Local Guide to the PHOS/EMCAL APD Bias Control (PABC) software

Version 4

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Abbrevations

APD	= Avalanche Photo Diode
CSP	= Charge Sensitive Pre-amplifier
DCS	= Detector Control System
DCS card	= Detector Control System card
DID	= DIM Information Display
DIM	= Distributed Information Managment
DIM_DNS	= DIM Dynamic Name Server
FEE	= Front End Electronics
FEEC	= Front End Electronics Card
GUI	= Graphical User Interface
HV	= High Voltage
LV	= Low Voltage
PABC	= Phos APD Bias Control
PC	= Personal Computer
PHOS	= Photon Spectrometer
RCU	= Readout Control Unit

Chapter 1

Introduction

This is the User Manual for the PHOS APD Bias Control (PABC) Front End Electronics FEE configuration software. The PABC GUI interacts graphically directly with the software libraries that will be used for ALICE/PHOS DCS in the LHC. The communication with the PHOS detector is based on DIM.

The PHOS DCS software is separated in two parts. The Configuration part and the monitoring part. This manual covers the FEE configuration part.

The PHOS DCS FEE configuration software package consists of standalone C++ classes to configure the PHOS FEE and a graphical C++ layer to interact graphically with these classes. The graphical software layer and the configuration software layer is completely separated so that the FEE configuration software can be interfaced either from the PABC GUI, from PVSS, from the command line, or from any other program.

The PABC GUI is intended for commissioning and calibration of the PHOS detector. For the final system the interaction with the PHOS DCS software will be via PVSS. The PABC GUI however is made in ROOT. The reason for the decision of making this GUI in ROOT and not in PVSS was that the requirements for commissioning and calibration is different from the requirements in the final system. More specific one needs much more detailed control of the configuration during calibration and commissioning than during physics data taking.

1.1 Terms, Items and definitions

1.1.1 The Readout Control Unit (RCU)

The RCU is responsible for reading out the front end electronics. The RCUs is situated just outside the PHOS module and is connected to 28 front end cards situate inside the module. A total of four RCUs is necessary in order to read out one PHOS module. Before reading out data the RCU must know which channels to read out, the front end cards must

know how many samples to take for each event/trigger. In addition the PHOS Monitoring and Safety Module (PCM) of each of the cards must know which APD bias DAC settings to apply. The configuration of the FEECs is the responsibility of the RCU. The RCU receives the FEE configuration from the PABC GUI via a DIM server (feeserver) running on the DCS card and it is the responsibility of the RCU to apply these settings to the electronics.

1.1.2 DCS card

The DCS card is a mezzanine card that is connected directly to the RCU. The task of the DCS card is to configure the RCU, to tell the RCU which trigger input to use etc and to give the RCU the configuration of the FEE. The DCS card includes a FPGA with an embedded arm processor. The arm processor on the FPGA runs under a Linux operating system (Busy Box). This makes it possible to communicate with the DCS card via Ethernet. From the point of view of the network the DCS card looks like any other PC.

1.1.3 Distributed Information Management DIM

Most of the information given about DIM in this section is taken unmodified from [1]. The PHOS DCS software is based on DIM. DIM was developed at CERN for the Delphi experiment and is widely used in several other experiments at CERN. DIM, like most communication systems, is based on the client/server paradigm.

The basic concept in the DIM approach is the concept of "service". Servers provide services to clients. A service is normally a set of data (of any type or size) and it is recognized by a name - "named services". The name space for services is free. Services are normally requested by the client only once (at startup) and they are subsequently automatically updated by the server either at regular time intervals or whenever the conditions change (according to the type of service requested by the client). The client updating mechanism can be of two types, either by executing a callback routine or by updating a client buffer with the new set of data, or both. In fact this last type works as if the clients maintain a copy of the server's data in cache, the cache coherence being assured by the server.

1.1.4 The DIM DNS server

In order to allow for transparency. as well as to allow for easy recovery from crashes and migration of servers, a name server is used. Servers "publish" their services by registering them with the name server (normally once, at startup). Clients "subscribe" to services by asking the name server which server provides the service and then contacting the server directly, providing the type of service and the type of update as parameters. The name

server keeps an up-to-date directory of all the servers and services available in the system. Figure 1.1 shows how DIM components (Servers, Clients and the Name Server) interact. Whenever one of the processes (a server or even the name server) in the system crashes or dies all processes connected to it will be notified and will reconnect as soon as it comes back to life. This feature not only allows for an easy recovery, it also allows for the easy migration of a server from one machine to another (by stopping it in the first machine and starting it in the second one), and so for the possibility of balancing the machine load of the different workstations.

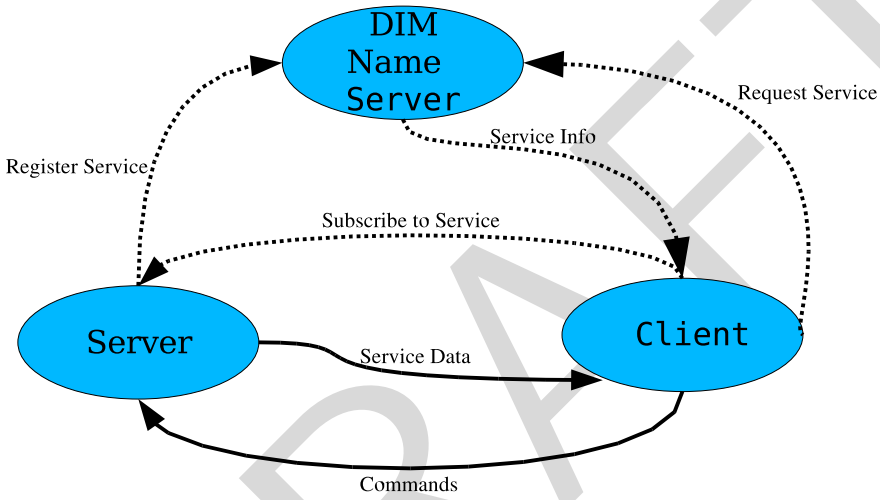

Figure 1.1: Communication via DIM

1.1.5 The Feeserver

The feeserver consist of a DIM server and a software package specific to PHOS. The PHOS specific software is called the Control Engine (CE) and contains several services specific to PHOS. One such service is for instance to run scripts on the DCS card.

The DIM server and the CE combined is called a feeserver. The feeserver runs on the DCS cards and takes commands from the feeclient (the PABC GUI) running on a PC, and sends the results of various commands back to the PABC GUI.

1.1.6 The Control Engine (CE)

The control engine (CE) runs on the DCS cards an is a part of the feeserver software. The CE interprets the content of data sent via DIM and also provides service data to the feeclient (for instance temperatures of the electronics). In addition the CE takes care of the communication between the RCU and the front end electronics.

1.1.7 The Feeclient

The feeclient is a DIM client with some additional functionality. There is also a PHOS version of this client. In the DCS software this client is called the PhosFeeClient. From now on we will refer to this client as the feeclient.

