Operating and Reference Manual for ADSC Q210 and Q315 Detectors

Procedures for the following are described:

1. System startup and shutdown.
2. Software startup and shutdown on frame grabber computers.
3. Temperature control.
4. Software configuration for the frame grabber computers.
5. Software configuration for workstation computers.

An appendix describing the following is at the end:

1. Startup and shutdown short summary.
2. DBGLX32 and PixelView use.
3. Installing the driver for the LionM PCI card

System Startup and Shutdown

Detector Power Up

If the detector system mains power is on, skip this paragraph. If the system mains power is off, begin by turning on the main power switch on the left hand side of the system firewall box. Make sure the vacuum pump is running; on some systems the vacuum power is not provided by the firewall box but from a local circuit. Wait until the line vacuum is less than 10 microns if the pump has been off. Use a large screwdriver to open the detector vacuum valve. Wait until detector vacuum reads 10 microns or better.

Push the yellow start button on the firewall box to begin chiller coolant flow. The coolant temperature should automatically begin to drop to 12 degrees C.

To apply power to the detector system it is necessary to have:

1. Coolant flow from the chiller.
2 Good line vacuum.
3. Good detector vacuum.

These conditions form an important part of the detector system interlocks that prevent operation under conditions which may cause damage to the detector. Each

corresponds to a light on the front panel of the system "firewall" box. The green "Normal Operation" light on the firewall indicates that the detector power may be turned on. If any of the three conditions above fails to be met the firewall box automatically removes power from the detector power supplies (Q315) or detector power supply (Q210) preventing detector operation or (with a running system) initiating an emergency shutdown of the detector power.

For a Q210 detector system, simply turn on the detector power with the green detector power switch located in the lower right hand side of the detector power supply front panel followed by the TE cooling power switch on the upper right hand side of the detector power supply front panel.

For a Q315 detector system there are three power supplies. It is important to turn them on in the correct order. Turn on the bottom power supply first using the green switch in the lower right hand side of the bottom detector power supply front panel. Wait 5 seconds, turn on the middle detector power supply, wait 5 seconds, and turn on the top detector power supply. Turn on the TE cooling power switch on the bottom power supply using the green switch on the upper right hand side of the front panel, wait 5 seconds, turn on the TE cooling power on the middle power supply, wait 5 seconds, and turn on the TE cooling power on the top power supply.

Power Sequencing Unit

Some systems include a Power Sequencing Unit (PSU) to handle system power up and power down automatically. This unit is labeled "SmartStartjr" on the front panel and is found in the power control rack. In systems with a PSU, the output interlocked power from the firewall box is connected to a 20 Amp surge protector; the PSU power is connected to this surge protector and the detector power supply (Q210) or supplies (Q315) are connected to the PSU. Each detector power supply AC power cable should be connected to the appropriately labeled PSU output socket. The "1/0" switch on the left hand side of the PSU should be in the "1" position and each detector power supply should have its green detector power and cooling power switches turned to the on position. When the interlock conditions are met in the firewall box, the detector power supplies will automatically turn on in the correct sequence. It is not necessary to follow the instructions in the preceding two paragraphs when there is a PSU included in the detector system. It is possible to sequence down and sequence up the power supplies from a remote computer for systems that have a PSU.

Generally, the program "REMOTE Detector OP" should be started (manually, using the icon on the front screen) on each frame grabber computer after the computers are booted or after a major system restart. After these programs are started, the remote control programs for detector power and temperature control will be usable.

Cooling the Detector – Quantum Console

The detector may be run safely when no thermoelectric (TE) cooling has been done; diagnostics are normally done with the detector "warm". However, for normal data collection the detector should be cooled to its operating temperature of -45 degrees C.

To cool down the detector to its normal operating temperature, start the "Operate Detector" processes on each frame grabber computer, then start the "Quantum Console" process on *any* one frame grabber computer. Push the top "Connect to Detectors" button on the Quantum Console dialog, wait a moment, until you see connections established for each module then push the "Enable Temperature Control" button. Readings of 10 to 20 degrees C should be expected for each module. Occasionally a higher temperature might occur, or if the detector was just warmed up the readings might be lower than 10 degrees C. If any modules read about -270 degrees C this indicates cooling is not enabled in that module. Either the TE cooling power is off on one or more detector power supplies (turn on to remedy), or the chiller water has not been circulating long enough to generally cool the module (wait a bit longer; cooling will eventually be enabled on the module).

Enter the value 0 in the "Temperature Set" box (do **NOT** hit return or enter) and press the "Set Temperature" button. In about 10 minutes all modules should be "Ready at Final Temperature", in this case, 0 degrees C. Press the "Ramp to Cold" button, confirm to the program that you want to make this move (you get the option to cancel), and within an hour all the detector modules should be "Ready at Final Temperature" at approximately -45 degrees C. Note that the temperature read back can have a few degrees variation around the final temperature; it is an inaccuracy in the read out values not the actual module temperatures. Module temperatures are remarkably stable.

Temperature control can **NOT** be enabled when data collection images are being collected; data collection and temperature control are mutually exclusive. You may leave various data collection programs running as long as you do not collect images.

