1 General

The operating system delivered with the Sr90 setup sets the basic environment. This includes the environment variable $USBBOARDPATH. The $LD_LIBRARY_PATH and the $PATH variables contain $USBBOARDPATH/Builds, where the readout libraries and the executables are placed.

2 Updates

in $USBBOARDPATH do
> git pull (enter your CERN credentials)
> qmake (to create Makefiles)
> make (to compile)

You can and should do regular updates of the distro, either from the command line
> sudo apt-get update
> sudo apt-get dist-upgrade
or via the update manager GUI. In case the kernel is updated, you may need to reinstall the kernel module for the QuickUSB device used in the USB boards. This is done from the command line
> cd $USBBOARDPATH/support/QuickUsbLibrary_v2.15.2_Linux
> sudo -s
> ./install-linux.sh
> exit
(Do not use "sudo ./install-linux.sh" otherwise you may need to run the readout beeing root all the time)

3 Configuration Files and Light Injection

You can find the configuration files in $USBBOARDPATH/cfgFiles, one for every board. Please only change the values for your board. There are three values you may need to adjust depending on your setup: laserModulationCurrent, laserBiasCurrent, laserPulseWidth. The board is capable of driving up to four LASER diodes, therefore you see four values for laserModulationCurrent and laserBiasCurrent. The values should be adjusted such that pedestal and the one-pixel peak is roughly at the same height for all channels. In order to increase the amount of light, you should first increase the laserModulationCurrent value up to 64. If that is not enough light, you can increase the laserBiasCurrent up to a value of 4 (make sure the LASER is not permanently shining/glowing, reduce again otherwise). The final possibility to increase the light is to increase laserPulseWidth up to 15.

4 Configuration Files and Delay Scans

In order to do delay scans with the light injection system or particles you have to change the following:

Enable/disable random triggers from USB board
selfTrigEnable | | 1 | |
selfTrigEnable | | 0 | |

Delay added to either the trigger passed to the USB board or the light injection pulse. It is used to save the current signal on the frontend chips for the later sequential digitization. We should sample on the maximum value of the pulse shape. The value is given in 25ns steps. Unfortunately, the delay adds a 25ns jitter for clock-asynchronous triggers, i.e. particle triggers.
holdDelayTime | | 11 | |

You can choose if you want to actually enable the delay for every uplink. When doing a delay scan with particles it is recommended to disable the delay and to use an external cable delay unit to set the timing. In this case there is no jitter.
holdType | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | | 1 | |
holdType | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | | 0 | |

Enable/disable light injection. When used together with selfTrigEnable you can choose if you want to take light injection or pedestal data.
lightInjectionModeEnable | | 1 | |
lightInjectionModeEnable | | 0 | |

In oder to do a delay scan with particles, it is advisable to collimate the Sr90 beam to a few channels—maybe four channels or 1 mm gap between the absorbers on top of the mat. When you set the projection line in adcView into one of these channels you are not dominated by the pedestal and you can directly determine the gain in the software. When you plot gain vs. delay you will the pulse shape of the front-end chips. You should take the delay corresponding to the maximum

5 adcView

Fig. 1 shows a screenshot of the adcView software, which is mainly used for debugging purposes like delay scans. It shows online the data read from the USB board for each of the eight uplinks. One plotter is used per uplink. You can use "add plotter" to see several uplinks at the same time. The uppermost row in a plotter are the raw ADC values of an uplink of the currently read event. The lowermost row is a two dimensional histogram of these values since the time the "clear histograms" button was pressed. The central row is the projection of the channel marked by a line in the lowermost histogram. You can select the projected channel at the top of the GUI. The other items:

- start/stop readout: clear

- auto calibration: the software can do an automatic determination of the SiPM gain of the projection histogram. The lines mark the determined gain/pedestal. Use the determined values only if you see the lines matching the peak positions!