1.2 The PHOS DCS infrastructure

Figure 1.2 shows schematically the communication infrastructure for a single PHOS module. When the feeserver on one of the four DCS cards starts it automatically register itself and its services on the DIM DNS server. When the PABC GUI starts up it automatically starts a feeclient that communicates with theese feeservers. There is only one such client in the system. The client requests services from the feeservers running on the DCS cards by contacting the DIM DNS node. The DIM DNS node replies by giving the service information to the client. Thereafter the client and the servers communicates directly, independently of the DIM DNS node.

There is four readout partitions on a single module. Correspondingly it is indicated a one to four relationship between the feeclient and the feeserver. The Figure would have looked almost the same if there were more than one, lets say N PHOS modules except that there would have been a one to Nx4 relationship between the feeclient and the feeserver. No matter the number of PHOS modules there will never be more than one[1] feeclient to the feeservers.

Once the communication chain is established the user can send commands to the RCU and the FEE via the feeservers. The feeclient can also receive service data. Such service data might for instance be temperatures, voltages, and currents of the front end cards.

[1] Unless you start the PABC GUI from more than one terminal

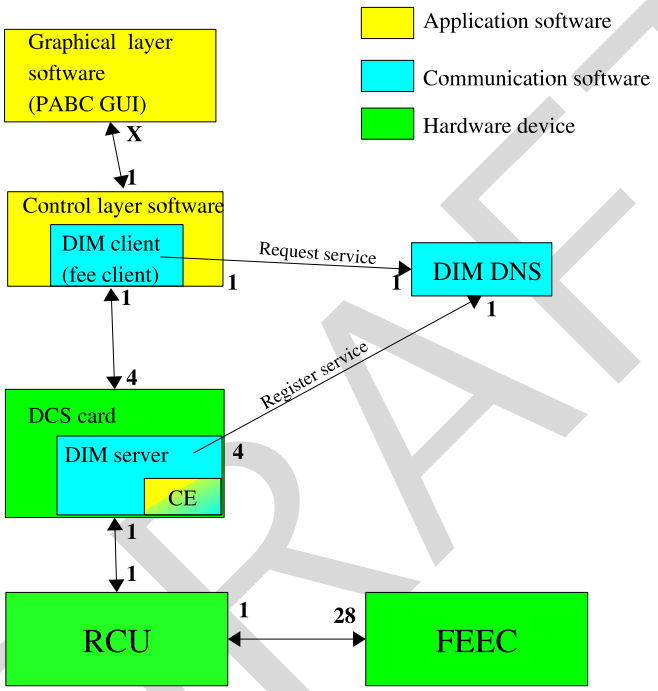

Figure 1.2: The PHOS DCS Communication infrastructure via DIM for a single PHOS module.

Chapter 2

Setting up the APD bias control from scratch

This chapter explains how to set up the communication chain for the PHOS APD bias control from scratch. If the the communication chain already works the procedures in this chapter are not necessary. To set up the communication chain requires several steps listed below. The steps must be done in the given order.

1. Ramp down HV for the front end electronics.
2. Ramp down LV for the front end electronics.
3. Turn off the voltage for the RCU/DCS.
4. Turn on the voltage for the RCU/DCS.
5. Reboot the PC that will run the DIM_DNS server + the PABC +DID
6. Make sure that the DIM DNS node is running.
7. Start the DID information display (optional)
8. Make sure that a feeserver is running on each of the DCS cards.
9. Start a feeclient that communicates with the feeservers on the (This will be the PABC GUI).
10. Ramp up LV for the front end electronics.
11. Make sure the the LV for the CSP preamplifiers are ON[1].

[1]The reason is that the voltage for the DACs holding the APD bias settings is derived from the 13.7 Voltage for the CSPs

12. Apply APD configuration.
13. Ramp up HV for the front end electronics.

If you want to apply new APD settings to the electronics it must be done **before** ramping up the HV for the APDs. Otherwise the HV power-supply can trip

Steps that are governed by the PABC software will be explained below. Turning on/off voltages etc will not be explained. There are in addition several other steps necessary to get a full communication chain working. These steps are done automatically provided that you use the following PC and DCS cards.

- The DIM DNS node, and the DID information display runs on the PC *alphspcdcs01.cern.ch* under user **phos**
- The DIM servers runs on the DCS cards, all as user root. Which DCS cards to use is subjected to changes. The currently mounted DCS/RCUs are listed below.

alphsdcs0060.cern.ch	#DIM name **alphsdcs0060**
alphsdcs0279.cern.ch	#DIM name **alphsdcs0279**
alphsdcs0281.cern.ch	#DIM name **alphsdcs0281**
alphsdcs0282.cern.ch	#DIM name **alphsdcs0282**

- The PABC GUI runs on the PC

  alphspcdcs01.cern.ch

If you want to use different DCS cards than the the ones listed above please contact the author at *perthi@fys.uio.no*.

2.1 Preparing to start from scratch

Reboot alphspcdcs01 In order to make sure that there are no background processes that can cause trouble, if you are not already logged in then log in either via the network or directly to the PC.

- Turn off the power for the DCS cards
- Reboot *alphspcdcs01*

  From the network

```
[any machine]  > ssh phos@alphspcdcs01.cern.ch

[any machine]  > username: phos

 phos@alphspcdcs01's password: > password: phosbeamtest

[alphspcdcs01] /home/phos > reboot
```

Directly on the PC

```
user: phos

username: phosbeamtest

[alphspcdcs01] /home/phos > reboot
```

Please note that you will lose the connection to *alphspcdcs01* when you reboot.

- Reboot the DCS cards *alphsdcs0060, 0279, 0281, 0282* by turning ON the power.

2.2 Starting the DIM name server

The DIM DNS node should start up automatically when rebooting *alphspcdcs01.cern.ch*. If you really want to make sure that the DNS node is running go to Chapter 4.12.

2.3 Starting the DIM Information Display (optional)

The DIM Information Display (DID)is not mandatory but a very useful tool for debugging and monitoring of the DIM communication. It can run on *alphspcdcs01* or any other machine that has the necessary software and environment. Note that on some occasions the DID will crash when run remotely due to a bug in DID. If this happens you can run it directly on *alphspcdcs01*. To start DID do the following.

```
[any machine ~] >  ssh -X phos@alphspcdcs01.cern.ch

 phos@alphspcdcs01's password: phosbeamtest

[alphspcdcs01] /home/phos > . dcs_cern.sh        ##sets up the enviroment

[alphspcdcs01] /home/phos > did
```

Now the DID information display will show up. To view all available servers select "View" from the menu and then "all servers". It is useful to also select from the menu "Commands" and then "Set Debug On". Currently the display will only show one server, the DIM DNS name server.

