NEUTRONOPTICS GRENOBLE

Inexpensive x-ray & neutron CCD cameras...
Real-time 2D-imaging of samples in-beam

Home | New | Clients | Cameras | Examples | Details | Soft | Help | Options | Order

NeutronOptics Fast Imaging Camera Assembly

The NeutronOptics Fast Imaging Camera is shipped partly assembled because of the fragile nature of some components, such as the mirror and the CCD. These components are designed to be fitted quickly and easily by the end-user, and instructions are attached to the camera itself. This section illustrates and expands on those assembly instructions. The illustrations below show this L-shaped camera complete with the CCD and its B_4C/Pb protection on top, with the imaging box containing the scintillator in front of the interior mirror at the bottom.

Some photos show slightly different versions of this camera
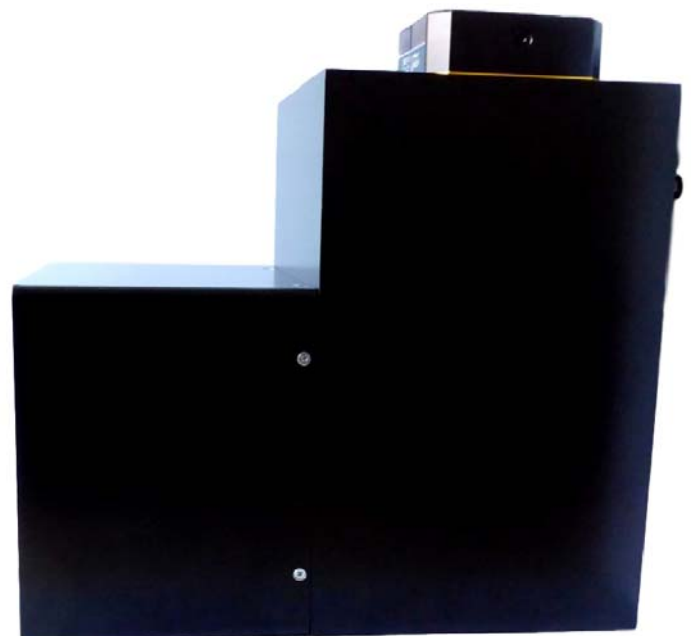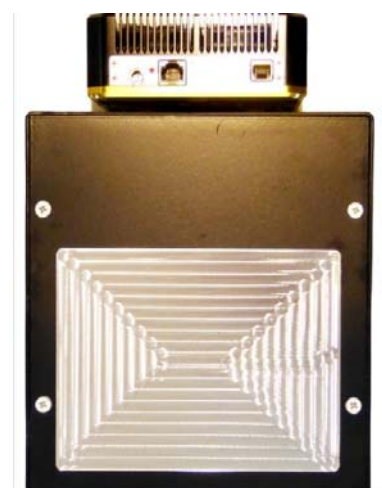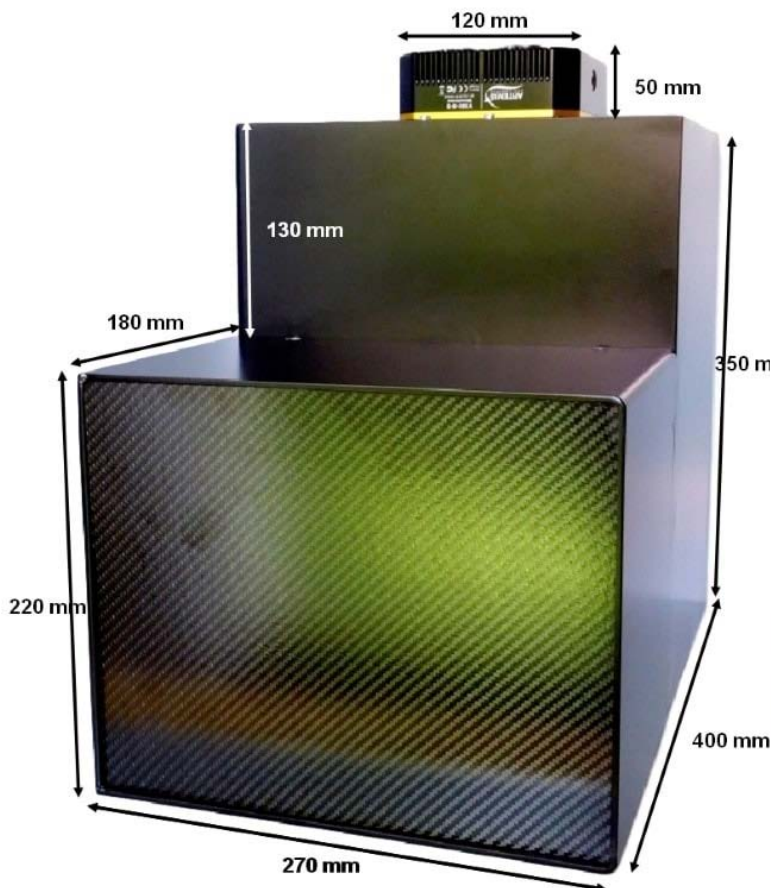
Installing the front-surfaced mirror