- motherboard: The electrical order, i.e. the order of the frontend card data, is not the geometrical order. Enabling the motherboard checkbox, puts the channels into a geometrically adjacent order. You should press the reset histograms button afterwards. (The frontend board cards are upside down in the sr90 setup. Therefore, the uplink data is flipped as well. Not corrected for the $0, 1, 2...254, 255 \rightarrow 255, 254, ..., 2, 1, 0$ flip, but they are adjacent.)

- set range: you can use this to zoom into the ADC value range for all histograms.
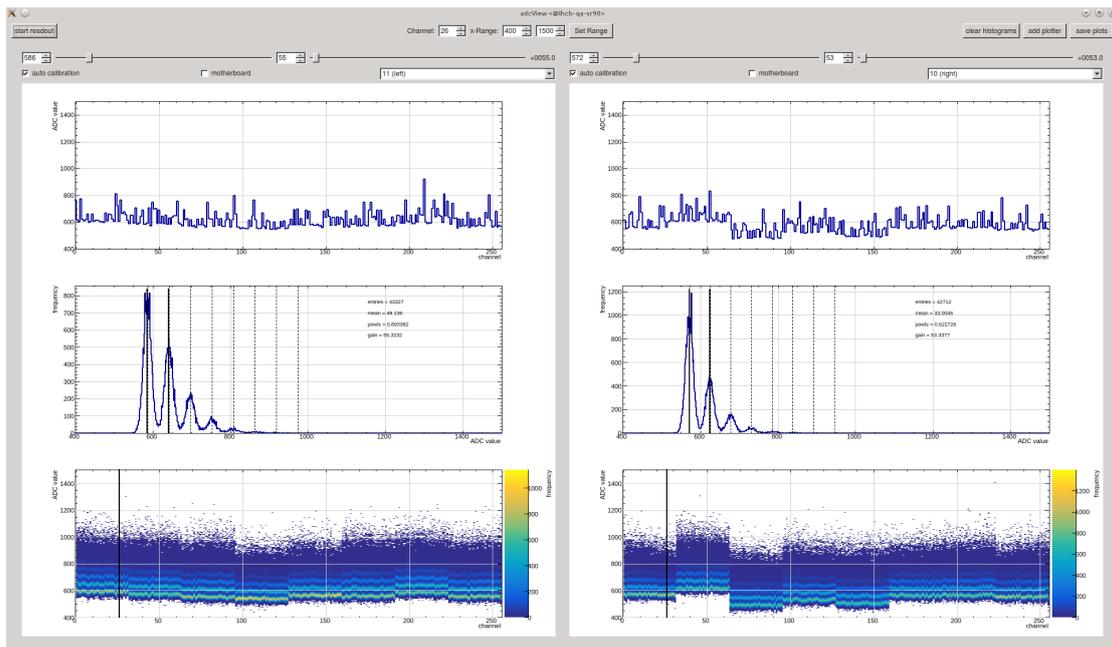

Figure 1: Screenshot of the adcView software.

6 strosmic90

The strosmic90 software is used to take data and to analyze both online and offline. It automatically uses the configuration files in $USBBOARDPATH/cfgFiles.