2.4 Starting the DIM servers on the DCS cards

If the DCS cards are mounted on the dedicated private network on the PHOS DCS gateway (*alphspcdcs01.cern.ch*) then the feeservers should start automatically when the DCS cards are powered on. If the DCS cards are accessible on the CERN network then the feeservers must be started manually. In the latter case the procedure described in this section must be repeated for the four DCS cards *alphsdcs0060, 0279, 0281, 0282.*

The procedure will be shown only for *alphsdcs0279.cern.ch.* The procedure is identical for *alphsdcs0060.cern.ch, 0279, 0281, 0282.*

To start the DIM servers do the following.

```
[any machine ~] > ssh root@alphsdcs0279.cern.ch

root@alphsdcs0279's password: dcs

alphsdcs0279:\$ ./home/phos/feeserver_start.sh
```

After all the four DIM servers are started you should see five servers in the DID information display. One server is the DIM DNS node, and the other four are the servers running on the DCS cards. The DID display should look as shown in Figure 2.1.

2.5 Starting the APD GUI (The DIM client)

To start the PABC bias control GUI do the following.

```
[any machine ~] >  ssh phos@alphspcdcs01.cern.ch

phos@alphspcdcs01's password: phosbeamtest

[alphspcdcs01] /home/phos > . dcs_cern.sh        ##sets up the enviroment
```

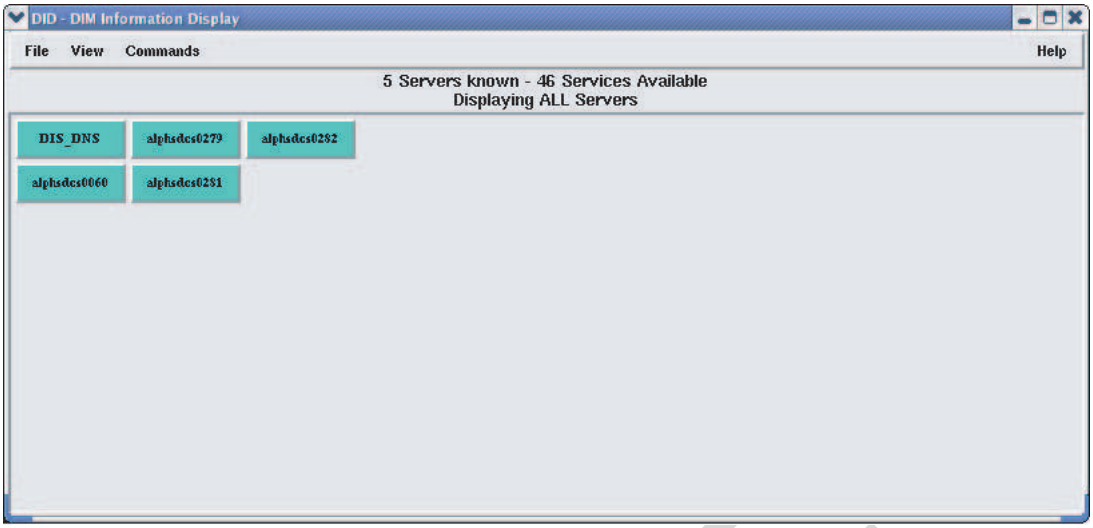

Figure 2.1: The DIM Information Display (DID).

```
[alphspcdcs01] /home/phos > cd phos_dcs

[alphspcdcs01] /home/phos > apdgui
```

Chapter 3

Using the PABC Graphical User Interface (apdgui)

This chapter gives an explanation on how to use the various options of the APD bias control GUI. It is assumed that the communication chain is already set up and working.

3.1 Starting the PABC Graphical User interface

Log in to *alphspcdcs01.cern.ch* with user **phos** and password **phosbeamtest**. Make sure that the feeservers and the DIM DNS server are running (see Chapter 2.2 and 4.9 for details). Before starting the PABC GUI you must set up the environment variables.

```
[alphspcdcs01] /home/phos > . dcs_cern.sh
```

To start the GUI do

```
[alphspcdcs01] /home/phos > cd phos_dcs/
[alphspcdcs01] /home/phos/phos_dcs > apdgui
```

3.2 Actions of the PABC program at startup

When the PABC is started (see section 2.5) it performs the following actions.

- It initializes a feeclient.
- It to establish contact with DIM DNS server and asks for the services of the feeservers running on the DCS cards, it will use the DIM DNS server defined in the setup script **dcs_cern.sh** the folder */home/phos*.
- It attemts to establish contact with the feeservers.

