

## Nicos Integration - CHARMing software suite

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In the last year I worked on implementing a new software (<https://github.com/zweistein-frm2/CHARMing> , binaries in [https://github.com/zweistein-frm2/CHARMing\\_binaries](https://github.com/zweistein-frm2/CHARMing_binaries) ) for fast Data Acquisition of Neutron X-Y data. This software interfaces with the new Charm detector and with existing Mesytec hardware as used for example in the SANS1 detector. The software has been newly designed from scratch with the goal of highest data throughput, easy installation, highest reliability and full integration into the Entangle framework.

Below an already fully operational proposal for a Charm or SANS1 detector interface in Nicos. The server side data is supplied by the CHARMing software entangle server .

The following key features are implemented and fully working:

- histogram and raw histogram display
- charm and mesytec device(s) support
- ROI (Region Of Interest) manager with polygon ROI support
- Real-time histogram with improved contrast using CLAHE algorithm
- Easy control of charm high voltage supply
- Listmode file replay functionality

The screenshot shows the Nicos GUI interface. The top panel, 'NICOS devices', displays a tree view of connected devices and their status. The 'charm' device is expanded, showing sub-devices like 'counter', 'histogram', 'histogramraw', 'monitor0', 'roimanager', 'settings', and 'timer'. The 'detector' device is also expanded, showing 'charm' and 'hvsupply'. The 'system' device is expanded, showing 'Erwin', 'Exp', and 'LogSpace'. The bottom panel, 'Experiment info', shows the 'Proposal' tab selected, with a console window displaying the command 'count(t=30)' and a status window showing 'Status: Counting' and a log of device creation and setup loading.

Name	Value	Status
charm		
counter	357 cts	DAQ_Running sync_ok
histogram	0 cts	
histogramraw	0 cts	
monitor0	0 cts	
roimanager	[357] energy unit cts	[POLYGON((0 0,0 256,512 256,512 0,0 0))]
settings	[{"writelismode": false}]	
timer	7.05 s	DAQ_Running sync_ok
detector		
charm	timer = 7.05, monitor0 = 0, counter = 357, histogram = 0, histogramraw = 0	counters=DAQ_Running sync_ok, timers=DAQ_Running
hvsupply	[{"0_1_7": "-40.0000V"}, {"0_1_0": "74.9998V"}, {"0_1_1": "89.9997V"}, {"0_1_2": "85.0002V"}, {"0_1_4": "75.0000V"}, {"0_1_5": "79.9999V"}]	CONNECTED : 55004ed5d0f14-29
system		
Erwin		
Exp		
LogSpace	33.495 GiB	33.49 GiB free

