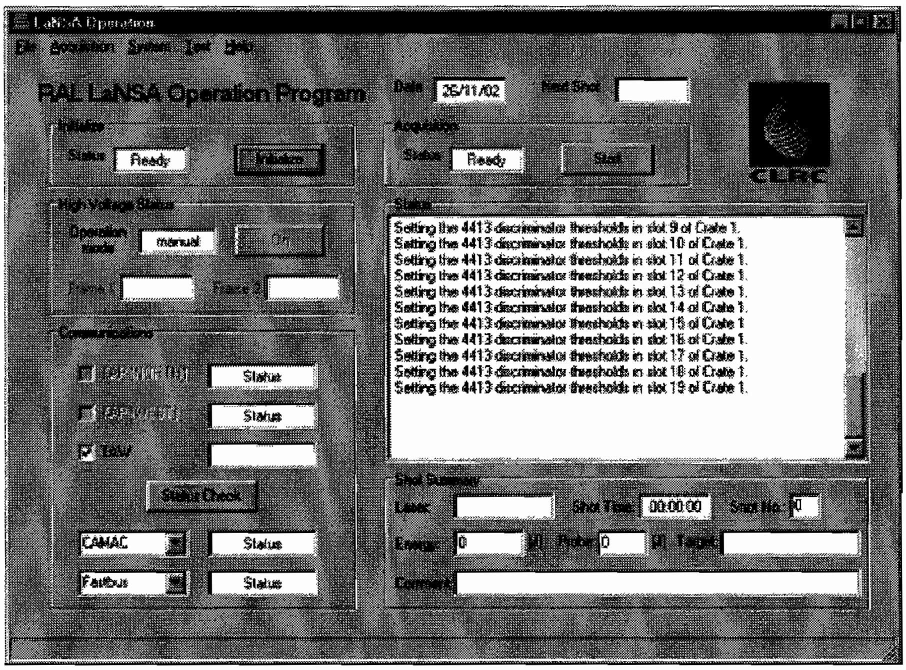


Figure 2.7: The window status when an acquisition is ready.

During the initialization process, logs are displayed in Status box. As a default, the logs can't be saved automatically. The setting can be changed by checking the "Save log" item in File menu of the main window. See section 6.

2.3 High voltage

If high voltage is in remote mode, it also needs to initialize the high voltage for the PMTs. Push the "HV on" button in High Voltage groupbox. The software set the high voltage according to the values in "setting_old.txt" (or "default_setting.txt"). Until the process is completed, the colour of "HV on" button changes in grey. The process will take a couple of minutes.

2.4 Acquisition

When initializing processes and high voltage (if remote mode) have finished successfully, the caption of the button in Acquisition box changes to "Ready". Then the unit is now ready for acquisition. Click the "Start" button at least 1 min. before the shot. See section 5 for more details. If not, check the status of electronics according the comment in the Status box.

2.5 System shut down

When you finish to use the system, you must turn off the system. It is not allowed to leave the power of the system on through the night in the viewpoint of safety.

The shut down processes are very simple - reverse of the power on processes. Quit the program and driver, and log off the computer. If high voltage is in remote mode, it takes about a minute to turn off the high voltage. Then turn off the supply of CAMAC creates, fastbus crate, and high voltage unit (after push "HV off" button if manual mode). Finally, turn anti-clockwise all the knobs of main power.

Chapter 3

Set up LaNSA program software

These files should be put in the same folder to run the software. (This folder can be placed on anywhere you like.)

LaNSA.ini
LaNSA.exe
default_setting.txt
(and setting_old.txt if there is)

LaNSA.exe is executing software file. LaNSA.ini is a file in which the initial parameters for LaNSA.exe are defined. "default_setting.txt" sets the default parameters for CAMAC modules, TDCs and ADCs.

3.1 LaNSA.ini

LaNSA.ini consists of two sections, [lansa] and [camac].

IMPORTANT : you MUST NOT change all item names in the file. If you want to change some of these parameters, change the value followed the item name and rewrite the file.

In the [lansa] section, the initial parameters for LaNSA.exe are written.

inidir : Initial directory where the "LANSA.exe" is.

debug : Allow displaying detail comments and status for every fastbus command executions, which is equivalent with the FBOPB[1] parameter in fastb21.f (see LeCroy 1821 SM/I manual). 0 means false, and 1 is true.

remotehv : Select the high voltage operation mode. If the value is 0 then the high voltage is in manual operation. If it is set to 1, then it is in remote mode.

initdc : Choose whether initializing process includes TDC initialization or not in the execution. 0 means false and 1 is true.

iniadc : Choose whether initializing process includes ADC initialization or not in the execution. 0 means false and 1 is true.

iniped : Select using the pedestal subtracting system to the ADC in the execution. 0 means false and 1 is true.