1. Place the foot of the mirror against the labelled B_4C ledge on the camera back
2. The plastic protected face with its instruction label must be on top
3. Push the top of the mirror into the top labelled B_4C holder
4. When the camera assembly is complete, peel off the protective film
5. The front aluminised face is protected by a transparent SiO layer for 95% reflectivity
6. Do not touch or dirty the surface. If necessary, clean gently with window cleaner
8. If necessary, use cyanolite glue spots for security, or glue a B_4C strip to hold the mirror


Adjusting the lens focus

- Manual focussing must be done with light, not in the neutron beam
- Place a paper grid over the scintillator plate being careful not to touch it
- Slide the scintillator front-end box onto the main camera box
- Open the lens trap at the back of the camera to allow light to enter
- Connect the CCD cables and loop expose ~0.1s
- Adjust focus to obtain the sharpest image with light (bottom lock screw)
- When finished, fully open the lens aperture, remove the focusing grid & close the box
- Check that it is light-tight for a long exposure. Note that the camera is very sensitive and **scintillator afterglow can be seen for some minutes after exposure to light**
- **For very long exposures, wait several hours for the afterglow to completely disappear**

The CCD unit can be removed after first unscrewing the lens (left) to reveal three M3 bolts (right), which can then be unscrewed. There is no seal between the CCD unit and the box, and no adjustments, so the CCD unit can be easily replaced. **Do not touch the exposed surfaces of the CCD cover glass or lens**, the front of which is protected by a UV filter.