**Experiment info**

Proposal

Title

Users

Local Contact

Setups: detector

Samples

Environments

Detectors: charm

Scans

Remark

Console

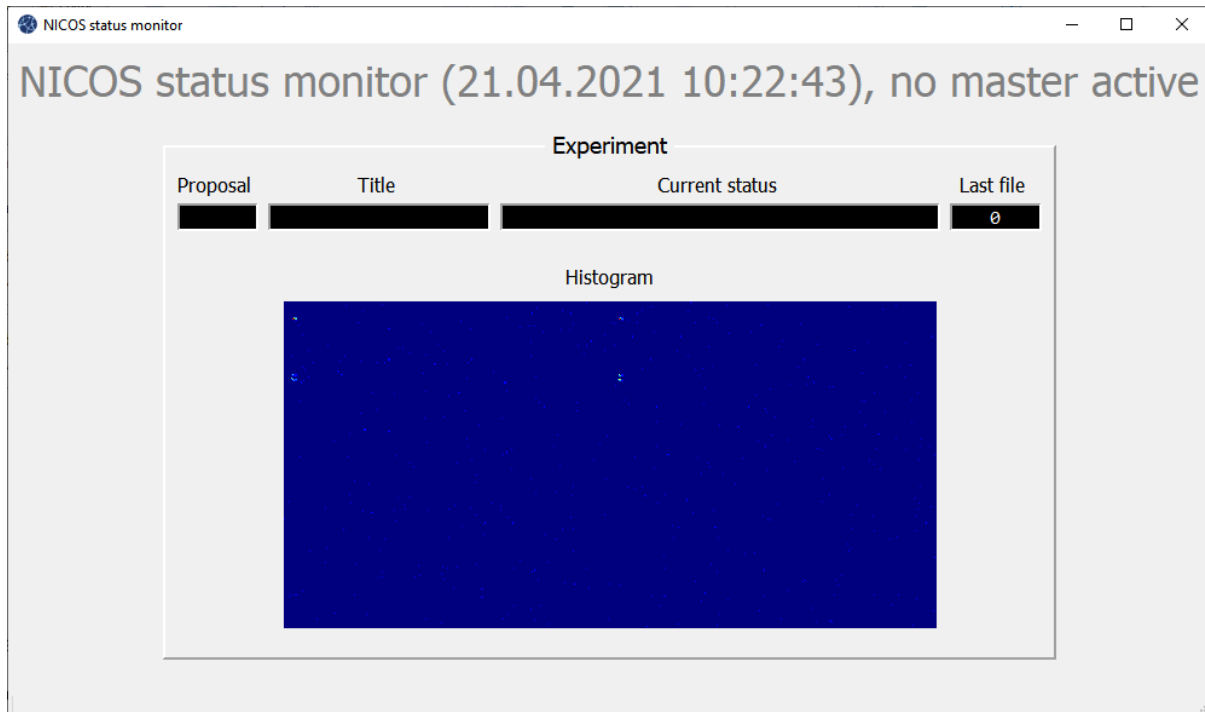
```
count(t=30)
```

Status: Counting

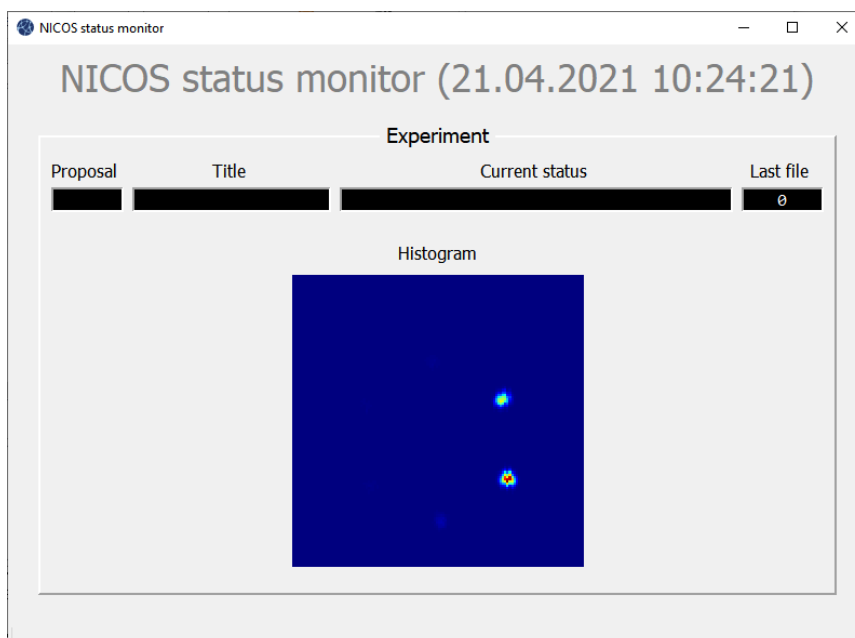
```
[15:19:27] creating device 'livesink' (Sends image data to LiveViewWidget)...
[15:19:27] creating device 'rawsink' (Saves image data in RAW format)...
[15:19:27] setups loaded: startup
[15:19:27] checking master status...
[15:19:28] switched to master mode
[15:19:28] loading previously used master setups: 'detector'
[15:19:28] loading setup 'system' (system setup)
```

### Charm and Mesytec device support:

Both Charm device format and Mesytec device format (for example SANS1) are supported. Currently the Charm 2 segment detector support is implemented, but any segment number can be easily realized; here an Charm example histogram with size 512x256 (2 segments) :



Here a SANS1 histogram with size 128 x 128 :