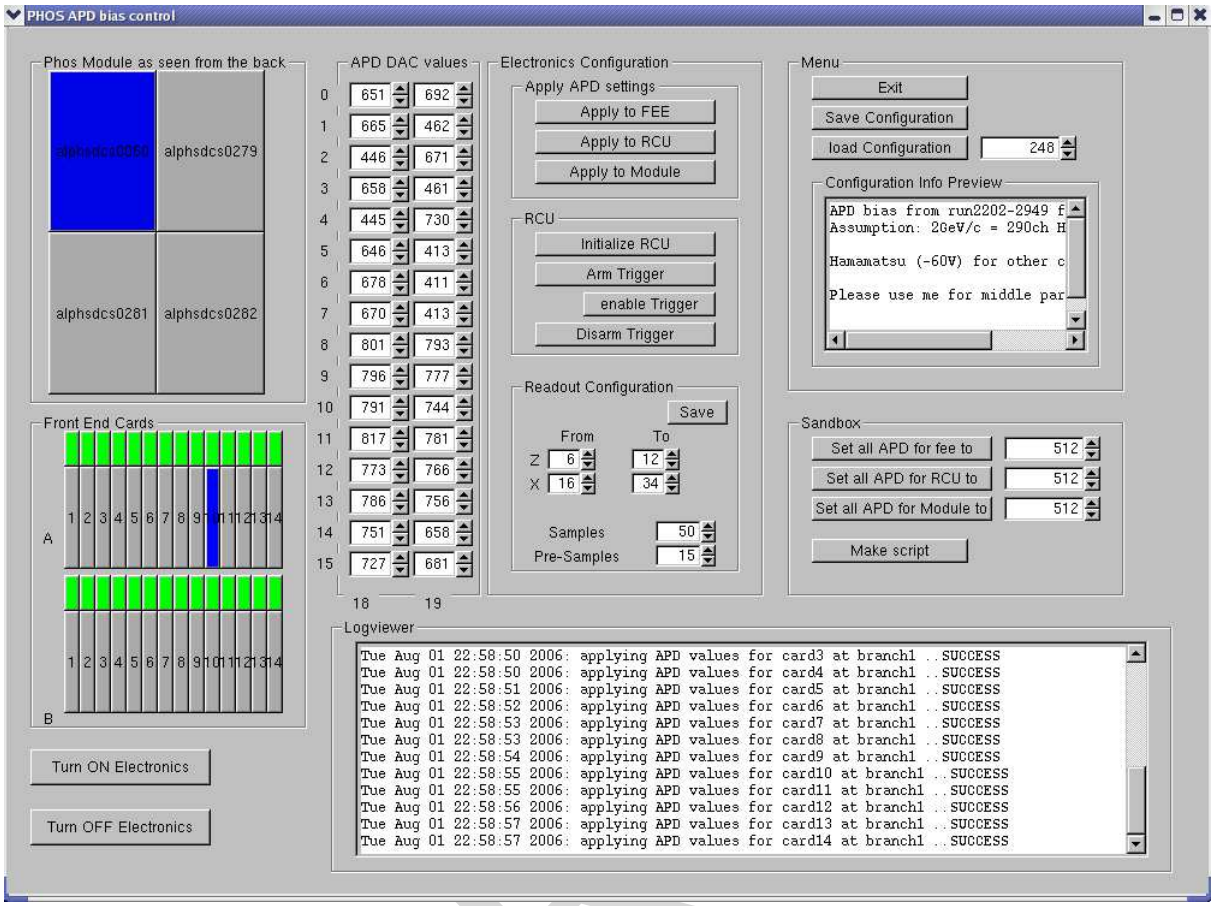

Figure 3.1: The PABC Graphical User Interface (GUI)

- It loads the latest configuration of the APD bias settings from the folder */home/phos/data/ConfigurationFiles*
- It puts a copy of the latest configuration in to the folder */home/phos/data/APD_settings*.
- It loads the values from */home/phos/data/APD_settings* into the GUI to display it to the user.

3.3 The PABC GUI User menus and their actions

The PABC user panel has a number of different buttons to manipulate the APD configuration and apply it to the FEECs. In addition it is possible to reset the RCU and to configure which crystals to read out during data taking.

The user actions are separated into several Menu groups. Different menu groups have different domains of actions. The available menu groups and their domain of actions is explained below. A detailed description is given in the following sub chapters.

- **Menu:** This is the main menu that deals with the interaction with the database. It loads configurations from the database into the local working directory and saves configuration from the local directory to the database.

- **Sandbox:** The word *sandbox* refers to your local playground. Actions in this menu group only applies to files in the local working directory */home/phos/data/APD_settings*.

- **Electronics Configuration:** This the menu that interacts directly with the electronics. It has several sub-menus.

  Apply APD settings: Applies the settings in the local working directory to the electronics. Please note that applying the settings to the electronics does not store the data in the database. If you want to save the settings that was applied, use the save configuration button in the Main menu.

  RCU: Menu to reset RCUs and to configure trigger settings.

  Readout Configuration: Menu to select readout region.

3.3.1 Menu: Phos Module as seen from the back

The PHOS module is divided into four readout partitions. The name of the partitions is identical to the DIM name of the feeserver used to communicate with that partition. At the startup of the GUI the color of all the RCU partitions will be grey which means that no RCU is selected. The user selects one of the RCUs by a single click with the mouse. Clicking one of the RCU partition buttons of the PHOS Module will perform the following actions:

- The PABC will contact the feeeserver(DIM server) controlling that readout partition and ask for the active front end card list of selected RCU.

- The PABC will try to contact all the cards marked as active and if contact is established, it sets the state of the corresponding FEEC to ON. If contact is not established the state is set to unknown (grey).

- The color of the selected RCU will be set to blue.

After all the FEECs in the active front-end card list of the selected RCU is accessed the GUI will draw all the FEECs of the currently selected RCU on the bottom left of the GUI. Please note that it will take several seconds for the PABC to probe all cards.

3.3.2 Menu: Front End Cards

One front-end card consists of two parts. One small button to turn on or off the card, and one long button to select the card in order to configure the APD settings. The "Front end card" menu shows all the FEECs for the currently selected RCU.

The ON/OFF button By clicking on the ON/OFF button the user can turn the card ON or OFF. The color of this button indicates the state of the card. A click on the button will turn the card OFF if it is already ON, otherwise it will be turned ON provided that the PABC is able to contact the card. The meaning of the various colors of the ON/OFF button is explained below.

- *Grey*: The state is unknown. It means that The RCU did not manage to contact the card or that the RCU has been reseted. If the RCU has just been reseted (from the GUI) then all cards will be grey.
- *White*: The card is present, but power is OFF.
- *Green*: The card is ON and ready to take commands from DCS.
- *Red*: The card is in the state ERROR.

Please note that the status of the cards are only updated on selection of an RCU or when the ON/OFF buttons are clicked. If one has interacted with the corresponding DCS card manually by for instance running scripts on the command line of the DCS card, then the state of the card might not correspond to the state shown in the PABC GUI. To get the correct display of the FEE states in this case will require the PABC GUI to be closed and then started again.

The select FEEC button The long button below each ON/OFF button is the button to select the corresponding card for APD configuration. Clicking on a FEE button will perform the following actions:

- The current APD settings will be read from folder */home/phos/data/APD_settings*. If no file exists, a file with default values will be created. The current default value is DAC=512 for all APDs which corresponds to ≈300 Volt on the HV output.
- The color of the card will be set to blue.
- A 2x16 matrix of APD DAC values will be drawn in the middle of the GUI.
- If a card was already selected and the user selects another card, then the APD settings of the previous card will be saved to the corresponding file in the folder */home/phos/data/APD_settings*

3.3.3 Menu: APD DAC values

In this menu the user can change the DAC values of the individual APDs. This is done either by clicking the up down arrows to the right of the number entry, or by typing a number in the number entry field and pressing *enter* on the PC keyboard.

By using the up down arrows it will only be possible to set value's in the range 0 - 1023. If one types a number outside this range in the number entry field then: if the number is higher than 1023 then it will be set to 1023 and if the number is less than zero it will be set to zero.

3.3.4 Menu: Menu

- **Exit:** Not yet implemented
- **Save Configuration:** Saves everything in the folder */home/phos/data/APD_settings* in a single file in the Folder */home/phos/data/ConfigurationFiles*. Please note that clicking this button will never overwrite any data. The ID number , N, of the latest configuration will be read from the file */home/phos/data/ConfigurationFiles/Id.txt* and the new configuration file will be written to the file */home/phos/data/ConfigurationFiles/configuration_N+1.txt*.
- **Load Configuration:** Loads the configuration with the ID given by the user specified number to the right of the button. The default value of the number entry is the configuration that was loaded at startup of the *apdgui*. If the given configuration does not exist an error is issued on the command line,and the data in */home/phos/data/APD_settings* is left untouched.

3.3.5 Menu: Sandbox

- **Set all APD for FEE to:** Clicking this button will set all the APD values for the currently selected FEE to the value given in the entry to the right of the button. The values will be written to the sandbox /home/phos/data/APD_settings. Please note that the changes will not be updated in the database unless you click the **Save Configuration** button.
- **Set all APD for RCU to:** Clicking this button will set all the APD values for the currently selected RCU to the value given in the entry to the right of the button. The values will be written to the sandbox */home/phos/data/APD_settings*. Please note that the changes will not be updated in the database unless you click the **Save Configuration** button.
- **Set all APD for Module to:** Clicking this button will set all the APD values for the currently selected Module (Module 2) to the value given in the entry to the right

of the button. The values will be written to the sandbox */home/phos/data/APD_settings*. Please note that the changes will not be updated in the database unless you click the **Save Configuration** button.