Powering On and Cooling the Detector – Remote Operation

This section applies to those system with a PSU installed. The detector may be powered on and cooled remotely from a Linux computer. Cooling a warm detector to -45 degrees C will take approximately one hour. Using the command *Quantum_detector_on* will power up the detector and cool it to -45 C. Using the command *Quantum_detector_make_cold* will cool the detector to -45 C without issuing the PSU power up command.

Warming Up the Detector – Quantum Console

To warm the detector to room temperature, start the "Operate Detector" processes on each frame grabber computer, the start the "Quantum Console" process on *any* one frame grabber computer. If the "Remote Detector OP" processes are running you may

use these in place of the “Operate Detector”, but remember that data images can NOT be collected while you warm up the detector. Push the top “Connect to Detectors” button on the Quantum Console dialog, wait a moment, until all modules show connections, then push the “Enable Temperature Control” button. Readings of about -45 degrees C, plus or minus, should be expected for each module. Press the “Warm Up Detector to +10 C” button, confirm that you really want to do this (you can cancel if need be), and within approximately one hour to 1 hour ten minutes each module should be “Ready at Final Temperature” of +10C. You should exit the Quantum Console program (“Enable Detector and Exit”). Normally you would terminate the “Operate Detector” or “Remote Detector OP” process on each frame grabber computer as well.

Warming Up and Powering Down the Detector – Remote Operation

This section applies to those systems with a PSU installed. The detector may be warmed up and powered down remotely from a Linux computer. Warming up a cold (-45 C) detector to +10 C will take about an hour. Using the command *Quantum_detector_off* will warm up the detector to +10 C and power the detector down. Using the command *Quantum_detector_make_warm* will warm up the detector to +10 C without issuing the PSU power down command at the end. Powering the detector down will not affect the water chiller.

Detector Power Down

Before powering off the detector system, the detector temperature should be raised to +10 degrees C as described above. See below for what to do if the detector needs to be powered off or power cycled when one or more modules are cold.

Exit the Quantum Console process and any Operate Detector or Remote Operate Detector processes which may be running to assure a clean start up when the detector is turned back on.

For Q210 systems, turn off the TE power then the detector power on the single power supply for the detector.

For Q315 systems, to help remember the proper detector power up sequence, we recommend that that detector be turned off in the reverse sequence to the detector power on sequence. However, the order and speed for shutting off the detector power and TE cooling does not matter.

To shut off the coolant circulation, locate the chiller and on the rear find the main power switch. Put the switch in the down position, wait 5 seconds, the put in the up position. This ensures that the chiller will restart when the yellow Start button on the firewall box is pressed for system restart. It is frequently a source of confusion on system start up if you forget to “reset” the position of the power switch on the back of the chiller.

Important Note: Please do not use the ON/OFF (1/0) button on the front of the chiller; only use the black switch on the back of the chiller. If the 1/0 switch is used, then the ONLY way coolant circulation can be re-established is for one person to hold down the yellow "system start" button on the firewall box while a second person pushes the 1/0 switch on the front of the chiller. The order of this operation matters: Yellow button held down FIRST, followed by pressing the 1/0 switch. The reverse order (1/0 followed by yellow button) will NOT start the chiller.

It is not necessary to raise the coolant temperature before shutting off the chiller; it should always be programmed to go to +12 degrees C when powered.

If mains power is to be shut off and the vacuum pump is connected to the firewall power, close the detector valve with a screwdriver before shutting off power. Do the same if the detector vacuum pump is connected to local power and is to be turned off. It is very desirable to place a card or note taped to the top of the detector stating "DETECTOR VALVE CLOSED", dated and initialed, to help you remember to open the valve as part of the detector start up procedure later on.

Exceptional Circumstances

The detector may need to be powered off or power cycled under exceptional circumstances. This might occur if a computer is accidentally powered down, or if the detector system becomes unresponsive in one or more modules (always gives an error when the Operate Detector or Remove Detector starts). In this case it will not be possible to use the computers to warm up the detector in the normal way, so the best course of action is to turn off power to all the detector power supplies, wait approximately one half hour, and then follow the normal detector power up procedure. Please leave the chiller running.

The most frequent reason for needing to power cycle the detector is a power glitch in the input mains power to the detector system. This can occur during weather incidents such as thunderstorms or if building power has a problem. You may want to wait to restart the detector system and cool it down depending on the circumstances, particularly if you suspect the problem will reoccur soon.

Frame buffer computer setup.

There are five frame grabber delivered with a Q210 system; ten with a Q315 system: one per CCD module plus a spare. Depending on the installation site, the spare computer may or may not be powered and on-line at all times.

General Notes

Each frame grabber computer has two Ethernet ports. At the ESRF, both Ethernet ports are configured, at other sites only one Ethernet port is used. In general there are two computer naming conventions:

1. Frame buffer computers are named **xxx-0** through **xxx-3** for a Q210 detector, and **xxx-0** through **xxx-8** for a Q315 detector. The spare is always called **xxx-sp**. Here **xxx** is the system serial number, like 910 or 448. Only one of the two gigabit Ethernet interfaces is used, and the network connection is made from each frame grabber computer to the gigabit switch located in the data control rack. These computers may have public or private Ethernet addresses as site policy or circumstance dictates.
2. At the ESRF, the computers are named following the beam line where the detector is installed. The first Ethernet port is configured as 100 base T and is connected to the ESRF Lab Network. It has a 160… network address. The computer naming convention is adsc*yyyn* where *yyy* is a beam line identifier and *n* is a letter from a to d (Q210) or a to i (Q315). The first computer on ID14-4 is called adsc144a, the ninth adsc144i. The second Ethernet port is configured as gigabit and has a 192.168... network address. The name is the same as the ESRF Lab Network name with the suffix –local at the end. So the first computer's gigabit network port at ID14-4 is called adsc144a-local. The spare computer is called adsc144spr and adsc144spr-local. ID23-1 computers start with adsc231, and ID29 computers start with adsc29.