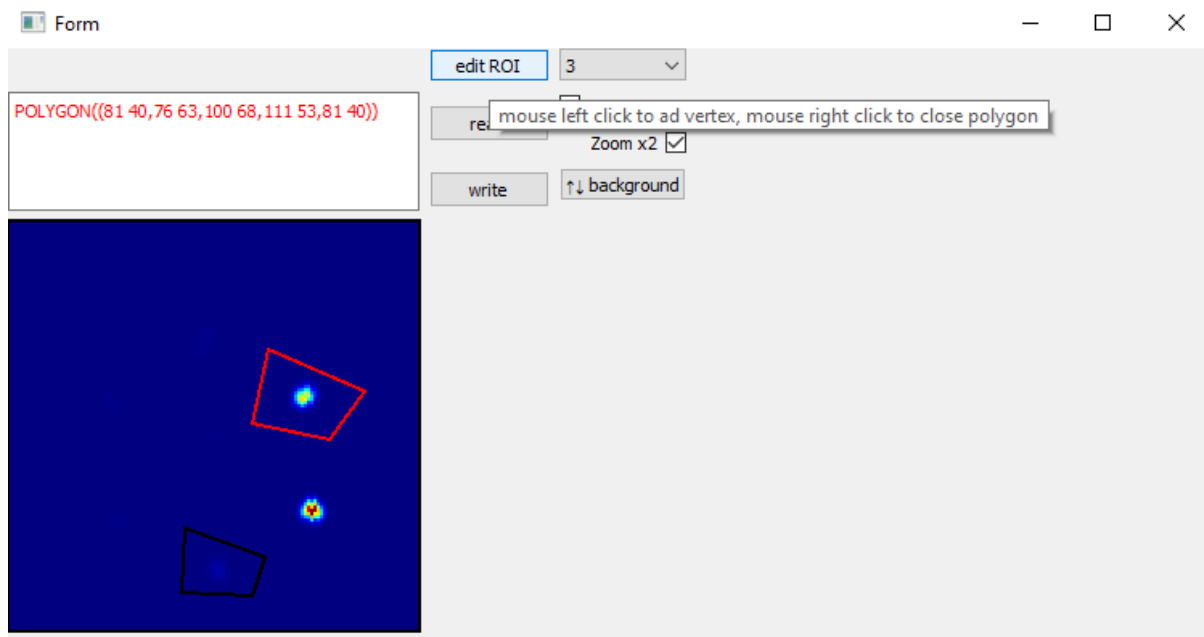
Acquisition of binned histograms and raw histograms can be done contemporaneously.

## ROI (Region of Interest) Manager

Measuring X-Y Neutron data is all about counting the Neutrons in specific areas. Therefore a flexible ROI manager was implemented: All ROI counting is already done at the CHARMing entangle server.

Multiple Polygon ROIs can be defined.

The following form pops up by choosing the edit... menu of the roimanager device.



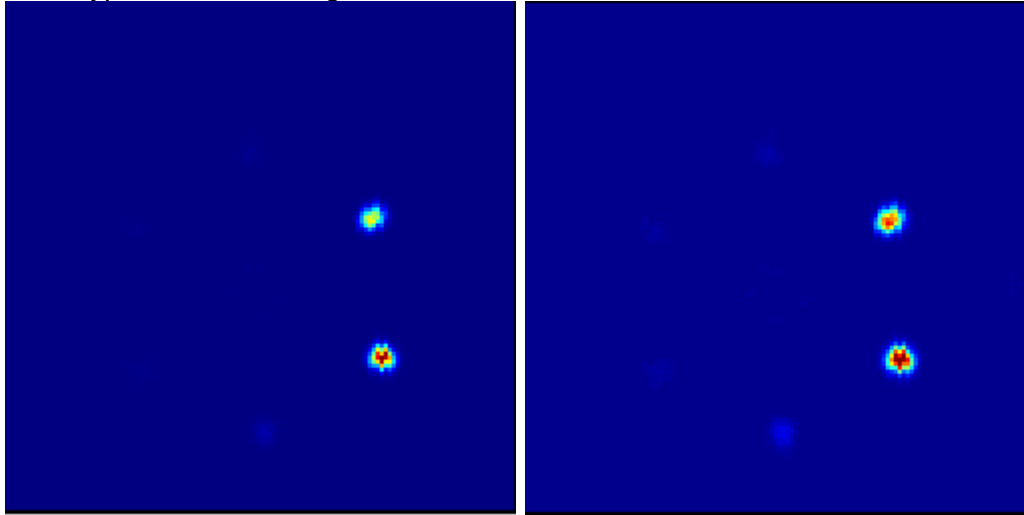
Polygon ROIs can be defined with a few mouse clicks: The procedure is the following:

1. Choose Polygon Number
2. Click edit ROI button
3. Left mouse clicks add vertices to the polygon
4. Right mouse click closes the polygon.
5. When satisfied with the polygon click the “write” button.
5. Esc key cancels a current edit.

