D8 Series

User Manual

LYNXEYE XE User Manual

Original Instructions

Innovation with Integrity

XRD

We have checked the contents of this manual for agreement with the hardware and software described. Since deviations cannot be precluded entirely, we cannot guarantee full agreement. However, the data in this manual are reviewed regularly and any necessary corrections are included in subsequent editions. Suggestions for improvement are welcome.

All configurations and specifications are subject to change without notice.

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LYNXEYE XE™ Detector User Manual

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LYNXEYE XE™ Detector User Manual

1 Safety Issues

This manual contains notices which you should follow to ensure your own personal safety, as well as to protect the product and connected equipment. These notices are highlighted in the manual by a warning triangle and are marked as follows according to the level of danger:

Danger

The word 'Danger' indicates that death, severe personal injury, or substantial property damage will result if proper precautions are not taken.

Warning

The word "Warning" indicates that death, severe personal injury or substantial property damage can result if proper precautions are not taken.

Caution

The word "Caution" indicates that minor personal injury or property damage can result if proper precautions are not taken.

Note

The word "Note" draws your attention to particularly important information on the product, handling the product or to a particular part of the documentation.

1.1 Qualified Personnel

The LYNXEYE XE™ may only be set up and operated in conjunction with this manual. Only personnel authorized by Bruker AXS is allowed to work on this equipment. All repairs, adjustments and alignments performed on any components of the LYNXEYE XE must be carried out strictly in accordance with the established safety practices and standards of the country where the equipment is installed.

1.2 Correct Usage

This device and its components may only be used for the applications described in this manual and only in connection with devices or components from other manufacturers which have been approved or recommended by Bruker AXS.

This product can only function correctly and safely if it is transported, stored, set up and installed correctly and operated and maintained as recommended by Bruker AXS. Protection provided by this equipment may be impaired if it is used in a manner not specified by Bruker AXS.

1.3 X-ray Equipment

Warning

X-ray equipment produces potentially harmful radiation and can be dangerous to anyone in the immediate vicinity unless safety precautions are completely understood and implemented. All persons designated to operate or perform maintenance need to be fully trained on the nature of radiation, X-ray generating equipment and radiation safety. All users of the X-ray equipment are required to accurately monitor X-ray exposure by proper use of X-ray dosimeters.

For safety issues related to the operation and maintenance of your particular X-ray generator, diffractometer and shield enclosure, please refer to the manufacturer operation manuals or your Radiation Protection Supervisor. The user is responsible for compliance with local safety regulations.

The LYNXEYE XE detector itself is no source generating X-rays, it just senses X-rays.

Warning

Voltage Danger - Before installing the detector, switch off the system to avoid high voltages.

Bias voltages up to 500 V DC are accessible from the outside! They are present on the metal sensor window on the front side of the detector! Never operate the detector with Bias voltage switched on without having the detector optics mounted!

Inside the LYNXEYE XE, Bias voltages up to 500 V DC can occur which are not accessible from the outside. After turning off the system, Bias voltages are still present. They discharge over time.

Warning

Sometimes complex D8 systems will be supplied by several power supply lines. The system and its components will be live until all power lines connected to the system are disconnected from the mains power supply.

Caution

Switching ON/OFF the detector Bias will initiate a ramping process for the Bias voltage. This process is indicated by a flashing BIAS READY LED. In all cases wait until the ramping process has finished.

When switching ON the detector Bias this will be indicated by a steadily lit BIAS READY LED.

When switching OFF the detector Bias this will be indicated by the BIAS READY LED turning off.

Any violation of this precaution rule might result in a reduced lifetime or damage of the detector.

Caution

Never touch the metal sensor window of the detector entrance window with fingers or tools. Any partial damage on this thin layer might lead to non-repairable malfunctions of the detector; the warranty is not valid any more.

Caution

Use care when moving the detector head to avoid mechanical shock to the assembly.

1.4 Proper Lifting

Installation of the detector requires lifting of components with heavy weight (e.g. enclosure front panel). Whenever possible, two or more people should lift objects together. Use proper lifting techniques at all times. Use the following steps as an overview of proper lifting techniques.

1. Plan: practice the lift. While lifting, bend at the knees, keep your back straight, tighten your stomach and lift with your legs.
2. Position: keep your body close to the object you wish to lift - your stability increases the closer you are to the object. Keep your feet shoulder width apart.
3. Movement: avoid making awkward movements while holding a heavy object. Get help if the object is too heavy or cumbersome.

2 Introduction

This manual covers installation and basic operation of the LYNXEYE XE detector. The LYNXEYE XE is a 1-dimensional detector for X-ray powder diffraction, based on Bruker AXS' compound silicon strip technology. Compared to a simple point detector the LYNXEYE XE dramatically increases measured speed – without sacrificing resolution and peak shape. A Diffraction Solution equipped with the LYNX-EYE XE records a typical powder pattern in approximately $1/100^{th}$ of the time required using a point detector, with identical data quality.

The LYNXEYE XE is based on the silicon strip detector technology. The active area of the detector is 14.4 mm by 16 mm (along the scattering plane respectively perpendicular). The 192 strips of the sensor act as 192 individual detectors. This technology allows operation at count rates much higher than those typically possible with gaseous detectors while maintaining all benefits. Together with the innovative front-end electronics, optimum tuning of the silicon strip sensor to the requirements of the X-ray energy from 4 keV to 25 keV is provided. The factory settings are optimized for Cu-Kα.

The LYNXEYE XE fits to all Bruker AXS D8A25 Diffraction Solutions running under DIFFRAC.Measurement Suite. It can be easily exchanged by any other point, linear or 2-dimensional detector. There is no need for counting gas, cooling water or liquid nitrogen, making the LYNXEYE XE a compact, robust and maintenance-free detector. With the 2013 release of DIFFRAC.MEASUREMENT CENTER, the 1-dim LYNXEYE XE detector is fully supported (0- and 1-dimensional measurement mode). The 0-dim mode means coupling of several neighboring channels of the detector to one counting channel. All events collected by the selected channels are counted as one single rate – equal to how a scintillation counter works. The LYNXEYE XE in 0-dim mode completely replaces the scintillation counter for many applications, even the basic alignment of the diffractometer.

Special feature is the good energy resolution of <680eV FWHM for Cu-radiation at 298K (energy resolution slightly depends on environmental laboratory temperature). Operation with all common characteristic X-ray emission lines (Cr, Co, Cu, Mo, and Ag radiation) is supported. A baseline restorer circuit ensures a stable energy peak position as function of count rate.

Depending on the operation mode, one strip can detect up to ~20,000 cps (high energy resolution) or ~500,000 cps (high count rate), resulting in ~100,000,000 cps in 0-D mode and 90° detector orientation, count rates are not dead time corrected.

Five modes of operation are available:

- Scanning 1-D mode for fast data collection
- Fixed 1-D mode for ultra-fast measurements
- Fixed 1-D mode and turned by 90° for ultra-fast non-coplanar measurements
- 0-D („point detector“) mode for high-resolution parallel-beam geometry
- 0-D mode and turned by 90° to cover an extremely large dynamic range

Supplied with dedicated software the LYNXEYE XE can also be operated as a standalone solution.

3 Basic Operation

This section covers the power-up, power-down, and basic operation procedures for the LYNXEYE XE detector system and gives an overview of system operation and collection of data.

3.1 LYNXEYE XE Power-Up Procedure

There is no special procedure to power up the LYNXEYE XE. Once the Detector is integrated in the system as described in chapter 5 and 6 power up runs automatically. Ramping time is about 30s (10V/s).

Caution!

After switching on the diffractometer or setting the detector bas in TOOLS wait until the BIAS READY LED stays lit to make sure that the Bias voltage ramped up completely.

3.2 LYNXEYE XE Power-Down Procedure

There is no special procedure to power down the LYNXEYE XE. It is recommended but not a must to set the detector bias to 0 V in TOOLS until the Bias voltage ramped down completely

3.3 Performing a Measurement

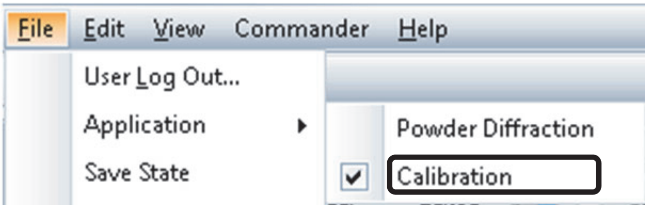
DIFFRAC.COMMANDER is the main measurement program in the DIFFRAC.Measurement Suite. It can be used to perform immediate measurements to get a quick overview of a sample, as well as to perform batch measurements using jobs. Operation details for DIFFRAC.COMMANDER are described in the DIFFRAC.Measurement Suite (DOC-M88-EXX191). This section gives an overview of the system operation and collection of data.

> **Note**
>
> It is highly recommended to use the air scatter screen for every measurement to prevent background from hitting the detector. Even 4mm above the sample is useful.

3.3.1 Select the Detector Type

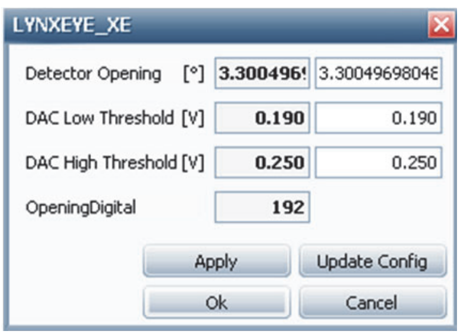
Select the COMMANDER plugin in the DIFFRAC.MEASUREMENT program.

1. Use the ‘File’ tab on the top of the screen and select ‘Application/Powder Diffraction.



2. Select detector type (LYNXEYE XE for 1D-mode) in the Selection tab.

3. Depending on the detector type you can select in the settings tab the number of active strips and discriminator settings (or opening in mm –multiples of one strip of 75µm– for 0D-mode):



3.3.2 Select the Scan Parameters

The following parameters must be selected prior to running a measurement: scan type, start, stop, speed, and increment (see Figure 3.1 and Figure 3.2). Additional settings may include divergence slit size, rotation of the stage, and generator settings for KV and mA.

When using a PSD Fixed scan, the maximum scan length may vary and is dependent upon the Config geometry angle.

To perform a measurement:

1. Turn the X-ray generator on.
2. Figure 3.1 and Figure 3.2 show the location of the parameters for different immediate measurements. The fields show the actual settings for the current measurement.

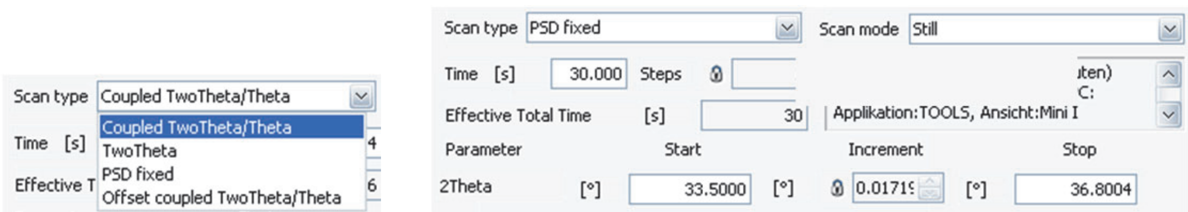


Figure 3.1: A: Drop down menu for 1D-scans, B: Example of measurement parameters for fixed scan

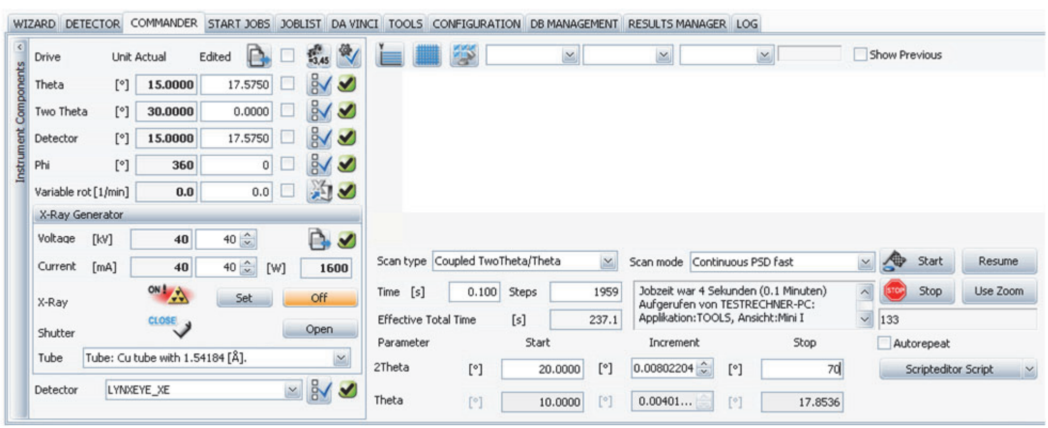


Figure 3.2: Example of measurement parameters for locked coupled scan

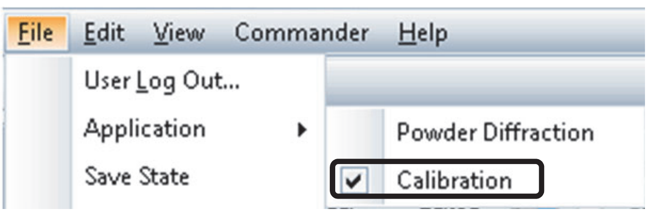
3. Scan type: Choose the scan type from the drop-down menu, see Figure 3.1 A. You must select LYNXEYE XE as a detector in the selection field before the scans are available.
4. Time and Increment: Enter the scan time and increment here. LYNXEYE XE operation uses seconds per step. You will get an error if the scan speed is faster than the configured slow speed.
5. Continuous/Step scan: Click this button to change between continuous or step scan mode. The actual setting will be displayed on the button. It is recommended that continuous scan is used to reduce wear on the goniometer. 1D-Scans only allow continuous scans.
6. Start, Stop: Use these buttons to begin or end an immediate measurement.

3.4 Discriminator Scan (Pulse Height Analysis, PHA)

Photons are converted to electronic pulses proportional to their photon energy. Discriminator (PHA) scans allow to check the correct setting of the discriminators with respect to the noise level, fluorescence and Kβ-suppression, the used radiation and the inherent resolution of the x-ray tube.

3.4.1 Perform a Measurement

1. Turn on the X-ray generator.
2. Use the 'File' tab on the top of the screen and select 'Application/Calibration'.



3. Preposition the goniometer circles to get a representative reflection of the sample centered on the detector or insert the PMMA sample (th=15°, 2th=30°).
4. Figure 3.3 shows an example of a measurement parameter set suitable for a discriminator scan using Cu radiation and the backside of a PMMA sample (2mm divergence, 2.5° prim Soller, Ni-filter). The fields show the selected settings for the measurement, the smallest increment is 0.002V.

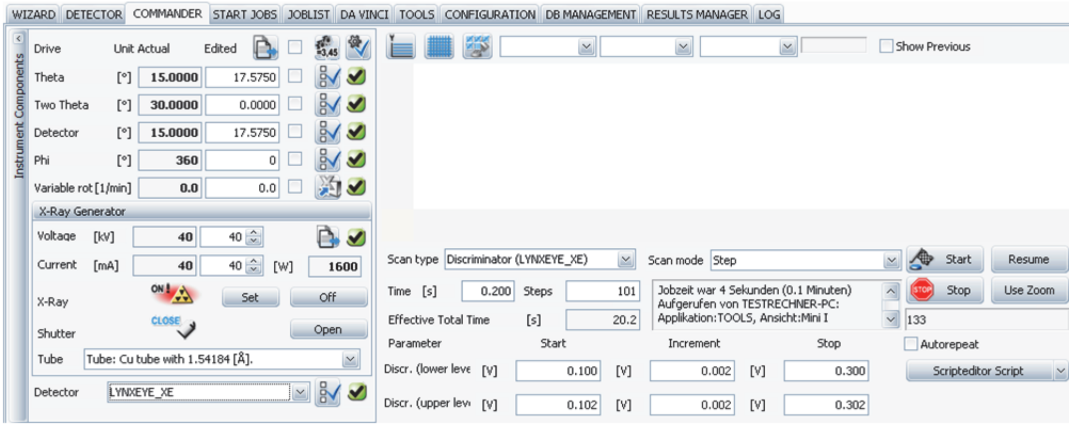


Figure 3.3: Example of measurement parameters for DISCRIMINATOR scan

5. Start value, Stop value: when doing a DISCRIMINATOR scan the measuring unit is V. There are no default settings for the LYNXEYE XE. Approximate range for different tube materials is given in Table 6.2 and Table 6.3:
6. Time and Increment: Enter the scan time and increment here. LYNXEYE XE operation uses seconds per step, the smallest increment is 0.002V.
7. Start, Stop: Use these buttons to begin or end an immediate measurement.

3.4.2 Determine Optimized Discriminator Settings

Figure 3.4 shows an example of a DISCRIMINATOR scan on a PMMA sample using Cu radiation. The black line is measured with Veto=0.04V (recommended setting for this detector mode), the blue line uses Veto=0.51V and shows the influence of this parameter.

To determine the different discriminator levels move with the cursor along the scan. The x value of the cursor position (in V) is shown in the bottom line of the DIFFRAC.COMMANDER window.

The values for the lower level and the window width can be checked and modified in the Settings tab.

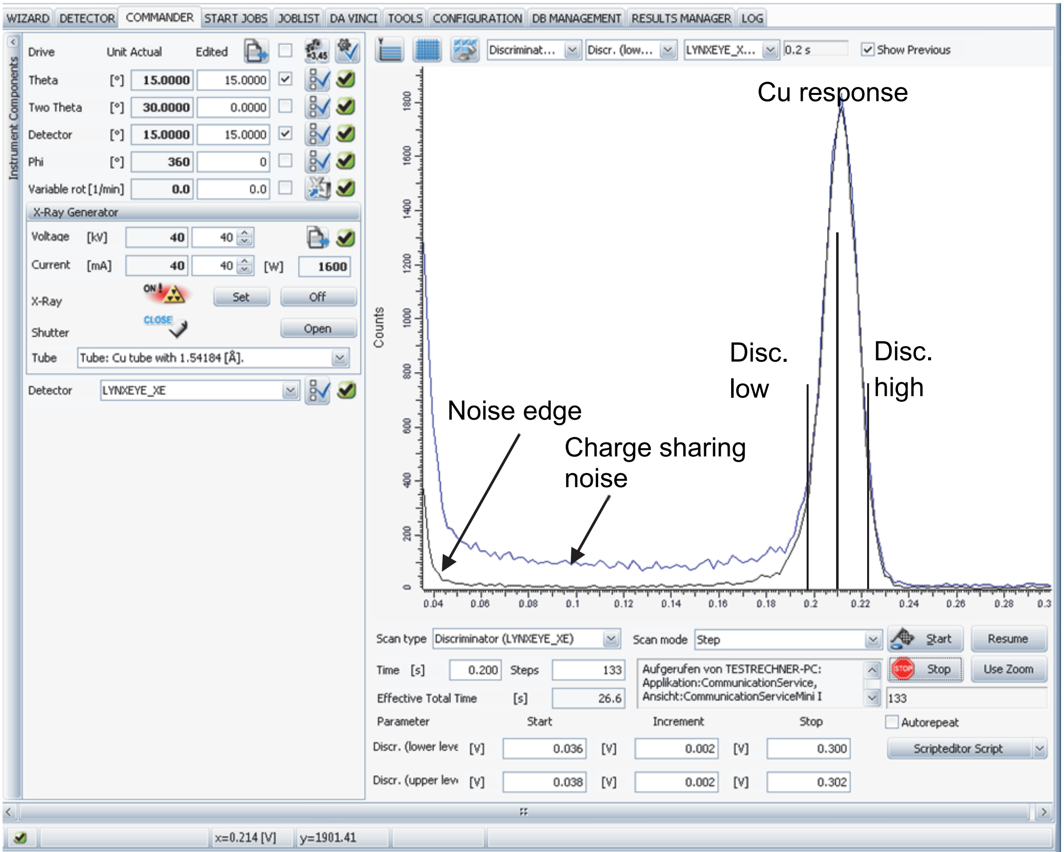


Figure 3.4: Example of a DISCRIMINATOR scan for PMMA sample, Cu radiation)

Figure 3.5 shows a discriminator scan for a SiO2/Fe2O3 mixture (5:1), Cu radiation). The detector is positioned for the Quartz main reflection, Fe-fluorescence is generated by the Hematite phase. Energy lines at 6.4 and 7.06 (Fe Kα and Kβ) and 8.04 keV (Cu Kα) appear.

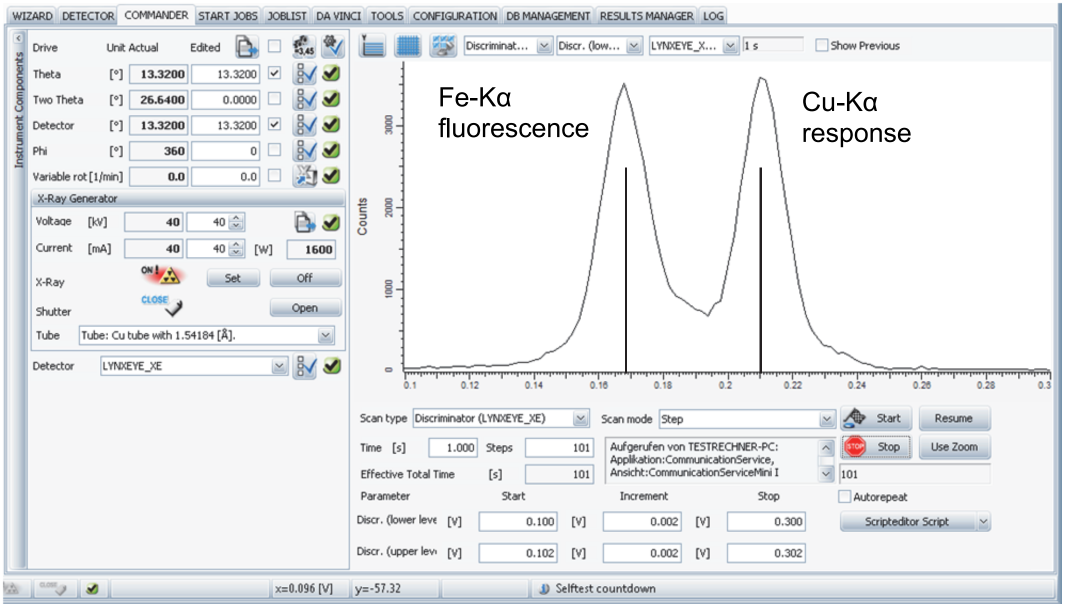


Figure 3.5: Example of a DISCRIMINATOR scan for SiO2/Fe2O3 mixture (5:1), Cu radiation)

Note

To ensure the correct allocation of intensities to the detector channels do NOT set the discriminator lower level lower than 1/2 of the level determined for the signal peak maximum!

3.5 Instrument Performance Test

For a quick performance test of the instrument use the NIST SRM 1976 standard sample and determine the resolution of the main peak. The system should match the specifications in Table 3.1.

Perform a 2 degree locked coupled (continuous) scan with the main peak centered (e.g. 2Theta = 34.15 to 36.15 for Cu radiation). Refer to Table 6.4 for instrument parameters.

The FWHM (resolution) is determined using the AREA feature of the program DIFFRAC.EVA, which is part of the DIFFRAC.Measurement Suite Basic package supplied with the diffraction system. To learn how to use EVA and its AREA function, refer to the DIFFRAC.EVA User Manual (DOC-M88-EXX200).

