CCD Data Acquisition - HowTo

Two dimensional scattering data acquisition is possible in SPEC sessions that are specially configured, e.g MSENSI on ID02 or PSIC on ID01. Before starting a new experiment you must define the destination folder and the filenames with the command **`ccdnewfile`**.

ccdnewfile

```
Directory for saving CCD files ()? ./
CCD file prefix (test_)? dg13_
CCD file suffix (ccd)?
Next run number (1)?
Next file (camera 0) -> "./dg13_0_0001ccd"
Next file (camera 1) -> "./dg13_1_0001ccd
```

You should also update the experiment info for each camera with the command **`ccdexpinfo`**.

ccdexpinfo

This command is used to update some information that will be saved in the file header together with the data. At start, you will get an information about the currently used detector region:

```
Detector number 0
Current binning:  BSize_1=  1,  BSize_2=  1
Current offsets: Offset_1=  0, Offset_2=  0
```

All input must refer to the currently chosen binning sizes and offsets.

`Proposal number`: Proposal number of the experiment.

`Title`: Title that describes the next exposure. It can also be given later when the exposure is started (free format string, max 255 characters).

`ExperimentInfo`: General description of the experiment and, name of participants (free format string, max 255 characters).

`Center_1, Center_2 [pixel units]:` Horizontal and vertical pixel coordinates of the center. This position is usually approximately correct for the SAXS detector, because it is calculated automatically for the different binning modes. It is defined on the full detector image. It is the same whatever region of interest (ROI) is chosen. The point can lie outside the active detector area. In the case of an inclined detector it is identical to the point where the detector normal points to the sample (PONI). In the special case of a detector perpendicular to the primary beam, e.g. a 2d-SAXS detector, this point is identical to the position where the primary beam would hit the detector.

`Pixel Size 1, Pixel Size 2 [mm]:` The pixel size of the detector for the current binning mode. This value is usually already approximately correct, because it is calculated automatically for the different binning modes. If a spatial distortion correction is applied during the correction this value will be overwritten by the more accurate value that is contained in the spatial distortion file (see below).

`Sample to detector distance [mm]:` This value sets the sample to detector distance if the value is not updated automatically.

The following three parameters select the scalers that will be used for transmission measurement, normalization and exposure time. All signals are integrated over the exposure time. The preselected scalers are usually already sensible and do not need to be changed.

The I0 scaler is used to get a reference value for the transmission measurement. A scattering foil scatters a small fraction of the primary beam into a PIN diode.

Only the I1-scaler is included into the normalization. It is usually a PIN diode that is mounted inside the beamstop. Because it absorbs the full primary beam after the sample the signal quality is usually better than that of the I0 scaler. The transmission value T=I1/I0 is valid on the condition that the number of scattered photons is very small compared to the number of incident photons and that the sample is a flat plate that covers the full beam.

`Scaler number for incident photons:` The number of the I0-scaler that integrates the number of incident photons.

`Scaler number for transmitted photons:` The number of the I1-scaler that integrates the photons in the transmitted primary beam. If there is no valid I1-scaler available the I0 scaler should be used. In this case the calculated sample transmission is always 1 and the transmission must be determined separately.

`Scaler number for exposure time:` The scaler that integrates the exposure time (usually called "Seconds").

ccdscalers

To get an overview over all defined scalers independend of ccdexpinfo type **ccdscalers**, to dump all scaler settings type **ccddump**. This list can be written into a file and can be reloaded with qdo, e.g. **ccdump dumpfile** and **qdo dumpfile.**

The command **wss** can also be used to display scaler settings (zerovalue, factor) but the output cannot be reloaded easily.

The scaler counts and values of the last acquisition can be displayed with **ws [<frame-number>]**. If no frame-number is given the values of the last acquired frames are shown.

The calculation of scaler values from scaler counts is done in the following way:

```
value = (counts - exposuretime * zerovalue) * factor
```

ccdscalerzero

The monitor signals are amplified and converted to frequencies with voltage to frequency converters (VFCs). The output pulses are integrated over the exposure time.