3.3.6 Menu: Electronics Configuration

This menu groups contains several sub menus. Actions in this menu group is applied to the electronics.

Warning: Make sure that High Voltage is turned off before making any changes to the APD/DAC values. The High Voltage must be ramped up **after** the APD settings is applied.

Apply APD settings

- **Apply to FEE:** Applies the setting shown in the 2x16 matrix of crystals/APDs that is currently selected. The currently selected FEEC is marked with blue (by click from the user). If no card is selected an error is issued on the command line. Please note that clicking this button only attempts to apply the settings for the selected FEEC as it is given in the folder */home/phos/APD_settings*, it does not store any data in the configuration database.
- **Apply to RCU:** By clicking this button all the APD settings for the currently selected RCU in the "sandbox" directory (/home/phos/data/APD_settings) is applied to the FEE. The settings is applied one by one on FEEC basis.
- **Apply to module:** Disabled for the moment.

RCU All buttons in this menu group perform actions on all RCUs of the PHOS module except the **Initialize RCU** button that initializes only the currently selected RCU (the one colored blue).

- **Initialize RCU:** Performs the following actions:

  Resets the the RCU driver.

  Resets the DCS firmware.

  Reloads the firmware for the currently selected RCU. (equivalent to the command 0xb000 0x4).

  Resets the RCU firmware.

  Gives the DCS card access to the readout bus (equivalent to the command 0xe000 0x0)

- **Reset All RCUs:** Performs the following actions.

  Reloads the firmware for all RCUs (equivalent to the command 0xb000 0x4)

  Resets the RCUs

  Powers down all FEECs

  Gives the DCS card access to the readout bus (equivalent to the command 0xe000 0x0). WANING: all the FEECs will be turned off and any configuration such as for instance the APD settings of the cards will be lost. After clicking the **initialize RCU** button. The card will have to be turned on and the APD bias settings must be applied again.

- **Arm Trigger** performs the following actions.

  Reads the number of samples + pretrigger samples from the GUI an applies it to the electronics.

  Calculate a suitable trigger window between L1 and L2 trigger from the number of samples and applies it to the electronics.

  Generates the active channel lists (AFL) for the four readout partitions to read out based on the readout region specified by the user.

  Distribute the AFLs to the four readout partitions (RCUs) and applies them to the electronics.

- **Enable Trigger** Enables triggers for all four readout regions.

- **Disarm trigger** Disables the external hardware trigger and resets the RCU.

  Tells the RCU that it is a PHOS type RCU.

  WARNING: Clicking the **Disarm Trigger** button resets the RCU and all registers in the RCU including the register that specifies if the RCU is TPC type or PHOS type. The mapping of the power on lines of the GTL bus is different for TPC and PHOS. After a reset the register telling which type of RCU (register 80009) is set to the default value which is TPC. Unless ALL FEEC is powered ON when resetting the RCU the APD settings will be gone and the FEEC APD bias settings must be reconfigured. If all FEECs is turned on when disarming the trigger then it does not matter if the mapping is changed during reset and the settings of the FEECs is not lost.

Readout Configuration In the readout configuration menu the user specifies the number of samples, the number of pretrigger samples to use. The readout region specifies the matrix of crystals to read out. The Z axis is horizontal and the X axis is vertical. Origo (0,0) is in the upper left corner and the coordinate (55, 63) is in the bottom right corner

of the PHOS module as seen from the back (looking at the electronics). Changes made in the "Readout configuration" menu takes effect when the user clicks the **Arm Trigger** button. If you want to retrieve the readout configuration automatically the next time you open the PABC GUI then click the **save** button.

3.3.7 The LogViewer

The LogViewer display various messages from the system as response to user actions. The messages shown in the LogViewer is also written to the file */home/phos/phos_dcs/log.txt*.

Chapter 4

PABC How To...

4.1 Turn ON/OFF a FEEC

To turn ON/OFF a FEEC simply click the ON/OFF button for the card. The ON/OFF button of the FEEC is the small button on top of each of the cards. Clicking the ON/OFF button will attempt to turn the FEEC OFF if it is already on, otherwise the PABC will attempt to turn it ON. If you successfully turned ON the FEEC the ON/OFF button will turn green as indicated in Figure 3.1. The LogViewer will issue the message.

```
CardX at branchY was turned ON, pcmversion is 0x20
```

If you get any other messages[1] you can try to do it once more. If you still don't get this message go to section 5.2

4.2 Apply APD settings to a single FEEC

To apply APD settings to a FEEC the card must be turned on (see Section 4.1), and the card you want to apply the APD settings to must be selected. To select the card just click on the card. The card should turn blue and the current APD settings of the card will be shown in the 2x16 matrix to the right. The PABC GUI should look something like Figure 3.1 Please note that the entries in the 2x16 matrix does not necessarily reflects the APD bias settings of the actual front end card unless you apply the settings successfully to the electronics.

To apply the settings of the currently selected FEEC in the GUI to the electronics click the **Apply to FEE** button in the **Apply APD settings** sub-menu under the **Electronics Configuration** menu. If the APD settings was applied correctly the LogViewer will issue the message

[1] The pcm version number is subjected to changes

```
applying APD values for cardX at branchY ..SUCCESS
```

If you get any other message go to Chapter 5.8

4.3 Apply APD settings to all cards on readout partition

The readout partition (RCU) you want to aplly the APD bias settings too must be selected. An readout partition is selceted if it has the color blue. To apply the current APD configuration click the button **Apply to RCU** button.

4.4 Apply APD settings to all cards of the Module

Click the **Apply to Module** button in PABC GUI.

4.5 Take data

Before attempting to take any data please make sure that ALL FEECs of all four readout partition is ON even if you are only taking data from a part of the PHOS module. There is several issues/conflicts between DAQ and DCS. The problem is that DAQ occasional leaves the RCU in a state of error when it is impossible to access it from DCS or to take any data. There is however a recipe to follow that will keep the system working both for DCS and DAQ/DATE. The recipe is given below.

Recipe for taking data

1. PABC: click the **Disarm Trigger** button if it was not already done after previous run. If you are not sure if you clicked the button just click it in any case.
2. PABC:(optional) apply new APD bias settings.
3. PABC: click the **Arm Trigger** button
4. DATE: click **Start Process** and the **Start**.
5. PABC: click the **Enable Trigger** button.
6. Wait until you have enough events from DATE.
7. PABC: click the **Disarm Trigger** button.
8. DATE: click **Stop**.