In the [camac] section, the crate, slot and address of the CAMAC modules are described.

ibrnc : BRANCH number of CAMAC. This should be always 0.

crat_FBI and slot_FBI : Crate and slot number of LeCroy 2891 Fastbus Interface.

crat_DIS and slot_DIS : Crate and slot number of LeCroy 4413 Discriminator for external trigger input.

crat_SCR and slot_SCR : Crate and slot number of LeCroy 2551 Scaler for triggering of the program.

crat_HVI and slot_HVI : Crate and slot number of LeCroy 2132 High Voltage Interface.

crat_GDG_TRG, slot_GDG_TRG, addr_GDG_TRG, and gate_GDG_TRG : Crate, slot and address number of LeCroy 2323A Dual Gate and Delay Generator for scaler. gate_GDG_TRG is the gate width.

crat_GDG_TDC, slot_GDG_TDC and addr_GDG_TDC : Crate, slot and address number of LeCroy 2323A Dual Gate and Delay Generator for TDC stop.

crat_GDG_ADC_D, slot_GDG_ADC_D and addr_GDG_ADC_D : Crate, slot and address number of LeCroy 2323A Dual Gate and Delay Generator for ADC gate delay.

crat_GDG_ADC_G, slot_GDG_ADC_G and addr_GDG_ADC_G : Crate, slot and address number of LeCroy 2323A Dual Gate and Delay Generator for ADC gate width.

3.2 default_setting.txt

This file consists of several sections. If you want to change the parameters, it is recommended not to change the values in the file, but to change via "Setting" menu and save it in a new setting file, or edit "setting_old.txt" file if it is. See also "Setting" section. As same as "lansa.ini" file, the title and any comments in the file MUST NOT be changed.

3.2.1 TRIGGER SETTINGS

trigger address : the address in the LeCroy 2551 scaler connected to the trigger source via lemo cable. That is used for a trigger on the software in acquisition process.

trigger threshold : the threshold of the LeCroy 4413 discriminator for external trigger input in mV. Selectable from 0 to 1024.

trigger pulse width : the LeCroy 2323A GDG output width connected to scaler in nsec. LeCroy 2551 scaler requires the width over 7ns (recommended 50ns). Selectable from 0 to 1023×10^7.

3.2.2 CAT SETTINGS

cat mpi : Measure Pulse Interval (MPI) of 1810 CAT in μsec. MPI defines the temporal cycle of one acquisition process. See more detail in 1810 CAT and 1879 TDC manuals.

3.2.3 TDC SETTINGS

See more detail in LeCroy 1879 TDC manual for below parameters.

tdc stop delay : the delay time from external trigger input to issue of TDC stop signal for the LeCroy 2323A GDG (in nsec) - selectable from 0 to 1023×10^7.

tdc delay width : the signal temporal width of the GDG delay output (in nsec) for TDC stop. Required over 50ns.

tdc active bins : the bin number will be used in TDC data memory - selectable from 16 to 512.

tdc bin width : the temporal width of one bin (in nsec) - selectable in 2, 4, 8 and 16 nsec.

tdc compacting parameter (Z) : Selectable between 0 to 15. TDC ignores the edge data if the signal bin size doesn't exceed this parameter in order to remove the burst noise and reduce the data size.

3.2.4 ADC SETTINGS

See more detail in LeCroy 1885F ADC manual for below parameters.

adc threshold : the two thresholds for low and high range mode (in pC) - selectable from 0 to 1638.

adc channel depth : the channel number will be used. From 0 to 96.

adc gate width : the temporal gate width (in nsec) - selectable from 0 to 1023×10^7.

adc delay width : the delay time for Gate signal (in nsec) - selectable from 0 to 1023×10^7.

adc range : the ADC range mode (0: auto range, 1: low range, 2: high range).

3.2.5 CAMAC MODULES

Detail list for LaNSA module.

Array : LaNSA unit (0: TAW, 1: TAPN, 2: TAPW).

Number : the assigned number within the array.

ID : the module ID.

Discri Crate and Slot : the crate and slot number of discriminators for each module.

DLevel : the discriminator level.

TDC Slot and Group : the TDC slot number and group corresponding to the module.

ADC Slot and Group : the ADC slot number and group corresponding to the module.

HV Frame and Ch : the HV frame number and channel corresponding to the module.

HV : the high voltage to the module.

Chapter 4

Initializing

Initializing can be performed via "Initialize" button in Initialize box or "Initialize" item from "Setting" menu. This section describes the initialization of the system.

4.1 During Title window displaying

When "LaNSA.exe" is starting, the program checks whether "ECC_HOST.exe" has already been running and tries to communicate with 4 CAMAC crates.

If "ECC_HOST.exe" isn't executed, the program raises a caution and enters into test mode for just testing of the program or displaying existing data. In test mode, you can't access to CAMAC and fastbus, which means to inhibit to start acquisition.

The inhibition also happens when the CAMAC crate in which LeCroy 2891 Fastbus interface is inserted doesn't reply to ping from the HOST. When the other crates don't reply, the program raises a caution that the array corresponding to the crate will be unavailable. As a default setting, IP address for CAMAC crates are allocated as below.

Crate	Module	IP address
1	TAW discri.	130.246.56.16
2	TAP North discri.	130.246.56.17
3	TAP West discri.	130.246.56.18
4	Controller	130.246.56.15

Table 4.1: CAMAC crate IP address.

When the program confirms that "ECC_HOST.exe" is running and at least two CAMAC crates include control crate have replied, the caption in Status panel in Initializing box changes "required" and "Initialize" button becomes active status.

Now the connection between HÓST PC and CAMAC crate uses Ethernet hub for LaNSA system near the HOST PC in TAP control room via no. 128 BNC cable from LaNSA control tower.

4.2 Initialize system

The initializing is performed with two stages. In the first stage, the program initializes Segment Manager and Interface (SM/I) module in fastbus to enable communication with the fastbus crate to be established.

If it is successful, the program initializes and sets the discriminators, CAT, TDCs and ADCs according to the parameters described in "default_setting.txt" or "setting_old.txt" as a second step. If the program can't find "setting_old.txt", then the file "default_settng.txt" will be read as a default.