## Real time histogram with improved contrast (CLAHE algorithm)

For better contrast during real-time display of histogram data you can apply the CLAHE algorithm : [https://docs.opencv.org/master/d5/daf/tutorial\\_py\\_histogram\\_equalization.html](https://docs.opencv.org/master/d5/daf/tutorial_py_histogram_equalization.html)

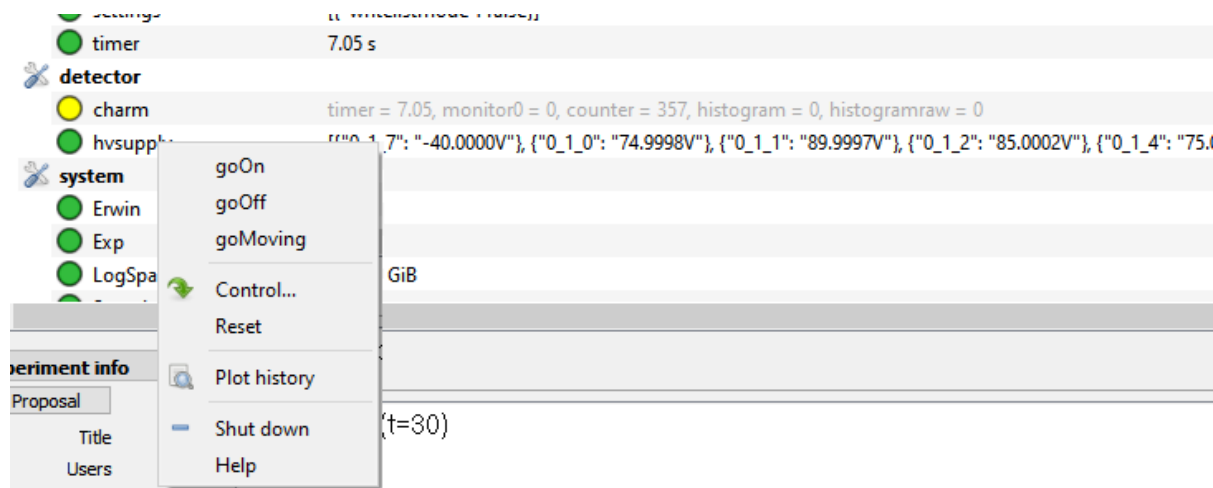
For a typical SANS1 image here the difference:



In this example the CLAHE equalized image on the right shows better contrast and all 6 diffraction areas are visible while in the normal image only 3 diffraction areas are visible.

## Easy control of Charm High Voltage supply.

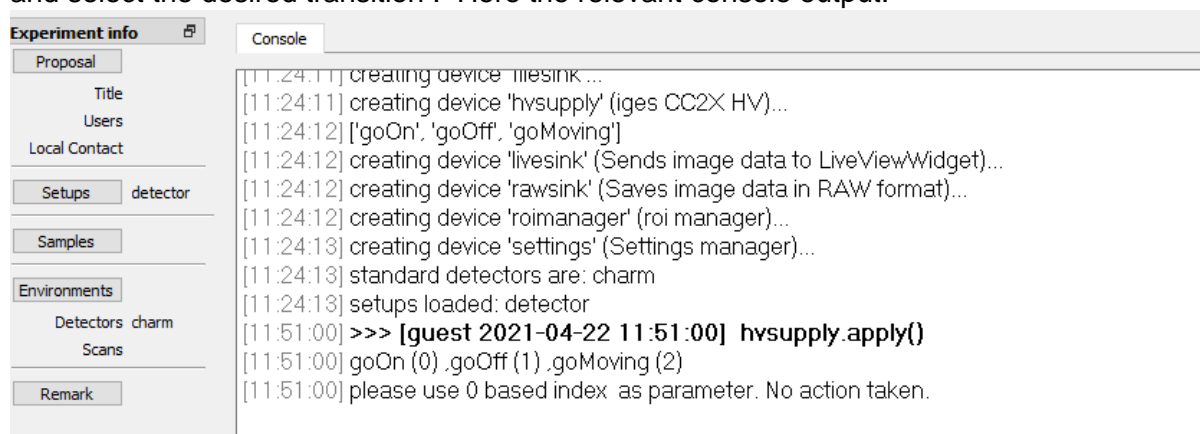
The Charm High voltage supply device is an intelligent power supply that supports ramping operations of multiple channels in a defined manner. For the current Charm device three different ramping operations, “goOn”, “goOff” and “goMoving” are defined. The desired action can be selected by a right mouse button click on the hvsupply device:



If you prefer the command line interface : The underlying device function inside Nicos is the `hvsupply.apply()` function. It is self explanatory and integrated in the help system.

