

AD-4 ACE Data Acquisition System v.2.0

Reference Manual

12. Sep. 2009 /NB

1 Description

The PBar AD-4 ACE Data acquisition system was rewritten from scratch for the October 2007 run. Now it features a real-time user interface, asynchronous multi-threaded data acquisition which will not block the main process and monitoring of the applied dose. Five different systems are being controlled and read out from the front-end:

1. **CCD** camera. This is controlled via the PXE PCI board.
2. **NPBARs**. This is referring to the amount of antiprotons in the AD measured at the last beam monitor before exiting the DEM line.
This year (2009), a file system containing the pbars is mounted on ppace03 in /mnt/npbar. The appropriate file is read by the pbar_main_loop.
3. The **UNIDOS** electrometer connected to the Ionization chamber Interfacing is done by a serial RS232 line.
4. Bergoze beam current monitor, called **BCM**. The LeCroy 9450 oscilloscope records the voltage level by the Bergoze after a trigger pulse. The trace of the oscilloscope is read out via GPIB, and an average voltage is calculated.
5. A scintillator is monitoring the secondaries from annihilation. A peak is visible on the oscilloscope other channel and is also read out via GPIB. The trace is integrated by the data acquisition program.

The entire readout process is triggered by a TTL-like pulse which is interfaced via the parallel-port to the data-acquisition computer.

2 Quick setup

Before turning the ppace03 computer on, make sure all devices are connected properly. Especially, the CCD camera is not hot-pluggable, and may suffer from damage when plugged in while the computer is on.

Locally, on the computer you wish to work from, open a terminal and login on ppace03 as "ace" (password will be available elsewhere):

```
ssh -X ppace03
```

(Important: use capital X, else no X windows are forwarded!)

Next, the remote directory containing the NPBAR files should be mounted.

[instructions not included for safety reasons, call 165654, I can do that remotely]

Now start the CCD camera control software:

```
./startapogee &
```

and close the "Saolmage ds9" window. In the "Apogee Camera Control" window select

Temperature -> Cooler on

Edit -> Properties -> Temperature

here you can follow the temperature of the CCD, it should be as cold as possible. It is set to -40 deg C, but will probably stabilize around -10 degrees after 20 minutes or so.

Now open a second terminal on your local computer, login onto ppace03 again:

```
ssh -X ppace03
cd PDA
./pbar_main_loop 0
```

where "0" + 1 is the number which will be given to the first shot. The CCD and UNIDOS camera will be disarmed at the first shot, since the arrival time of the first shot is unknown.

From now on, all will be running automatically. The data and the log files are being stored in /data/incoming on ppace03.

To quit the program, press 'shift' + 'q'.

3 Subsystem Description

3.1 CCD Control

The CCD camera should start exposing just before the next spill arrives, and the exposure time should be minimized as much as possible to reduce dark current.

Adjust the start time of exposure "Exp." and duration "Sht." by using 'e' 'E' and 'h' 'H' respectively. If the cycle time is 90 seconds, let the CCD camera start 1 or 2 seconds before, and keep the shutter open for 2-4 seconds. Check for beam signature on the .fits file stored in /data/incoming/CCD with the ds9 software.

3.2 NPBAR

The NPBARs are grabbed from the computer pslinux1.cern.ch. The last known value of the AD TFA7049 Schottky transformer is placed in the file /mnt/npbar/Transfo.xml_log0

. There may be some further delay when the file actually is updated, so this means the acquisition grace time for the NPBARs should be set large enough, e.g. 20 seconds, or possibly even more. Use 'n' and 'N' to adjust this parameter.

To check if the NPBAR acquisition is out of sync, consult the values logged in /data/incoming/NPBAR/NPBAR_DATA.dat. Here both the CERN database time stamp and the time stamp from our data acquisition system are recorded.