Table 3.1: FWHM specifications for Cu radiation

Cu	**Bragg**	**Göbel Mirror***
401 mm	≤ 0.060°	≤ 0.130°
435 mm	≤ 0.055°	≤ 0.120°
500 mm	≤ 0.050°	≤ 0.110°
600 mm	< 0.050°	< 0.110°

* parallel beam type

Start DIFFRAC.EVA and load the BRML data to evaluate.

1. Open the EVA toolbox to perform background subtraction and a $K\alpha_2$ stripping, ensuring a properly adjusted $K\alpha_1/K\alpha_2$ ratio to minimize artefacts and a 0.5 intensity ratio. Select the Append button to create a new phase.
2. Use the Create Area function in the EVA toolbox to create an area measurement using the complete measured range (see Figure 3.6). Use the mouse to select the range. Review the data displayed in Toolbox.

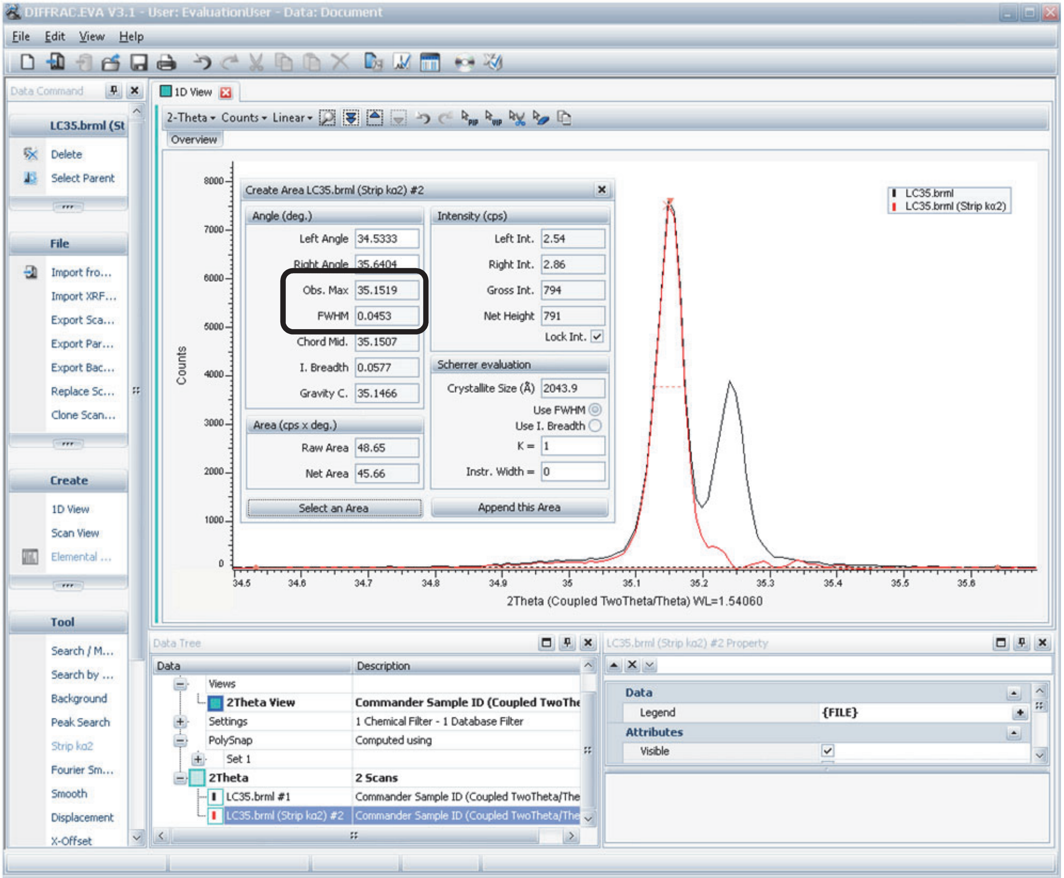


Figure 3.6: EVA main window and result for Create Area

Note

The primary installation and Verification (DOC-M88-EXX157) may require additional testing.

3.6 Detector Flood Field Correction

The flood field correction is a special feature to improve the LYNXEYE XE detector performance for PSD Fixed Scans. It might be usable only for some special kind of applications.

It does NOT influence or alter the characteristics of continuous scans.

Caution!

An improper performed flood field calibration might influence PSD Fixed Scan data!

Note

Enabling/disabling the flood field correction is not easy possible in CONFIG! As long as the flood field correction numbers ≠ 1 for each strip is set for 'Flood Corrections' in CONFIG it will automatically be applied to all PSD fixed scans. It is highly recommended to save the configuration file before performing a flood field correction.

Please remember that the flood field correction depends on any measurement condition which will influence intensity distributions, especially:

- Alignment
- Detector trimming
- Detector Calibration
- Discriminator settings and detector HV
- Measurement circle
- Soller slits
- …

You have to perform and analyze a new flood field file whenever measurement conditions have been changed.

1. Set the diffractometer to the measurement conditions and insert the optical elements you want to use later for the flood field correction.
2. Use a same in a 2th range where no peaks appear. For the PMMA sample 2th=80° is a useful position.
3. Perform a Fixed scan and collect at least 10000cps in each channel to check if a correction can make sense. Scatter of intensity in the channels of <2% should not be corrected.

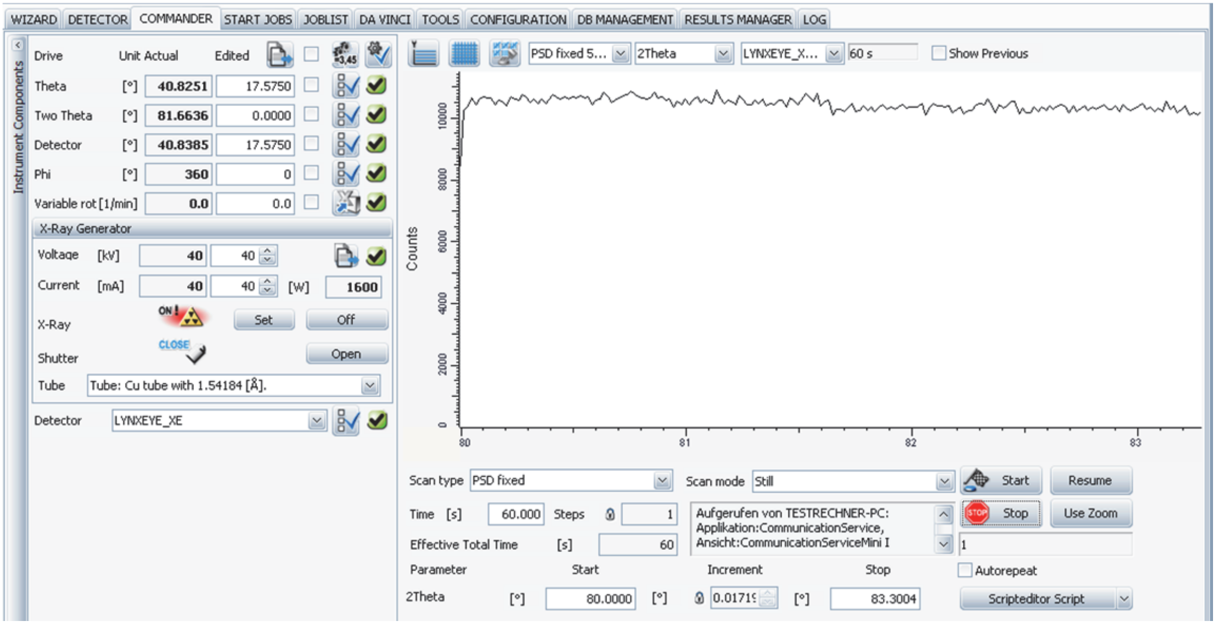


Figure 3.7: Fixed scan with PMMA sample before correction, Cu radiation)

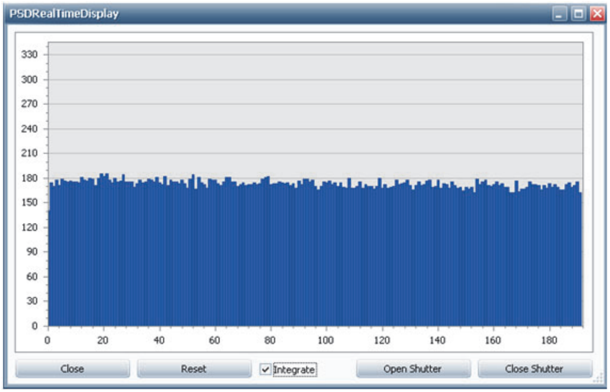


Figure 3.8: PSD real time display with PMMA sample, Cu radiation)

4. Switch to the DETECTOR plugin, set a ‘Measure time’ and start the flood field correction procedure by pressing the ‘Measure and Set’ button.

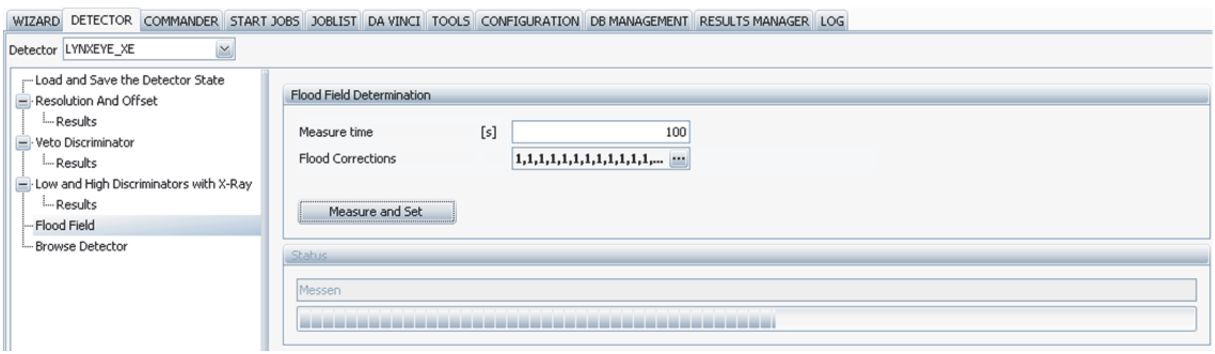


Figure 3.9: Starting the Flood field calibration

At the end values are calculated and automatically activated and inserted in the CONFIGURATION.

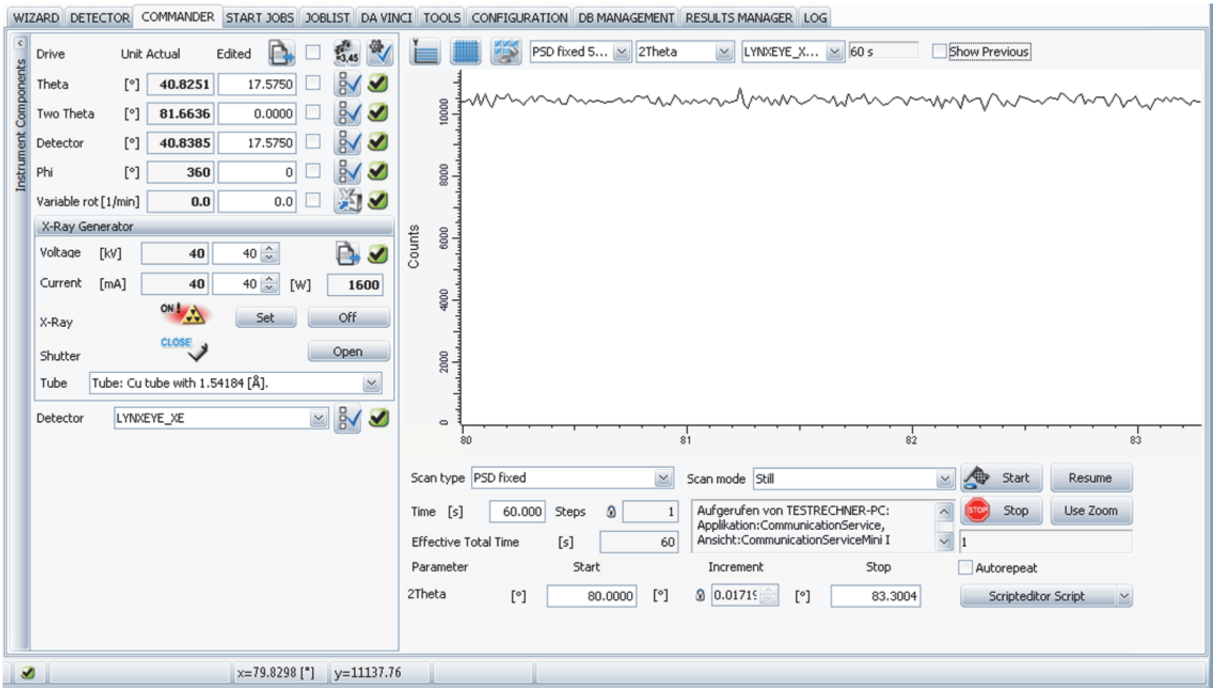


Figure 3.10: Fixed scan with PMMA sample after correction, Cu radiation)

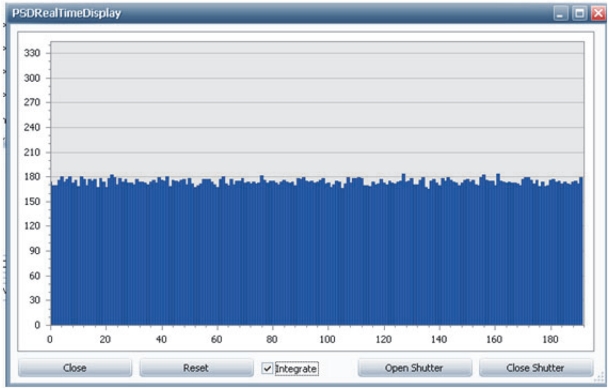


Figure 3.11: PSD real time display with PMMA sample after correction, Cu radiation)

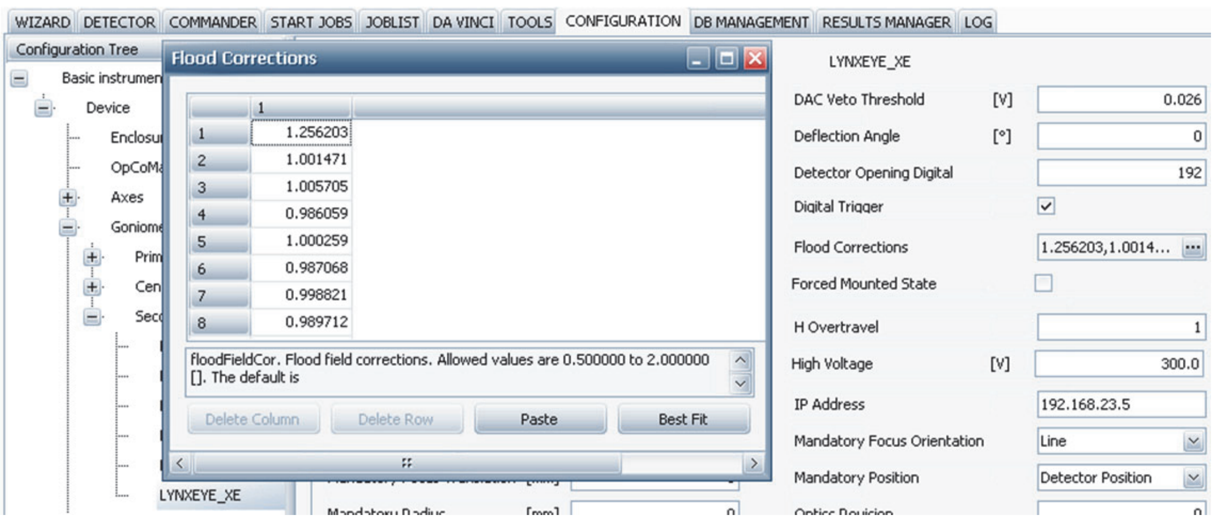


Figure 3.12: Flood field correction is updated after determination

5. Save the configuration.

4 System Description

Figure 4.1: LYNXEYE XE detector

The LYNXEYE XE consists of two components which are installed in the D8 system: The detector itself and the recognized optics. This section also contains information on the counterbalance, as the setting may vary depending on your configuration.

4.1 The Detector

4.1.1 Detector Specifications

Table 4.1: Basic specifications of the LYNXEYE XE

Detector Specifications	
Suitable systems	All D8 diffraction solutions systems with DIFFRAC.Measurement Suite V3 or higher.
Active area	14.4 mm (192 x 0.075mm) x 16 mm; (in and perpendicular to the scattering plane)
Max 2-theta range simultaneously covered	3,3° at 500 mm measurement circle diameter
Usable wavelength range	Cr, Co, Cu, Mo, and Ag radiation. Factory settings are optimized for Cu-Kα
Maximum global count rate	> 100,000,000 cps (special detector settings)
Maximum local count rate (per strip)	> 500,000 cps
Energy resolution	Energy resolution <680 eV for Cu radiation at 298K (energy resolution slightly depends on environmental laboratory temperature)
Efficiency	> 99 % for Cr and Co radiation, >98% for Cu radiation, ~35% for Mo radiation and ~20% for Ag radiation (300 μm crystal thickness)
Detector Bias Voltage	300V for 300μm (A17B100), 350V for 500μm (A17B140) sensor
Spatial resolution (pitch)	75 μm, 192 individual readout channels
Maintenance	No counting gas, cooling water or liquid Nitrogen

Detector Specifications	
Detector (overall dimensions and weight)	130 mm L x 120 mm W x 130 mm H, 2.2 kg
Length of cables between the detector and control rack	5 m
Software	DIFFRAC.Measurement Suite V3 or higher
Included in delivery	LYNXEYE XE detector; mounting and optics assembly, including 0.2mm Cu absorber, 2 open plug-in slits, connecting cables, Filter adapters, PMMA sample holder, transport box

4.1.2 Environmental Ratings

Table 4.2 shows the range of environmental conditions for which the equipment is designed.

Table 4.2: Environmental ratings of the detector

Operating temperature	15 – 35°C, recommended temperature range 20 – 25°C
Maximum temperature gradient	+ 0.5°C (+ 0.9°F) per hour
Relative humidity	Max 80%, non-condensing
Location of	Indoor use only
Altitude	All terrestrial locations

4.1.3 Detector Components

The detector contains the Silicon Strip Sensor, the signal pre-processing electronics (ASICs) and a non-volatile memory where all detector specific parameters are stored. The detector controller is integrated in the detector.

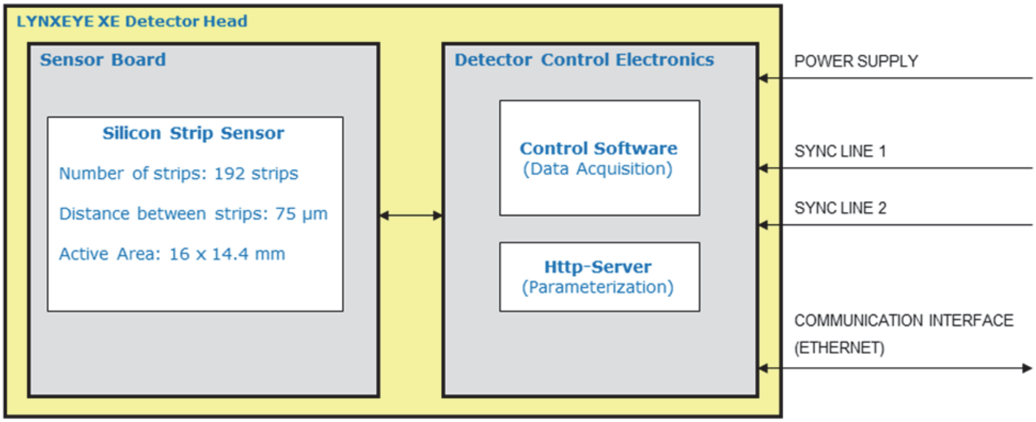


Figure 4.2: Block diagram of the detector electronics

4.1.4 Detector Cables and Connectors

The detector has two cable connectors:

- One LAN connector X1 for the detector's communication including data readout
- One 15 pin HD-SUB connector X2 for the detector power and clock pulses

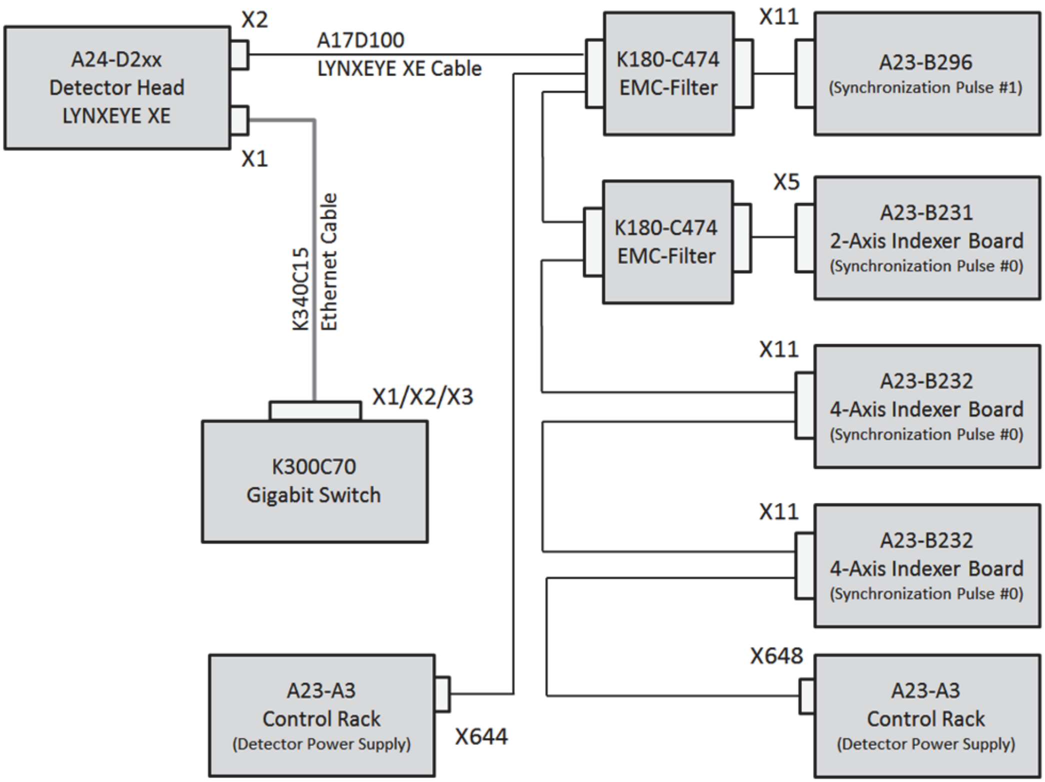


Figure 4.3: Block diagram of the detector wiring

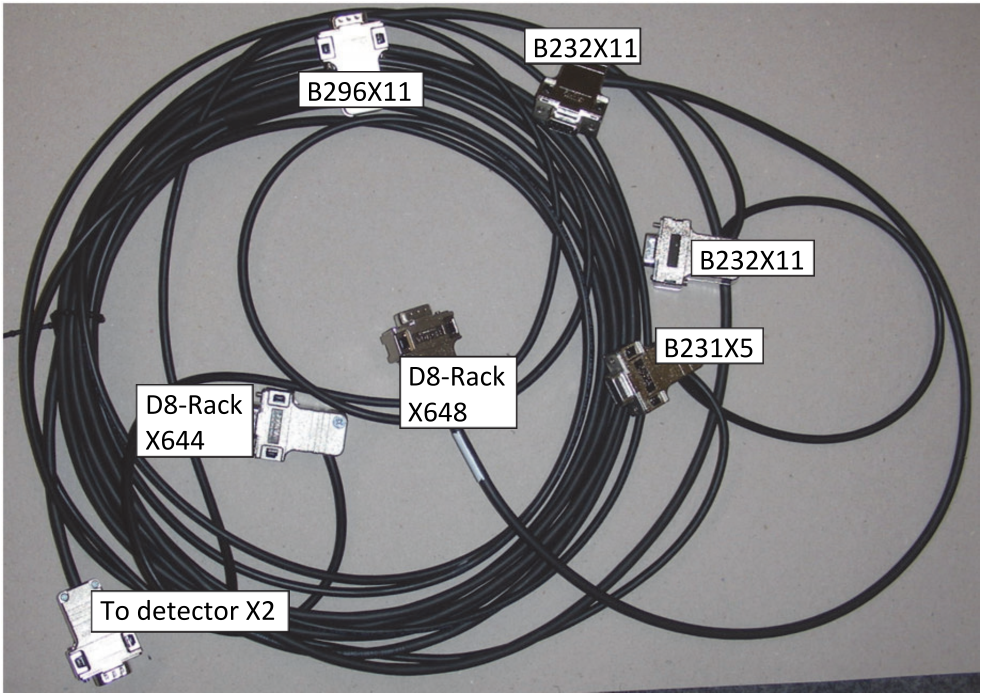


Figure 4.4: LYNXEYE XE Cable A17D100 version 4

4.1.5 Detector Status LEDs

Table 4.3 shows the different states of the detector's LAN and back side LEDs.