The initializing process is recorded in Status window and the final status of each module is displayed in Communication box. If the initialization process is successfully finished, the captions in Status panels in Initializing box and in Acquisition box change "Ready", and "acquire" button in Acquisition box gains active status.

If a situation will arise to need to terminate the initializing cycle for some reason, for example hung up of the fastbus system, you can terminate the cycle from "Force Exit" item in "Setup" menu.

4.3 Communication box

As mentioned above, the status of the modules after initializing process is displayed in the appropriate component in Communication box.

The top 3 panels next to label named each array indicate whether the array is available or not. There are four different status:

Disable means the array can't be used due to failing of initializing.

no TDC means the array can't be use TDC(s).

no ADC means the array can't be use ADC(s).

Enable means the array is able to be used normally.

The next "Status Check" button is used to open Status window. This enables the operator to see the parameters for each module of LaNSA array.

Bottom two Combination boxes indicate the initialized status for CAMAC and Fastbus modules. When you select the module in the box, the status will be displayed in the status panel next to the box.

Chapter 5

Acquisition

When the panel in Acquisition box is "Ready", the acquisition cycle can be started. Before the acquisition, you must choose using arrays and check at least one of active "Combination boxes" in Communication box.

When the acquisition cycle is started, at first the program tries a simple communication test with the fastbus crate to check its status. If the process is successful, the program will wait for a trigger signal by reading a scaler value addressed in system setting with messages in Status window. If the messages don't appear in the Status window, the first of which is "waiting for trigger...", then the fastbus will have frozen. It is then necessary to terminate the cycle using "Force Exit" item in "Acquisition" menu and restart the LaNSA system.

When the messages do appear after detecting the trigger, the program automatically reads the data from the TDCs and the ADCs, saves them, and finally open a data window to show the TDC data. The obtained data can also be read from "Open" item in File menu.

5.1 Shot summary box

When the program automatically saves the data reading from TDC and ADC, the comments in Show Summary box are also saved. It is useful to identify the shot. The available items are below:

Laser : the description of laser system such as 100TW or PW.

Shot number : the assigned shot number.

Laser energy (J) : the laser energy.

Probe : the probe beam energy.

Target : the description of what kind of target is used.

Comments : the any comments in terms of the shot.

The shot summary is never corrected automatically, therefore you should edit suitable value in each panel by yourself. And the comments are saved immediately after the shot, therefore you should edit the comments before the shot. The comments can be edited in the Data window opened to show the TDC data.

5.2 Output file

The output file generated after the acquisition is saved in the same directory with the program. The location and the auto-naming style can be changed from "Acquire as..." window appeared when you select the same name item in Acquisition menu. Note: the change is valid during the execution of the program. The default style of file name is "lansa(dd/mm/yy/xx).txt", here dd is the date, mm the month, yy the year and xx the shot number at the shot.

The file contains several sections: (1) the setting parameters to CAMAC, TDC and ADC. (2) the trigger information, and (3) the TDC and the ADC data. The description style of the setting parameters is same as the setting file such as "default_setting.txt". See subsection 3.2 for more detail.

The trigger information includes the time detects the trigger in a scaler channel and the number of coming trigger during one CAMAC reading cycle (usually 1).

The TDC and ADC data are written in order of the slot number at the fastbus crate. Two data style are available: one type is the hexadecimal value as a raw data of TDC and ADC, other is the series of three integers, group, channel and time data, of each fastbus module. This selection can be also changed in "Acquire as..." window. Note: the change is also valid during the program execution. As a default, the program uses hexadecimal style.

5.3 Data window

A Data window will be opened automatically after the shot or by selecting "Open" item in the File menu.

There are two main windows. Upper window displays a raw data of the TDC timing. Red and blue dots in this window indicate each the leading and

Figure 5.1: Data window.

trailing edges of the TDC signal. The horizontal and vertical axis represent the time and the channel of the selected unit displayed in Array group box.

On the other hand, the lower window shows the temporal spectrum just summed up the raw data of every channel. The spectrum doesn't include the compensation against the temporal variation among each channel and against the random walk of the signal timing. Basically user should measure the timing deviation before or on the experiment using gamma-flush for example. Furthermore this operation program doesn't convert the data into the neutron energy spectrum. For these purposes, "Neutron spectrum conversion" program is provided. See more detail in the software's manual.

5.3.1 File menu

Open : Open and display a new data from file.

Save Ascii Data : Save data in ASCII format (module - channel - time[ns]). When both horizontal and vertical markers are not selected, you can select a save data region (surrounded by black rectangle) by mouse operation.

Save Wave Form : Save temporal spectrum data appeared in Wave Form window as a text file.

Save Graph in File : Save graph image in Time Data window.

Print Form : Print the whole window image on the HOSTPC's default printer.

Close : Close the window.

5.3.2 Graph menu

Enable zoom in and out against temporal axis when the number of the temporal bin is more than 512. In zoom in condition, the graphs become to be able to scroll using the scroll bar at the bottom the Time Data window.

5.3.3 Shot summary

Display the shot summary described in the file on "Shot summary" box. When you edit the summary, you should save the changes from "Summary" menu. You can also reset the changes by "Reset" menu in "Summary" menu.

5.3.4 Array

If the file contains TDC data for two or three arrays, the program displays graph for the data of only one array. The display can be changed to check appropriate radio button named the array you want to see in "Array" box. Selecting the "slot" radio button enables to display single TDC module data.