There is a data filter, which prevents updating of the target dose shown in the pbar_main_loop frontend, if the NPBAR value is below 0.05×10^7 pbars. Those filtered results are logged in /data/incoming/log_data.txt. The exact values is still logged in /data/incoming/NPBAR/NPBAR_DATA.dat

The summed NPBARs can be reset with 'shift' + 'F5'. If any problems arises with this sub-

system, it can be disabled any time with 'F5'. Pressing 'F5' again will enable the system again.

3.3 UNIDOS

The UNIDOS charge is read out via RS232. The pbar_main_loop program does NOT setup the UNIDOS device, it is expected that this was done beforehand.

Only a few data are send via the bus, which makes it fast. To prevent dark current from accumulating, the active integration time is limited to a 15 second window starting from the “grace time” has ended. The acquisition start (“grace time”) should be approximately the cycle time minus 5 seconds or more, since there may be some jitter and latency in the timing.

The summed UNIDOS values can be reset with 'shift' + 'F6'. If any problems arises with this sub-system, it can be disabled any time with 'F6'. Pressing 'F6' again will enable the system again.

3.4 BCM

The BCM is read out via GPIB interface set at address 4. The GPIB device may lockup any subsequent calls to the device, if the device was powered off / not connected or similar at any time. The device must be set properly up before pbar_main_loop is started.

If a lockup occurs, you must disable both the BCM and SCI acquisition ('F7' and 'F8'), as these will invoke new get_trace processes at each trigger event. Then kill all get_trace_9450* processes which are running. To view all running processes:

```
ps -e | grep get_trace
```

to kill each of them

```
kill PID
```

where PID is the process id found by the previously issued ps command.

Keep enough space (a few seconds) between the SCI and BCM readout, so the GPIB interface is not accesses by two processes at once.

The summed BCM values can be reset with 'shift' + 'F7'. If any problems arises with this sub-system, it can be disabled any time with 'F7'. Pressing 'F7' again will enable the system again.

3.5 SCI

The scintillator is not good for predicting any dose, but a good diagnostic whether if annihilation events have occurred in the vicinity. The peak will be small if the beam was blocked upstream, or if the water phantom is empty and the beam annihilates well down the DEM zone. The SCI data is also read out via the GPIB interface to the oscilloscope, in case of hangups, consult the previous section about the BCM. Keep enough space (a few seconds) between the SCI and BCM readout, so the GPIB interface is not accesses by two processes at once.

The summed SCI values can be reset with 'shift' + 'F8'. If any problems arises with this sub-system, it can be disabled any time with 'F8'. Pressing 'F8' again will enable the

system again.

3.6 Trigger Box

A daemon resides on PCACE03 which via the parallel port checks the trigger box for a trigger signal. The trigger box is galvanically isolated from the TTL system via an optocoupler, but the parallel port is not protected further. Therefore, power is provided by an internal 9V battery in the box. **This battery lasts only 48 hours and must be changed regularly.** Disarm the data acquisition software by increasing the trigger lockout time by pressing 'I' to a value large enough to prevent any wild behavior during battery change. After the battery was changed, reduce the value again to what it was before by pressing 'shift'+ 'I'.

Alternatively you can quit the data acquisition system, and restart it again after the battery was changed.

4 Requested Target Dose

4.1 Set NPBAR/UNIDOS/BCM Conversion Factors and Target Dose

The file pbar_conv.dat located in /home/ace/PDA contains 4 lines with numbers.

Open this file on ppace03 with e.g. emacs

```
emacs /home/ace/PDA/pbar_conv.dat &
```

The first 3 numbers listed in the file are the conversion factors for NPBAR, UNIDOS and BCM respectively. The units are native to each device, and are shown in the data acquisition system. They should always be in [Gy/"native-unit"], where Gy is the **plateau** dose.

The requested target dose (in Gy) is the 4th number in the pbar_conv.dat file. After the numbers are set, save the file ('ctrl'+x and 'ctrl'+ 's', or use the menu).

It is important to maintain the format of this file, and there must be a line feed / carriage return after the last number.

After the file has been updated, tdl the data acquisition system to reload the values by pressing 'shift' + 'r'.