Installing a Newport Micro-Controle Turntable for Tomography
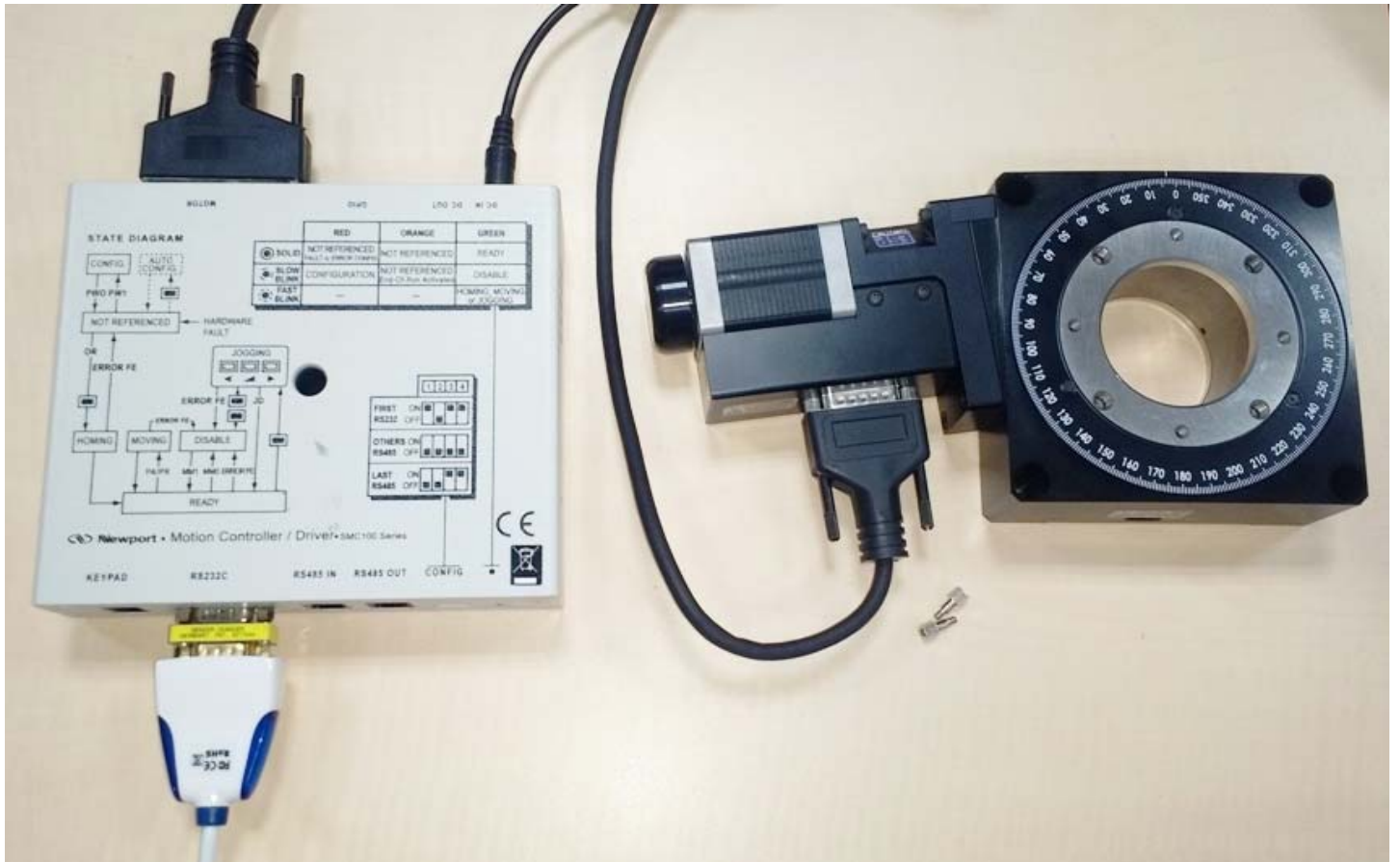
We recommend the Newport Micro-Controle URS turntables which start at ~€2500, together with the SMC100PP motor controller (~€650) with the SMC-PS80 power supply (~€93) and SMC-USB interface(~€63). The URS150BPP is usually sufficient, but for high loads, the RV120BPP can be used. These turntables use stepper motors for precise relative positioning without encoders.

You can use an SMC-RC manual remote control and display to rotate the turntable for alignment, and you may need an M-SK-4MA M4 screw kit to assemble the optional mechanical components such as a manual 9204-M Z-elevator, and X-Y translations M-423 with SM-25 Vernier Micrometers.