5.3.5 Marker

Line markers are provided on both windows. "Time" and "Channel" check box enable to display the vertical and horizontal markers on Time Data window. In Wave Form window, only vertical marker is available.

To move the marker, check the radio button in Control box in Marker box to select which marker will be moved. There are three ways to move the selected marker: (a) Input the time in "index" box in Control box in Marker group box, (b) Push or click one of arrow buttons in Control box in Marker group box, and (c) Double click or click and hold left button of mouse on the window at the point where you want to move. The active marker can be chosen by click of right button of mouse.

According to the marker position, the time and channel at the position are displayed in "Position" group box in Marker group box. The expression of time at the vertical marker position can be changed by mouse click at the time indication in Position group box. There are three expressions of time:

(1) Time from start, (2) Time to stop, and (3) Temporal duration between two markers.

Chapter 6

Menus

This chapter indicates the menu items in main window.

6.1 File menu

6.1.1 Open

Open previous shot data. After selecting a file in Open Dialogue, the raw data and temporal spectrum are displayed in a new opened Data window. See subsection 5.3.

6.1.2 Save Log

Choose to save the logs in Status window into text file or not.

6.1.3 Quit

Quit the program. If it is on the way of initialization or acquisition cycle, there are compulsively canceled.

6.2 Acquisition menu

6.2.1 Acquire

Start acquisition. It is equivalent with Start button in the Acquisition box. See section 5.

6.2.2 Acquire as...

Open "Acquire as..." window for the output data file setting.

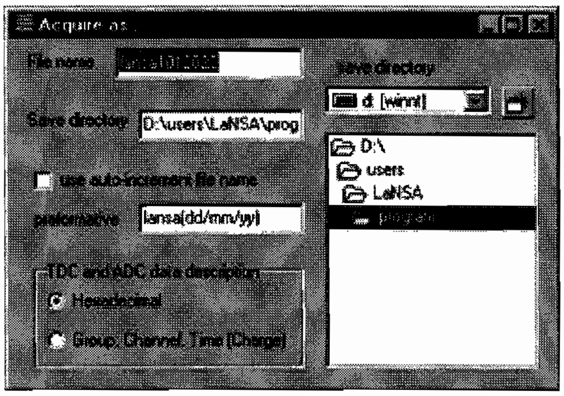


Figure 6.1: Acquire as.. window.

file name : the file name to be saved at next acquisition cycle.

save directory : the directory in where the file will be saved. The directory can be changed using file tree box at the right hand of the window.

use auto-increment name : select to use automatically increment number (from "00") as a output file name. When this option is selected, the program uses prefix described in the prefix edit box to the file name. As a default, the option is not used.

TDC and ADC output description : choose the data description in the output file, hexadecimal or the series of three integers, group, channel and time data.

6.2.3 Get Pedestal

Get pedestal for all ADCs. The obtained data will be automatically saved in "pedestal_old.txt" file and set the pedestal in the pedestal subtraction system of the fastbus.

6.2.4 Pedestal from File

Read pedestal from the chosen file and set the data in pedestal subtraction system of the fastbus.

6.2.5 Force Exit

Force exiting the acquisition process without saving any data. The possible situations to use this command are cancellation of the laser shot or a fastbus freezing.

6.3 System menu

6.3.1 Initialize

Initialize CAMAC and fastbus modules. It is equivalent with pushing "Initialize" button in Initialize box. See section 4.

6.3.2 Setting...

Open 'Setting' window to set CAMAC and fastbus parameters such as discriminator level, TDC timing, ADC delay and so on. See section 7.

6.3.3 Setting from File

Read an old setting file and set the system specification.

6.3.4 Force Exit

Exit compulsively initializing or setting process. The possible situation to use this command is the fastbus freezing.

6.4 Test menu

The program has several testing for CAMAC and fastbus modules to check its status.

6.4.1 CAMAC

Open CAMAC test window to test communication with CAMAC. See section 8.

6.4.2 Trigger

Perform triggering test. Waiting for signal input in a scaler channel addressed by LaNSA.ini file.

6.4.3 FB Mode Scan

Perform fastbus mode scan. Read all manufacture ID of fastbus modules inserted in the fastbus crate.

6.4.4 Fastbus

Open 'Fastbus test' window to test SMI, TDC and ADC. See section 9.

6.4.5 Force Exit

Exit compulsively fastbus test process. The possible situation to use this command is a fastbus freezing.

6.5 Help

6.5.1 Help

Open the help window conformable to Windows standard.

6.5.2 Version

Display current version of the program.

Chapter 7

Setting window

This section explains about the setting window. If some of these parameters are changed, reinitializing is needed. In this situation the program asks you whether to perform reinitializing immediately soon or not, when the window is closed.

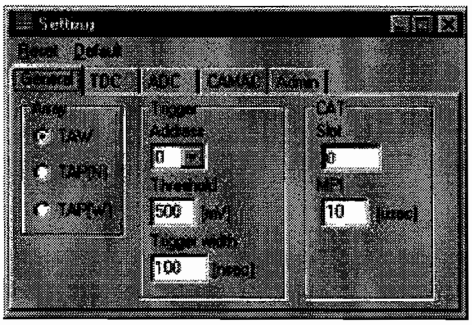
The setting can be changed for each array unit except with the timing control and the threshold setting of ADC. To select the unit to edit the settings, choose the radio button in Array box in General Tab.