In the following discussion we need to distinguish between the first frame grabber computer, the remaining 3 (Q210) or 8 (Q315) frame grabber computers, and the spare frame grabber computer. The *primary* computer will be the first computer: the -0 ("910-0") computer or the "a" computer ("adsc144a"). The *spare* computer will be the –sp ("910-sp") computer or the "spr" computer ("adsc144sp"). The remaining 3 or 8 computers will be *secondary* computers.

Software Setup for the First ***(Primary)*** Frame Buffer Computer

We use a mechanism that allows us to have only one copy of the software and calibration information per system; this created "Shared Folder" (*C:\pv_sw*) contains the single copy of the software and calibration information for the detector and is associated with the primary frame grabber computer. Each computer, including the primary computer, will access programs and calibration data in this shared folder via a "Network Mapped Drive"; by convention this is drive **F**:

The following directories are found in *C:\pv_sw* on the primary computer:

1.	*C:\bin*	Programs, logs, databases, and environment files.
2.	*C:\tables_xxx_swbin*	Software binned calibration files.
3.	*C\tables_xxx_hwbin*	Hardware binned calibration files.
4.	C:*cdb_files*	DBGLX32 module ID "fix" files.
5.	C:*stored_dark*s	Stored darks.

This folder, *C:\pv_sw*, is shared on the network with name *pv_sw* with the sharing and security attribute: "Allow network users to change my files". This is *very* important as obscure errors will occur later on in program execution if this is not done. Once the folder *C:\pv_sw* is shared, you can access any of the directories above from any frame grabber computer thusly:

1.	*F:\bin*	Programs, logs, databases, and environment files.
2.	*F:\tables_xxx_swbin*	Software binned calibration files.
3.	*F\tables_xxx_hwbin*	Hardware binned calibration files.
4.	F:*cdb_files*	DBGLX32 module ID "fix" files.
5.	F:*stored_darks*	Stored darks.

Generally you should access any file in any of the above folders only via the F drive; you can then do this from any of the four or nine frame grabber computers without regard to which one you are using.

Software Setup for Each Frame Buffer Computer.

On each computer (4 for the Q210, including the primary computer, or 9 for the Q315, including the primary computer), a "Network Mapped Drive" **F:** to the shared folder *pv_sw* on the primary computer is created. It is important that a network mapped drive **F:** is created *even on the primary computer*. Windows explorer is to move the "**OPERATE Detector**", the "**REMOTE Detector OP**", and the "**Quantum Console**" shortcuts to the positions on the Desktop of each computer, usually along the left hand side of the Desktop. Note that unexpected crashes can undo your Desktop look if it has changed from the last reboot, so it is usually a good idea to reboot each computer as the Desktop configuration is finished to preserve the work.

Configuring Detector Specific Information

There are two detector serial number specific files in the *bin* directory *F:\bin* for each detector. The file *F:\bin\detector_db.txt* is used to relate the module information to the frame buffer computer to which it is connected. All references to **xxx** in the file would be changed to the correct serial number for the detector. There are two instances

of each name in the file (top set of lines and the bottom set of lines). The first group of "host" entries is used to define which hosts have modules on the system. In the "module" lines each module is give a type ("master" or "slave"), a controller serial number, a module rotation value, a computer hostname, and a set of port numbers which are used for connections between workstation software and the frame buffer computers.

Prototype file for a Q210

```
#
# xxx  Prototype detector_db.txt file fill in the Serial Number for xxx below!
#
#        Fill in the 4 controller numbers below for 0000, 0001, 0002 and 0003.
#
chip 2160 2124 2048
host xxx-0 1
host xxx-1 1
host xxx-2 1
host xxx-3 1
#
module ? slave     0000 0  180 xxx-0   9041 9042 9049
module ? slave     0001 1   270 xxx-1   9041 9042 9049
module ? master  0002  2    90 xxx-2   9041 9042 9049
module ? slave     0003  3     0  xxx-3   9041 9042 9049
```

Here is an example where all of the *xxx* entries are changed to **454** and the correct controller numbers are specified.

```
#
#   SN 454
#
chip 2160 2124 2048
host 454-0 1
host 454-1 1
host 454-2 1
host 454-3 1
#
module ? slave     a489 0  180 454-0 9041 9042 9049
module ? slave     4270 1  270 454-1 9041 9042 9049
module ? master  4126 2    90 454-2 9041 9042 9049
module ? slave     a663 3      0 454-3 9041 9042 9049
```