- Download SMC100-V2.0.0.3.zip right-click & "extract all", then launch **Drivers/ EasySync.exe**
- Run the **SMC100 Utility Installer** from the V2.0.0.3 folder. Use it to manually monitor the turntable
- Download and install PuTTY This will also install the command-line version called **Plink**
- Open a **Windows Command Prompt** (cmd) as Administrator and check that Plink runs
- Connect the **RS232C socket** on the controller to a USB socket on the computer using SMC-USB
- Connect the 25 pin **Motor socket** on the controller to the 15 pin turntable socket
- Connect the **DC-In socket** on the controller to the 48V power supply and plug it in
- In the **Windows Device Manager** check under Ports (COM) for a USB serial port
- **Open the SMC100 Software, click "Initialize"** so the controller light turns blue (ready state)
- Note the number of the of this USB serial port eg COM4: this is used in the **Orient.bat** script
  C:\commands.bat | Plink -v -serial COM4 -sercfg 57600,8,n,1,N
  Plink opens COM4 and configures it as required for the controller
- The **Command.bat** script is then piped to the port to execute the following commands:
  echo 1PR0.5
  timeout /t 1 /nobreak >nul 2>&1
  taskkill /f /IM Plink.exe
  exit
  Command **1PR0.5 steps motor 1** to **P**osition **R**elative **0.5**^{o}, we wait 1s, then kill Plink and exit
- These ***.bat scripts** can be kept on disk **C:** or anywhere else. Double click **Orient.bat** to test it
- The camera control software **ArtemisCapture** will execute Orient.bat after each image acquisition

NeutronOptics Fast Imaging Camera Operation

Fast high resolution thermo-electrically cooled Sony 2750x2200 pixel CCD unit

- **X-ray Scintillator:** Interchangeable fast, fine x-ray scintillator
- **Neutron Scintillator:** Interchangeable high resolution neutron scintillator
- **Optics:** Interchangeable high resolution 25mm f/1.4 low-light lens
- **CCD Sensor:** 1 inch Sony ICX694ALG *EXview HAD CCD II*
- **Chip size:** 12.40x9.99 mm, diagonal 16 mm (Type 1")
- **Resolution:** 2750x2200 pixels (**90 µm resolution over 250x200mm**)
- **Pixel Size:** 4.54x4.54 µM (larger pixels & micro-lenses collect more light)
- **Binning:** from 2x2 to 8x8 (for boosted frame-rate and efficiency)
- **Region-of-Interest:** fully variable (for full resolution at higher frame-rate)
- **High sensitivity** (QE~75% at 500-600nm), low smear
- **Low dark current:** 0.002 electron/pixel/sec @ -10 °C
- **Full well capacity:** 20,000 electrons (large dynamic range)
- **A/D Conversion: 16-bit 65536 levels** in Flexible Image Transport System
- **LiveView Mode:** 8 bit readout mode for faster readout
- **Digitisation Speed:** 6-12 MPixels/s
- **Readout Noise:** 6 e- at -10°C
- **Interface:** USB 2.0 High Speed with 10-20m amplified USB cables
- **Power:** Regulated 12v DC 2.5A, to EU, UK, US/Japan, AU/CN standards
- **Minimum Exposure Length:** 0.001 seconds
- **Maximum Exposure Length:** Unlimited
- **Cooling:** Regulated dual fan thermo-electric Peltier with max ΔT = -35°C
- **External Trigger:** For synchronisation with sample environment
- **CCD Unit:** 120x120mm dimensions, 50mm height, 800g weight
- **SDK:** C++, VB Wrapper, .net Wrapper, ImageJ, LabView drivers


```
1 2 3 4 5 6

1 – Vcc 3.3V
2 – GND
3 – GPIO Line 0
4 – GPIO Line 1
5 – Trigger Input
6 – Exposure Output
```



Installing the Driver and Artemis Capture software

- Browse the CD & launch "SetupArtemisUniversal.exe" or "artemisinstaller.exe"
- This installs the driver & "ArtemisCapture" to control the camera
- You can also download and pre-install the Artemis core software & drivers
- Plug the 12V supply into the camera; the fan should start up
- Connect the 10m USB extension to the computer, and wait for its driver to be installed
- Then connect the camera to this cable, or directly to a USB port on your computer
- The computer should automatically search for and install the driver. Be patient !
- The Windows Device Manager should now show an ArtemisCCD USB controller
- Launch ArtemisCapture to control the camera (see next section)

- If the driver is not found automatically, try manual installation:
    - Click the Windows "Start" button and open "Devices and Printers"
    - Double-click the "Unknown Device", select "Hardware" then "Properties"
    - Click "Change Settings" under the "General" tab
    - Click "Update Driver" under the new "General" tab
    - Choose "Browse for Drivers" on the Product Software CD
    - Select the 32-bit or 64-bit driver from the drivers folder
    - Click "OK" then "Next" then accept and install the camera driver