Because the output frequencies of the VFCs are not and should not be zero when there is no beam, the zero values of all scalers that are connected to a VFC must be calibrated. The integrated scaler counts without beam are proportional to the exposure time and must be subtracted for a correct measurement. The command

ccdscalerzero <counting-time[s]> [<fst_scaler> <lst_scaler>]

is used to calibrate all scalers between **fst_scaler** and **lst_scaler**. When this command is executed the beam shutter must be closed. The range between fst_scaler and lst_scaler must only include monitors after the beam shutter.

If in doubt, close the front end beam shutter in **IDAPPLI**, type **ccdscalerzero 60** and reopen the front end beam shutter afterwards. Dump the setting to a file.

ccdscalercalib

The following command can be used to calibrate the measured transmission value to one. They should be used with care. If you are not really sure how to use them ask the beamline staff for help.

After centering the beamstop in the primary beam and after defining the monitor scalers the command **ccdsettrm** can be used to calibrate the transmission to 1.

More generally, the command

ccdscalercalib <ref_scaler> <fst_scaler> <lst_scaler>

allows to calibrate the values of a range of scalers to the value of a reference scaler.

This calibrations are done by adapting the scaler calibration factors.

ccdactive

Before using a CCD camera it must be activated with

ccdactive <ccdu1> [<ccdu2> ...],

where ccdu1 and ccdu2 are the unit numbers of the CCDs that should be exposed simultaneously. The main detector is usually number zero. Please ask the beamline staff what detectors are available.

corimgmenu

Use **`corimgmenu [<ccdu>]`** to set-up the desired online corrections.

ccdcoron

The commands **`ccdcoron [<ccdu>]`** and **`ccdcoroff [<ccdu>]`** allow to activate and to deactivate online correction. Without a parameter the command is applied for all active cameras.

ccdacq

A CCD exposure can be started with the command

```
ccdacq <time[s]> [<title>]
```

This command acquires simultaneously for each detector a dark image (fast shutter closed) and a scattering image. Once a dark image is taken it can be used for subsequent exposures using the same exposure times:

```
ccdacq_nodark <time[s]> [<title>]
```

Depending on the detector system slight differences in the exposure times can be admitted. Ask the beamline staff for details.

Alternatively, the commands **`ccdexpose`** and **`ccdexpose_nodark`** are available.

ccdtrans

The command ccdtrans allows scan of the motor <mne> and to take an exposure at each scan point. Only at the beginning <ndark> dark images are taken. The minimum cycle time between exposures can be defined by <sleep>. If this time is shorter than the duty cycle the exposures are done as fast as possible. If <mne> is an empty string "" the scan is done without a motor. This is identical to the command **`ccdframes`**.

```
ccdtrans <mne> <first> <last> <steps> <time(s)> [<sleep(s)[0]>
                <title> <ndark> <save(0|1)>]
```

alldump

Use **`alldump [<filename>]`** to dump all settings, experiment infos, filenames, scaler calibrations and correction options to a file.

ccdhelp

A summary of useful commands can be displayed with the command **`ccdhelp`**:

```
Type 'ccdexpinfo' to set-up CCD header information
Type 'ccdnewfile' to define CCD-filename and directory
Type 'ccdactive' to set a CCD active/inactive
Type 'ccddark' to acquire CCD dark images
Type 'ccdpause' to pause before a CCD acquisition
Type 'ccdacq' to start a single CCD acquisition
Type 'ccdframes' to start several CCD acquisitions
Other macros: 'ccdtrans'

Type 'corimgmenu' to set-up CCD online correction options
Type 'ccdcorrect' to correct CCD images without saving.
Type 'ccdcorsave' to correct and save CCD images.
Type 'ccdcoron/off' to switch on/off correction of CCD images.
Use 'alldump <dump-file>' <-> 'qdo <dump-file>' to save
CCD settings, e.g. before a start from fresh

Type 'ccdhelp' to redisplay this message.
```