Table 4.3: States of the detector's LAN and back side LEDs

LED	State
ALARM (red)	Normal operation (blinking) or Alarm (lighting permanently).
Power (green)	The LED stays turned on if power is applied and the firmware has been started or hangs.
BIAS (orange)	The bias LED displays the status of the high voltage supply which produces the bias voltage for the silicon strip detector. LED off: Bias voltage is turned off. LED blinking: Bias voltage is ramping up or down. LED on: Bias voltage is on and equal to the set value.
LAN LED (green and orange)	The green LED is turned on when a hardware connection is established. The orange LED shows the data transfer status.
RESET	Insert carefully a stump tool of approximately 3mm in diameter (like an Allen screw driver) and press with little force the hidden RESET button.

Figure 4.5: LYNXEYE XE Status LEDs and RESET hole

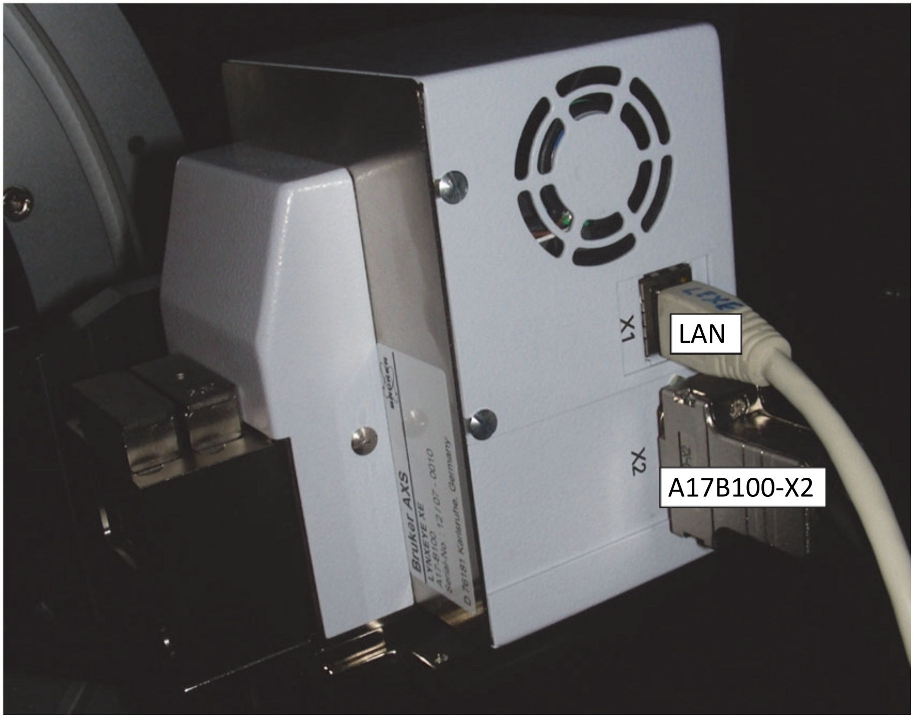


Figure 4.6: LYNXEYE XE in 90° position showing LAN and power plug

4.2 Detector Optics

Warning!

Voltage Danger - Bias voltages up to 500 V DC are accessible from the outside! They are present on the metal sensor window on the front side of the detector! Never operate the detector with Bias voltage switched on without having the detector optics mounted!

The optics of the detector consists of two major components, the Optics recognition block and the alignment unit (see Figure 4.7):

The optics recognition block with two plug-in positions for e.g. Axial Soller slit, Kβ filter etc. All Sollers, filters, slits and absorber have magnets which fix the slit in position when properly (two edges were cut) inserted (see Figure 4.8). The plug-in modules can be inserted in one or the other position and are recognized and displayed in DAVINCI if correct configured (see Figure 4.9).

Alignment possibilities (hidden behind a cover), normally do not need to be adjusted by the user. Translation (ca. ± 2 mm, mind the backlash) allows to move the strips perpendicular to its length. This changes the ‘Zero Offset’ value and allows to center a strip with respect to another optical slit in front of the LYNXEYE XE.

Rotation (total range ca. 20 turns, loose the 2 fixing screws (1) by a 1/8 rotation) allows to align the strips with respect to the slit focus. This movement is used to optimize spatial resolution (FWHM of Bragg peaks) which requires a sample with well known sharp Bragg peaks.

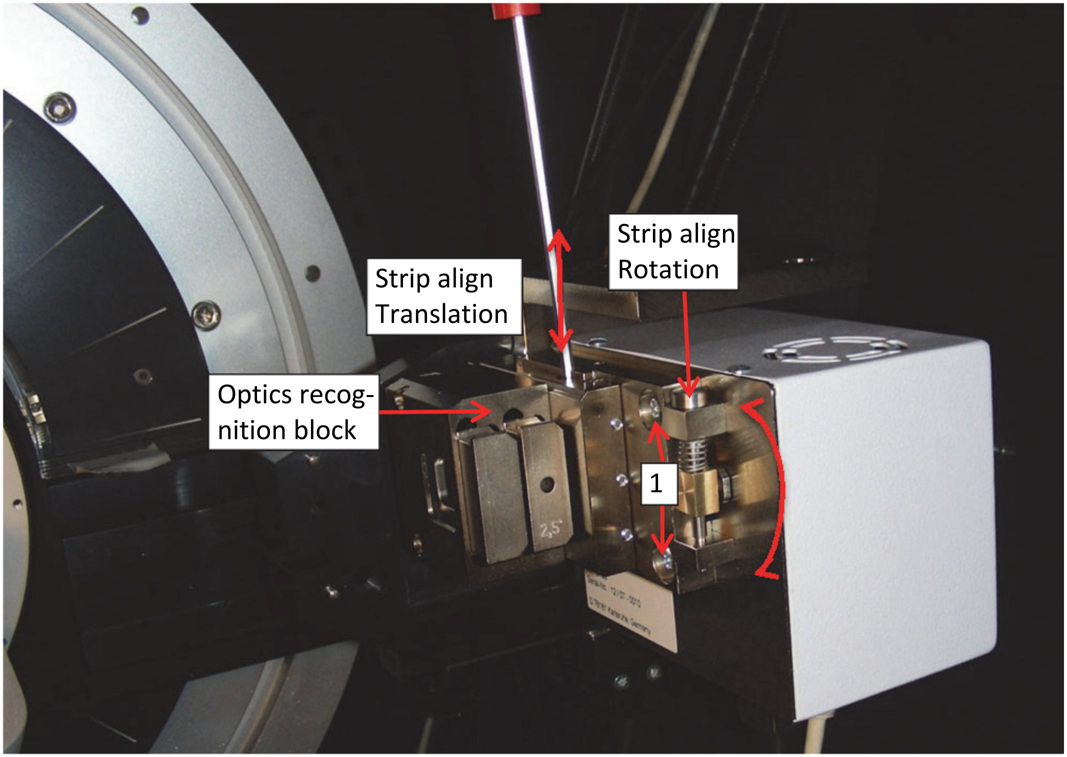


Figure 4.7: LYNXEYE XE alignment possibilities (cover removed) and optics block

Figure 4.8: Plug-in slit and Axial Soller slit

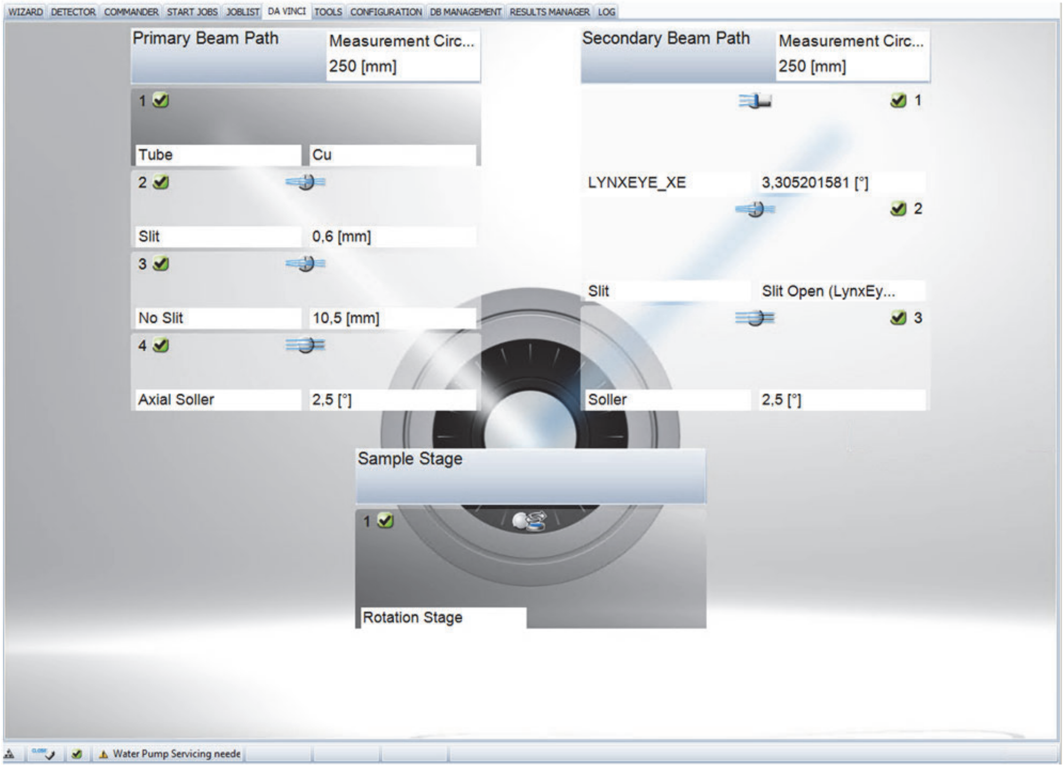


Figure 4.9: DAVINCI plugin with standard components for LYNXEYE XE

4.3 Counterbalance

There is no special counterbalance setting required for the LYNXEYE XE detector. The standard setting for the Scintillation counter should be used.

Please refer to the counterbalance test sheet in the Instrument supplement folder.

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5 Hardware Installation in the D8

This section describes hardware installation for a D8 ADVANCE.

5.1 Servicing Precautions

Warning!

Risk of electric shock!
Some steps of the hardware installation require opening the side panels of the D8 base and accessing parts inside.

When the equipment is connected to the mains supply, some terminals, components, and multiple power supply lines may be live. It is not sufficient to just press the D8 base cabinet's Power OFF button (O). The line disconnector must be rotated to the '0' position.

It is highly recommended that any work on components of or inside the D8 base cabinet is performed by Bruker AXS employees only!

Note

It is recommended to switch off the LYNXEYE XE detector Bias by the TOOLS plugin before switching off the D8 mains power. Wait until the BIAS READY LED turned off to make sure that the Bias voltage ramped down completely!

Caution!

T Components attached to the goniometer will move during operation.

5.2 Shipping and Unpacking

1. Check for external shipping damage to the packages.
2. Open the boxes containing the detector and its components.
3. Check for any damage to the components.
4. Inventory all items for completeness.
5. Save the packaging when practical for return shipping.

Note

For Systems delivered without secondary slit systems the initial alignment of the system has to be done with the LYNXEYE XE detector in 0-D mode with 10 mm opening for theta and 0.075 mm opening for detector to determine the ZI-values with the glass slit. For additional information about the parameters see section 6.6.3.

5.3 Hardware Installation

The following sections discuss the integration of the detector in D8A25 systems using second-generation axes indexer boards (AIB2G). 1st generation axes indexer boards (SXI-boards) are not supported by LYNXEYE XE.

Caution!

Use care when moving the detector head to avoid mechanical shock to the assembly.

5.3.1 Connect the Cable Wiring

2 cables are delivered with the complete detector system (see 9 for part numbers).

- Detector Power and clock cable A17D100 (also called Multi Axes Clock Cable)
- Ethernet cable with RJ-45 connectors

See Figure 4.3 for the connection of the wiring. Guide the Detector Power cable and the LAN cable through the safety labyrinth at the back of the D8 enclosure. Make sure that no cables will be pinched when closing the back cover.

1. Connect Detector Power cable to detector (Figure 4.6), to D8 control rack and to the distribution board.
2. Connect Detector Data cable to detector (Figure 4.6) and to LAN switch close to the D8 controller.
3. Use a cable tie on the detector to fix the cables and remove the stress on them.
4. The clock pulses are generated by the Axes Indexer Boards (3 identical plugs labeled 1x B231X5 and 2 x B232X11) and by the distribution board (labeled B296X11). It is important to tighten all screws carefully for a good electrical contact.

   4.1. The connection of the motor clock cable differs dependent on the axes indexer boards. In any case the filter plug has to be attached to the clock pulse output where the tube/omega motors are connected (standard is B231X5 port):

   - On the B231 2-axes indexer board the X5 9-pin socket on the front side or
   - On the B232 4-axes indexer board the X11 9-pin socket on the top side.

   4.2. The connection for the distribution board uses also a filter plug. The plug has to be attached to the socket B296X11

5. Use the network cable to connect the LYNXEYE XE and an unused LAN adapter port of the of the D8 control rack.

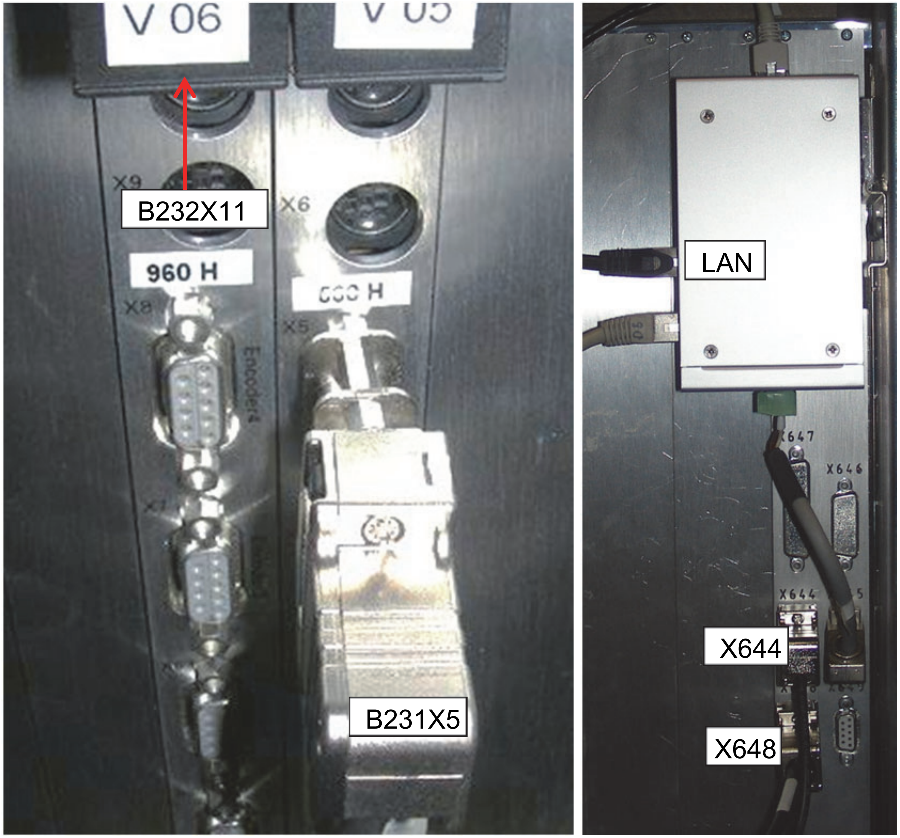

Figure 5.1: A: Clock cable connector for AIBs. B: Power supply on D8 control rack

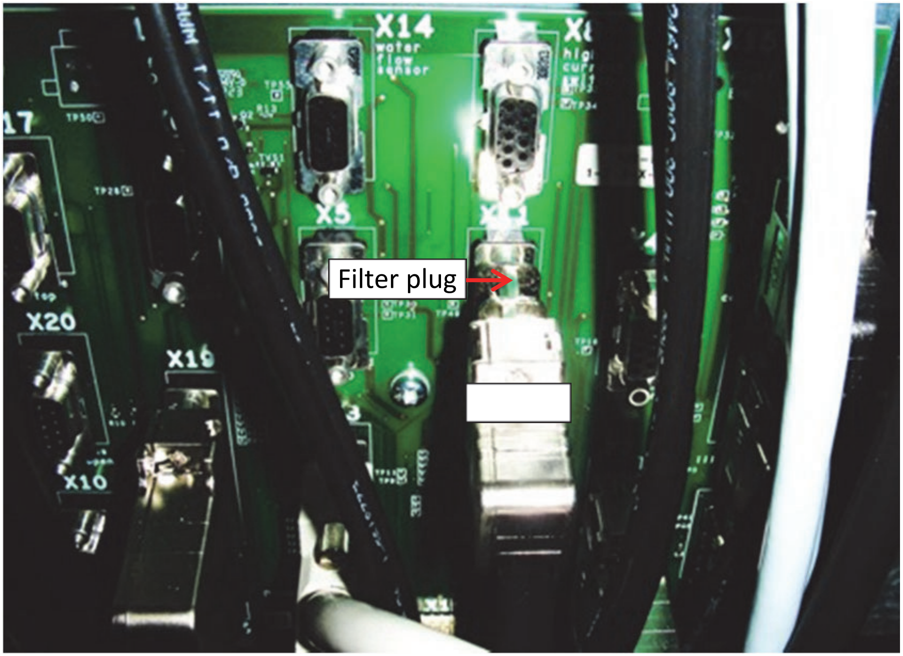

Figure 5.2: Clock cable connector on board B296X11

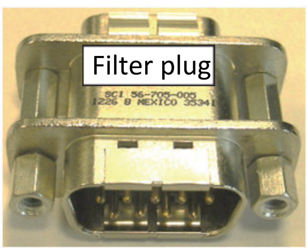

Figure 5.3: Filter plug

5.3.2 Mount the Detector to the 2-Theta Axis

The detector fits like other detectors on the universal detector mount.

The detector is equipped with either a 0/90° or a 0° mount (Figure 5.4, Figure 5.6).

1. Move the 2-theta drive to a position where the detector can be placed on the track (approximately 35° 2-theta).
2. Apply the detector against the guidance block (Figure 5.5).
3. Rotate it until its base plate touches the three balls of the support point and fix the detector with the knurled screw (Figure 5.7).

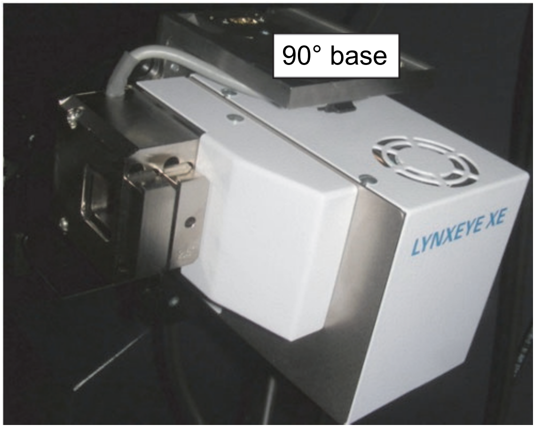

Figure 5.4: LYNXEYE XE with 0/90° mount.

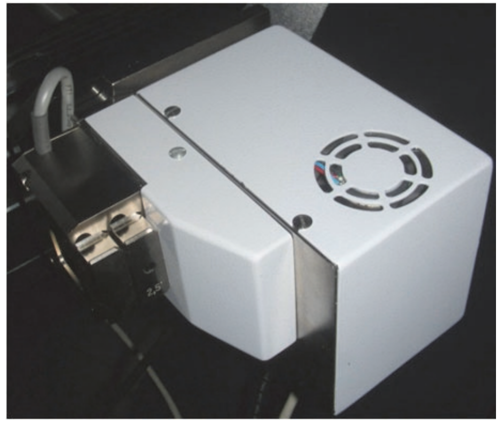

Figure 5.6: LYNXEYE XE with 0° mount.

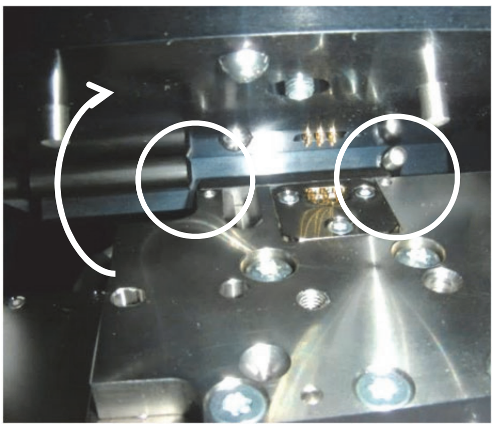

Figure 5.5: Applying the Detector to the guidance block.

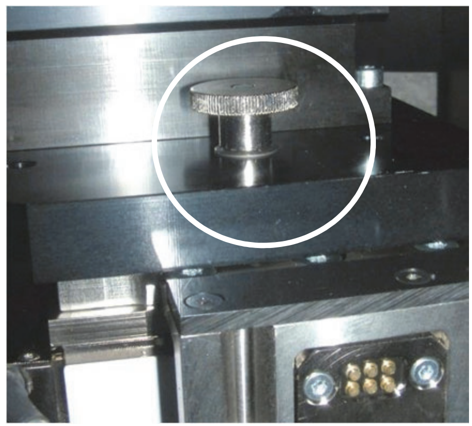

Figure 5.7: Fixing the detector with the knurled screw.

4. Check the correct radius distance for your set up (especially when switching the applications in TWIN/TWIN systems). For active sensor surface and position see Figure 5.8 and Figure 5.9.

Note

To confirm the proper measurement circle radius, measure from a point at the center of the sample stage (goniometer center) to a point approximately 9.7 mm behind the front side of the detector cover (see Figure 5.8). Use this as a reference when placing the detector on the track.