4.6 Initialize the RCU(s)

WARNING: before clicking the **initialize RCU** button please make sure that the LV voltage for the FEE and CSPs and the HV is OFF. The RCU is initialized evry time the DCS cards is rebooted or the power for the RCU is switched on. It should therefor normally not be necessary manually to intialize the RCU. Howevere it might be that for various reasons the RCU must be re-initialized.

To initialize an RCU first click on the readout partition corresponding to the RCU that you want to initialize. After selecting the RCU, wait a few seconds to let the DCS card probe the electronics. Then click the **"Initialize RCU"** button in the RCU menu group in the PABC GUI. This will intialize the currently selected RCU (the one marked with blue). If no RCU is selected you will get an error message from the Logviewer. If you want to initialize all four RCUs you will have to select them one by one and repeat the procedure.

4.7 Log in to a DCS card

To log in to a DCS card do the following:

```
[any PC ~] ssh root@alphsdcsXXXX
 root@alphsdcsXXXX's password: dcs
```

Here XXXX represents the serial number of the DCS card. For the moment the available DCS cards is *alphsdcs0060, 0279, 0280, 0281, 0282*. For instance, if you want to log in to the DCS card with serial number 0279 replace XXXX with 0279 and do the following.

```
[any machine ~] > ssh root@alphsdcs0279 ssh

root@alphsdcs0279's password: dcs

alphsdcs0279:\$ ./home/phos/feeserver_start.sh
```

4.8 Check if the feeserver is running

First log in tho the DCS card where you want to check if the feeserver is running (see Section 4.7). On the command line of the DCS card type the command **ps -a**.

```
alphsdcsXXXX:/ \$   ps -a
```

This will write out the complete list of processes running on the DCS card (the **-a** means *all*). The list will look something like the one below. If the feeserver is running there will be three processes associated with it. You should have under the column "Command" three entries with the name **/bin/feeserver**. If you started the feeserver with the startup script (the normal way) there will also be an entry called **/bin/sh ./home/phos/feeserver_start.sh**. The list of processes will look something like the one below.

```
  PID  Uid     VmSize Stat Command
    1 root        356 S   init
    2 root            SW  [keventd]
    3 root            SWN [ksoftirqd_CPU0]
    4 root            SW  [kswapd]
    5 root            SW  [bdflush]
    6 root            SW  [kupdated]
    7 root            SW  [mtdblockd]
    8 root            SWN [jffs2_gcd_mtd3]
   34 root        340 S   /sbin/syslogd -m 0 -O /var/log/messages
   35 root        296 S   /sbin/klogd
   38 root        396 S   /sbin/devfsd /dev
   65 root        360 S   udhcpc -b
   70 root        908 S   /usr/local/sbin/sshd -D
   75 root        352 S   /usr/sbin/inetd
   76 root        360 S   /usr/local/sbin/boa
   80 root        348 S   /usr/sbin/crond -l 9 -c /etc/crontab/
   86 root        216 S   /usr/local/sbin/writer
  113 root        416 S   -sh
  116 root       1180 S   /usr/local/sbin/sshd: root@pts/0
  125 root        428 S   -sh
  971 root        372 S   /bin/sh ./home/phos/feeserver_start.sh
  972 root        384 S   /bin/feeserver
  973 root        384 S   /bin/feeserver
  974 root        384 S   /bin/feeserver
  982 root       1160 S   /usr/local/sbin/sshd: root@pts/1
  984 root        416 S   -sh
 1010 root        340 R   ps
```

In this case the feeserver is running with Process Ids (PID) 972, 973, 974, while the script that started the feeserver has PID 971. Please note that the PIDs will vary.

4.9 Start a feeserver on the DCS card

To start the DIM servers first log into the card where you want to start the feeserver (Section 4.7). To start the feeserver do the following:

```
[any machine ~] > ssh root@alphsdcsXXXX ssh

root@alphsdcsXXXX's password: dcs

alphsdcsXXXX:\$ ./home/phos/feeserver_start.sh
```

Here XXXX represents the serial number of the DCS card. If for instance you are logged in to *alphsdcs0279* and wants to start a feeserver there, then do the following:

```
[any machine ~] > ssh root@alphsdcs0279 ssh

root@alphsdcs0279's password: dcs

alphsdcs0279:\$ ./home/phos/feeserver_start.sh
```

When the feeserver is started it will issue several lines relevant (and irrelevant) information on the command line. If the feeserver was started up successfully the las few lines of information should look exactly like this.

```
-----------------------------------
init services for configuration PHOS
... done
Init OK
DIM Server successfully started, ready to accept commands.
```

Anything else means that there i some kind of problem. To solve them go to Chapter 5.4.

4.10 Kill a feeserver running on the DCS card

There is two ways to kill a feeserver running on the DCS card. In the following discussion XXXX Will refer to the serial number of the DCS card. Before you kill a feeserver please talk to your colleagues so you don't interfere with their work.

- From the terminal window where the feeserver was started: press **CTRL + C** on the PC key board. No you should get back the normal command prompt an the last few line should look either like something like this.

```
CE Info: (../src_ce/ce_base.c line 592) program rm exited with error code 0
CE Debug: issue result buffer: 0x30377830
Retcode of CMND timedwait: 0
Issue-nRet: 0
ErrorCode in Header: 0
ACK

alphsdcsXXXX:/ \$
```

Or something like this

```
-----------------------------------
init services for configuration PHOS
... done
Init OK
DIM Server successfully started, ready to accept commands.

alphsdcsXXXX:/ \$
```

- If you want to kill the feeserver from another terminal window than where the feeserver was started do the following. First log in to the DCS card where the feeserver you want to kill is running (see Section 4.7). To kill the feeserver process you need to know the Process Id (PID). See Section 4.8 for how to obtain the PID. If a feeserver is running there will be three processes called **/bin/feeserver** To kill all processes associated with the feeserver it will be sufficient to kill only the first one. To kill it do the following on the command line.

  ```
  alphsdcsXXX:/ \$ kill -9 XXX
  ```

  Where **XXX** represents the PID of the process. For the example given in Section 4.8, XXX = 972 an you would kill it with the command

  ```
  alphsdcsXXX:/ \$ kill -9 972
  ```

In addition There is currently two more ways to kill the feeservers. One is to turn on and off the power of the DCS/RCU card. The other one is to reboot the DCS card. Please not that in the near future the feeserver will start up automatically on reboot or power up an it will not be possible to kill the feeserver by turning on/off power or by rebooting. If you want to kill the feeserver by rebooting do the following:

```
alphsdcsXXXX:/ \$ reboot
```

After this command you will loose contact with the DCS card. The DCS card will use ∼1 min to reboot. Shortly after the **reboot command** the command prompt should look like this.

```
alphsdcsXXXX:/ \$ Connection to alphsdcsXXXX closed by remote host.
Connection to alphsdcsXXXX closed.
[any PC ~] >
```