When Setting window is opened, the current parameters are displayed in the appropriate boxes in each window tab.

In the top of the window, there are two menus, one is "Reset" which enables to reset the any changes and other "Default" which read "default_setting.txt" and set the parameter according to the file.

7.1 General Tab

Set general parameters.



7.1.1 Array

Choose to display the setting for the selected array in Array box. When the array is changed, the displayed parameters are changed according the current setting.

7.1.2 Trigger

Address : Select an address of scaler using as a trigger in the program. The address should be connected to one of LeCroy 2323A GDG channels.

Threshold : Threshold for external trigger input to LeCroy 4413 Discriminator.

Trigger width : Time width of LeCroy 2323A GDG output to scaler. The value should be more than 50 nsec.

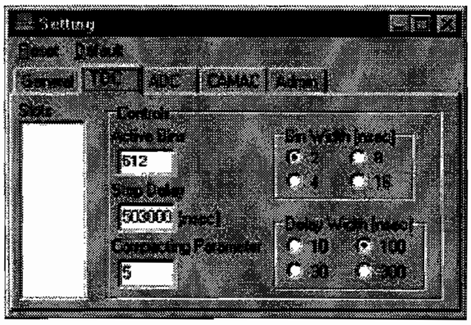
7.1.3 CAT

Slot : Read-only panel to display CAT slot number in the fastbus crate.

MPI : Measure Pulse Interval. Fastbus modules are re-clocked after MPI in when the modules are rocked. See also 1810 CAT manual.

7.2 TDC Tab

Set TDC parameters. See 1879 TDC manual to know the detail about each parameters.



7.2.1 Slots

Read-only panel to display slot number of TDCs for selected array in the fastbus crate.

7.2.2 Controls

Active Bins : TDC Active Bin Number.

Stop Delay : Delay time of LeCroy 2323A GDG output connected to TDC stop on 1810 CAT.

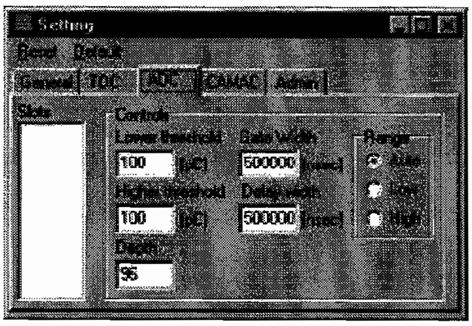
Compacting Parameter : TDC Compacting Parameter.

Bin Width : TDC Bin Width. Due to latching mode specification of TDC, actual time resolution is the half of this setting.

Delay Width : Temporal width of LeCroy 2323A GDG output connected to TDC stop on 1810 CAT.

7.3 ADC Tab

Set ADC parameters. See 1885 ADC manual to know the detail about each parameters.



7.3.1 Slots

Read-only panel to display slot number of ADCs in the fastbus crate.

7.3.2 Controls

Lower threshold : Threshold for low range mode of ADC.

Higher threshold : Threshold for high range mode of ADC.

Depth : ADC active bin depth.

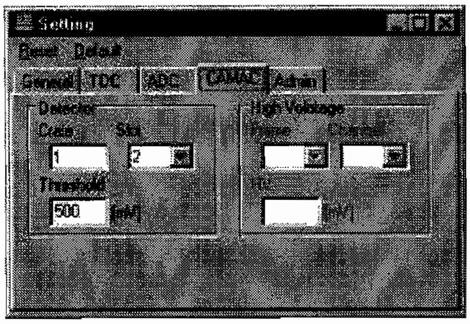
Gate Width : Open gate time of LeCroy 2323A GDG output connected to ADC gate on 1810 CAT.

Delay Width : Delay time of LeCroy 2323A GDG output connected to start input of the other channel of GDG using a gate width of ADC.

Range : ADC range mode.

7.4 CAMAC Tab

Set other CAMAC parameters. See 4413 Discriminator manual to know the detail about each parameters.



7.4.1 Detector

Setting for the discriminators. Crate and Slot are position of LeCroy 4413 Discriminator for the selected array in General Tab. Threshold is its threshold value.

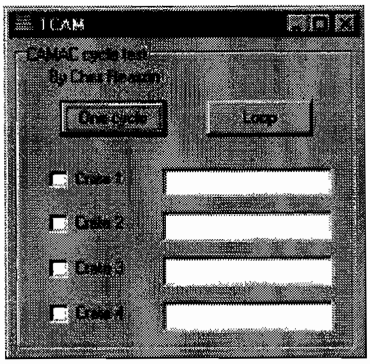
7.4.2 High Voltage

Remote mode only. HV is the high voltage value selected Frame and Channel combination box.

Chapter 8

CAMAC test window

Perform CAMAC communication test.



Select test crates by checking the box. This test accesses the Gateway module in the crate and transfers some integer value to light up the display lamps. IMPORTANT: Don't select inactive crate in Communication box.