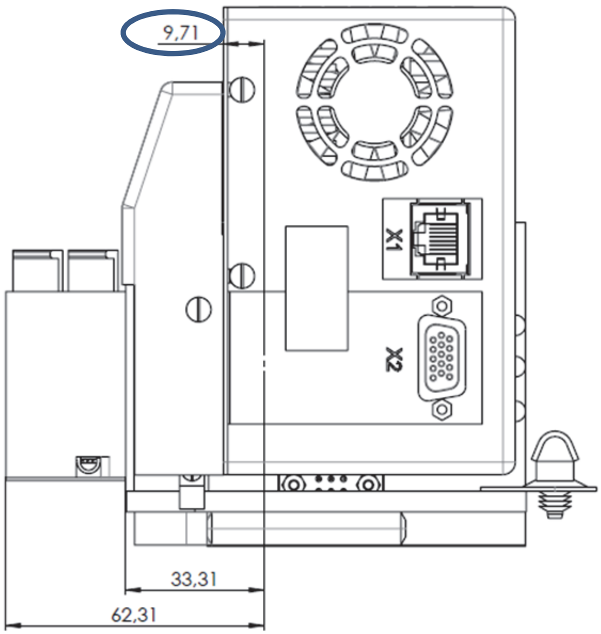

Figure 5.8: Reference for checking the measurement circle radius

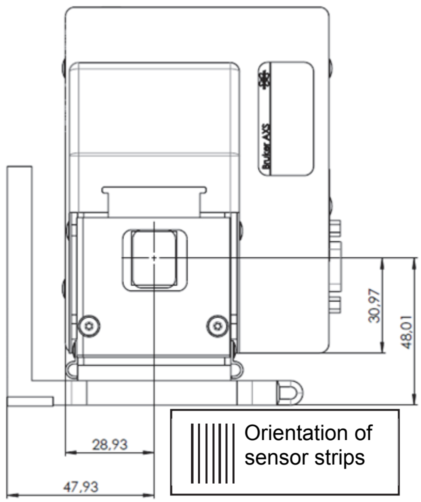

Figure 5.9: Detector center and sensor strip orientation

5. Move the 2-theta drive through the complete range to make sure the detector moves freely and is not restricted by the cables.

5.3.3 OpCo Registration of Additional Components

All parts coming with the delivery are registered and ready for use. It is assumed that all components are burned correctly.

The two positions for optical elements in front of the detector are represented in the configuration by a 'DetectorOpticsMount1 and 2' and their associated 'EmptyPositionDOM1 and 2'.

The optics components itself are collected in two containers 'DetectorOptics /Slit and Soller. 'Slits' holds all Slits, Filters and Absorbers, 'Soller' all Sollers.

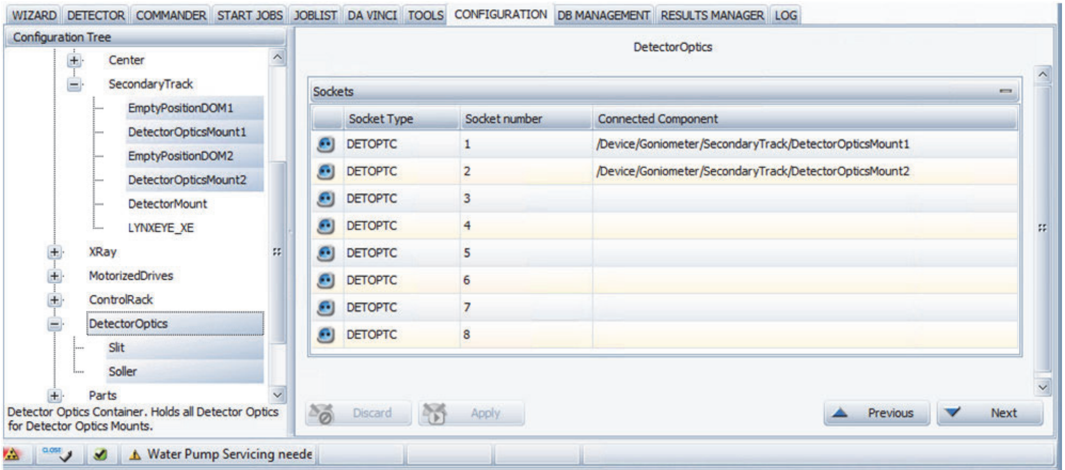

Figure 5.10: All components in CONFIG for LYNXEYE XE optics

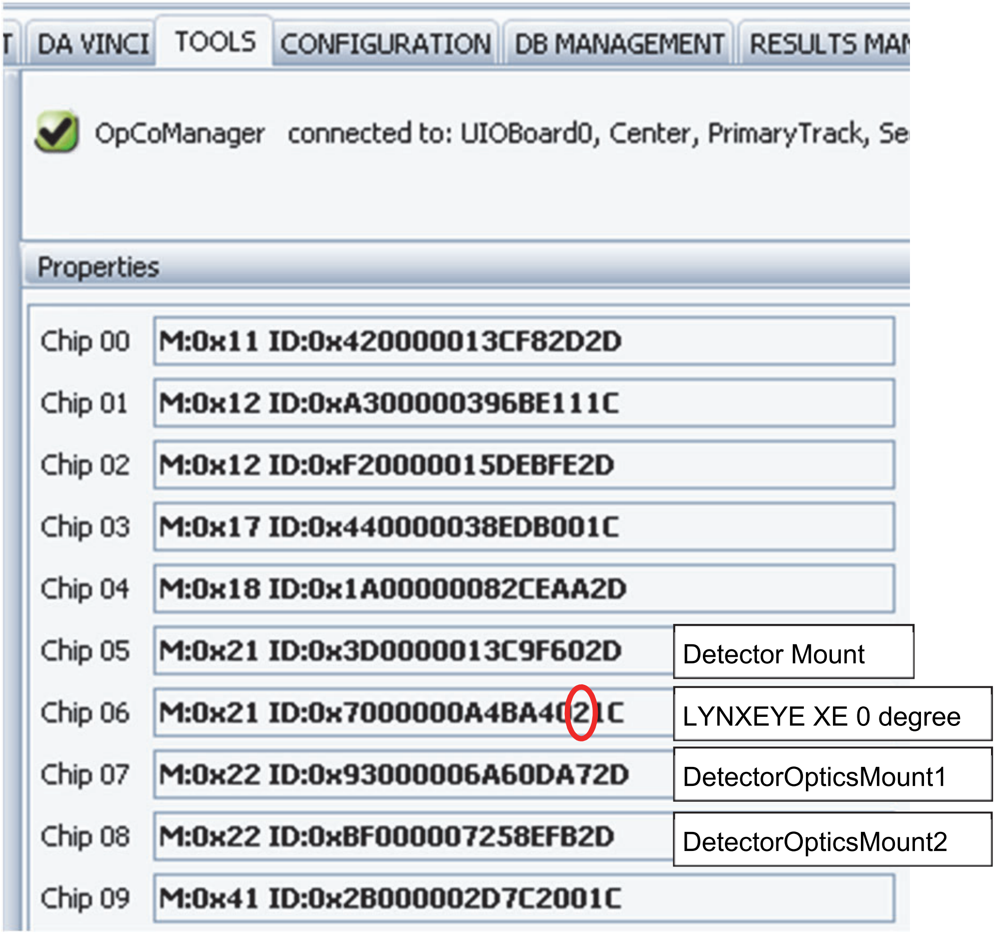

Figure 5.11: Chip IDs for 0/90 Mount, 0° position, no components inserted for LYNXEYE XE

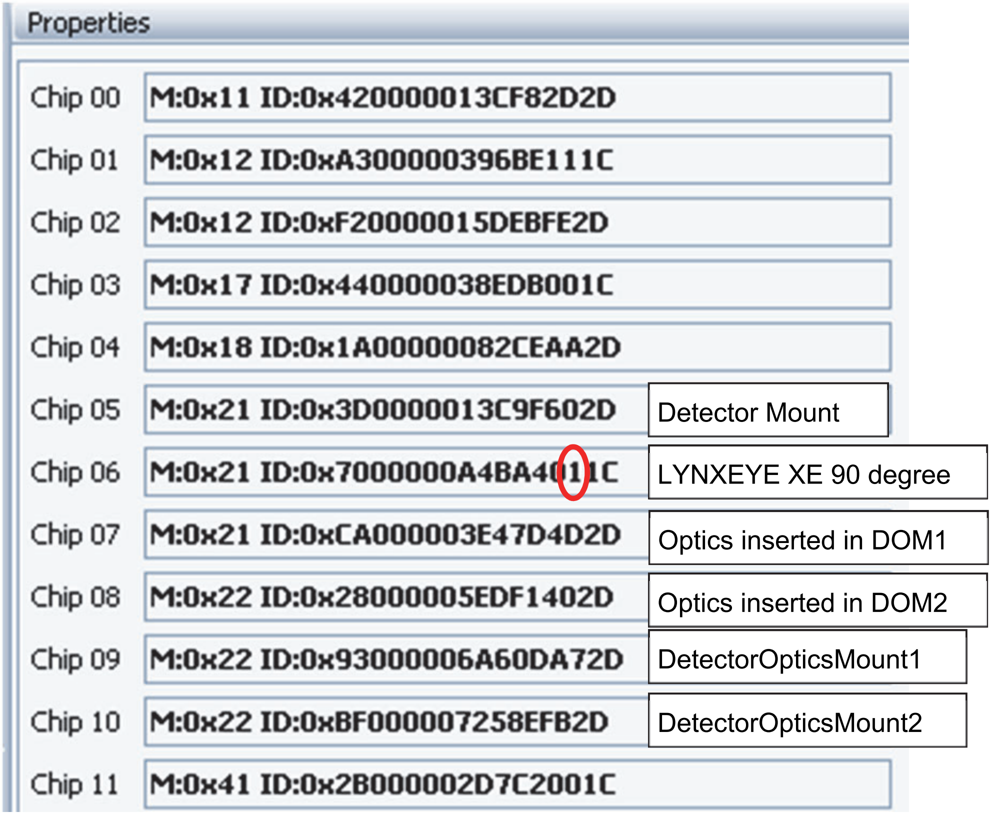

Figure 5.12: Chip IDs for 0/90 Mount, 90° position, components inserted in both slots

Examples for registration

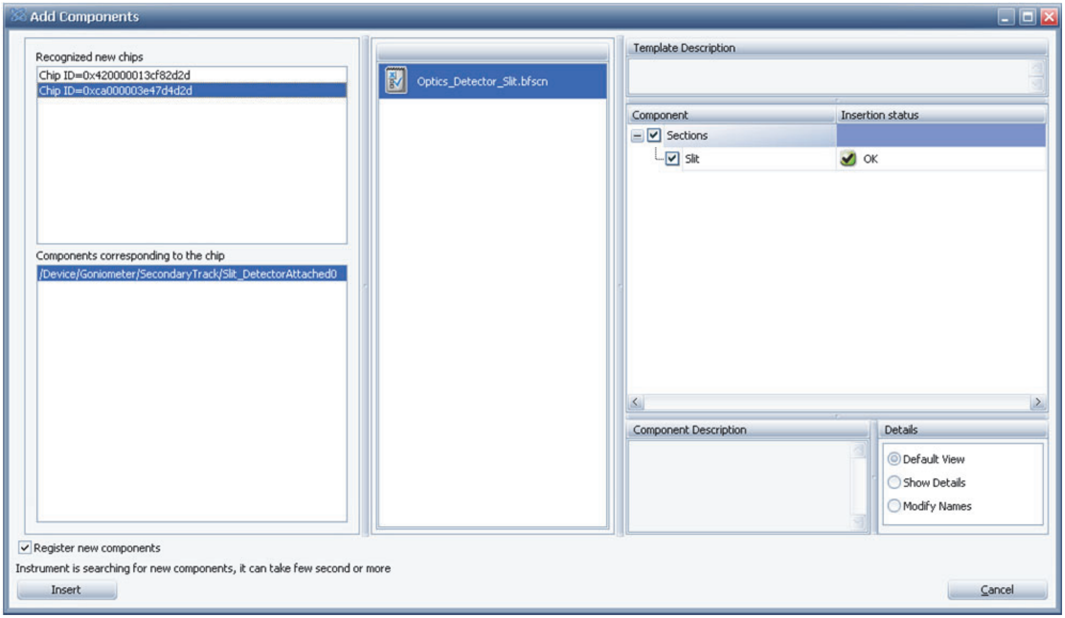

Figure 5.13: Ni Filter registration.

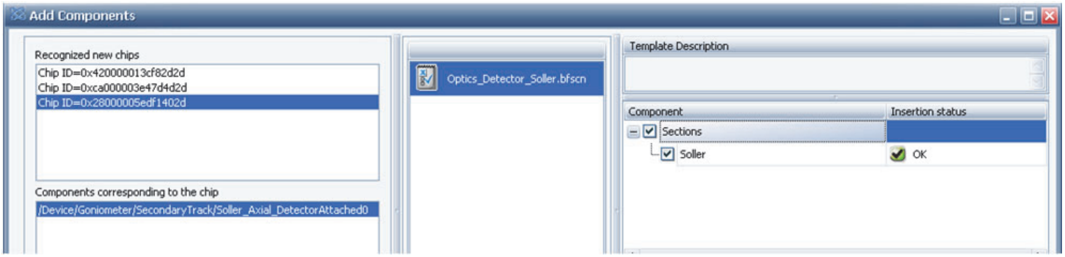

Figure 5.14: Soller registration

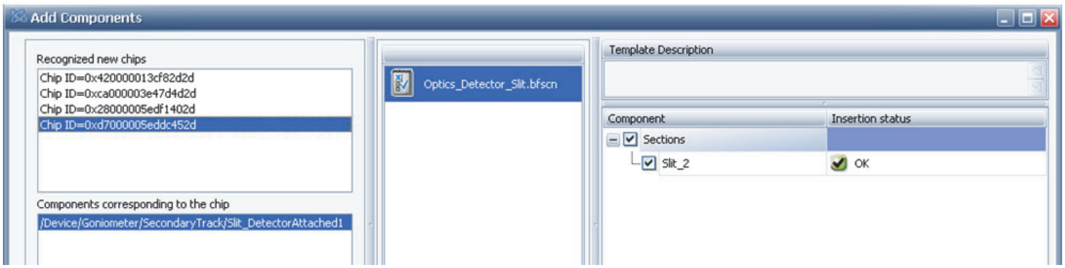

Figure 5.15: Empty slit registration

Table 5.1: All available OpCo components for LYNXEYE XE

Component	Order Nr	ICS Type
Ax. Soller 1.5	A17B109	Soller
Ax. Soller 2.5	A17B108	Soller
Ax. Soller 4	A17B107	Soller
Ni filter for Cu	A17B115	Slit
Ni filter for Cu (low β)	A17B116	Slit
V filter for Cr	A17B117	Slit
V filter for Cr (low β)	A17B118	Slit
Zr filter for Mo	A17B119	Slit
Zr filter for Mo (low β)	A17B120	Slit
Fe filter for Co	A17B121	Slit
Fe filter for Co (low β)	A17B122	Slit
Cu absorber 0.1mm	A17B127	Slit
Cu absorber 0.2mm	A17B128	Slit
Slit 4mm	A17B125	Slit
Slit 10.5mm	A17B126	Slit
Empty Slit	A17B130	Slit

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6 Software Configuration

This section describes the basic software configuration. Software is in detail described in Bruker AXS DIFFRAC.Measurement Suite User Manual DOC-M88-EXX191.

6.1 Communication Line

Communications between the D8 controller, LYNXEYE XE detector and the Control PC are made via a network connection.

The parameters for communication need to be defined by the user and are stored in the *.bfcfg file. The DIFFRAC.CONFIG plugin is used to set the parameters. Perform the following steps to configure the system (see Figure 4.3 for the cabling scheme).
It is highly recommended to use the local network addresses for communication. Standard IP addresses are 192.168.23.1 for Control PC, 192.1.68.23.3 for D8-Controller and 192.168.23.5 for LYNXEYE XE Detector.

6.2 Detector Configuration

Open the DIFFRAC.Measurement Center and make sure that a connection to the diffractometer is established. Activate the CONFIGURATION plugin within the DIFFRAC.Measurement Center. The following steps describe the way how to introduce a LYNXEYE XE in the configuration from scratch, if the LYNXEYE XE was delivered separately. For a complete system, this integration was done at Bruker AXS test field and instead of these templates, similar configuration files are generated (including optics recognition9. Two detector specific template files (1308-0080 represents the serial number for the detector) have been created at Bruker AXS production, e.g.:

LXE_1308-0080_Cu-HighGain-HighResolution.bfscn

LXE_1308-0080_Cu-HighGain-HighCountRate.bfscn

Additional, two templates (no energy discrimination, high count rate) for aligning the diffractometer or as starting values for detector calibration are supplied in the configuration templates subfolder C:\ProgramData\Bruker AXS\Instrument Configurations\A25\D8_Advance\Detectors:

LYNXEYE_XE_Diff_Align_Cu_Cr_Co_Fe_Tube.bfscn (High Gain)

LYNXEYE_XE_Diff_Align_Mo_Ag_Tube.bfscn (Low Gain)

Note

Mind that ‘Zero Offset’ and ‘Resolution’ does not fit to your detector radius and needs to be determined.

1. From the main CONFIGURATION plugin, select the Secondary Track. A ‘DetectorMount’ is expected to be configured (Figure 6.1).

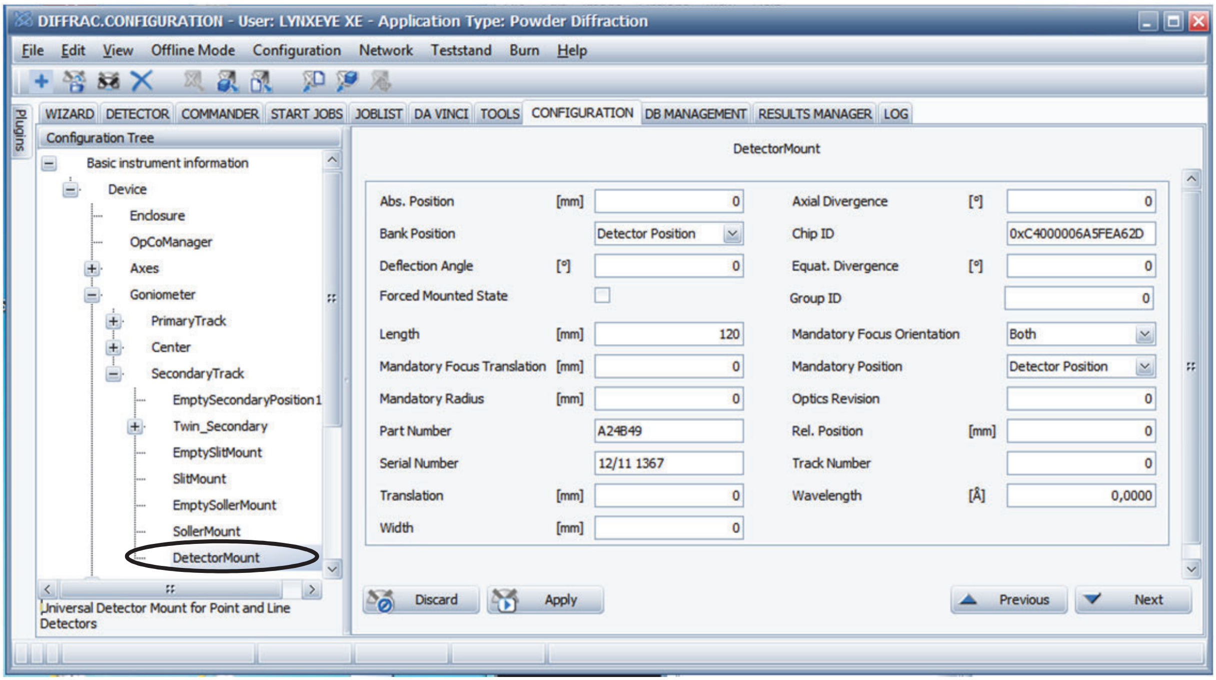


Figure 6.1: Detector menu in CONFIGURATION plugin before inserting the LYNXEYE XE template

2. Insert a LYNXEYE XE template of your choice, depending on your x-ray wavelength and application type (High –energy- Resolution or High Count Rate’), e.g. ‘LYNXEYE XE_Diff-Align_Cu-Cr-Co-Fe-Tube.bfscn’ (Figure 6.2).

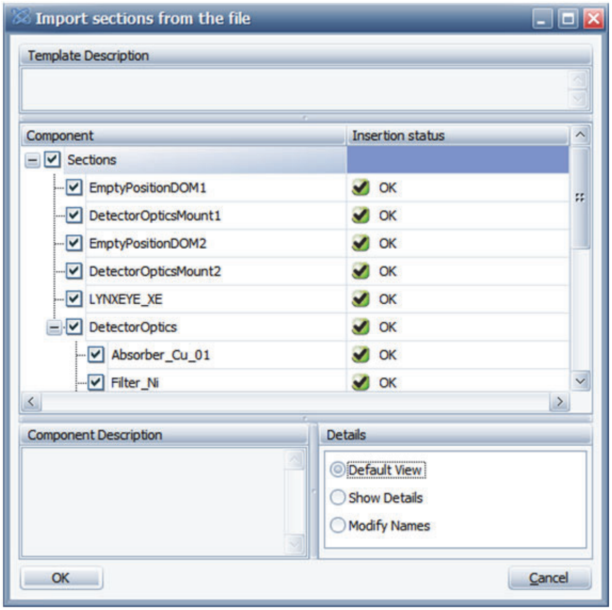


Figure 6.2: Template insert in CONFIGURATION plugin.

3. Click OK.
4. Together with section LYNXEYE XE, which contains all relevant detector parameters, additional sections which are responsible for optics recognition, appear (Figure 6.3 and Figure 6.4). The parameters are described in a separate chapter.

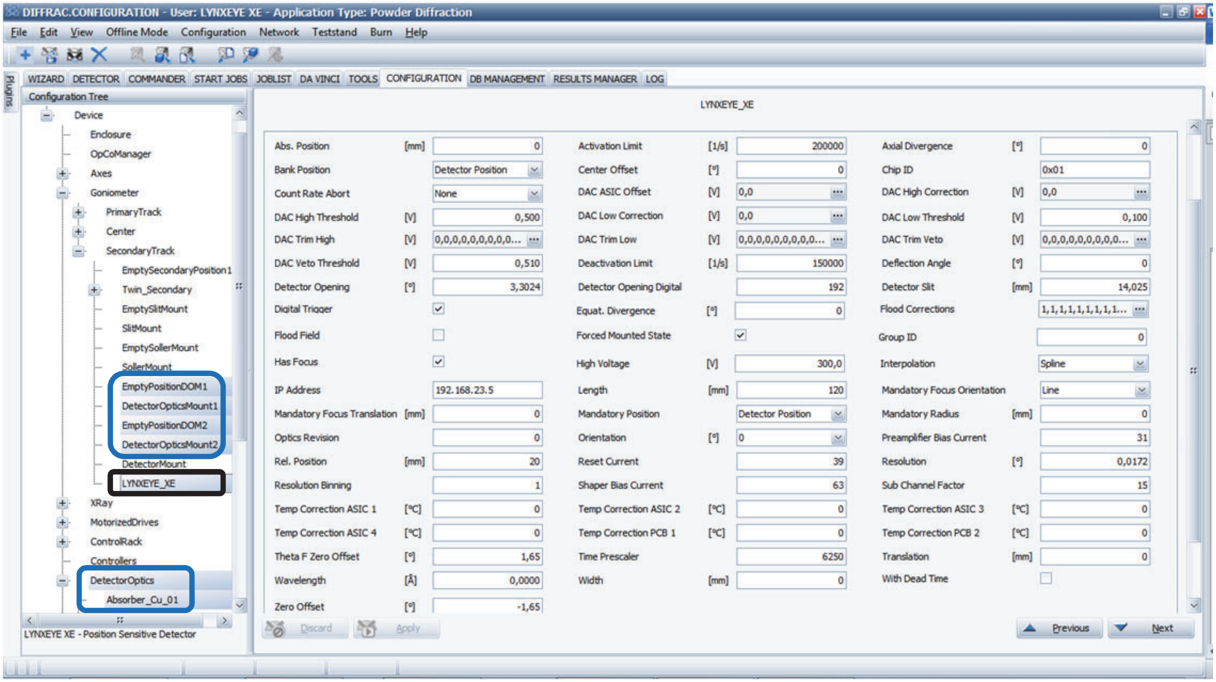


Figure 6.3: Default Template for diffractometer alignment (high count rate, Cr, Co and Cu rad.).