Here is an example of a Q315 computer SN 913. Note that 315 modules all have module rotations of 270, whereas each Q210 module rotation is different. Be careful creating a detector database for one kind of detector from the database of another!

```
#
# 913 ALS 5.0.2
#
chip 2160 2124 2048
host 913-0 1
host 913-1 1
host 913-2 1
host 913-3 1
host 913-4 1
host 913-5 1
host 913-6 1
host 913-7 1
host 913-8 1
#
module ? slave    a225 0  270 913-0 9041 9042 9049
module ? slave    a223 1  270 913-1 9041 9042 9049
module ? master  a216 2  270 913-2 9041 9042 9049
module ? slave    a220 3  270 913-3 9041 9042 9049
module ? slave    a218 4  270 913-4 9041 9042 9049
module ? slave    a219 5  270 913-5 9041 9042 9049
module ? slave    a224 6  270 913-6 9041 9042 9049
module ? slave    a221 7  270 913-7 9041 9042 9049
module ? slave    a215 8  270 913-8 9041 9042 9049
```

The second detector specific file found in the bin directory contains temperature control parameters and detector pedestal settings. It is *F:\bin\controller_kind.txt*. A prototype file is given below, again with xxx representing the detector serial number.

Prototype file for a Q210 detector:

```
#
#  SN XXX  Customer not assigned  Example file.
#
#   Fill in the Serial number above; fill in the controller number,
#   the TE gain and offset, and the 4 pedestal numbers for each controller
#   from the QC file for the detector.  The Slope and Int(ercept) values
#   will be determined after temperature read back calibration.
#
#   0000  0001   <-- View of module number in Q210 from FRONT.
#   0002  0003
#
#
#   Ped 0  Ped 1 <-- In PixelView, this is the “Balance Tool” view.
```

```
#    Ped 2  Ped 3
#
#ctl# type      Slope    Int     TE.G TEoff  Ped0            Ped1          Ped2          Ped3
#
0000 slave   1.0000  0.0000    206    200   2761  2048  2765 2048 2763  2048 2785 2048
0001 slave   1.0000  0.0000    206    200   2773  2048  2760 2048 2785  2048 2791 2048
0002 master 1.0000  0.0000    207    199   2728  2048  2759 2048 2752 2048 2759 2048
0003 slave   1.0000  0.0000    207    199   2746  2048  2767 2048 2748  2048 2813 2048
```

Example for Q210 serial number 454:

```
#
#  SN 454
#
#    a489  4270
#    4126  a663
#
#
#ctl# type      Slope    Int     TE.G TEoff  Ped0      Ped1          Ped2          Ped3
#
a489 slave    1.0022  0.3007   208 199 2752 2048 2743 2048 2740 2048 2765 2048
4270 slave    1.0000  1.4000   207 199 2733 2048 2748 2048 2753 2048 2783 2048
4126 master 0.9783 -4.5000   209  200 2759 2048 2754 2048 2723 2048 2743 2048
a663 slave    1.0000  1.5000   209  199 2810 2048 2820 2048 2821 2048 2840 2048
```

In the first line above, a489 is a controller number, 208 and 199 are TE gain/offset pairs, and the numbers before each 2048 are the quadrant pedestal offset values.

Example for Q315 serial number 913:

```
#
#  SN 913 ALS
#
#    a225  a223  a216
#    a220  a218  a219
#    a224  a221  a215
#
a225 slave  0.9978 -0.0998 210 199 2764 2048 2750 2048 2795 2048 2768 2048
a223 slave  0.9847 -1.7724 209 200 2751 2048 2716 2048 2726 2048 2730 2048
a216 master 0.9890 -2.0769 207 201 2769 2048 2755 2048 2736 2048 2755 2048
a220 slave  0.9934 -0.2980 208 199 2715 2048 2750 2048 2726 2048 2740 2048
a218 slave  0.9890 -1.6813 209 199 2762 2048 2707 2048 2740 2048 2722 2048
a219 slave  0.9847 -1.8709 208 200 2750 2048 2739 2048 2774 2048 2731 2048
a224 slave  0.9934 -1.0927 208 200 2739 2048 2740 2048 2724 2048 2745 2048
```

a221 slave 1.0045 0.8036 209 198 2748 2048 2734 2048 2760 2048 2733 2048
a215 slave 0.9934 -1.9868 208 200 2764 2048 2731 2048 2778 2048 2738 2048

Configuring the Detector Environment (Options)

The detector APIs ("Operate Detector" and "Remote Detector OP") which run on the frame grabber computers have features which can be selectively enabled or disabled, and default locations for files such as the module calibration files. The environment file *F:\bin\detector_env.txt* is used to select program options and file location information. A sample *detector_env.txt* follows (from SN920 DLS I03):

```
ADC0_INDEX=1
CCD_SW_BIN=1
CCD_TABLES_DIR=..\tables_920_swbin\
CCD_GAIN_REMAP_FILE=gain_remap
CCD_TABLES_HB_DIR=..\tables_920_hwbin\
CCD_GAIN_REMAP_HB_FILE=gain_remap_hb
CCD_RAW_SATURATION=64000
CCD_UNIFORM_PEDESTAL=1500
CCD_PEDESTAL=40
CCD_MSERVER_MEM_LIMIT=2000M
#CCD_REMOTE_EXEC_ON_STARTUP=1
#
CCD_DETECTOR_DB=detector_db.txt
CCD_MODULE_NROWS=2124
CCD_MODULE_NCOLS=2160
CCD_MODULE_IMSIZE=2048
CCD_N_CTRL=9
```

Lines beginning with # are comments. This is a way to enable or disable options while remembering how to disable or enable later on.