Using ArtemisCapture with the High Resolution Camera

Launch ArtemisCapture to display the image and controls. The "File" menu is used to save the last image, the "Camera" menu connects the camera if it is not done automatically, and the "Colour" menu should be set to "Raw". The icons under the menus launch a single exposure or continuous loop exposures. The three remaining icons open the Exposure, Display and Cooler tabs.
IMPORTANT: Zoom out to see the green outline of the full CCD.
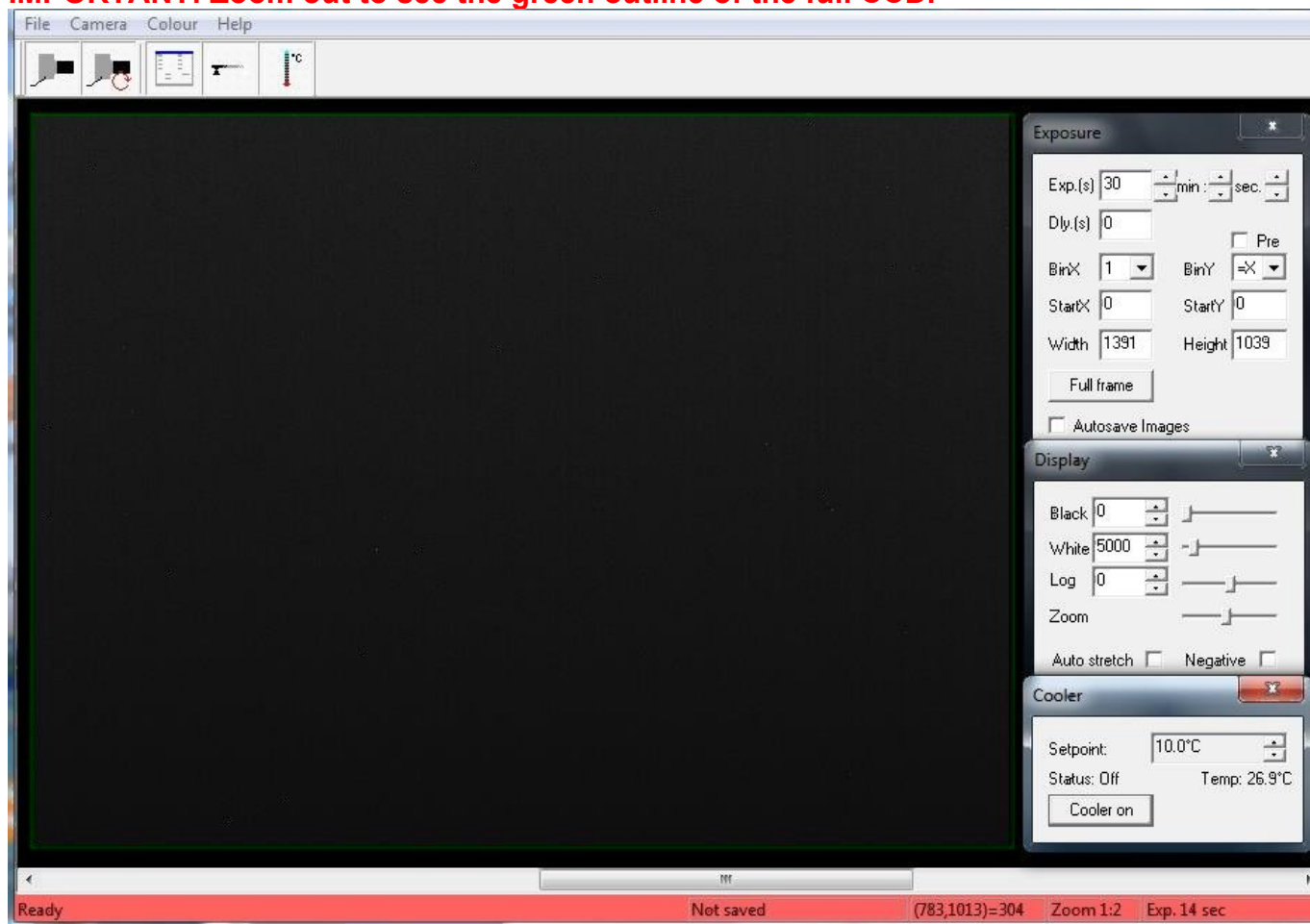
On the "Exposure" tab: (to speed up downloads e.g. when focussing with light)
- Set the exposure time (s) with **BinX=4 and BinY=X** for 4x4 binning
- Select a **subframe** "Width", "Height", "StartX" & "StartY" to reduce readout time
- Use **"loop"** exposures of ~0.1s, which are sufficient for light (but not for neutrons)