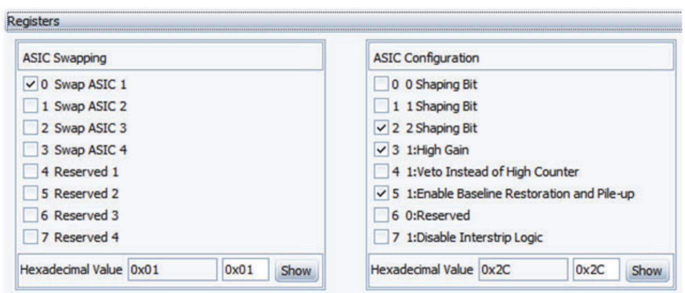


Figure 6.4: Registers for diffractometer alignment Template

ASIC Swapping: Always 0x01

ASIC Configuration:

- 0x2C: high count rate, high gain for Cr, Co and Cu rad.
- 0x2F: high energy resolution, high gain for Cr, Co and Cu rad. (standard for powder diffraction)
- 0x24: high count rate, low gain for Mo and Ag rad.
- 0x27: high energy resolution, low gain for Mo and Ag rad.

5. Selecting AOUT plug for LYNXEYE XE: Depending on your goniometer type, (Th/Th or Th/2Th) you must select the correct AOUT source for the LYNXEYE XE scans:

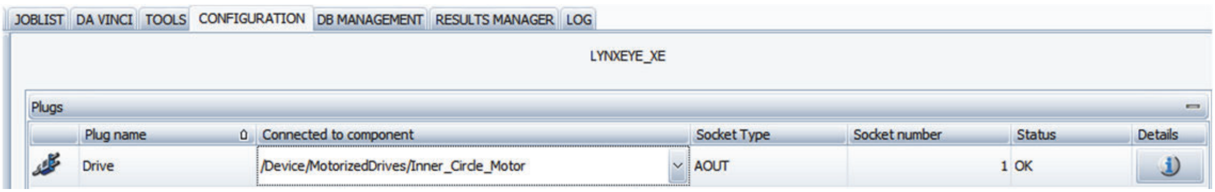


Figure 6.5: Inner_Circle_Motor for Th/Th-diffractometer

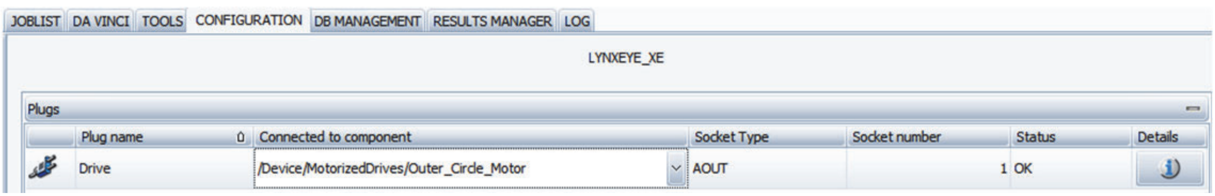


Figure 6.6: Outer_Circle_Motor for Th/2Th-diffractometer

6. You now can save and download this configuration and the detector will work but without energy discrimination or OpCo recognition. If you insert the Chip ID for your LYNXEYE XE, the Detector Optics and its two Detector Optics Mounts, OpCo recognition is working.

6.3 Detector Trimming and Energy Calibration

Trimming of the discriminators (veto, low and high) is required because the amplification in the two ASICs for each strip is varying a bit.

Due to the fact that trimming is done by a one-point calibration, the trimming is perfect only for one photon energy (wavelength), it has to be repeated for each photon energy.

Trimming is stable for a long time and needs not to be repeated routinely.

If the x-ray-tube is changed to a different target material, the trimming has to be repeated or loaded from a previous configuration with the same target.

Trimming is also different for ‘High Resolution’ and ‘High Count Rate’ modus and for ‘High Gain’ and ‘Low Gain’.

Trimming for ‘veto’, ‘low’ and ‘high’ discriminators must be done for the same ‘Mode’ and ‘Gain’ setting.

6.3.1 Veto Trimming

The Veto threshold is a special electronic circuit which cuts photons with a ‘wrong’ photon energy. Assuming pure Cu-k-alpha radiation, photons can lose partly its energy, due to charge sharing effects in the detector. A photon hitting the detectors generates electrons proportional to its energy. If this photon hits one strip at its border, some charges can be lost to the neighboring strip. The result is two events of different energies showing up as a low energy ‘tail’ in the Discriminator scan. The ‘Veto’ can detect and eliminate such photons.

The Veto threshold ranges from 0.51V to 0.0V, step size 0.002V. The smaller the Veto is set, the more photons are cut, which leads to losses in counts and improvement of energy resolution. The Veto trimming range is -0.008V to 0.0075V, step size 0.0005V.

1. Open the DETECTOR plugin and select the LYNXEYE_XE and activate the ‘Veto Discriminator’ (Figure 6.7).

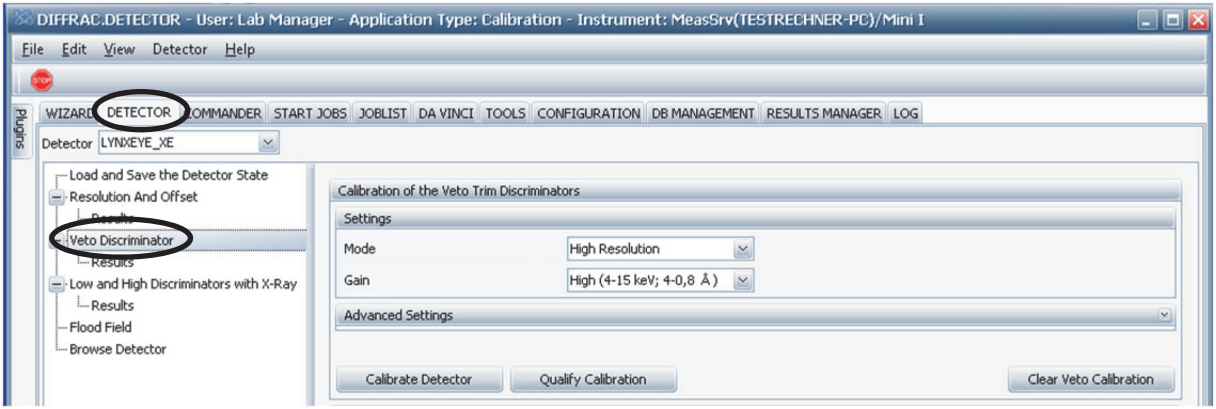


Figure 6.7: Selecting DETECTOR Plugin for Veto Discrimination

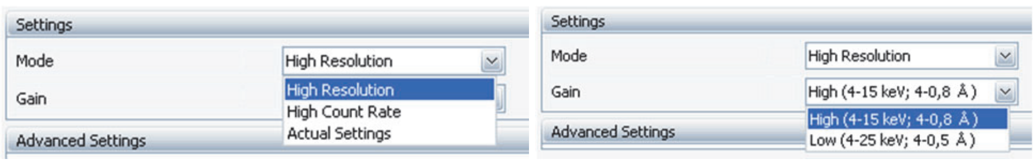


Figure 6.8: Selecting Mode and Gain for Veto Discrimination

Select Mode and Gain as required for your application. Keep shutter closed for starting the calibration.

Figure 6.9: Starting calibration for Veto Discrimination

Select ‘Calibrate Detector’ to determine new values or ‘Qualify Calibration’ to check the actual ones. The calibration will take several minutes. **Result shall be at least ‘Satisfactory’.**

Note

'Qualify Calibration' performs a check of the actual trimming values without changes.

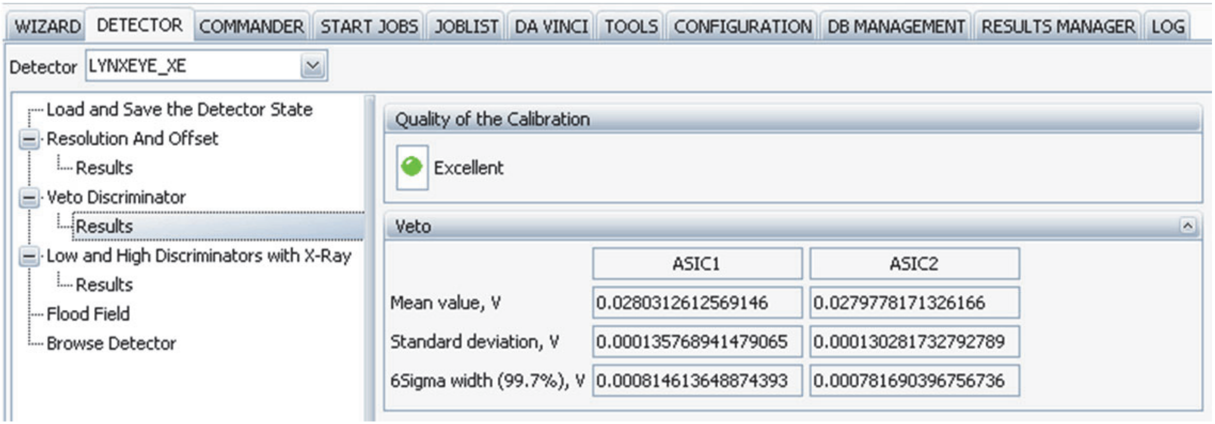


Figure 6.10: Result from Veto Trimming

As a result from the Veto trimming individual trim values (192) for each strip and a global DAC (Digital Analogue Converter) Veto Threshold (here 0.028V) is determined and inserted in CONFIGURATION and TOOLS.

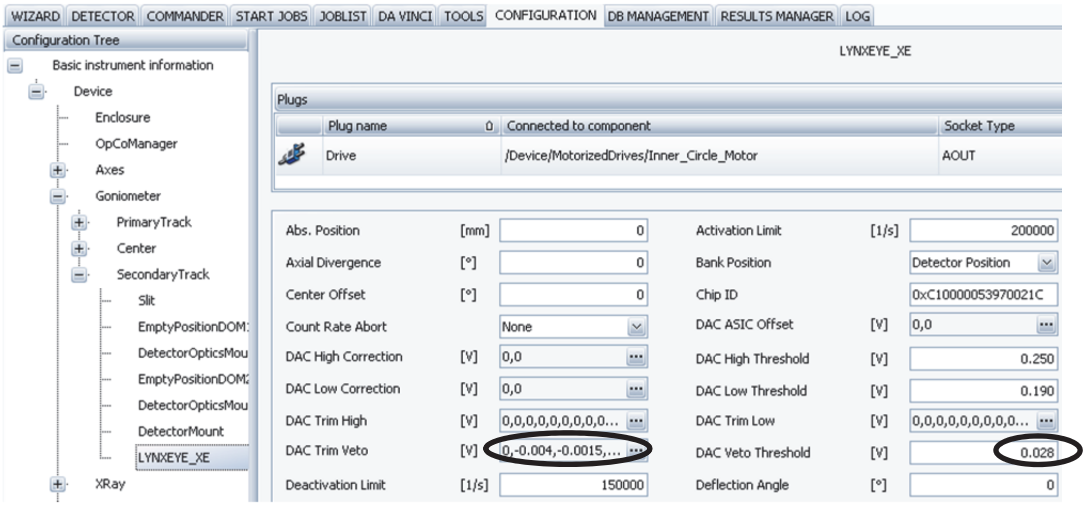


Figure 6.11: Values modified by Veto Trimming

6.3.2 Low and High Discriminator Trimming

Instrument Setup:
Switch to COMMANDER Plugin
Use settings from Table 6.1 according to your anode material
Set mA to adjust the intensity to <5000 cps / strip
Θ=15°, 2 Θ =30°
2mm or 1° primary divergence
kβ-Filter
2.5° primary Soller, no secondary Soller
Sample: backside of plastics PMMA sample holder

Table 6.1: Instrument settings* for Detector Discriminator Trimming

Tube KFL	kV/mA	Mode	Gain	DAC Low Thr.	DAC High Thr.	DAC Veto Thr.
Cr	30/40	High Res.	High	0.09	0.25	0.040
Cr	30/40	High CPS	High	0.09	0.25	0.060
Co	35/40	High Res.	High	0.10	0.30	0.040
Co	35/40	High CPS	High	0.10	0.30	0.060
Cu	40/40	High Res.	High	0.10	0.30	0.040
Cu	40/40	High CPS	High	0.15	0.35	0.060
Mo	50/50	High Res.	Low	0.15	0.35	0.026
Mo	50/50	High CPS	Low	0.15	0.35	0.040
Ag	50/30	High Res.	Low	0.19	0.44	0.026
Ag	50/30	High CPS	Low	0.19	0.44	0.040

* Use different recommended settings according to your tube type.

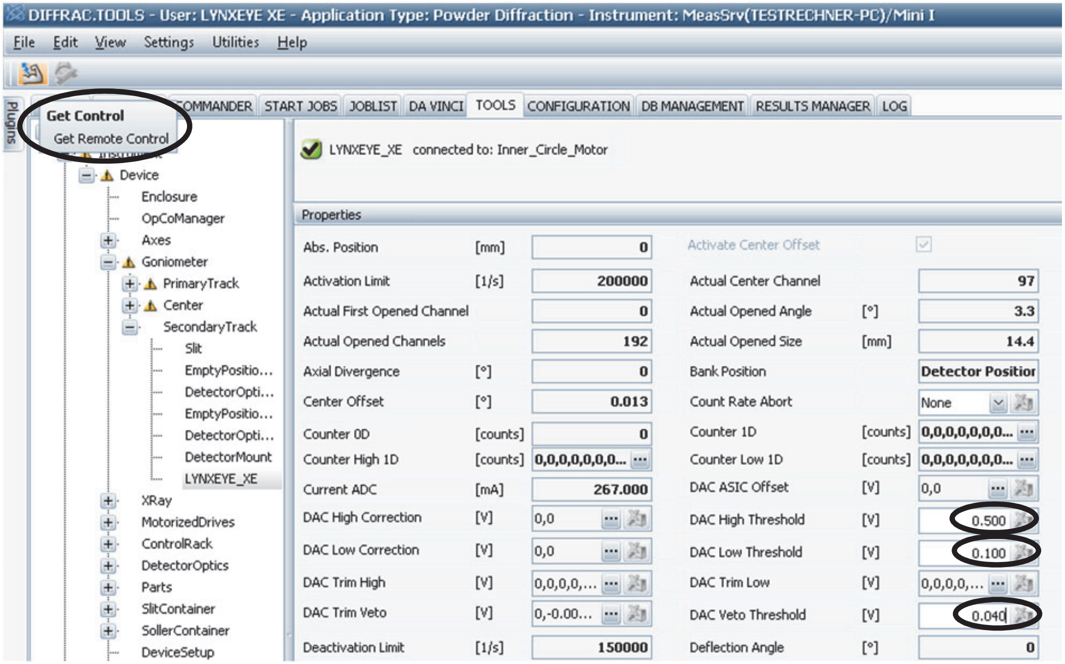


Figure 6.12: Getting control in TOOLS to change values for Discriminator trimming.

Activate your changes by pressing the field right next to the figure.

Open the ‘PSD Real Time Display’ under ‘Commander’ and check the intensity.

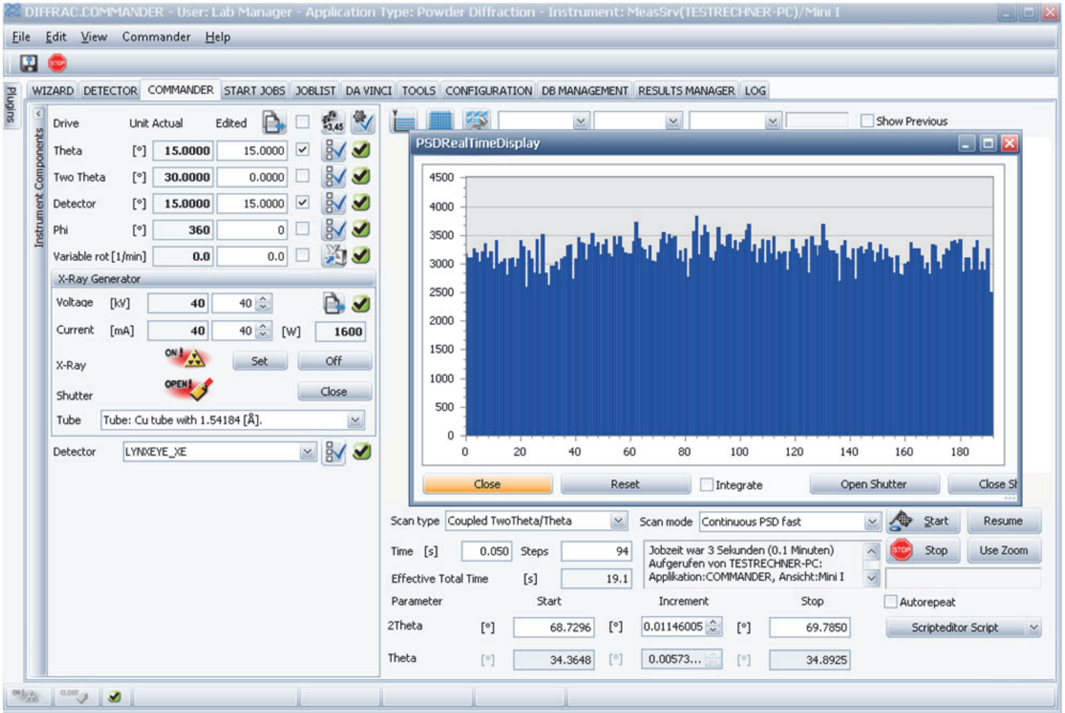


Figure 6.13: Intensity check for Discriminator trimming using values of Table 6.1.

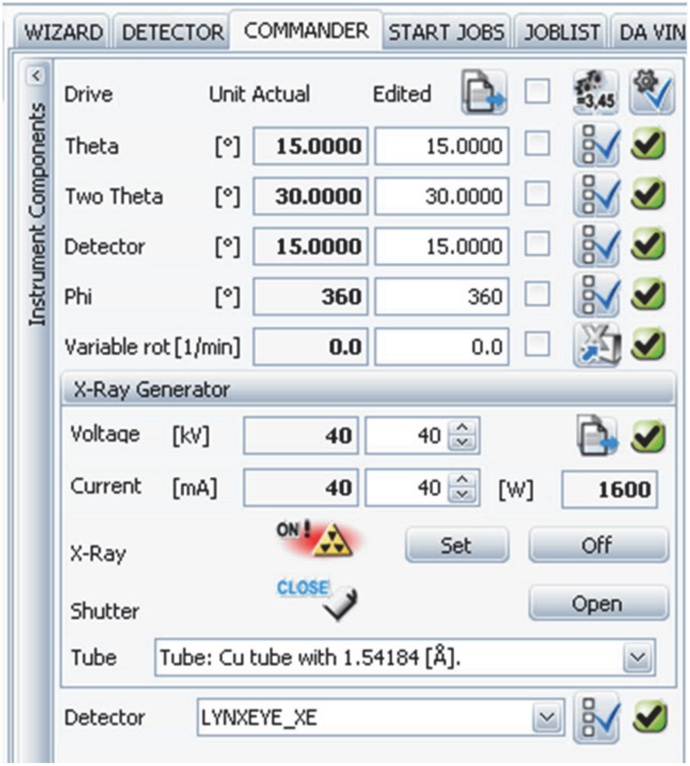


Figure 6.14: Diffractometer settings for Cu-radiation

Figure 6.15 shows the Discriminator screen with Advanced Settings opened. Energy, Mode and Gain are by default set to 'High Resolution' for your tube. Values in Advanced Settings are inserted automatically and normally need not to be changed. In case of low intensity, increase the Measure Time. Modify the Discriminator Start/Stop values (check range by Discriminator Scan) if the result is not satisfactory. The range must cover completely the Discriminator peak but should also not to be too wide.

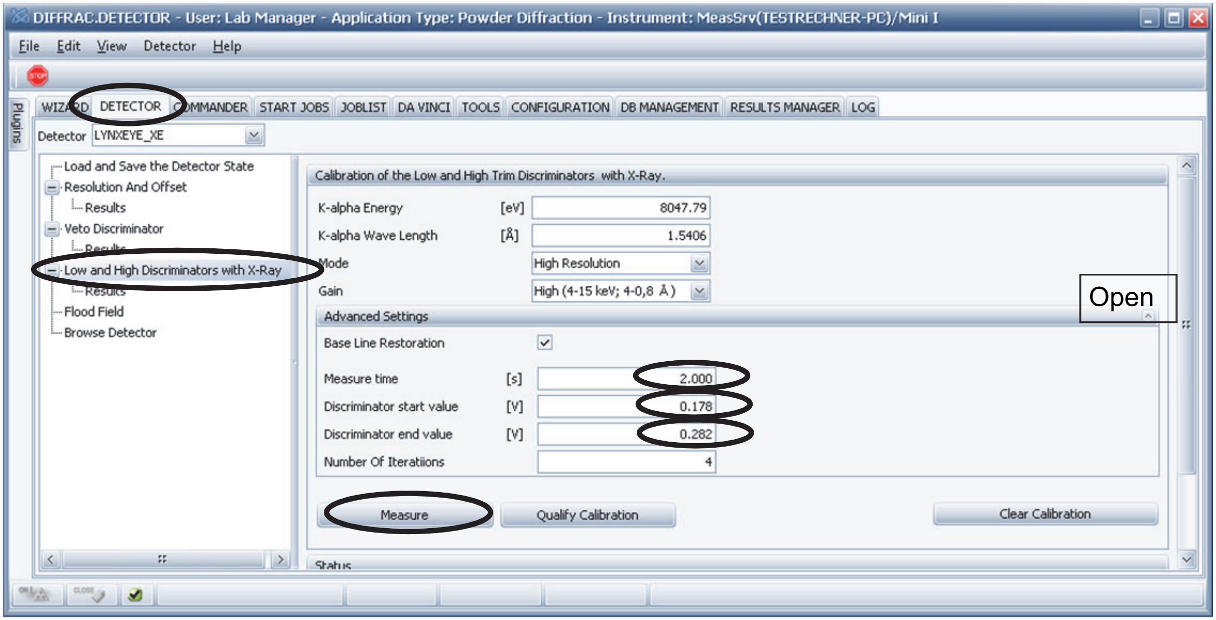


Figure 6.15: Selecting DETECTOR Plugin for Low and High Discriminators with X-Ray

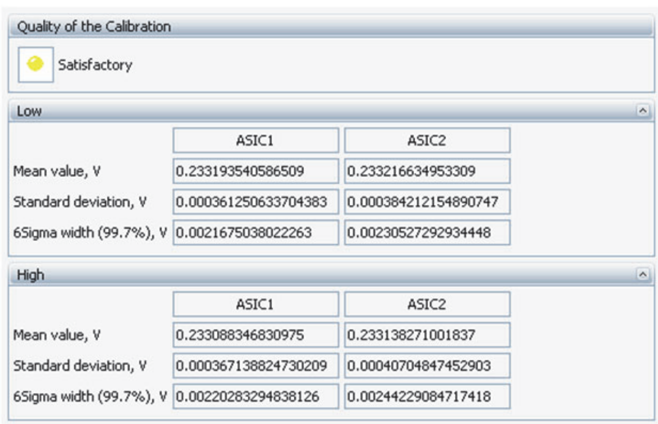


Figure 6.16: Result from Low and High Discriminators with X-Ray

The calibration will take several minutes. Result shall be at least ‘Satisfactory’. Especially for long wavelengths or ‘High Count Rate’ modus it might be impossible to get ‘Satisfactory’. Even in this case the energy resolution will be improved and can fulfill the specification.