ADC0_INDEX is 1 for Q210r or Q315r detectors, and 0 for older detectors. It is used for detector temperature read back.

CCD_SW_BIN is used to tell the detector API which binning mode, software or hardware, is the default if only binning (1 or 2) is specified to the program. This is primarily for backward compatibility for control software which does not support switching between hardware and software binning.

CCD_REWRITE_SERIALNUM_ERRORS is set to 1 to cause the detector API to rewrite CCD controller serial numbers which don't match the *F:\bin\detector_db.txt* entry for the frame grabber computer. This is only available on Version 8 of the API .

Care needs to be taken if fiber optic cables are moved around between the computers for diagnostic reasons to always make the database file consistent with the detector cabling!

The TABLES and REMAP entries are used to locate detector calibration files.

The CCD_MSERVER_MEM_LIMIT is used to specify how much memory to use for data frame storage in the frame grabber computers; the "M" specifies units of megabytes. It is currently limited to 2GB (2000M) pending a revision of the API. Values larger than 2GB are negative 32 bit integers; some arithmetic revisions to the code are necessary.

CCD_REMOTE_EXEC_ON_STARTUP set to 1 will cause the "Remote Detector OP" version of the API to spawn and execute the API on start up. The default is to wait for the socket signal from the program "signal_pc_remote" before doing the spawn and execute. This distinction is important if the Remote Detector OP is started when the computer is booted; you do not want to execute the API when the detector hardware may be off. Care must be exercised when choosing to set this option to 1.

The value CCD_N_CTRL tells the API how many detector modules there are; this should be 4 for a Q210 and 9 for a Q315. The CCD_DETECTOR_DB variable is used to specify the *F:\bin\detector_db.txt* file location; this is also the program default. The NROWS and NCOLS variables specify the raw chip size for the detector; they are the same for a Q210 or Q315.

The CCD_PEDESTAL value is the number which is added to each pixel after image correction is done. Since the image correction involves subtracting a dark image from an X-ray image it is possible for pixels in the output image to be negative. The convention for crystallographic images is "unsigned short (16 bit) integers". Adding a small number to each pixel (CCD_PEDESTAL) is a way to use unsigned short integer output file formats. Various data reduction programs will need to know this number since it should NOT be counted for statistical purposes. In MOSFLM this value is given as ADCOFF; similar keywords for HKL and XDS exist.

The CCD_RAW_SATURATION value should be kept at 64000; it interacts with the CCD_UNIFORM_PEDESTAL value of 1500 which should also be kept as is. These variables are used in the preparation of raw images after the CCD detector has been read out.

Control Computer Software: "Generic" Configuration.

Frame buffer computers take images for one module. To run the detector as a complete system and take images with all the modules at the same time two processes are used. These processes, "det_api_workstation" and "ccd_image_gather" run on the ADSC supplied Linux Raid control and storage computer at each beam line. By current

convention, the control computer is called **raidxxx**. The detector serial number *xxx* is substituted into this name. For example, I03's raid control computer at Diamond beam line I03 is called **raid920**, since Q315 detector serial number 920 is located there. These naming conventions are used by ADSC when the detector is configured and calibrated but they are completely arbitrary and may be changed by local stites.

The root of the ADSC software on the raid control computer is located in */data/ccd/ccd_dist*. In this directory find subdirectories *binlinux, logicals, src_std and src_bls.* The *bin/liunux* subdirectory contains executables and shell files, including the shell file restart_detector.sh. This is the primary mechanism for restarting the APIs on the frame grabber computers followed by det_api_workstation and ccd_image_gather. Using this script it is possible to put the detector system into a known state for the local control software system. Programs in src_std are considered applicable in "general" situations. Programs in src_bls are interfaces to goniostats or other beam line control components for various beam lines around the world.

The *logicals* subdirectory contains an environment file for the two processes det_api_workstation and ccd_image_gather, called **log_raidxxx_api_xxx**. The detector database file **detector_db.txt** and configuration file *config_ccd* are located in the subdirectory *tables_api_xxx***.** The detector database file is identical with the one on the frame grabber computer *F:\bin\detector_db,.txt*. The **config_ccd** file is primarily used by the "ESRF device server library" **libdetcon_mp.a.** This device server library is used at many locations outside the ESRF; the name refers to the location where the software was developed (ESRF) and the interface protocol (their device server). It may be linked into any local control software and be used to interface local control software to the detector system.

Swapping in the Spare Frame Grabber Computer: "Generic" Configuration.

Frame grabber computers may fail, or the ADSC PCI interface card to the CCD detector controller module may develop a problem. A spare computer is supplied with each detector, complete with PCI interface card. This computer is configured and is kept either off (some locations) or on line (other locations). ADSC recommends that the spare be kept off. In order to substitute in the spare computer, called xxx-sp, where xxx is the detector serial number (example: 920-sp is the spare for detector serial number 920), warm up the detector with the normal Quantum Console program if the "bad" computer can perform this operation (see Exceptional Circumstances above if not). Turn off the detector power supplies, move the fiber optic cable from the "bad" computer to the spare computer if it already racked up and accessible, otherwise remove the "bad" computer from the rack and put the spare in its place, then reconnect the fiber optic cables. Turn on the detector power supplies (see power up section above). Test with DBGLX32 on the spare computer (statusframe & voltages_v2.cdb macro; see more on how to run this program in the appendix to this document) to make sure the serial link is good after this

swap (check that you did not interchange the 0 and 1 fiber optic ends by accident; DBGLX32 reports solid "Serial Link Bad" errors in this case).