4.2 Select Device for Target Dose Calculation

The data acquisition system can calculate the progress of irradiation, and show how much time is left before the target is reached. Depending on which device gives the most reliable result, the active device used for these calculations can be selected (or deselected) by pressing 't' subsequently. (This has no effect on the logging.)

Experience from previous runs tell us that the ionization chamber gives the best results, and the NPBAR is mostly in good agreement herewith.

When the requested target dose is reached, 4 quick beep tones are being made instead of one at each received spill, to notify the user.

5 Logging

All events are being logged with a unique time/date stamp.

Two log files are created and can be found in /data/incoming:

log.txt contains all messages from the status window, and occasionally supplementary information in case of errors.

log_data.txt contains the relevant (raw, i.e. unconverted) data acquired from the various subsystems. This file is formatted for easy processing in various plotting programs.

The logged data are:

shot number	time_stamp	NPBARs	UNIDOS	BCM	SCI
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Note, the CCD, BCM and SCI directories may get cluttered with 1000 files a day, it is recommended to move all files to archive directories once a day.

6 Manual Control

6.1 Manually Dump Oscilloscope Trace

You can manually dump a trace with the `get_trace_9450` command (NOT the `fifover` version) while in the `~/PDA` directory:

```
./get_trace_9450 4 1 foo.dat
```

will dump channel 1 into `foo.dat`.

4 is the GPIB address.

6.2 Dump a CCD frame

dump a frame to `foo.fits`, 0.5 seconds exposure time:

```
./test_apogeepci_nb -i foo.fits -t 0.5 -s 1
```

the "s" option controls the shutter, useful for dark-current pictures.

6.3 Send Manual Trigger

In case of trigger problems, you can still manually force a trigger. Open a new terminal to `pface02`

```
ssh -X pface03
```

and emit the `USR1` signal to the process:

```
kill -USR1 PID
```

where `PID` can be seen in the `MAIN TIMER` window of the acquisition system.

In order that this can have an effect, the system must be armed. Do this by pressing 'shift'+`'a'`, or reduce the lockout time to 0 by pressing 'shift'+`'l'`.

7 External Access to Data

Currently no data are exported.

~~The /data directory is exported on the local network via HTTP and SAMBA:
—— <http://pface10/data> —— \\pface10\data~~

~~(read-only)~~

8 In Case of Problems

call 165654 (from outside CERN +41 76 487 5654)

This documentation, recommended settings and the program source can be found on:

http://neptun.phys.au.dk/~bassler/CERN_OCT2008

9 Phone numbers

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Key map Reference Table

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'F4' : Enable/disable CCD data acquisition

'F5' : Enable/disable NPBAR data acquisition

'F6' : Enable/disable UNIDOS data acquisition

'F7' : Enable/disable BCM data acquisition

'F8' : Enable/disable SCI data acquisition

'SHIFT' + 'F5' : reset NPBAR sum.

'SHIFT' + 'F6' : reset UNIDOS sum.

'SHIFT' + 'F7' : reset BCM sum.

'SHIFT' + 'F8' : reset SCI sum.

'e' : increase CCD acquisition grace time

'E' : decrease CCD acquisition grace time

'h' : increase CCD exposure duration

'H' : decrease CCD exposure duration

'n' : increase NPBAR acquisition grace time

'N' : decrease NPBAR acquisition grace time

'u' : increase UNIDOS acquisition grace time

'U' : decrease UNIDOS acquisition grace time

'b' : increase BCM acquisition grace time

'B' : decrease BCM acquisition grace time

's' : increase SCI acquisition grace time

'S' : decrease SCI acquisition grace time

'l' : increase trigger lockout time

'L' : decrease trigger lockout time

'A' : pre-arm trigger

't' : toggle device (NPBAR/UNIDOS/BCM) selected for target dose

'd' : toggle degrader step* (0-6 degrader)

'R' : reload conversion factors and target value

'k' : toggle silence mode

'Q' : quit program.

*) = not available in heikki version