4.11 Log in to the PC where the PABC and the DIM DNS server is running

The PABC GUI, the DIM DNS server and DID will all run on the PC *alphspcdcs01.cern.ch*. This PC is currently situated in the corner behind the PHOS module in 167 R-006. You can either log in directly to this PC with user name **phos** and password **phosbeamtest** or remotely from another machine. To log in remotely via the network do the following:

```
[any PC ~] >   ssh phos@alphspcdcs01
Scientific Linux CERN Release 3.0.6 (SL)
phos@alphspcdcs01's password: phosbeamtest
[alphspcdcs01] /home/phos >
```

4.12 Check if the DIM DNS server is running

On the command prompt of the PC *alphspcdcs01* type the command **ps -e** [2] You will get long list of processes that looks someting like the list below (not all the processe)

```
[alphspcdcs01] /home/phos > ps -e
PID TTY          TIME CMD
1 ?        00:00:05 init
2 ?        00:00:00 migration/0
3 ?        00:00:00 migration/1
      ....... more processes
2982 ?        00:00:00 rpciod
2986 ?        00:00:00 rpc.mountd
2995 ?        00:00:00 dhcpd
```

[2] the **e** stands for *every* process running on the PC as opposed to the option **-a** that means *all*processes exept session leaders and processes not associtated with a terminal.

```
3015 ?        00:00:05 sendmail
3024 ?        00:00:00 sendmail
3034 ?        00:00:04 gpm
3043 ?        00:00:00 crond
3066 ?        00:00:00 xfs
3083 ?        00:00:00 atd
3111 ?        00:00:28 dimNameServer
3114 tty1     00:00:00 mingetty
3115 tty2     00:00:00 mingetty
         ...... more processes
```

If the DIM DNS server is running there should be either a process with the name **dimNameServer** or with the name **dns**. If the DNS server was stared (as it should) automatically the name will be **dimNameServer** and if it was started manually from the commandline it will have the name **dns**. In this examples the DNS server is running with PID 3111.

4.13 Start the DIM DNS server

To start the DIM DNS server you need to first log in to the PC *alphspcdcsp1*. You must run a script to set up the environment. From the command prompt do the following:

```
[alphspcdcs01] /home/phos > . dcs_cern.sh

[alphspcdcs01] /home/phos > dns
PID 11250 - Sat May 27 18:08:06 2006 -  DNS (pid 11250) starting up on alphspcdcs01
```

The response from the DIM DNS server should be exactly as sown above except that the date and the PID will be different. If you get any other message go to section 5.5 *alphspcdcs01* (see Section 4.11)

4.14 Kill the DIM DNS server

The only reason to kill the DNS server is for debugging purphoses when the DCS system is not working properly and you want to see the messages from the DNS server on the commandline. In this case you kill it and then restart it manually from the command line.

There is three ways to kill the DIM DNS server. Before you kill the DIM DNS server please talk to your colleagues so you don't interfere with their work.

- To kill the DIM DNS server from the terminal window where you started the DIM DNS server type **CTRL +C** in the terminal window where the DIM DNS server is running.
- If you are not in the terminal window where the DIM DNS was stared you will first have to log in to the PC running the DIM DNS server. (see Section 4.11). To obtain the PIDs of the processes do the following:

  ```
  [alphspcdcs01] /home/phos > ps -e
  ```

  You will get list of processes similar to that given in section 4.12. Find the PID and kill it with the command

  ```
  /home/phos > kill -9 XXXX
  ```

  where XXX is the PID. If for instance the PID is 3111 as in section kill it by typing

  ```
  /home/phos > kill -9 3111
  ```

4.15 Kill the PABC GUI

If you are in the terminal window where you started the PABC GUI just press **CTRL + C** on the PC keyboard. Otherwise kill the the PABC GUI by logging in remotely from another PC to the machine that is running the PABC GUI and do the following:

```
[any PC ~] >  ps -a
```

The list of processes should look something like this

```
[any PC ~] > ps -a
    PID TTY          TIME CMD
  25005 pts/7    00:00:01 apdgui
   8456 pts/14   00:00:00 ps
```

The executable of the PABC has the name "apdgui". In this examples it has the PID 25005. To kill it do the following.

```
[any PC ~] > kill -9 25005
```

4.16 Kill a process i general

To kill a process in general type the command **ps -a** on the command prompt in the PC/DCS card where the process you want to kill is running. Look at the PID of the process you want to kill ant type on the command line

```
[any PC ~] > kill -9 PID
```

Chapter 5

Troubleshooting

5.1 I cannot take any data

Check if triggers are arriving at the RCUs First of all check if there are triggers arriving to the RCU and also read the error register (0x7800) the trigger configuration register (0x7801) and the trigger counter register (0x78002). You can read all three register with a single command.

```
alphsdcs0279:/  rcu-sh r 0x7800 3
0x7800: 0 0x1410160 0x1780178
```

Repeat the procedure for the RCUs you have activated for data taking. The result should look something like the one above. Here there are no errors (0x7800 = 0x0). The trigger configuration is hardware trigger and time window to L2 trigger is 0x160 clock cycles. The last register says that 0x178 L1 triggers has arrived to the RCU (most significant 16 bits) and that 0x178 L1 triggers was accepted least significant 16 bits. If you read out the trigger counter register several times and there are trigger then the counter will increase its value. If triggers arrives in the RCU and you cannot take any data then the problems is somewhere else

Check if the RCU is in error Read the status and error register of the RCU

```
alphsdcs0279:/  rcu-sh r 0x7800
0x7800: 0x80000000
```

The value of this register should be zero. If you get anything else the RCU must be reseted. This can be done by clicking the **Disarm Trigger** button on the PABC GUI. There are several conditions that can leave the RCU in some state of error. Some of the are listed below.

- The trigger rate is to high for the RCU

  Measure increase the trigger blocking (dead) time.

- Date was stopped before disarming triggers.

  Measure click the **Disarm Trigger** button and repeat the data taking procedure.

- Triggers was enabled before DATE was started,

  Measure click the **Disarm Trigger** button and repeat the data taking procedure.

Please note that the trigger blocking time necessary depends on how many channels you want to read out. To read out the whole module the trigger blocking time should be at least 5 ms. To read out a 7x7 matrix the blocking time should be around 200 - 300 us.

Check that you have enables the correct LDCs in DATE Make sure that only the DATE Equipments that you want data from is activated. If you activate an equipment in DATE but the readout region you want does not include any readout channels from that Equipment (RCU) then date will still expect data from it and will wait forever for data from that equipment. There are four DATE equipments per PHOS Module. The DATE name of these equipments is DDL8, DDL9, DDL10, DDL11 and they corresponds to RCU0 (alphsdcs0060), RCU1 (alphsdcs0279) RCU2 (alphsdcs0281) and RCU3 (alphsdcs0282) respectively. To activate/deactivate equipments issue the command **editDb** on the command line of the DAQ computer (currently *aldaqpc019*).

5.2 I cannot turn on the front end cards

Checklist.