Change the computer name xxx-sp to xxx-y, the name of the computer which you just removed from the system. Change the IP number of the spare computer to that of the computer which you removed. The system should now be ready to operate again. Test the detector (if possible, warm), and if it is OK, use the Quantum Console to cool the detector down for normal operations.

If the Primary frame grabber computer completely fails (disk dies, computer dies) then the Spare computer should be configured as the Primary computer. Note there is a backup copy of the *C:\pv_sw* from the Primary computer on the second computer which can be used. Be sure to make sure that the hostnames in the backup copy corresponds to the current beam line arrangement. See the section on the configuration of the Primary Frame Grabber computer above for details on sharing.

Control Computer Software Configuration at the ESRF.

Frame buffer computers take images for one module. To run the detector as a complete system and take images with all the modules at the same time two processes are used. These processes, "det_api_workstation" and "ccd_image_gather" run on the Linux control computer at each beam line. By current convention, the control computer is called adsc*yyy*ctrl.esrf.fr. The beam line number *yyy* is substituted into this name. For example, ID23-1's control computer is called adsc231ctrl, ID14-4 adsc144ctrl, and so forth.

The root of the ADSC software on each control computer is located in *~blissadm/local/adsc*. In this directory find subdirectories *bin, env,* and *log*. The *bin* subdirectory contains executables and shell files, including the shell file restart_detector.sh. This is the primary mechanism for restarting the APIs on the frame grabber computers followed by det_api_workstation and ccd_image_gather. Using this script it is possible to put the detector system into a known state for the ESRF device driver and SPEC.

The *env* subdirectory contains an environment file for the two processes det_api_workstation and ccd_image_gather, called **log_api_xxx**, the detector database file **detector_db_xxx.txt**, and the device server interface library configuration file **config_ccd_xxx**, where **xxx** is the detector serial number. The detector database file is identical to that in the *F:\bin\detector_db.txt* file except that the gigabit network hostname for the frame grabber computer is used in place of the ESRF laboratory network hostname (example: adsc144a becomes adsc144a-local). All Q315 beam line configuration files are identical save detector serial numbers substituted in appropriate places.

Swapping in the Spare Frame Grabber Computer at the ESRF.

Frame grabber computers may fail, or the ADSC PCI interface card to the CCD detector controller module may develop a problem. A spare computer is supplied with each detector, complete with PCI interface card. This computer is configured and is kept on line all the time (CS directive). In order to substitute in the spare computer, called adscyyyspr, where yyy is the beam line number (example: adsc144spr), warm up the detector with the normal Quantum Console program if the "bad" computer can perform this operation (see Exceptional Circumstances above if not). Turn off the detector power supplies, move the fiber optic cable from the "bad" computer to the spare computer. Turn on the detector power supplies (see power up section above). Test with DBGLX32 on the spare computer (statusframe & voltages_v2.cdb macro) to make sure the serial link is good after this swap (check that you did not interchange the 0 and 1 fiber optic ends by accident by running DBGLX32 which will reports solid "Serial Link Bad" errors in the case of interchange of fiber optic cables; see the appendix on DBGLX for details on running this program).

Edit the database files in TWO places: *F:\bin\detector_db.txt* on the frame grabber computer. Comment out the spare computer "host" entry, replace with a line for the spare (such as adsc144b replaced by adsc144spr) and the same for the "module" line entry. Save this file. Restart Remote Detector OP or Operate Detector on each frame grabber computer. Perform the same editing job on the file *~blissadm/local/adsc/env/detector_db_xxx.txt.* Write the file back out and restart the detector software. Test the detector (if possible, warm), and if it is OK, use the Quantum Console to cool the detector down for normal operations.

If the Primary frame grabber computer completely fails (disk dies, computer dies) then it is suggested that the Spare computer be configured as the Primary computer. Note there is a backup copy of the *C:\pv_sw* from the Primary computer on the second computer which can be used. Be sure to make sure that the hostnames in the backup copy corresponds to the current beam line arrangement. See the section on the configuration of the Primary Frame Grabber computer above for details on sharing. Note it would be easiest to actually change the hostname of the spare to that of the "a" computer, otherwise it will be necessary to redo all the mapped drives on the other 8 frame grabber computers.

Procedure Summaries

System Startup and Shutdown Summary

Startup Summary:

a. Vacuum under 10 microns, both meters.
b. Coolant flowing and at 12 degrees C.
c. Frame grabber computers on
d. Bottom detector power supply on, wait 5 seconds, middle detector power supply on, wait 5 seconds, top detector power supply on
e. Bottom TE cooling power switch on, middle TE on, top TE on.