`hvsupply.apply()` will communicate with the entangle device; for the iseg power supply ( see [https://github.com/zweistein-frm2/CHARMing\\_binaries/blob/master/linux/x86\\_64/entangle%20iseg%20CC2x%20interface.pdf](https://github.com/zweistein-frm2/CHARMing_binaries/blob/master/linux/x86_64/entangle%20iseg%20CC2x%20interface.pdf) )

and select the desired transition . Here the relevant console output:



## Replay of Listmode files:

The CHARMing software suite allows for writing real-time Neutron Data to listmode files. At a later time the user can then replay the listmode file in the very same way as conducting a real-time experiment.

Please choose the setup “replay” for this functionality (CHARMing entangle server needed, for a suitable configuration file see [https://github.com/zweistein-frm2/CHARMing/raw/master/entangle-charming/entangle/example/listmode\\_replay.res](https://github.com/zweistein-frm2/CHARMing/raw/master/entangle-charming/entangle/example/listmode_replay.res) )

This will create a listmode device that will behave as a detector, but in reality a listmode file is streaming data into Nicos.

The screenshot shows the Nicos software interface with the 'replay' setup selected. The 'NICOS devices' panel displays a list of devices and their values:

Name	Value	Status
listmode		
counter	108757 cts	
histogram	108019252 cts	
histogramraw	54017470 cts	
monitor0	4041387 cts	
monitor1	5729283 cts	
monitor2	416840 cts	
monitor3	0 cts	
playlistmanager	('C:/Users/alanghoff/0676769.mdat')	
roimanager	[53978350, 53978350] energy unit cts	
timer	9.60 s	
replay		
listmode	timer = 9.60, monitor0 = 4041387, monitor1 = 5729283, monitor2 = 416840, monitor3 = 0, counter = 108757, histogram = 108019252, ...	counter=sync_ok, tir
system		

The 'Console' panel shows the following log messages:

```
[12:04:26] creating device 'livesink'...
[12:04:26] creating device 'histogram' (Histogram image from the device)...
[12:04:26] creating device 'histogramraw' (Histogram raw image from the device)...
[12:04:27] creating device 'listmode' (Charm or Mesytec 2D Neutron listmode replay)...
[12:04:27] creating device 'monitor0' (Monitor 0 for the sans1 detector)...
[12:04:27] creating device 'monitor1' (Monitor 1 for the sans1 detector)...
[12:04:28] creating device 'monitor2' (Monitor 2 for the sans1 detector)...
[12:04:29] creating device 'monitor3' (Monitor 3 for the sans1 detector)...
[12:04:29] creating device 'timer' (Timer for the sans1 detector)...
[12:04:30] creating device 'livesink' (Sends image data to LiveViewWidget)...
[12:04:30] creating device 'playlistmanager' (PlayList manager)...
[12:04:30] creating device 'roimanager' (Saves image data in RAW format)...
```

## Installation:

### Prerequisite: You must install a

**Linux :** Please download [https://github.com/zweistein-frm2/CHARMing\\_binaries/raw/master/linux/x86\\_64/nicos-install-erwin\\_charming](https://github.com/zweistein-frm2/CHARMing_binaries/raw/master/linux/x86_64/nicos-install-erwin_charming)

Then: `chmod +x nicos-install-erwin_charming`

Then: `sudo nicos-install-erwin_charming`

This will install all files in the `nicos_mlz/erwin_charming` subdirectory of the Nicos installation.

Source code: can be downloaded from [https://github.com/zweistein22/erwin\\_charming](https://github.com/zweistein22/erwin_charming)

### Windows/Manual installation:

Please copy the files from [https://github.com/zweistein22/erwin\\_charming](https://github.com/zweistein22/erwin_charming) into the directory

`/<nicos_root>/nicos_mlz/erwin_charming`

Prerequisites : several pip packages have to be installed : These are defined in <https://github.com/zweistein-frm2/CHARMing/raw/master/entangle-install-charming/entangle-install-charming.cpp>

Please install these packages by hand.

**Run:** To run nicos in `erwin_charming` configuration please execute:

```
cd /<nicos_root>/nicos_mlz/erwin_charming
python3 erwin-loader.py
```