6.1 Data Taking

First you should enter the mat name. We use Hyperion 1300G-2 barcode scanners at Aachen (only bar codes, not QR) to fill in the mat name from the barcode. You may use any other that supports the KBW protocol, meaning the scanner acts like a
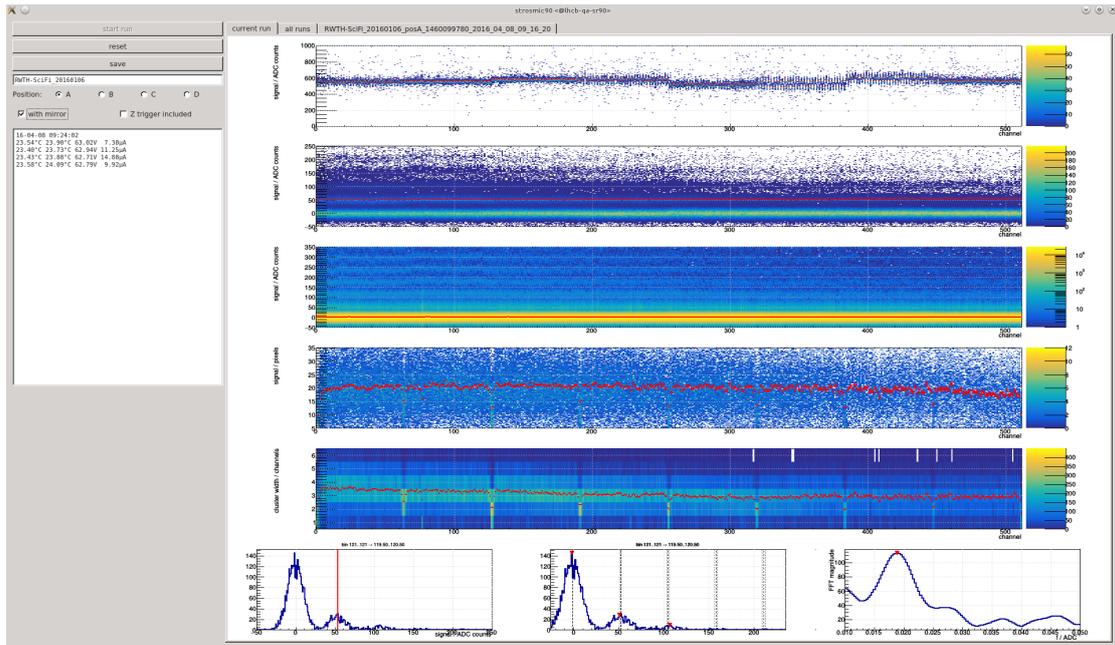
Figure 2: Screenshot of the strosmic90 software. Topmost histogram: pedestal position, second: light injection, third: raw ADC values, fourth: cluster light yield, fifth: cluster width, sixth: projections shown when you move the mouse over the histograms. On the left you can see the housekeeping data.

keyboard typing the text encoded in the barcode. In case you have a mirror attatched to the mat check the respective check box. You always measure at position A (close to the mirror).

After installing the mat in the setup, closing the light-proof box, and switching on the voltage (we recommend a KEITHLEY 2200-72-1) you can start a run. It will create a file like

"matname_posA_1458812734_2016_03_24_10_45_34.root"

in the folder you started the software. You will have "...posAM..." when you have checked the mirror check box.

The run is stopped after 30 Minutes and a new run is started automatically. Usually, you will only need 500k events for a measurement, which is five Minutes at the maximum readout rate of 2.0 kHz and you can stop the run earlier.

Please make sure that you see the typical light injection spectra in the second histogram from above and that the rest of the histograms look "normal".

After the data taking is finished the save button enables. You can press it and summary files are produced in the folder you started strosmic90:

- A root file that contains all the histograms you see in the software and some additional ones. You can use this file for later analysis.

- The root file is used to generate a pdf and txt file that should be uploaded to the database. This is done via a system call to strosmic90summary (a subprogram).

6.2 Offline Analysis

During data taking a root file with the raw data trees is created in the folder where strosmic90 was opened. The root file is always written (the save button, which is used to save the analysis results and the summary sheets, has nothing to do with it). The file has the name structure "matname_posA_1458812734_2016_03_24_10_45_34.root". You can at any time later run strosmic90 passing this raw file name and the software will read the events from the file just as if you were taking data.

7 strosmic90summary

As mentioned before the analysis can produce pdf and txt files for the database. If you only have the summary root files, you can also create these later in the folder you launch the following command

strosmic90summary 4TSAACFIM00034_posA_Summary_1464101452_2016_05_24_16_50_52.root