Cooling Summary:

a. Double click the "Operate Detector" on each frame grabber.
b. Double click the "Quantum Console" icon on one frame grabber.
c. Click the "Connect to Detectors" button.
d. Click the "Enable Temperature Control"..
e. Using the Temperature set box, put in "0" (do not hit enter or return). Push the "Set Temperature" button. This will lower the temperature to zero degrees C.
   - When all module status boxes read "Ready at Final Temperature", you are ready to continue.
f. Push the "Ramp to Cold Operating Temperature" button.
   - When all module status boxes read "Ready at Final Temperature", you are ready to operate the detector.
g Push the "Exit to Operate Detector" button and wait for the Quantum Console to exit.
h. If you use Remote Detector OP, exit Operate Detector and start Remote Detector OP on each computer.

Shutdown Summary:

a. Warm detector to +10 degrees C. (a-d above, push Warm up to +10 C button, then steps g, & h when all modules are at +10 C)
b. Exit all "Operate Detector" windows you may have open.
` c. Detector cooling power may be turned off.
d. Detector power may be turned off.
e. Coolant flow may be turned off if desired.
f. Vacuum pump may be turned off IF and ONLY IF the detector is VALVED OFF.

Appendix: DBGLX32

Using DBGLX32

DBGLX32 is a program which can run CCD controller macros stored in files. DBGLX32 can be used with a warm or cold detector. It is useful for diagnosing serial link or module ID errors (*statusframe & voltages_v2.cdb*), and repairing module IDs (*fix_wxyz.cdb*)

To look at the controller status, double-click the **DBGLX32** icon on the Desktop. Use the *File- ▪ Open* pull-down menu to select the file *statusframe & voltages_V2.cdb.* Push the **Run** button on the front panel of the **DBGLX32** dialog and scroll down the text window at the bottom until you see the line with the module serial number information at the end. You should verify that this is the correct serial number and that it agrees with the entry in *F:\bin\detector_db.txt* corresponding to the frame grabber computer you are using. If the output shows "Serial Link Error" for on each line, then there is a serial link problem. This could be detector power supply off, or the even/odd ends of this module's serial cable interchanged at one end. If the module ID is incorrect, then see below for a procedure to repair this. Exit **DBGLX32** when you are finished.

Note that for Version 8 of the detector API, an environment variable can be set to automatically repair module ID errors. See the section on detector environment variables.

Here is a listing of the statusframe *& voltages_v2.cdb* file for completeness:

```
pvInitCapture()
Reset
SendSerial U 5555
SendSerial $ 0000
SendSerial $ 0001
SendSerial $ 0002
SendSerial $ 0003
SendSerial $ 0004
SendSerial $ 0005
SendSerial $ 0006
SendSerial $ 0007
SendSerial $ 0008
SendSerial $ 0009
SendSerial $ 000a
SendSerial $ 000b
```

SendSerial $ 000c
SendSerial $ 000d
SendSerial $ 000e
SendSerial $ 000f
status frame

For each controller number *wxyz* there is a fix file called *fix_wxyz.cdb*. The file has the following form for NON-"r" Q210 and Q315 detectors:

```
pvInitCapture()
Reset
SendSerial U 5555
SendSerial &02yz
SendSerial &03wx
```

Use the Notepad program to change the letters *wx* and *yz* to the correct controller number values. For example, if you have controller serial number 6789, then the file will be called *fix_6789.cdb* and the contents will be:

```
pvInitCapture()
Reset
SendSerial U 5555
SendSerial &0289
SendSerial &0367
```

Note particularly that the first two digits *67* go on the last line with the "03" and the last two digits *89* go on the fist line with the "02". *Do not just assume you know the ordering and get this part backwards!*

For each controller number *wxyz* there is a fix file called *fix_wxyz.cdb*. The file has the following form for "r" Q210 and Q315 detectors:

```
Reset
SendSerial U 5555
SendSerial U 5555
SendSerial &02yz
Delay 1000
SendSerial U 5555
SendSerial &03wx
```

Use the Notepad program to change the letters *wx* and *yz* to the correct controller number values. For example, if you have controller serial number 6789, then the file will be called *fix_b789.cdb* and the contents will be:

```
Reset
SendSerial U 5555
SendSerial U 5555
SendSerial &0289
Delay 1000
SendSerial U 5555
SendSerial &03b7
```

Note particularly that the first two digits *b7* go on the last line with the "03" and the last two digits *89* go on the fist line with the "02". *Do not just assume you know the ordering and get this part backwards!*

One final note: All "r" controllers begin with "b". All non-"r' controllers start with some other hexadecimal character.

To repair a module ID, double-click the **DBGLX32** icon on the Desktop. Use the *File-▪ Open* pull-down menu to select the file *fix_wxyz.cdb* file and push the Run button. No confirming output is displayed, but you can open the file *statusframe & voltages_V2.cdb.* You need to power cycle the detector for this change to take place. Exit **DBGLX32** before cycling detector power. Naturally module ID repairs should be made on a warm detector.

Appendix: PIXELVIEW

Using and Configuring PixelView

You **MUST** use this program with the detector **WARM.** PixelView sets the temperature when it starts up and loads in the default library, and this temperature is set to correspond to room temperature.

Configuring PixelView

If the PixelVision driver has just been loaded (perhaps a system is being rebuilt from scratch), then there are some configuration steps so that PixelView will have a specific look with the proper options enabled with module pedestals set and a module library created. You will remove any other module library files that do not belong to this module in order to reduce possible confusion when this program is operated with a specific module.