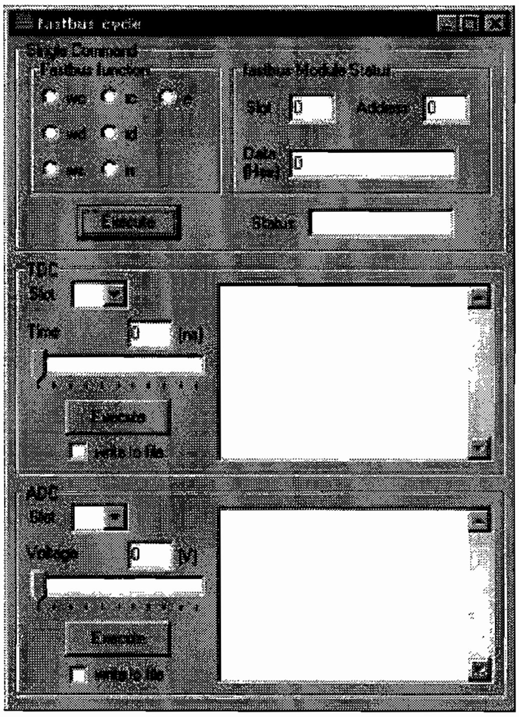
If the "One cycle" button is clicked, a single data transfer occurs and the values are displayed in the panel next to the label of each crate.

If the "Loop" button is clicked, continue to transfer the auto-increment value, therefore Gateway module flushes like a tote broad.

Chapter 9

Fastbus test window

Perform Fastbus testing. It requires to be completed system initializing before the test. Three tests are provided: for SM/I, TDC, and ADC.



9.1 Single Command

Perform a single command to SM/I. The procedures are:

1. Select a command in "Fastbus function" box.
2. Input the slot and address of the target module in "Fastbus Module Status" box. If writing command, "Data" should be also inputted.
3. Click "Execute" button. Then the status will be displayed in Status panel, and reading data will be also displayed if the reading command is selected.

The provided commands are

wc Write to Control Space Register (CSR) of a fastbus module.

wd Write to Data Space Register (DSR) of a fastbus module.

ws Write to SM/I buffer.

rc Read from CSR of a fastbus module.

rd Read from DSR of a fastbus module.

rs Read from SM/I buffer.

e Execute EXEC21.

See more details in 1821 SM/I manual.

9.2 TDC

Perform a test to read the trailing edge of the TDC data. See also LeCroy 1879 TDC users manual for more details.

To carry out the test, it is necessary to disconnect all cables on the test TDC module. The test processes are

1. Select a slot number for testing TDC module.
2. Enter the trailing edge timing in Time panel or move the slide bar.
3. Click "Execute" button, then start the test and the results are displayed in the Status window.

If "write to file" box is checked before the starting of the test, the results will be also written in "TDC_test.txt" file in the same directory of the program.

9.3 ADC

Perform testing to read the collecting charge on ADC. See also LeCroy 1885 ADC users manual for more details.

To carry out the test, it is necessary to disconnect all cables on test ADC module. The test processes are

1. Select a slot number for testing ADC module.
2. Enter the voltage in Voltage panel or move the slide bar. Note: Voltage [mV] = 2.44 × Charge [pC].
3. Click "Execute" button to start the test and then the results are displayed in the Status window.

If "write to file" box is checked before the starting of the test, the results will be also written in "ADC_test.txt" file in the same directory of the program.

Appendix A

LaNSA electronics

In this section, the workflow pattern is explained how the electronics system of LaNSA detects a neutron signal. In particular, it is important to know the path of a signal from the PMT to the PC and the mechanism of the trigger system for maintenance of the system.

A.1 Neutron signal flow

Figure A.1 shows the flow chart of the system.

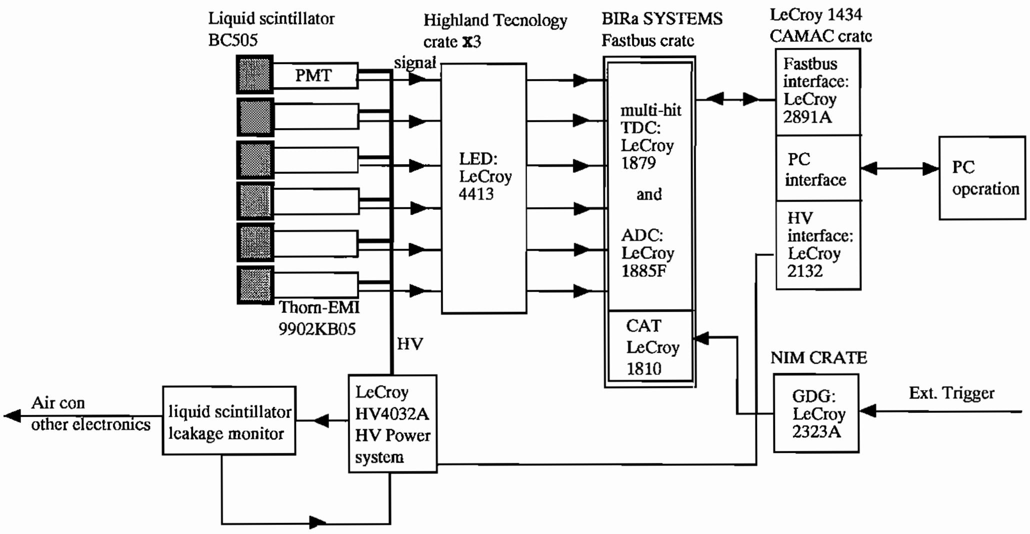


Figure A.1: Neutron detection system chart diagram.