On the "Display" tab:
- Check the **"Auto stretch"** option to select the best 8-bits out of the 16-bits. Note that **scintillator afterglow may be seen for some minutes after exposure to light.**
- **"Zoom"** (or the wheel mouse button) zooms the display window

On the "Cooler" tab:
- Set the temperature to -20°C to reduce noise when collecting neutron images
- If the CCD is cold, click **"Warm up"** and wait a few minutes before disconnecting power

Hints on getting Optimal Performance

- **If the image is black, reduce the exposure to avoid saturation.**
- The exposure time depends of course on the intensity of your beam
- 2x2 binning will give x4 the intensity and faster readout, but halve resolution
- You can also limit readout to a "sub-frame" region of the full image
- The "Display" panel controls what you see, but has no effect on what you collect
- "Zoom" (and the wheel mouse button) zooms the size of the image display
- "Auto Stretch" compresses the 16-bit range of intensities to 8-bits for display
- But usually you will want to select the black and white display limits manually
- Image display is for guidance. Open the image with ImageJ for measurement
- The CCD can be cooled to reduce noisy pixels. You can also use ImageJ filters
- Fogging may occur if you cool below 0^oC (the CCD chamber contains a desiccant)
- The desiccant can be replaced by removing the large screw on the camera shaft
- The center of the image doesn't correspond to the centre of the window
  because the CCD chip is not centred to better than 0.5mm in its housing

Cooling becomes particularly important for very long exposures to greatly reduce the number isolated hot pixels. Those remaining can easily be removed with the ImageJ Despeckle filter.

You can also use our custom PHD application for simple real-time image capture with the Hi-res camera (without cooling), or the demo Nebulosity3 application, with either the Atik/Artemis driver or the ASCOM driver.

Occasional Problems with camera operation

- Be patient when you first launch ArtemisCapture. Wait for it to load and detect the camera.
- If ArtemisCapture complains that it cannot connect to the camera, and the cables are in place, a background copy of the application may already be connected. Unplug the power to the camera - this will close any open connections - then try again.
- Check that an ArtemisCCD device is connected in the USB controller list in the Windows Device Manager, which is accessed by right-clicking MyComputer.
- Try deleting the ArtemisCapture.ini file from the C:\Windows folder to reset Artemis Capture.
- Try a different USB port, waiting for the driver to be found and re-installed.
- USB ports can sometimes become un-responsive. Shut down the computer and remove the computer's power cable for a few seconds. Then re-connect everything and reboot.
- If all else fails, try using a different computer.
- **A black image may simply mean the CCD is over-exposed. Reduce the exposure time.**

Image Treatment with ImageJ

ImageJ is recommended for image analysis. ImageJ will open the 16-bit raw FITS files produced by Artemis Capture, remove noise, modify contrast and other properties, and save them in various formats. More importantly, it will allow you to measure intensity profiles and display your data in ways that will make it more meaningful.

A complete ImageJ installation is included on the NeutronOptics software CD under "Extras". Just copy the ImageJ folder to your C: disk and launch ImageJ to set defaults and update ImageJ.