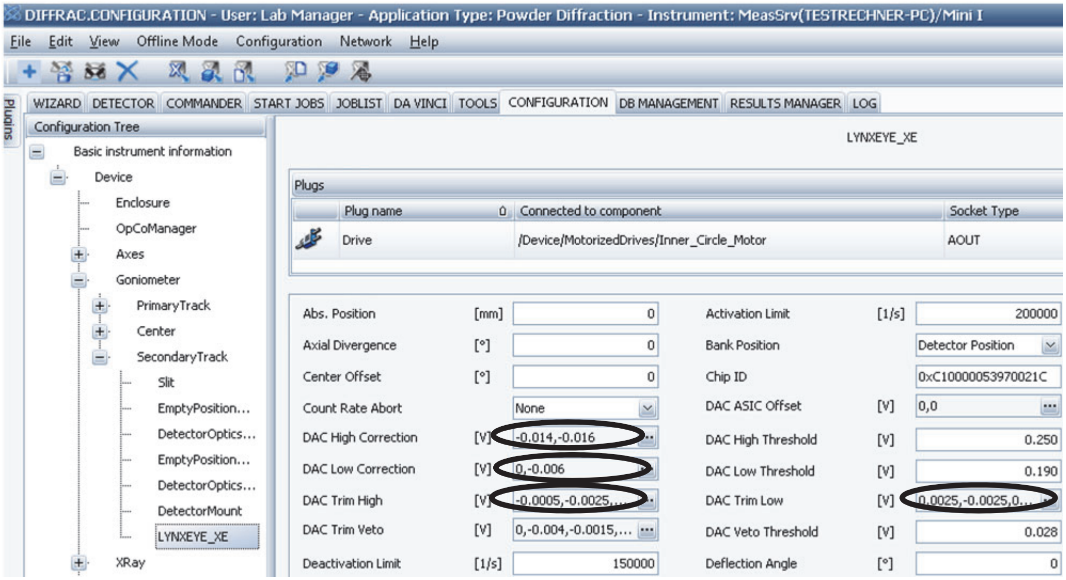


Figure 6.17: Values modified by High/Low Discriminator Trimming

6.3.3 Discriminator Setting and Kβ-Suppression

A correct setting of the ‘DAC Low’ and ‘DAC High Threshold’ together with a creful setting of the ‘DAC Veto Threshold’ allows to suppress significantly fluorescence radiation (increasing the DAC Low value) and kβ radiation (decreasing the DAC High value). The peak position for a given radiation is individual for each detector. The following table shows the range, where one can expect the peak position for a Discriminator Scan. Also listed are the energy resolution, remaining kβ part (NetInt(k_β) / (NetInt($k_{\alpha1}$+$k_{\alpha2}$))) together with the recommended settings for various target materials. Discriminator scans require’Calibration Application’.

6.3.3.1 Discriminator Setting

Instrument set up for Discriminator scans:

Use settings from Table 6.1 according to your anode material

Set mA to adjust the intensity to <5000 cps / strip

$\Theta=15°$, $2\,\Theta=30°$

2mm or 1° primary divergence

kβ-Filter

2.5° primary Soller, no secondary Soller

Sample: backside of plastics PMMA sample holder

Discriminator settings for High Energy Resolution (Cr, Co, Cu-rad.) and full discrimination for fluorescence reduction and kβ suppression: Set Disc.Low to (Obs.Max – 0.012V) and Disc.High to (Obs.Max + 0.012V)

Discriminator settings for High Energy Resolution (Mo, Ag-rad.) and full discrimination for fluorescence reduction and kβ suppression: Set Disc.Low to (Obs.Max – 0.012V) and Disc.High to (Obs.Max + 0.012V)

Discriminator settings for High Count rate (Cr, Co, Cu-rad.) and full discrimination for fluorescence reduction and kβ suppression: Set Disc.Low to (Obs.Max – 0.03V) and Disc.High to (Obs.Max + 0.03V)

Discriminator settings for High Count rate (Mo, Ag-rad.) and full discrimination for fluorescence reduction and kβ suppression: Set Disc.Low to (Obs.Max – 0.02V) and Disc.High to (Obs.Max + 0.02V)

Table 6.2: Detector parameters and settings for various target materials

Tube	Energy [eV]	Mode	Gain	Peak Pos [V]	Energy Resol.[eV]	Kβ part	DAC Veto Thr. [V]
Cr	5414	High Res.	High	0.141-0.155	<680	<8%	0.040
Cr	5414	High CPS	High	0.149-0.162	<1100	---	0.060
Co	6930	High Res.	High	0.180-0.198	<680	<3%	0.040
Co	6930	High CPS	High	0.190-0.216	<1100	---	0.060
Cu	8048	High Res.	High	0.209-0.241	<680	<2%	0.040
Cu	8048	High CPS	High	0.222-0.252	<1100	---	0.060
Mo	17444	High Res.	Low	0.226-0.261	<740	<1%	0.026
Mo	17444	High CPS	Low	0.238-0.274	<1150	---	0.040
Ag	22106	High Res.	Low	0.286-0.332	<780	<0.5%	0.026
Ag	22106	High CPS	Low	0.300-0.350	<1150eV	---	0.040

Note

Use a beta filter to determine the correct energy resolution. In High Resolution Mode the max. count rate in one strip should not exceed 10000 cps and in in High Count Rate mode 100000 cps to avoid significant dead time effects

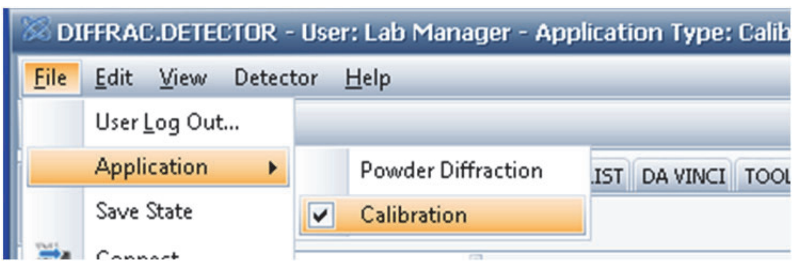


Figure 6.18: Switch to 'Application' and 'Calibration'

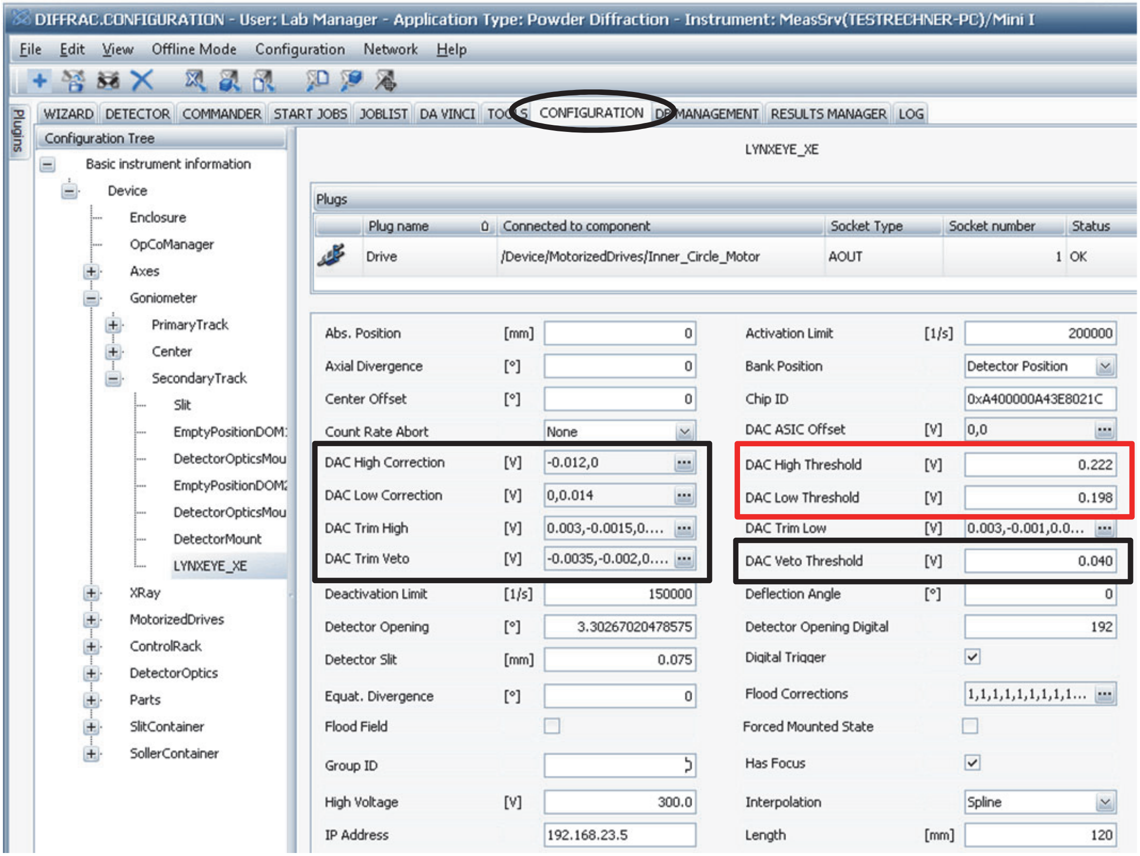


Figure 6.19: CONFIGURATION Plugin with modified values after Veto and Discriminators Trimming

Note

Use a beta filter to determine the correct energy resolution.

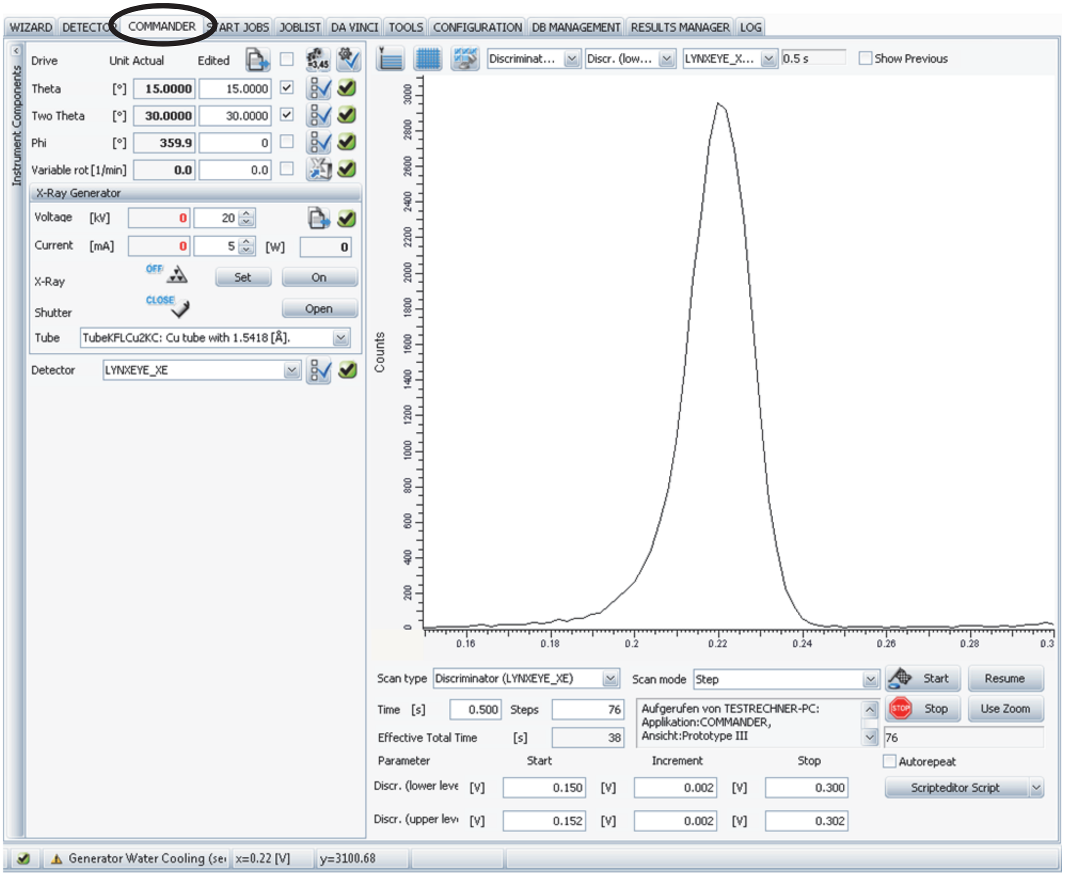


Figure 6.20: Discriminator Scan with values from Figure 6.19

Save Discriminator Scan to file ‘Disc_Scan_Cu_High_Resolution.brml’ and open with DIFFRAC.EVA.

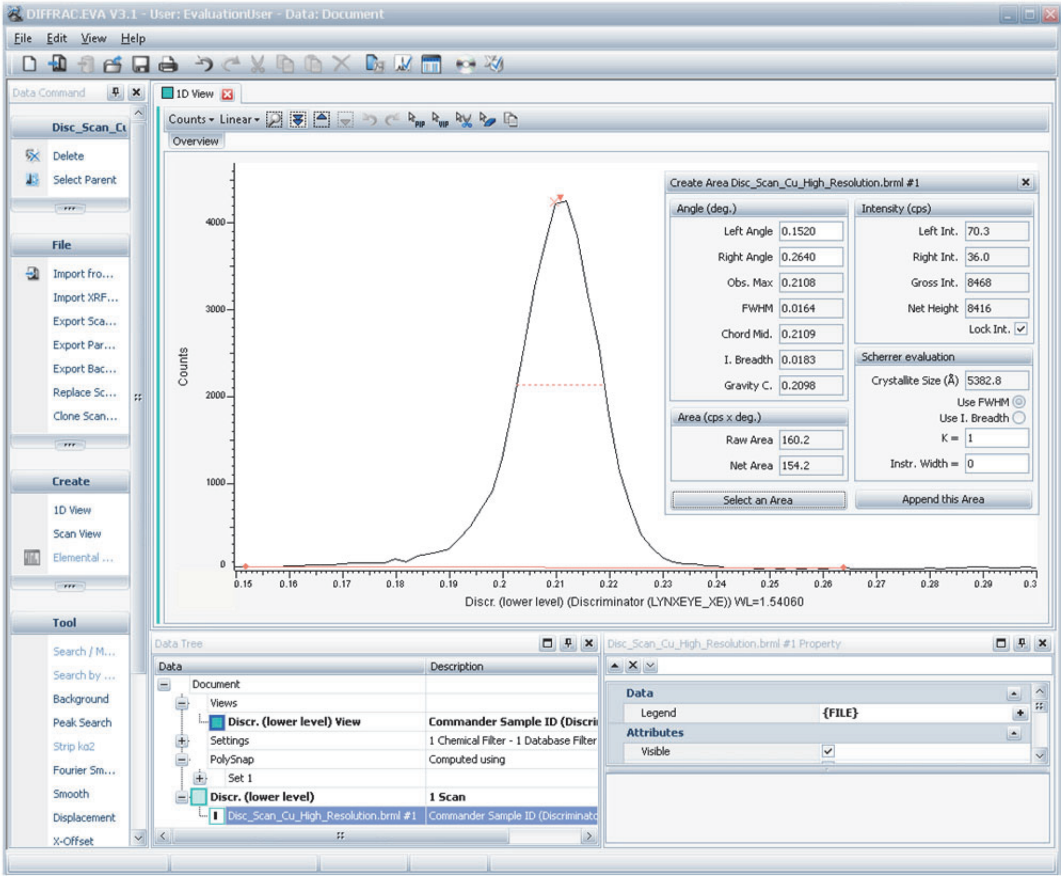


Figure 6.21: Create Area for Scan to determine peak position and FWHM.

The energy resolution (in eV) can be calculated by: FWHM/Obs.Max x PhotonEnergy.

In this example 0.0164/0.2108 x 8041 eV = 626 eV is achieved.

DAC Low/High Threshold should be set to 0.198V and 0.222V for full discrimination. Insert these values for this detector in the configuration for DAC Low and DAC High Threshold. The last values for the energy discrimination are now determined:

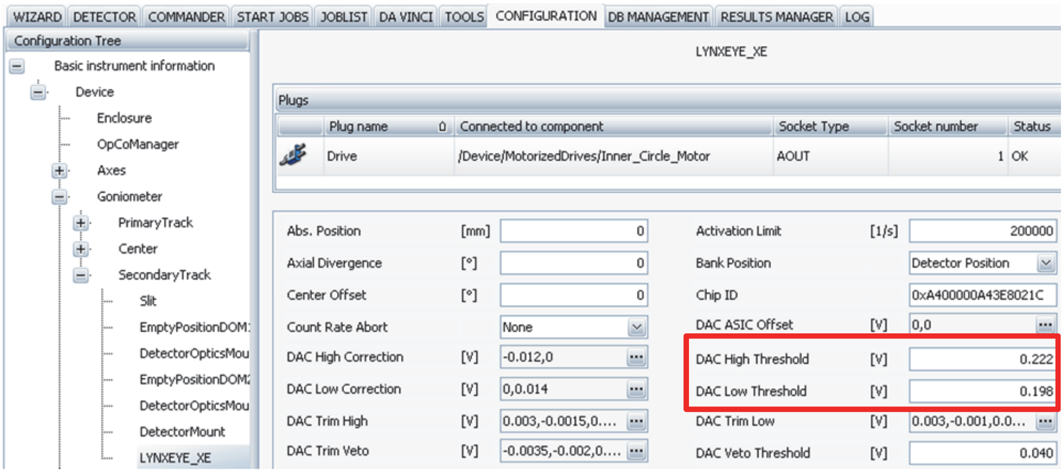


Figure 6.22: Inserting Values for ‘DAC High’ and ‘DAC Low Threshold’.

Perform a Discriminator scan under the same conditions but without kβ-filter. This scan gives a visual impression how well kα- and kβ-radiation are separated.

Note

Lowering the lower and upper discriminator by 0.002 or even 0.004V can reduce the Kβ-part but makes the detector sensitive (intensity fluctuation due to temperature changes)!

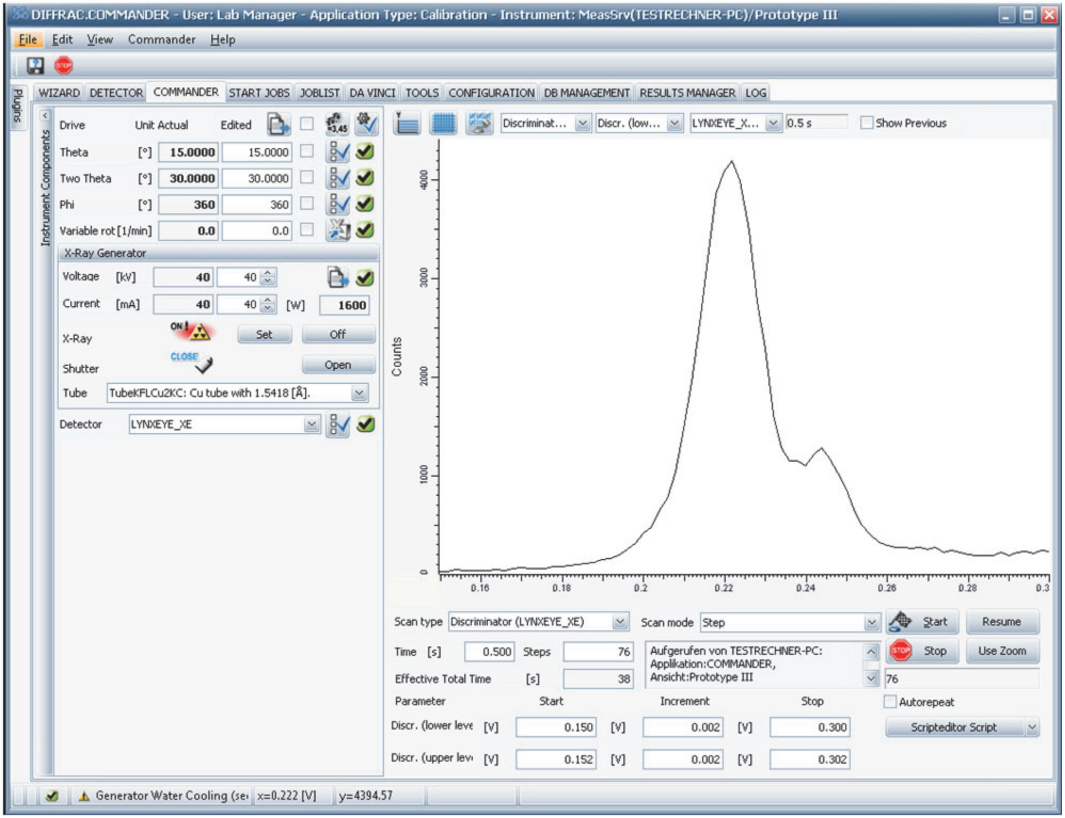


Figure 6.23: Discriminator scan for Cu radiation without Ni-filter.

Depending on your application (e.g. GM mirror or kα1 monochromator) it may also useful to use one of the following discriminator settings (example for this detector), which increases the intensity by a few percent:

DAC Low/High Threshold should be set to 0.208V and 0.3V for fluorescence suppression (requires kβ-filter)

DAC Low/High Threshold should be set to 0.120V and 0.232V for kβ-discrimination.

DAC Low/High Threshold should be set to 0.120V and 0.500V and DAC Veto Threshold. to 0.5V for max. count rates (No fluorescence suppression, requires kβ-filter).

6.3.3.2 Check of kβ-suppression

It is assumed that a ‘Spatial Calibration’ for your detector distance is performed and detector parameters for ‘Full Discrimination’ as in Figure 6.22 are applied.

Instrument set up for scans to check the kβ-suppression:

Use settings from Table 6.1 according to your anode material.

2mm or 1° primary divergence

No kβ-Filter

2.5° primary and secondary Soller

Sample: NIST1976 (example) or another known sample

Adjust power not to exceed intensity in one strip over 5000cps

Perform a ‘Coupled TwoTheta/Theta’ scan from 31° to 36° (0.008deg/0.05s) covering the positions of kα- and kβ-radiation reflections.

Switch to ‘Application’ and ‘Powder Diffraction’

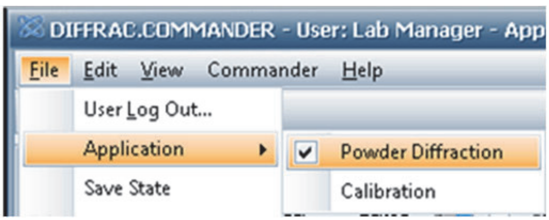


Figure 6.24: Switch to ‘Application’ and ‘Powder Diffraction’

1. Set the detector PSD angle to max. opening in degree in Config and remove any filters. Make sure that trimmed detector parameters for High Gain, High Resolution and Veto=0.04V are loaded.
2. Set Disc.Low to 0.120V and Disc.High to 0.320V in Tools and activate them.
3. Perform a Locked Coupled scan from 31 to 36° 2Th and save the file as LC_LL0d12-UL0d32.brml.