The signal detected at a scintillator is amplified at photomultiplier tube(PMT) and transferred to Leading-Edge Discriminator (LED) via a lemo cable. When the signal level is exceed to the preset level in LED, the LED generates a sharp-edge signal in this timing and it is brought into Time-to-Digital Converter (TDC) on the fastbus crate via a ribbon cable. TDC can record the signal input timing until TDC stop signal coming from one channel of Gate/Delay Generator (GDG) operated with an external trigger. The LED can also bring the analog signal to Analog-to-Digital Converter (ADC). These signals are collected in the HOST PC via ethernet interface on CAMAC crate. Then the signal timings recorded in each TDC can be converted into the neutron spectrum using TOF method.

A.2 Trigger system

As described in Figure A.1, the system uses external trigger as its clock. The system uses 4 different timing signal divided from the trigger: (1) for Scaler as a software trigger, (2) for TDC stop delay, (3) for ADC gate delay, and (4) for ADC gate width. The accurate timing for these has to be measured before the each experiment. The general guidelines are

(1) : The software will start reading the data immediately after getting a trigger from the Scaler independently of the fastbus status. Therefore enough delay time should be chosen, e.g. 5 μsec. The pulse width should be over 50 nsec. for the safety detection of the trigger.

(2) : The maximum time window of TDC is only about 1 μsec. The accuracy of the delay time should be within 50 nsec. The pulse width must be over 100 nsec. from TDC requirement. Note TDC stop stops the acquisition cycle, therefore the stop pulse must be generated after neutron signals will be detected at TDC.

(3) and (4) : ADC will open its gate according the input pulse width in gate input on 1810 CAT. ADC gate delay is used to delay the start timing of ADC gate pulse in the system.

The external trigger is directly taken from prompt trigger distribution box in TAP chamber room to LaNSA control tower. Since the time delay from the prompt trigger to the timing of TDC stop may be about 1ns, the user should measure the exact timing using an oscilloscope for each experiment.

IMPORTANT: All signal outputs MUST be NIM level.

CAUTION: In original configures of the system, the external trigger clocks 4 channels of 2 LeCroy 2142 Dual Gate and Delay Generator. However as the current status (), the external trigger is divided in 4 channel using a DG535 pulse generator due to the fail of one 2142 module. Therefore the user who want to use TDC and ADC at the same time should adjust the timing by hand using DG535 or any other pulse generator.

A.3 High Voltage mode

As mentioned in section 3.1, the HV mode can be selected in "LaNSA.ini" file. The user must also select the mode by switch on the HV units as shown in Fig. 2.4.

The connections to HV input of detector PMT are in the rear side of HV unit. These connectors in one unit correspond to the channel 00 to 31.

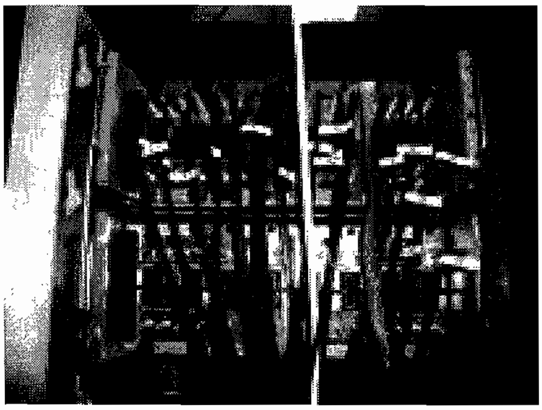


Figure A.2: Rear side view of the high voltage units.

Upper connectors are assigned 00 to 17 from left to right, on the other hand lower are assigned 18 to 31 "from right to left".

Appendix B

Importing files

Example of "LaNSA.ini" and the contents of "default_setting.txt" file.

B.1 LaNSA.ini

```
[lansa]
inidir = d:\users\LaNSA\program\
debug = 0
remotehv = 0
initdc = 1
iniadc = 1
iniped = 0

[camac]
// branch number
ibrnc = 0
// LeCroy 2891 Fastbus Interface
crat_FBI = 2
slot_FBI = 22
// LeCroy 4413 Discriminator for Trigger
crat_DIS = 2
slot_DIS = 10
// LeCroy 2551 Scaler for Trigger
crat_SCR = 2
slot_SCR = 14
// LeCroy 2132 High Voltage Interface
crat_HVI = 2
slot_HVI = 3
// LeCroy 2323A Dual Gate and Delay Generator for Trigger
crat_GDG_TRG = 2
slot_GDG_TRG = 19
addr_GDG_TRG = 0
gate_GDG_TRG = 100
// LeCroy 2323A Dual Gate and Delay Generator for TDC
crat_GDG_TDC = 2
slot_GDG_TDC = 19
addr_GDG_TDC = 1
// LeCroy 2323A Dual Gate and Delay Generator for ADC delay and gate width
crat_GDG_ADC_D = 2
slot_GDG_ADC_D = 16
```

```
addr_GDG_ADC_D = 0
crat_GDG_ADC_G = 2
slot_GDG_ADC_G = 16
addr_GDG_ADC_G = 1
```