For a specific module in the detector, double-click the PixelView icon on the Desktop. Maximize the PixelView dialog. Choose *Tools-▪ Options* and make these choices (and only these choices):

Upload Camera Settings at Startup
Use Small Buttons in Toolbars
Expert Mode

Select the *View* pull down menu and make these choices (and only these choices):

Balance Tool
Standard Toolbar
Image Toolbar
Cursor Toolbar
Exposure Toolbar
Status Bar

Select *Control ▪ Camera Setup*

Verify the following settings (when loaded, the computers should always have these settings):

CCD:

Channel Size 1100 1050

Binning 1 1
Data Size 2200 2076
Bytes per Pixel 2
Channels 4
Temperature (Kelvin) approximately 320 degrees K

Orientation:

Channels Wide 2 Channel Shift 0
Channels High 2
Horizontal Flip:
    Channel 1 selected
    Channel 3 selected
    All others not selected
Vertical Flip:
    Channel 2 selected
    Channel 3 selected
    All others not selected
Groupings A selected

Exposure

Extra Exposure Time 1000ms
Exposure Mode: Internal Trigger

ROI

Single ROI
Left 0 Right 1099
Top 2 Bottom 1039

Control

Gain High
Bandwidth High
Interrupt Mode Channel Mode

Rate

Pixel Period 5000 ns
Row Period 20000 ns
After Exposure Time 6.997445 ms
Image Transfer Period 20000 ns
Total Exposure Time (this is calculated by the program);

With a 1000 ms exposure it is about 1023 ms.

Use the Acquire button to take one image. If the program gives an error such as "Image too big to fit into buffers", then repeat the acquire request. PixelView will ask if you wish to "Reset the Camera?"; reply yes. PixelView should acquire an image successfully. Size the image window so that the border approximately fits the actual image size (which should be at 100% zoom). Select *Tools ▪ Save Workspace* to save your work up to this point.

Type the four pedestal values from the *F:\bin\controller_kind.txt* file which were for this module. These values will at least be close to correct. Determine the approximate value in each quadrant and adjust the pedestal value up or down to make this value as close to 1500 as possible. Changing the pedestal value by +1 will SUBTRACT about 10.5 ADUs from the value in a quadrant, and conversely changing the pedestal value by –1 will ADD about 10.5 ADUs to the value in a quadrant. When finished and the values in each quadrant about1500, select *Control ▪ Save Default Settings*. Then select *Control ▪ Save Settings as Library* and enter a library name in the format shown in the existing library (of the form mod_N_xxx_yyyy_320K, where N is the module number from 0 to 3 or 8, xxx the module serial number, and yyyy is the controller serial number). An example would be mod_0_402_2810_320K. Then select *Control ▪ Load Library Settings* and delete the prototype name mod_N_xxx_yyyy_320K. Write down the four pedestal values on a sheet of paper for this module. You may now exit Pixelview.

Using PixelView

You **MUST** use this program with the detector **WARM.** PixelView sets the temperature when it starts up and loads in the default library, and this temperature is set to correspond to room temperature.

Generally PixelView will be used to verify if the images a module takes have problems. Use the Acquire button to take one image. If the program gives an error such as "Image too big to fit into buffers", then repeat the acquire request. PixelView will ask if you wish to "Reset the Camera?"; reply yes. PixelView should acquire an image successfully.

We are looking for two things with the images. First, since the detector is warm, the images should look quite noisy. If they look exceptionally smooth with very low noise then there is a problem. Second, there should be a small but identifiable "step" in the image center, called the "over scan area". This is a vertical strip with slightly lower values as you go across the center of the chip. If there is no identifiable step in a one second image then there is a problem.

Installing the LionM PCI card device driver

The Windows XP system communicates with the detector controllers via a PCI card called a "LionM". Like all devices in a Windows computer, it needs to have a device driver installed in order for it to be used by the detector software.

The device driver comes in a zip file called PixelView_3.zip. Unzip this file and install it in the directory **C:** on a windows computer. The directory **C:\PixelView_3.21** will be created. Go to the directory **C:\PixelView_3.21\pv_for_xp** and double-click on the file **inst.bat.** This install batch file will put the files in all the necessary places in your system. Push the "OK" button when you are asked to acknowledge actions it is taking.

Next, right click "My Computer" ▪ "Mange" ▪ "Devices". Look at the right hand side of the dialog and under Data Acquisition you will find an "unknown data acquisition PCI card" (I think these are the right words, but I am not sure, but it as least should have a question mark by it). Double click on this and an Installation Wizard will be activated. Answer the question about "Find this on the Web" as "No, not this time". Choose the default for subsequent questions. When finished, the device driver installation should be successful. You should reboot the computer to make sure the new driver is properly installed.

After the computer is rebooted, you should rename the directory **C:\PixelView_3.21** to **C:\PixelView 3.21** (replace underscore with space). Then you can drag the shortcuts to PixelVIew and DBGLX32 onto the screen from the shortcuts directory **C:\PixelView 3.21\shortcuts** if they are not already present. The reason for the name change in the directory (underscore to space) is that the **inst.bat** file is a DOS file and as such cannot have spaces in the names it references. But the PixelView software and shortcuts expect the space in the name. So it needs to be changed after the driver install.