- Make sure that the frontend card you want to turn ON is actually connected.
- Check if the feeserver is running 4.8

5.3 Interpretation of messages from the LogViewer

5.3.1 Messages when applying APD bias settings

See Section 4.2 and 5.8.

5.3.2 Messages when Arming trigger

5.4 Error when starting a feeserver (DIM server)

Interpretation of error messages:

- ```
  DIM: [ERROR] - Connecting to DIM_DNS on alphspcdcs01.cern.ch: Connection ref
  DIM Server successfully started, ready to accept commands.
  ```

  This message from the feeserver means that feeserver started correctly, but did not manage to contact the DIM DNS server.
  Possible reasons:

  The DIM DNS server is not running: See Chapter 4.12 for how to check if the DIM DNS server is running, and Chapter 4.13 for how to start it if it is not running.

  The network cable is not connected properly
  Go to the PC *alphspcdcs01* and check if the Ethernet cable is properly connected bot tho the PC and to the switch.

- ```
  DIM Server successfully started, ready to accept commands.
  DIM: [FATAL] - alphsdcs0281: Some Services already known to DNS.
  Framework tries to exit FeeServer (3)
  Most likely FeeServer name already exists.
  Exit state: 204

  CE Info: (../src_ce/rcu_service.c line 104) releaseRcuAccess finished with e
  ```

  This message means that a feeserver with the same name as the one you try to start is already running. Either you have tried to start a feeserver twice on the same DCS card, or a feeserver with the same name is already running on another DCS card (Se Chapter 4.8).

5.5 Error when starting DIM DNS server

Interpretation of error messages:

```
PID 11372 - Sat May 27 18:12:09 2006 -  DNS (pid 11372) starting up on alphspcdcs01
PID 11372 - Sat May 27 18:12:09 2006 - (ERROR) Opening server port: Address already
```

This message means that the DIM DNS is already running. The DIM DNS server uses port 2025 and port 5100. The DIM DNS server starts and then kill itself because it finds that these ports are already in use.
Measure: Most likely everything is OK, it is just not possible to run two DIM DNS servers on the same PC. If you really wants to make sure that everything is OK then see Chapter 4.14 and Chapter 4.13 for how to kill the server that is running and to start your own. Before you kill the DIM DNS server talk to your colleagues so that you don't interfere with their work.

```
[alphspcdcs01] /home/phos > dns
-bash: dns: command not found
```

Reason: you have forgotten to set up the environment variable. To set up the environment do.

```
[alphspcdcs01] /home/phos > . dcs_cern.sh
```

Don't forget the dot + space.

5.6 Error message when starting DID

```
[alphspcdcs01] /home/phos > did
PID 4070 - Sun May 28 13:18:51 2006 -
(ERROR) Connecting to DIM_DNS on alphspcdcs01.cern.ch: Connection refused
```

This message means that you have forgotten to start DIM DNS server. See Chapter 4.13 for how to start the DIM DNS server.

DID crashes It can happen that DID crashes if you run it remotely due to a bug in DID. You will get an error message about *segmentation fault*. If this happen you can try to run DID directly on the PC.

5.7 Error when starting the PABC GUI

When starting the PABC GUI the GUI looks strange for several minutes and then it appear correctly:
Reason: The PABC GUI is not able to contact the DIM DNS server. The timeout period

is several minutes and in the meantime the PABC will hang. Either the DIM DNS server was not started or there are some network problems. If you are running the PABC GUI (apdgui) on the PC *alphspcdcs01.cern.ch* then the reason is that the DIM DNS server was not started. See Chapter 4.13 for how to start the DIM DNS server.

```
ERROR could not turn on CardX at branchY, Reason: DCS is not master.
```

There is several possible reasons for this message.

- The RCU was not reseted after it was powered up.
  measure: Reset the RCUs. See Chapter 4.6 for details
- The feeserver is not running.
  measure: Check if the feeserver is running (Chapter 4.8). If it is not running the start the feeserver (Chapter 4.9).
- Somebody have changed the access rights of DCS by for instance running scripts from the command line of the DCS card.
  measure: Reset the RCUs (Chapter 4.6).

If none of the measure does not solve the problem it might be necessary to set up the system from scratch. See Chapter 2 for details.

5.8 Error when applying APD settings

5.8.1 ERROR 1: No response from FEE

When attempts is made to apply APD settings to the FEE the LogViewer issues the message

```
applying APD values for cardX at branchY ...ERROR 1: No response from FEE
```

This message means that the PABC is not able to establish contact with the given FEEC.
possible reasons:

- FEEC is not turned ON.
  measure: Turn ON the FEEC (Section 4.1).
- The FEEC has no power.
  measure: Turn on power for the FEEC.
- The FEEC is not present.
  measure: Connect a FEEC on the corresponding slot on the GTL backplane and turn it ON (Section 4.1).

5.8.2 ERROR 3: DCS is not master

When attempts is made to apply APD settings to the FEE the LogViewer issues the message.

```
applying APD values for cardX at branchY ERROR 2: DCS is not master
```

The message means that DCS is not master of the RCU bus an is therefore not able to set the APD DAC values.
Reason:
Somebody has taken the control away from DCS by running scripts on the command line of the DCS card.
Measure: Reset the RCU (Chapter 4.6).

5.8.3 ERROR 3: Readback values are crazy

When attempts is made to apply APD settings to the FEE the LogViewer issues the message

```
applying APD values for cardX at branchY...ERROR 3: Readback values are crazy
```

This means that the APD values the PABC GUI reads back from the electronics does not make sense at all.
Possible reasons:

- The feeserver is not running (see Chapter 4.8.
  Measure: Reset the RCUs (see Chapter 4.6)
- The RCU is in some state of fatal error because somebody ran scripts on the command line.
  Measure: Reset the RCUs (see Chapter 4.6).

In none of these measure solves the problem it might be necessary to set up the communication chain from scratch (Chapter 2).

Bibliography

[1] http://dim.web.cern.ch/dim/. The DIM web-site.

Appendix A

Conversion between DAC and High Voltage

Table A shows the correspondence between the DAC values and High Voltage. Please note that these values are only rough estimates. Actual HV on the APD might vary with several Volt relative to the values given in the Table.

Table A.1: Correspondence between DAC values and High Voltage

DAC value	Voltage/Volt
0	210
30	215
60	221
90	226
120	232
150	237
180	243
210	249
240	254
270	260
300	265
330	271
360	276
390	282
420	288
450	293
480	299
510	304
540	310
570	315
600	321
630	327
660	332
690	338
720	343
750	349
780	354
810	360
840	366
870	371
900	377
930	382
960	388
990	393
1020	399
1023	400

Appendix B

Software Document

The the PHOS DCS software and HTML documentation is available for download at

http://folk.uio.no/perthi/alice/doc/phos_dcs.tar

The HTML documentation for the source code can also be viewed online at

http://folk.uio.no/perthi/alice/doc/phos_dcs/html/