B.2 default_setting.txt

```
{* TRIGGER SETTINGS *}
trigger address
0
trigger threshold [mV]
500
trigger pulse width [nsec]
200

{* CAT SETTINGS *}
cat mpi [usec]
10

{* TDC SETTINGS *}
tdc stop delay [nsec]
1000
tdc delay width [nsec]
100
tdc active bins
512
tdc bin width [nsec]
2
tdc compacting parameter (Z)
5

{* ADC SETTINGS *}
adc threshold (low range, high range) [pC]
100 100
adc channel depth
96
adc gate width [nsec]
1000
adc delay width [nsec]
100
adc range (0: auto range, 1: low range, 2: high range)
0

{* CAMAC MODULES *}
Array Number ID Discri Discri DLevel TDC TDC ADC ADC HV HV HV
# Crate Slot [mV] Slot Group Slot Group Frame Ch [V]
0 0 30 1 2 500 20 0 19 0 0 0 1000
0 1 56 1 3 500 20 1 19 1 0 1 880
0 2 48 1 4 500 20 2 19 2 0 2 1000
0 3 61 1 5 500 20 3 19 3 0 3 800
0 4 4 1 6 500 20 4 19 4 0 4 1000
0 5 57 1 7 500 20 5 19 5 0 5 1050
0 6 45 1 8 500 18 0 17 0 0 6 950
0 7 34 1 9 500 18 1 17 1 0 7 940
0 8 37 1 10 500 18 2 17 2 0 8 915
0 9 40 1 11 500 18 3 17 3 0 9 1000
0 10 22 1 12 500 18 4 17 4 0 10 1120
```

```
0 11 25 1 13 500 18 5 17 5 0 11 950
0 12 26 1 14 500 16 0 15 0 0 12 950
0 13 53 1 15 500 16 1 15 1 0 13 1047
0 14 35 1 16 500 16 2 15 2 0 14 920
0 15 59 1 17 500 16 3 15 3 0 15 700
0 16 17 1 18 500 16 4 15 4 0 16 1070
0 17 10 1 19 500 16 5 15 5 0 17 1010
1 0 32 3 2 500 14 0 13 0 0 18 1000
1 1 33 3 3 500 14 1 13 1 0 19 1000
1 2 55 3 4 500 14 2 13 2 0 20 1000
1 3 42 3 5 500 14 3 13 3 0 21 1000
1 4 63 3 6 500 14 4 13 4 0 22 1300
1 5 13 3 7 500 14 5 13 5 0 23 1060
1 6 8 3 8 500 12 0 11 0 0 24 1070
1 7 21 3 9 500 12 1 11 1 0 25 1000
1 8 36 3 10 500 12 2 11 2 0 26 1270
1 9 9 3 11 500 12 3 11 3 0 27 1160
1 10 49 3 12 500 12 4 11 4 0 28 1140
1 11 19 3 13 500 12 5 11 5 0 29 1070
1 12 3 3 14 500 10 0 9 0 0 30 1180
1 13 5 3 15 500 10 1 9 1 0 31 1170
1 14 46 3 16 500 10 2 9 2 1 0 1100
1 15 29 3 17 500 10 3 9 3 1 1 1140
2 0 14 4 2 500 8 0 7 0 1 2 800
2 1 18 4 3 500 8 1 7 1 1 3 1000
2 2 44 4 4 500 8 2 7 2 1 4 1120
2 3 11 4 5 500 8 3 7 3 1 5 1000
2 4 50 4 6 500 8 4 7 4 1 6 1160
2 5 6 4 7 500 8 5 7 5 1 7 1110
2 6 51 4 8 500 6 0 5 0 1 8 1090
2 7 47 4 9 500 6 1 5 1 1 9 1150
2 8 24 4 10 500 6 2 5 2 1 10 1100
2 9 15 4 11 500 6 3 5 3 1 11 1010
2 10 2 4 12 500 6 4 5 4 1 12 1050
2 11 54 4 13 500 6 5 5 5 1 13 1170
2 12 43 4 14 500 4 0 3 0 1 14 1160
2 13 41 4 15 500 4 1 3 1 1 15 1170
2 14 52 4 16 500 4 2 3 2 1 16 1020
2 15 31 4 17 500 4 3 3 3 1 17 1020
```

Appendix C

Programs

LaNSA operation program consists of below files.

LaNSA.dpr & .res		- Project file and the resource.
Main program	LaNSA_RAL.pas & .dfm	- Main program
Initial check of system	Title.pas & .dfm LaNSA_WINAPI.pas	- Title roll and check the electronics status. - routines using exported Windows API
Basic Functions for CAMAC and Fastbus system	CAMAC.pas FB_prim.pas fastb21.pas	- CAMAC operating and numeric procedures - routines for Fastbus primitive operation - routines supplied by LeCroy (translation of fastb21.f)
Operation Functions for CAMAC and FB modules	CAMAC_advance.pas FB_advance.pas	- routines for CAMAC module operations - routines for Fastbus module operation
Operation tools	STATUS_CHECK.pas & .dfm DISPLAY_DATA.pas & .dfm settings.pas & .dfm Test_fastbus.pas & .dfm TCAMUnit.pas & .dfm Acqureas.pas & .dfm Version.pas & .dfm	- Status check to each module - Display Acquired TDC data - Change LaNSA settings (TDC etc.) - Test for Fastbus - Test for CAMAC - Acquisition options - Display version information

Table C.1: Software files.

LaNSA.dpr is project file to manage the software like a main() function in C.

Main program file is "LaNSA_RAL.pas" and its form file, which is main window of the software.

As mentioned in subsection 2.2.3, the program check to prepare running the programme using windows APIs not supported directly in Delphi.

Basic functions supply basic routines for CAMAC and Fastbus systems to communicate and transport the Data between PC and the electronics.

High-level functions supply operational functions for each CAMAC and Fastbus modules such as Discriminator, TDC, ADC and so on.

Operation tools provide wide range of software services such as display of TDC data, module parameter setting, Tests, etc.

See more detail in LaNSA programmer's manual.