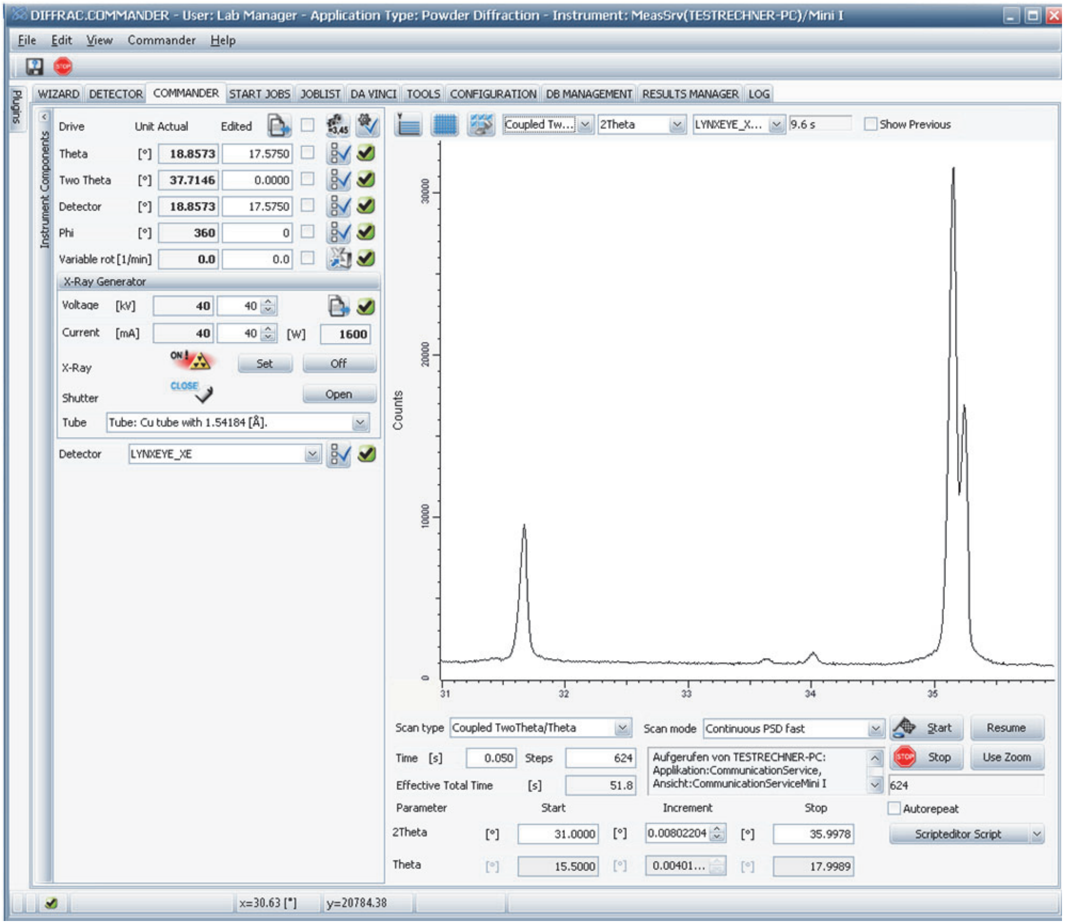


Figure 6.25: Locked coupled scan with open discriminators showing CuKα1/2-, -Kβ- and WLα peaks

4. Set Disc.Low to (Obs.Max – 0.012V=0.198) and Disc.High to (Obs.Max + 0.012V=0.222) in Tools and activate them
5. Perform a Locked Coupled scan from 31 to 36° 2Th and save the file as LC_LL0d198-UL0d222.brml.

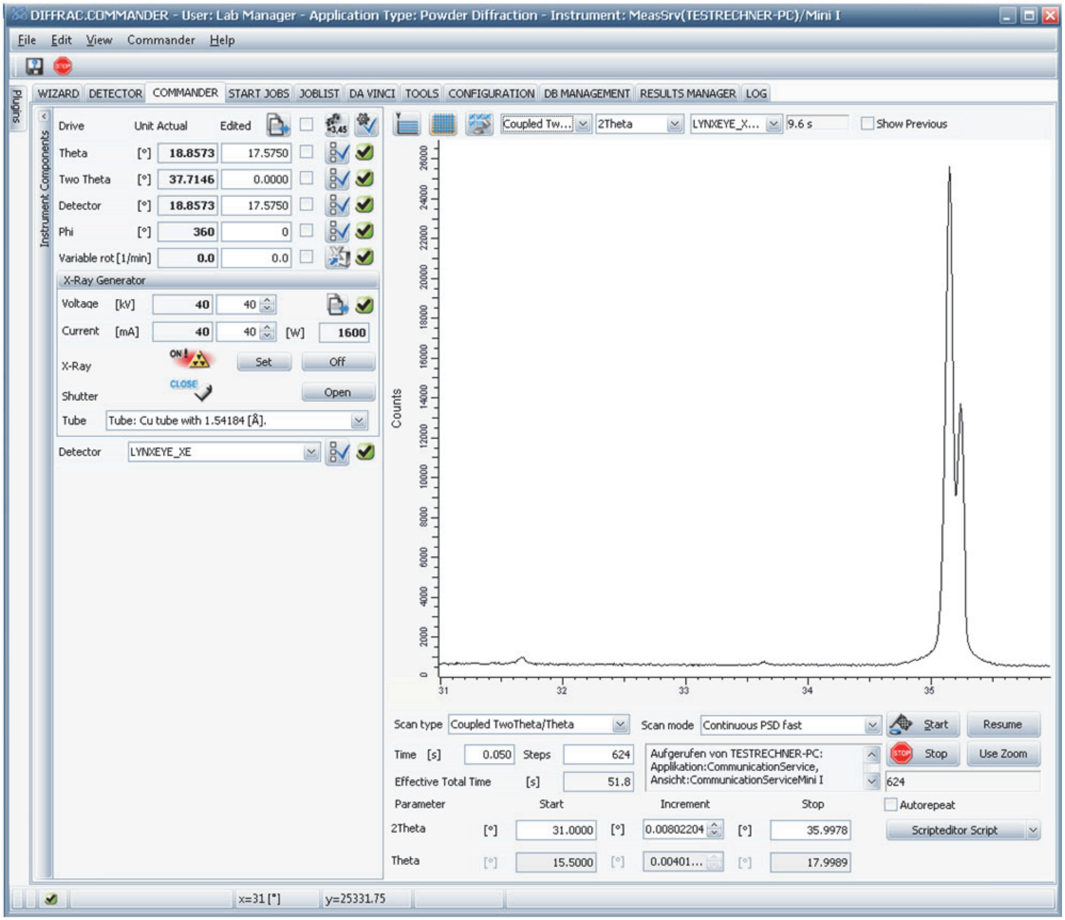


Figure 6.26: Locked coupled scan with closed discriminators showing CuK$\alpha_{1/2}$-, little -Kβ- and WLα peaks

6. Load both files into EVA and evaluate the intensities for Cu-Kα1/2 (range 34.5 to 35.7 deg.) and -Kβ peaks (range 31.2 to 32.1 deg.), save evaluation as Cu-Kbeta-suppression.eva

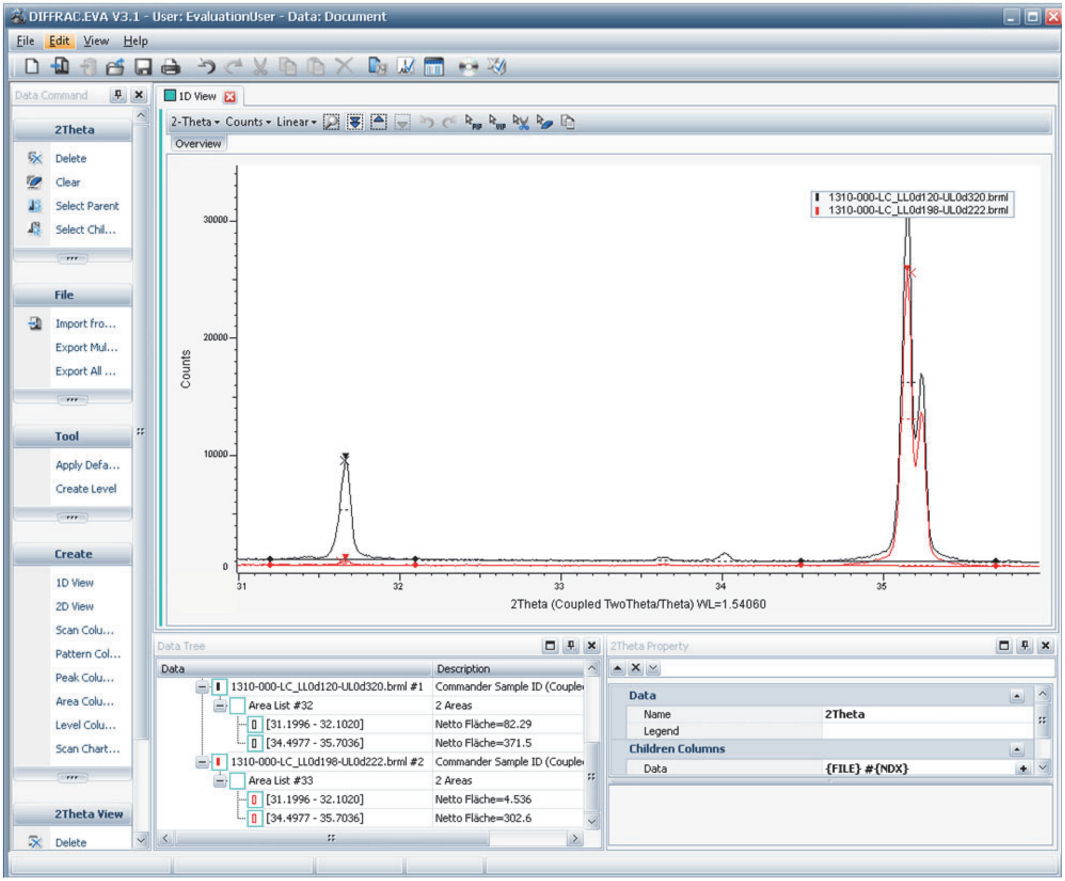


Figure 6.27: Evaluation of Locked coupled scans with open and closed discriminators showing $CuK\alpha_{1/2}$-, -Kβ- und WLα peaks

7. Kβ-part: Determine the intensity ratio of Cu-Kβ/Cu-Kα1/2 of LC_LL0d198-UL0d222.brml: Here: 4.536/302.6 = 0.013 (Limit I-ratio < 0.02)

8. Kα-ratio: Determine the intensity ratio of Cu-Kα1/2 LC_ LL0d198-UL0d222.brml / LC_LL0d12-UL0d32.brml: Here 302.6/371.5 = 0.81 (Limit I-ratio > 0.75)

In the same way these values can be determined for other wavelengths or detector settings according to tables Table 6.1, Table 6.2 and Table 6.3.

Table 6.3: Detector properties various target materials

Tube	Energy [eV], $K\alpha_{1,2}$	Mode	Gain	Energy Resol.[eV]	Peak Pos [V]	Kα-ratio	Kβ part	DAC Veto Thr. [V]
Cr	5414	High Res.	High	<680	0.141-0.155	>0.75	<0.08	0.040
Co	6930	High Res.	High	<680	0.180-0.198	>0.75	<0.03	0.040
Cu	8048	High Res.	High	<680	0.209-0.241	>0.75	<0.02	0.040
Mo	17444	High Res.	Low	<740	0.226-0.261	>0.90	<0.01	0.026
Ag	22106	High Res.	Low	<780	0.286-0.332	>0.90	<0.01	0.026

Note

Width and position of the discriminators influences also the peak tails in the diffraction peak profiles.

6.4 Spatial Calibration

Prior to calibration, the system must be aligned using the LYNXEYE XE detector in 0D mode. To make use of many strips as possible, it is necessary to download the default parameters for resolution and offset of the actual detector radius, see chapter 6.5.

Each detector is unique. A calibration process is used in conjunction with standard reference materials to determine a zero offset for the resolution in degrees. This value represents the angular difference between the zero angle of 2-theta and the zero channel of the PSD. The calibration program will refine the values and record them in the Configuration program. Spatial Calibration is independent of Energy Calibration.

6.4.1 Perform Positional Calibration

1. Remove / open all detector slits in front of the detector.
2. Ensure that the proper Kβ filter and the 2.5° Soller slit are in place.
3. Ensure that the reference material is mounted (NIST 1976) in the sample stage.
4. Set the goniometer to the parameters in Table 6.4 DIFFRAC.Measurement COMMANDER.

Table 6.4: Diffractometer settings and angular ($K\alpha_1$) Positions for NIST 1976b standard reference

Tube	Gen Volt.	Gen. Curr.	2 Theta	Theta	Time / Step
Cr	30	40	53.326	26.663	30
Co	35	40	41.049	20.525	20
Cu	40	40	35.147	17.574	10
Mo	50	50	15.981	7.991	10
Ag	50	30	12.589	6.295	10

5. Switch to ‘Resolution and Offset’ in DETECTOR plugin. At this time only some values in ‘Calibration by Measurement’ need to be changed.
6. Enter the value for ‘Theoretical 2 Theta Peak’ and ‘Time per Step’ according to Table 6.4. Insert ‘15’ for sample rotation if available.
7. Start the ‘Calibration by Measurement’ by activating the ‘Measure’ button
8. Save the experiment for further evaluation by ‘Save experiment’

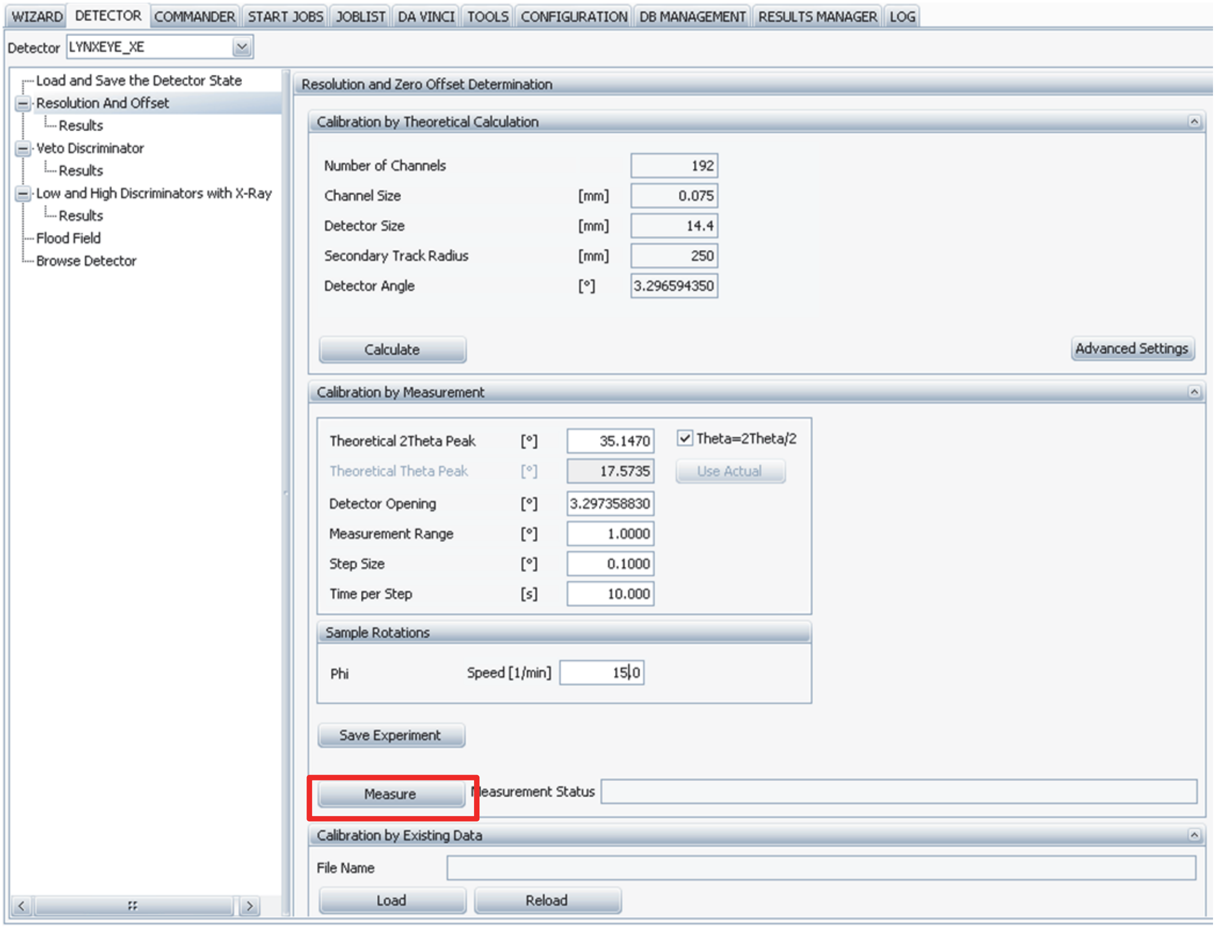


Figure 6.28: Starting the ‘Resolution’ and ‘Offset’ determination

9. As ‘Results’ you get new values for ‘Zero Offset’ and ‘Resolution’. Quality should at least ‘Satisfying’. You must double click on ‘Evaluation’ to open it and check the ‘Draw Data Frame’ box to display the scans, see Figure 6.29.

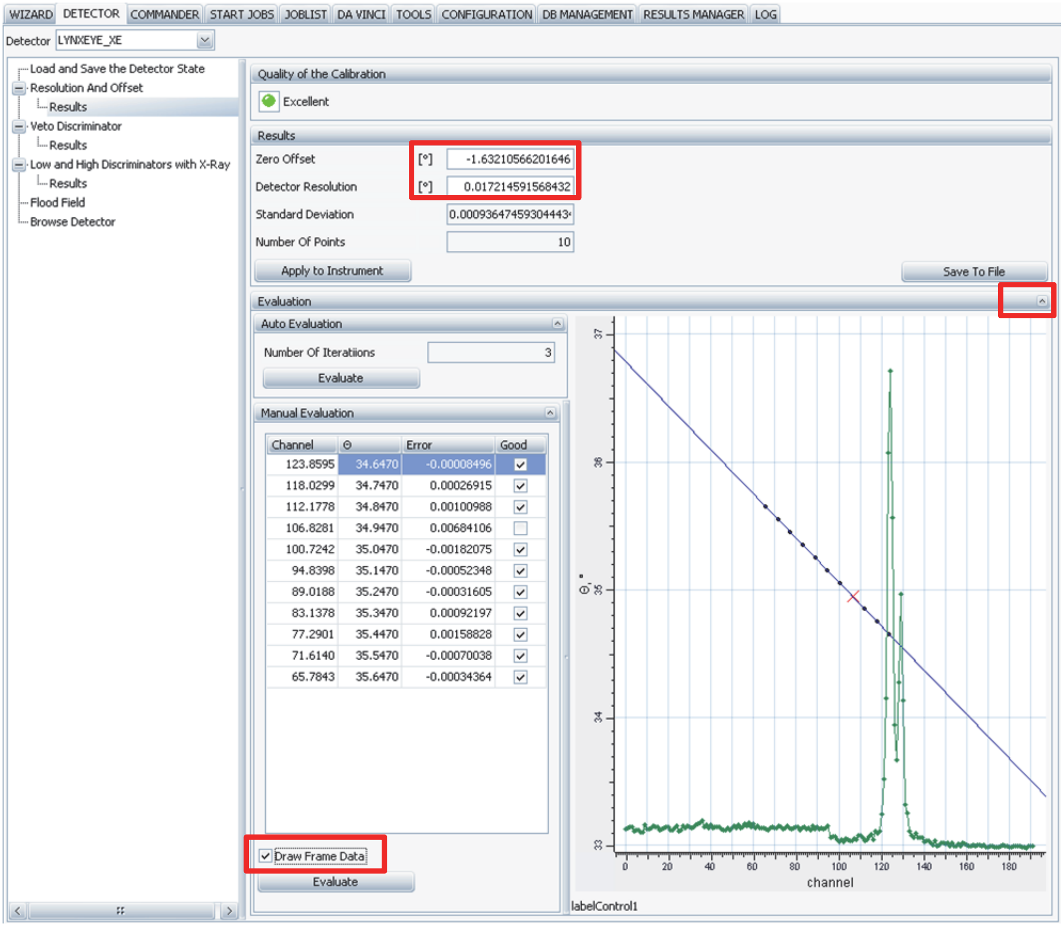


Figure 6.29: Result of the ‘Resolution’ and ‘Offset’ determination

10.‘Save to File’ stores the measured frames for further evaluation.

11.To Activate the Results you must press ‘Apply to Instrument’, does not require a download.

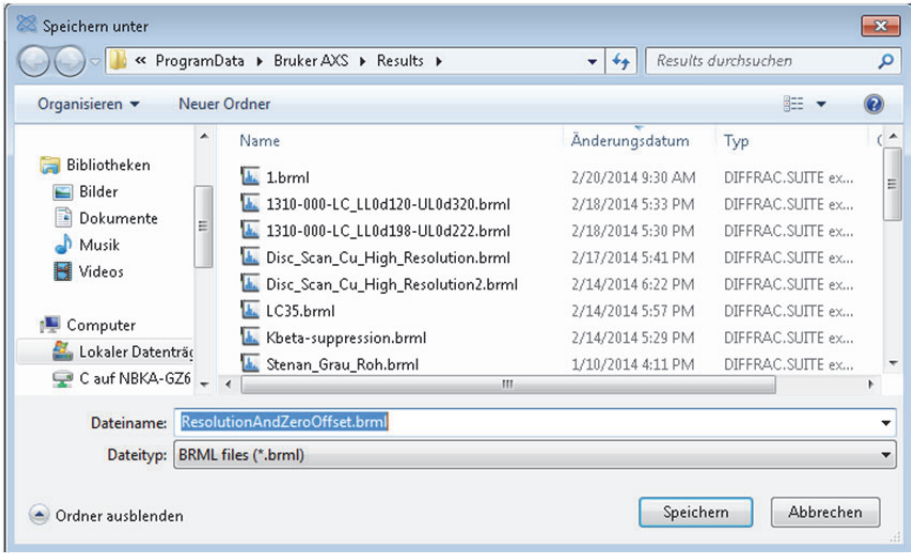


Figure 6.30: Saving the ‘Resolution’ and ‘Offset’ scans

12. Perform a locked coupled scan using 0.05s/0.008° from 34.5 to 35.7° in 2Th to check the result of the spatial calibration, see Figure 6.31

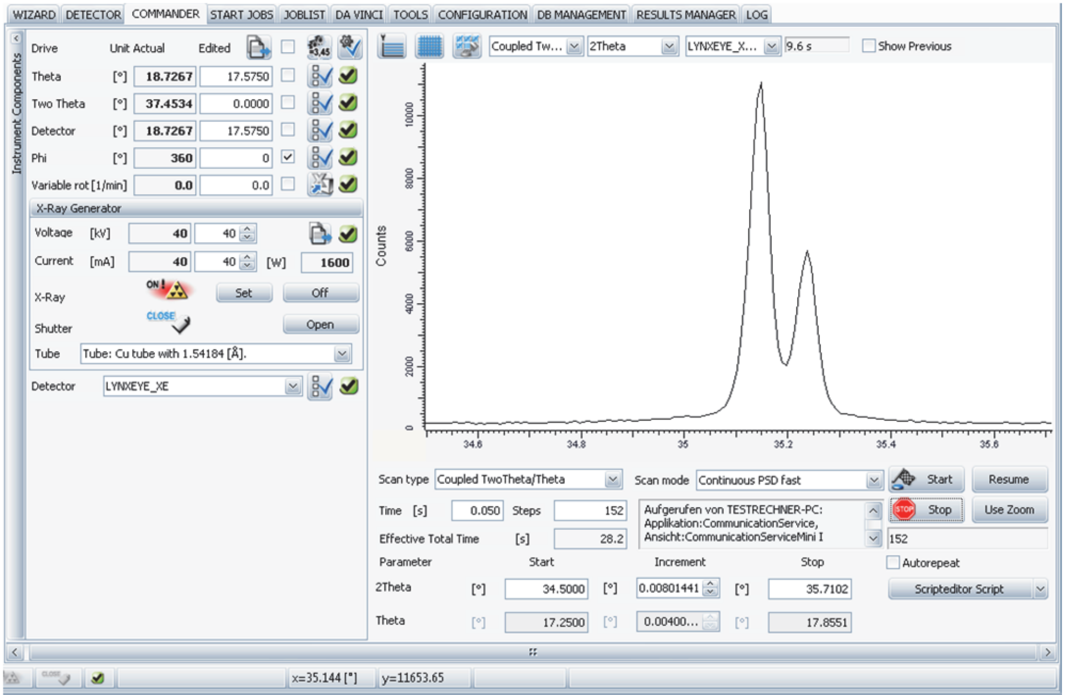


Figure 6.31: Position check of the ‘Resolution’ and ‘Offset’ determination

The detector is now completely adjusted concerning energy calibration (for one mode: Cu radiation and high energy resolution) and spatial calibration.