Tomography

For tomography you can collect a series of images, calling a script to rotate the sample after each image by using camera/sequencer. In this example we take 360 2x2 binned exposures of 4s (with no filter), writing individual files to "MyFile???.FITS" then executing script "orient.vbs" and waiting 5 seconds before starting the next exposure. You can substitute any application for "orient.vbs".

For tomography, a precision sample turntable is needed to rotate the sample in increments of eg 0.5 degree between images. For samples of up to 30 Kg, we recommend the [Newport Micro-Controle URS turntables](#) which start at ~€2500, together with the [SMC100PP](#) motor controller (~€650) and [SMC-PS80](#) power supply (~€93) and [SMC-USB](#) USB interface(~€63). For high loads, the [RV120BPP](#), a smaller version of the [RV350BPP](#) used at ILL, is recommended. The Newport turntable is controlled by COM port scripts eg using [PuTTY](#)'s Plink command. A system file **orient.bat** is used to pass a file **commands.bat** to the turntable to **P**osition **R**elative **0.5** degrees.
orient.bat: C:\commands.bat | Plink -v -serial COM4 -sercfg 57600,8,n,1,N
commands.bat: echo 1PR0.5 , timeout /t 1 /nobreak >nul 2>&1 , taskkill /f /IM Plink.exe , exit
Plink opens port COM4 and pipes commands such as 1PR0.5 to 1 Position Relative 0.5°.
waiting 1s before killing Plink, which will be restarted after the next camera acquisition.
But first **open the SMC100 Software, click "Initialize"** so the controller light turns blue (ready state)

[ImageJ for ASCOM](#). is also suitable for tomography, Laue diffraction and very low-flux acquisitions.

LabView and Artemis Software Development Kit (SDK)

The camera can also be controlled using [LabView](#), National Instruments' graphical programming environment for instrument control. You can download a [free time-limited version](#) if you want to control our camera together with other instruments. Excellent [LabView on-line tutorials](#) are available, as are a set of [simple LabView programs](#) (*.vi files) to control the high resolution camera.
Note that you also need the [LabView Vision Developement Module](#), but you can download a free evaluation version.

We cannot provide support for LabView, for which you must rely on National Instruments or the NI user group, which has posted example files for Artemis cameras. One of our clients used a simple LabView application to control his sample turntable, and then used the ArtemisCapture/sequencer to call that Labview routine after each image acquisition.

The Artemis SDK Software Developement Kit contains C++ support and example files to allow you to develop your own camera acquisition code.

Camera Control and Image Acquisition with Nebulosity

You can also use the PHD application for simple real-time image capture with the Hi-res camera (without cooling), or the Nebulosity3 application, with either the Atik/Artemis driver or the ASCOM driver. These applications are also available for macintosh systems.