At this point, the Configuration and the State file should be saved (e.g. as Cu-HighGain-HighResolution.bfcfg and Cu-HighGain-HighResolution.zip from the CONFIGURATION and DETECTOR plugin.

In the same way the detector can be energy calibrated for High Count Rate mode. The spatial calibration remains the same and needs not to be re-determined.

Note

Save the Configuration and the State file from the CONFIGURATION and DETECTOR plugin.

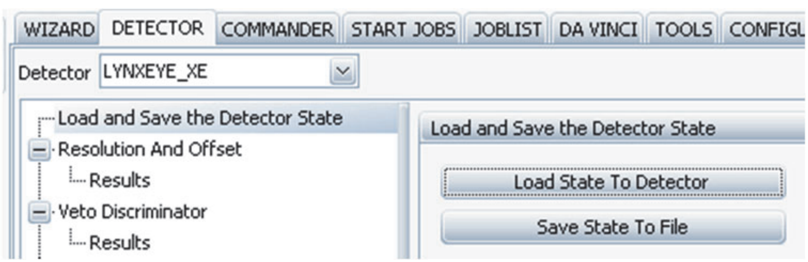
6.5 Changing Detector Settings with State Files

Loading state files are an easy method to change detector parameters without the need to download a configuration file. This avoids a restart of the diffractometer. The feature is available in the DETECTOR plugin. It is assumed that the ‘state files’ have been generated previously after determining the complete set of parameters (Trimming and setting of Veto, Low and High Discriminators as well as Resolution and Zero Offset).

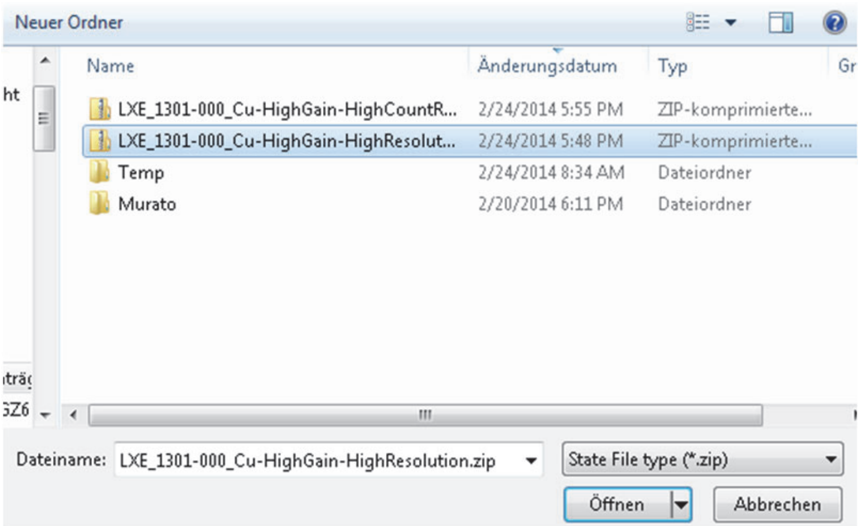
Note

All possible values have been applied. Low and High discriminators should be checked and can be set separately in Detector Properties or WIZARD. To ensure the changes, it is recommended to reconnect the diffractometer after loading the state file!

1. Activate the DETECTOR plugin and select ‘Load and Save the Detector State.



2. Press ‘Load State to Detector’ to activate new detector settings



3. Reconnect to the diffractometer:

6.6 0D-Mode

In 0D-mode a variable block of strips can be defined by software. All events collected by these strips are counted as one single rate at a specific angular position – similar to a scintillation counter. The most benefit can be achieved with the aid of a special detector holder (0/90° mount) by using the 90° rotated position (around the diffracted beam) in combination with a standard 0-dimensional optics. In this case, the line intensity is distributed to up to 192 strips of 75 µm width which results in detectable count rates of some 100 kcps, depending on the detector mode. This will give the option to measure some 10 million cps. Even if in most cases not needed, the LYNXEYE XE in 0-D Mode can be combined with the Automatic or Rotary Absorber in Auto Mode.

Continuous and Step Scans are supported for all motors configured in combination with up to 3 Axes Indexer Boards. This mode is most useful for aligning the diffractometer drives.

6.6.1 Performing Scans in 0-D Mode Using COMMANDER and WIZARD

6.6.2 Standard operation

0-D Mode does not require a special setting for the LYNXEYE XE in the configuration of the diffractometer. When selecting the Details button in the DIFFRAC.COMMANDER two buttons are available for the PSD under Scanning Mode (see Figure 6.32.

The default mode is ‘1D’. After clicking the 0D button a value for Opening has to be defined, (see Figure 6.32). The smallest possible value is 0.075 mm, corresponding to one strip. Odd multiples of 0.075 mm can be selected up to a complete opening of approximately 14 mm.

All available Scan types are shown in (see Figure 6.33). Step and Continuous scan are possible (see Figure 6.34). More or other scan types might be displayed according to your diffractometer setup.

The same features are available in the DIFFRAC.WIZARD (DOC-M88-EXX194).

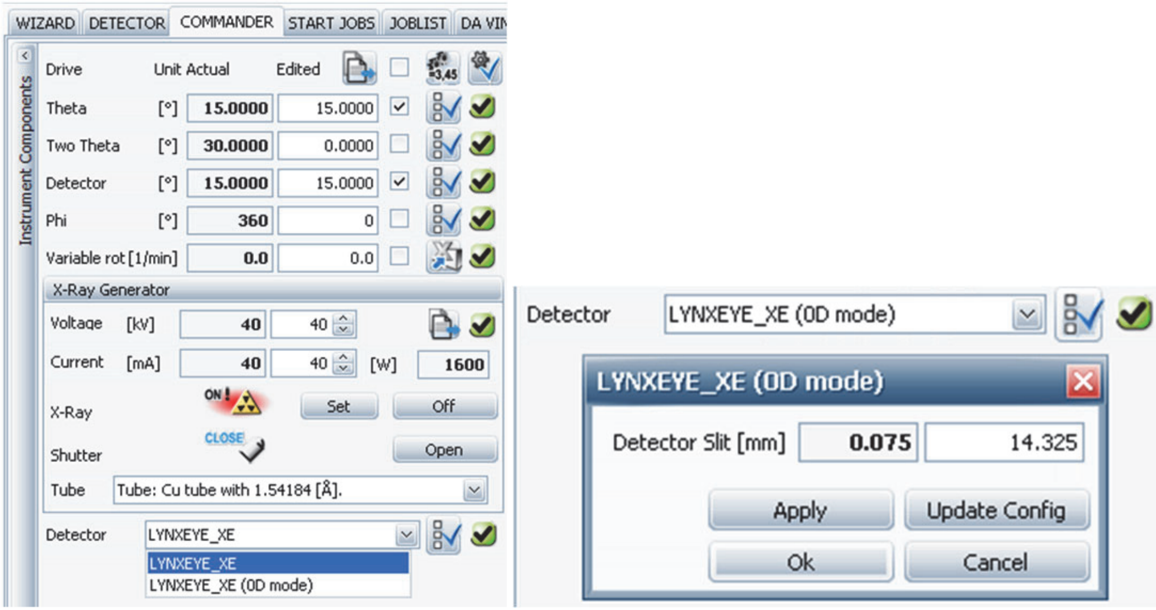


Figure 6.32: Selecting LYNXEYE XE 0D-mode and Detector Slit

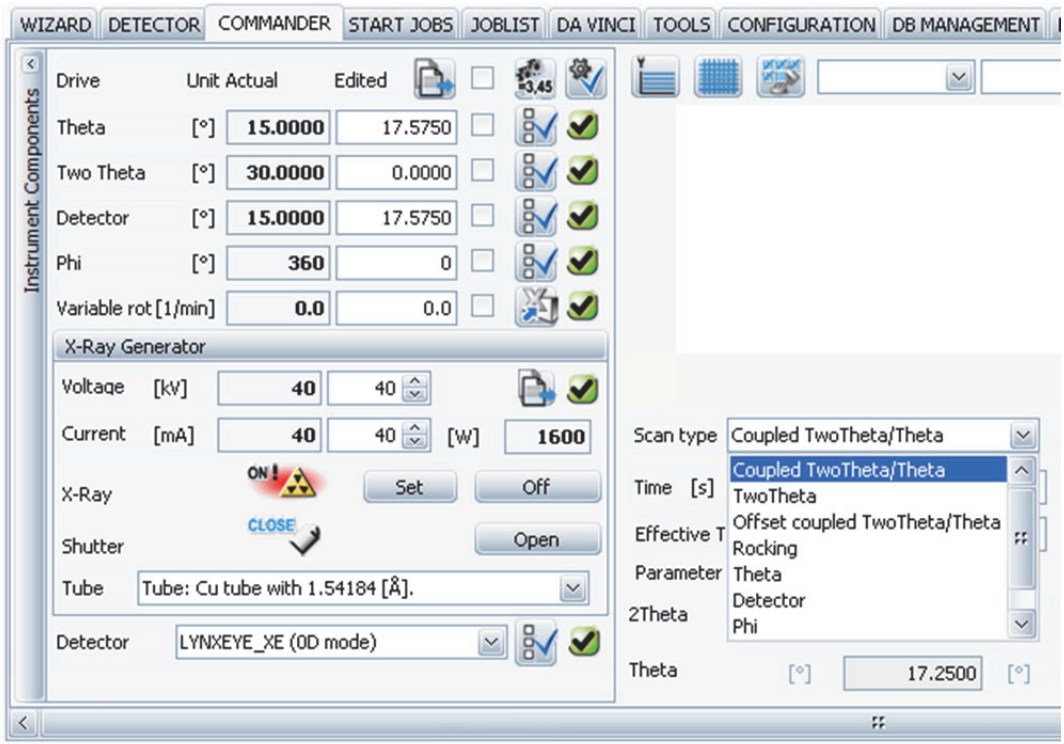


Figure 6.33: Available scan types for LYNXEYE XE 0D-mode.

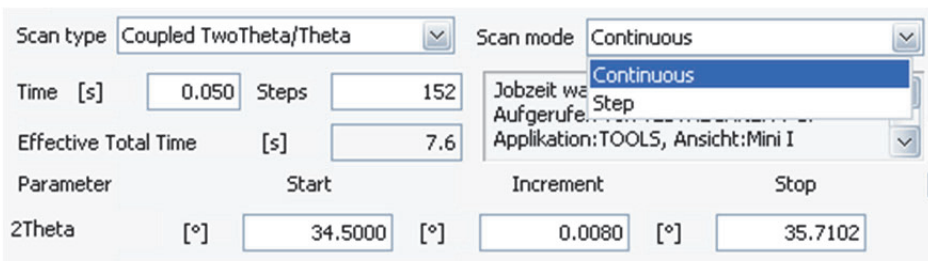


Figure 6.34: Selecting scan mode for scan types.

6.6.3 Aligning the Diffractometer

Note

Save the Configuration and the State file from the CONFIGURATION and DETECTOR plugin. It is recommended to start the alignment of the diffractometer with the default values set for the LYNXEYE XE detector in the CONFIGURATION.

The procedure might destroy any previously performed calibrations (when using the default configurations and should be the 1st step setting up a diffractometer.

The 0D functionality allows to align the diffractometer without a scintillation counter and without the additional secondary optics. The detector must be mounted in 0° position. It is highly recommended to download the default settings for the given detector distance to center the middle strip with respect to the detector arm. This allows later to use the maximum number of strips.

To minimize dead time effects, you should load one of the default configurations LYNXEYE_XE_Diff_Align_Cu_Cr_Co_Fe_Tube.bfscn or LYNXEYE_XE_Diff_Align_Mo_Ag_Tube.bfscn or the state file for ‘High Count Rate‘ of your detector, you should reduce the count rate by absorbers to maximum 100 kcps/strip.

In case you want to use your actual High (energy) Resolution Configuration, you should reduce the count rate by absorbers to maximum 10 kcps/strip.

- For Tube Scans the opening of the LYNXEYE XE should be set to 10mm.
- For Detector Scans the opening of the LYNXEYE XE should be set to 0.075mm.
- Under these conditions, the ZI values for the Tube and Detector can be determined.

6.6.4 Setting the diffractometer to Default Values

1. Open the ‘DETECTOR’ plugin
2. Load the state file for ‘High Count Rate‘ of your detector or one of the default configurations LYNXEYE_XE_Diff_Align_Cu_Cr_Co_Fe_Tube.bfscn or LYNXEYE_XE_Diff_Align_Mo_Ag_Tube.bfscn
3. Insert sufficient absorber and perform a download in case of Configuration files.

4. Calculate the 'Calibration of the Theoretical Position' and apply it, see Figure 6.35. Click on the 'Advanced Settings' tab to activate the input fields. Use the default values and change the secondary track radius if necessary, do not alter other values. Press 'Calculate'.

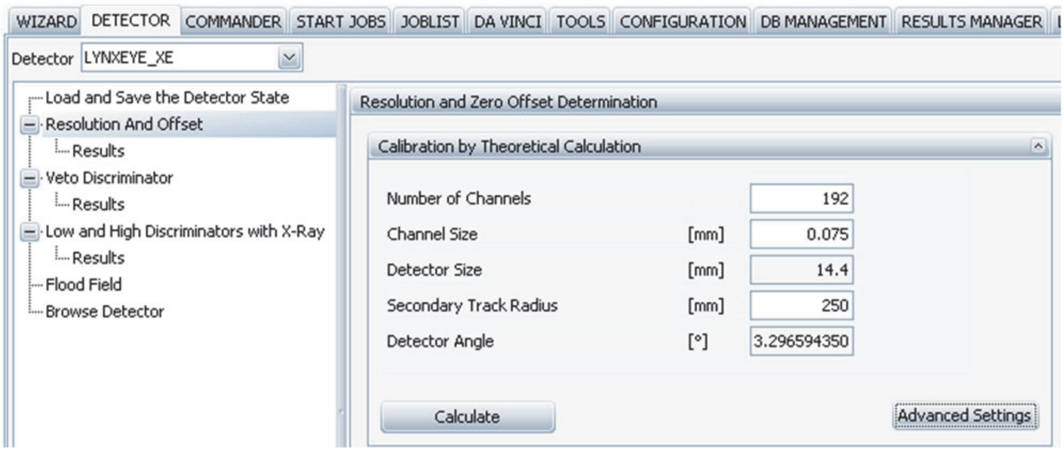


Figure 6.35: Calculate the 'Calibration of the Theoretical Position'

5. Press 'Apply to Instrument' to activate the calculated values, see Figure 6.36.

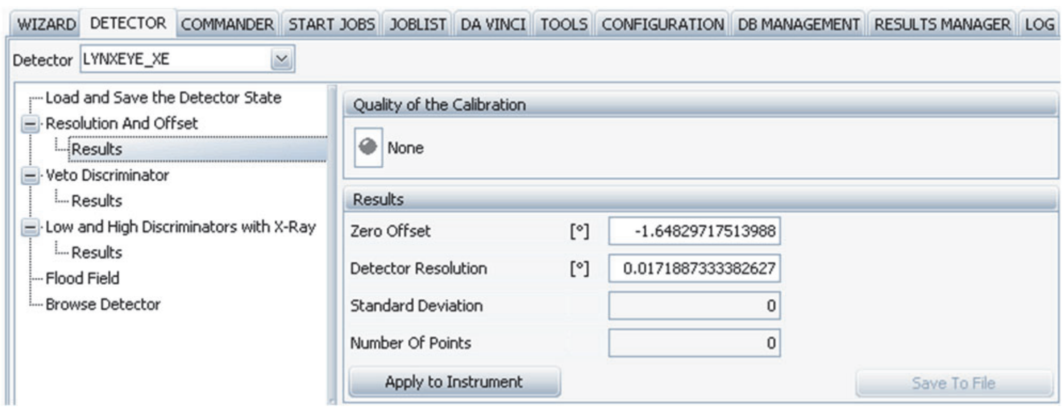


Figure 6.36: Apply the calculated values to the instrument.

6. Start aligning the diffractometer and save the configuration after finishing.

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7 Preventive Maintenance and Troubleshooting

The components of the diffractometer are basically maintenance-free for the user. However, Bruker AXS recommends a yearly preventive maintenance inspection. To schedule this inspection or for technical support, contact your local Bruker AXS Service Department.

Note

For standard maintenance and troubleshooting there is no need to open any of the LYNX-EYE XE components. Especially breaking the seal of the detector cover and/or removing the detector cover will lead to a complete loss of warranty!

7.1 Cleaning the LYNXEYE XE Detector

Caution!

In preparation of a cleaning of the instrument please shut down the complete diffraction system (i.e., all control electronics, accessory components, and the high voltage generator).

To clean the exterior of the detector components, use dry cleaning utensils only. Do not use water or aggressive cleaning agents. Clean laboratory conditions are recommended. Airflow is critical for maintaining proper operation of the detector control electronics. Do not place anything on the controllers that may restrict the flow of air. Regular cleaning of the detector components includes removal of any airflow restrictions, including dust.

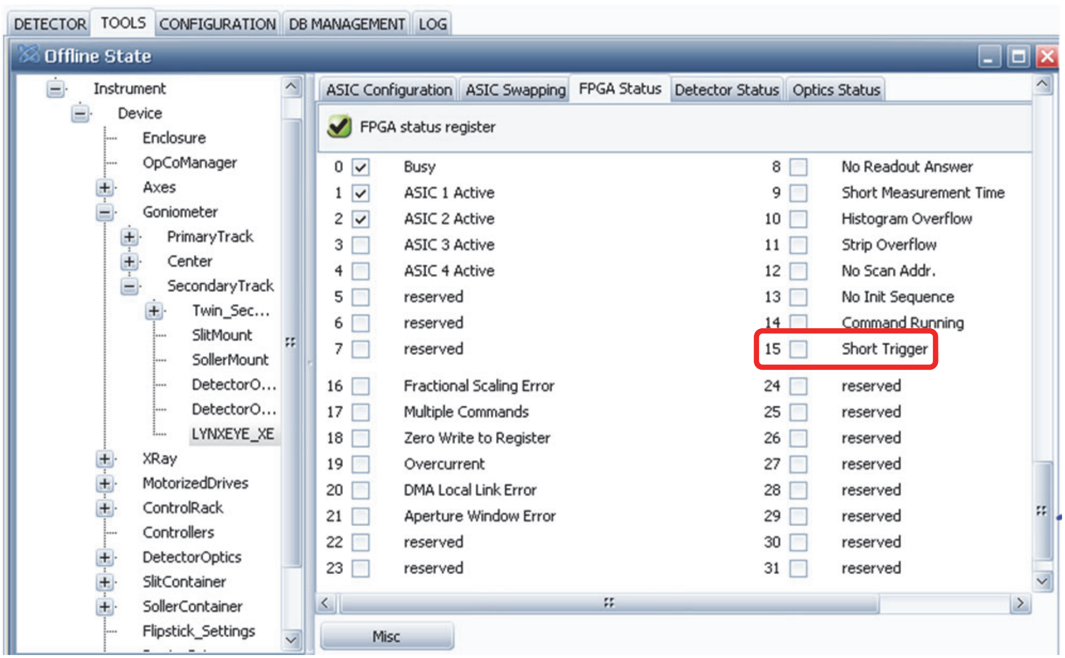
7.2 Troubleshooting

7.2.1 Display Data in the DIFFRAC.COMMANDER Window has Flat-lined or is Nonexistent.

- Check if the motor clock cable is properly installed.
- Check if the BIAS button is illuminated.

7.2.2 Locked Coupled Scan Does Not Start/Finish

- Alarm LED is red or flag for Short Trigger is activated in TOOLS:



- Reset the Detector and wait for reconnection.

7.2.3 The detector is not Selectable/Active in COMMANDER

- If this happens after download, press the RESET button of the detector and wait for reconnect.
- Check the LAN connection
- Is the detector correct mounted?
- Is the OpCo manager running
- Is the Chip ID set correctly.

7.2.4 High Background in Scans

- Fluorescence from sample: adjust lower discriminator setting.
- Detector Bias not set correctly.
- One strip became noisy: perform a fixed scan for all strips to identify the noisy one, contact Bruker AXS.

7.2.5 High Kβ-Part in Scans

- Check energy position for diffraction wavelength and compare with actual discriminator settings. Position might differ due to temperature change of detector.

7.2.6 Alarm LED Lights Red

- Reset the detector and wait for reconnection.

7.2.7 The BIAS LED is not Illuminated.

- Check the Bias Value in the TOOLS.

7.2.8 The Angular Accuracy Peak Position Data is Larger than +0.01° of the Expected Value.

- Repeat the calibration of the LYNXEYE XE detector.

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8 References

The following list of documentation is useful for operation the LYNXEYE XE detector:

Part Number	Description
D8 ADVANCE Introductory User Manual (Preinstallation, Safety, Specifications)	DOC-M88-ZXX146
D8 DISCOVER Introductory User Manual (Preinstallation, Safety, Specifications)	DOC-M88-ZXX151
D8 ADVANCE / D8 DISCOVER User manual Volume 1	DOC-M88-EXX153
D8 DISCOVER User manual Volume 2	DOC-M88-EXX162
DIFFRAC. Measurement Suite Installation Guide	DOC-M88-EXX190
DIFFRAC. Measurement Suite User Manual	DOC-M88-EXX191
XRD Wizard Reference Manual	DOC-M88-EXX194
DIFFRAC.EVA User Manual	DOC-M88-EXX200
Verification Booklet	DOC-M88-EXX157

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9 Assessories and Spare Parts List

Table 9.1 Accessories and Spare parts

Part Number	Description
A24D245	LYNXEYE XE detector 300µm thick, 0/90° holder for D8 A25, Univ. Det. Mount (UDM) required
A24D246	LYNXEYE XE detector 300µm thick, 0° holder for D8 A25, UDM required
A24D245	LYNXEYE XE detector 500µm thick, 0/90° holder for D8 A25, UDM required
A24D246	LYNXEYE XE detector 500µm thick, 0° holder for D8 A25, UDM required
A17B100	LYNXEYE XE detector 300µm thick incl. alignment base only
A17B140	LYNXEYE XE detector 500µm thick incl. alignment base only
A17D100	Multi Axes Clock Cable
K340C15	LAN cable black, 5m
K180C474	EMC filter adapter
A17B109	Ax. Soller 1.5
A17B108	Ax. Soller 2.5
A17B107	Ax. Soller 4
A17B115	Ni filter for Cu
A17B116	Ni filter for Cu (low β)
A17B117	V filter for Cr
A17B118	V filter for Cr (low β)
A17B119	Zr filter for Mo
A17B120	Zr filter for Mo (low β)
A17B121	Fe filter for Co
A17B122	Fe filter for Co (low β)
A17B127	Cu absorber 0.1mm
A17B128	Cu absorber 0.2mm
A17B125	Slit 4mm
A17B126	Slit 10.5mm
A17B130	Empty Slit

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