Sequential Image Stacking with Artemis Infinity

The Artemis Infinity software, which works for all Atik high resolution cameras, can be installed with the Atik core software; it can collect a series of short exposures, adding them together in real time. You can then **see how a long exposure is progressing**, e.g. with the 1-CCD Laue camera.
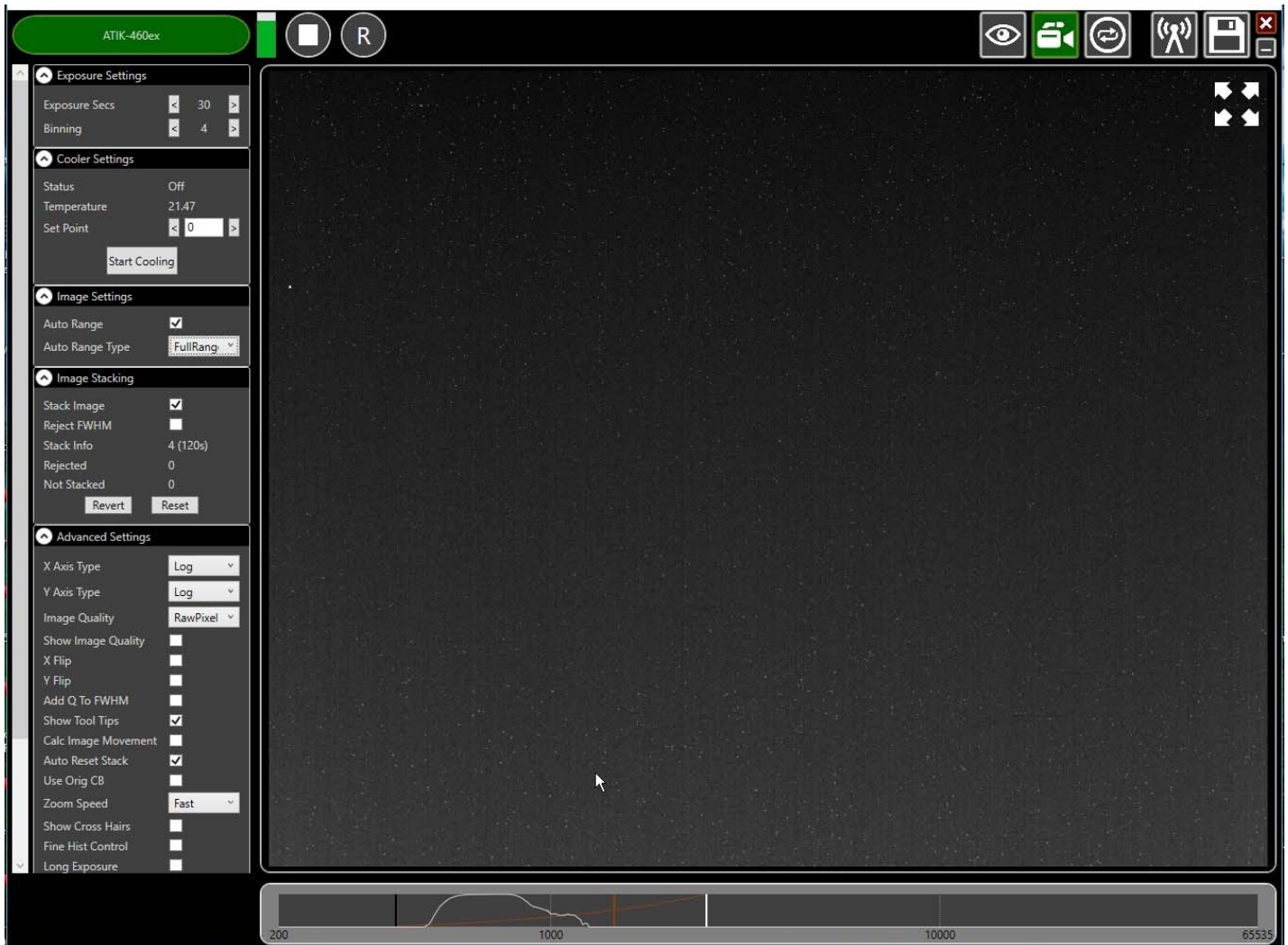
- Double-click the top bar to expand/contract the window.
- If connected, the camera name is shown in green
- Set the exposure time and binning (to 30s and x4 for the Laue camera)
- **Advanced Settings: Uncheck "Calc.Image Movement" & Check "Long Exposures"**
- Select the "video camera" icon on the top right to enable stacking
- In the "Image Stacking" dialogue that appears on the left **Uncheck "Reject FWHM"**
- The green triangle starts exposures, turning into a white square to stop exposures
- The "Stack Info" shows the number of images averaged (and the total exposure)
- The bar at the bottom controls the image display range
- Check "Auto Range" in the "Image Settings" and eg "FullRangeMinus"
- Otherwise, drag the vertical markers to bracket the display intensity range
- Noise is evident because we didn't cool. Set Temperature to 5C in "Cooler Settings"
- **If the camera is being cooled, click "Warm Up" before disconnecting power**

For the latest information, please check our web site http://neutronoptics.com/atik.html