

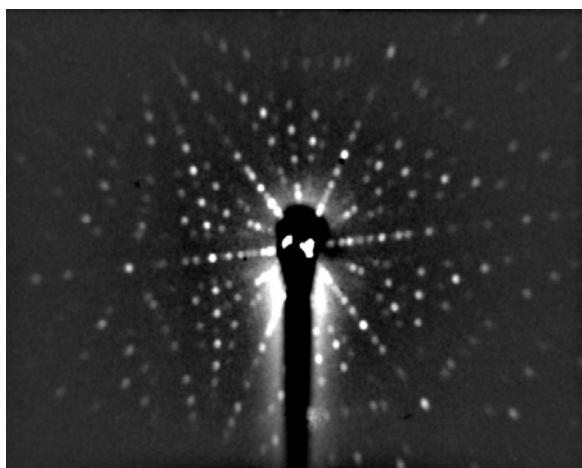


## Orienting Crystals with the 1-CCD Laue Camera

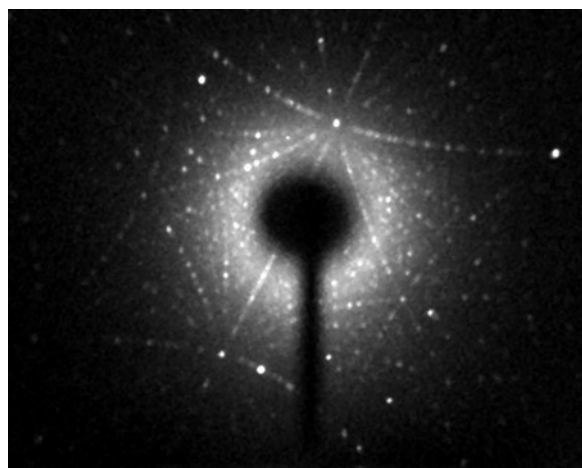


- Sensor Type: Sony ICX825ALA or ICX694ALG
- Image size: Diagonal 11mm (Type 2/3") or 16mm (type 1")
- Chip size: 8.98x6.71mm or 12.49x9.99mm
- Resolution: 1392x1040 or 2759 x 2200
- Pixel Size: 6.45x6.45  $\mu\text{m}$  or 4.54 x 4.54  $\mu\text{m}$
- Binning: from 2x2 to 8x8 (improved intensity and read-out )
- High sensitivity: (QE>75% at 500-600nm), low smear
- Low dark current: 0.003@-10 °C, excellent anti-blooming
- Full well capacity: 20,000 or 40,000 electrons
- ADC: 16 bit grey scale image, optional filtering and distortion
- Readout Noise: 4 e- typical (slower readout = less noise)
- Readout Time: 1-3s
- Interface: USB 2.0 High Speed with 10-20m USB cables
- Power: 12v DC 0.8A, to EU, UK, US/Japan, AU/CN standards
- Maximum Exposure Length: Unlimited
- Minimum Exposure Length: 1/1000s (1s at full resolution)
- Cooling: Thermoelectric set point with max  $\Delta T = -27^\circ\text{C}$
- CCD Unit: 60mm diameter, 122mm length, 400g weight
- Lens Coupling: T2-mount, C-mount, F-mount, micro 4/3
- SDK: C++, VB Wrapper, .net Wrapper, ImageJ, LabView

## Backscattered Laue with ~300s exposures of the 1-CCD Laue Camera



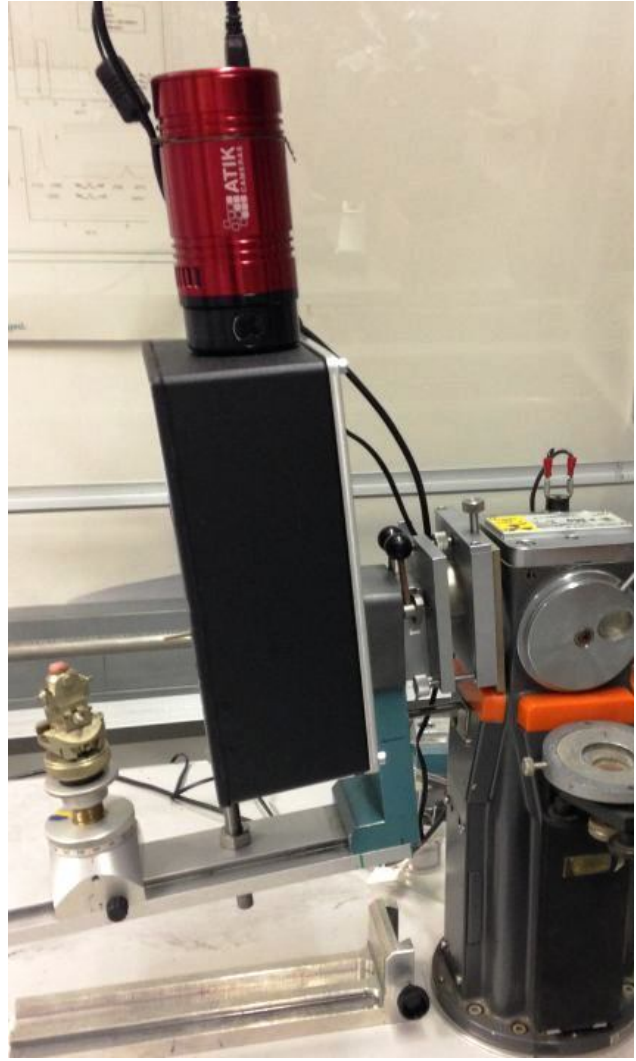
a) Si (Dean Hudek, Brown University USA).



b) Sm<sub>2</sub>Fe<sub>17</sub> (Léopold Diop T.U. Darmstadt)

## Installing the NeutronOptics1-CCD Laue Camera on the x-ray beam

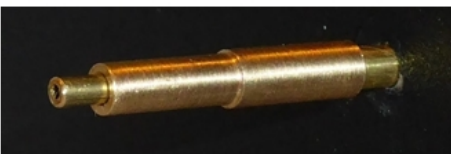
The photos below show how **Prof. W. Donner and Dr L. Diop at the T.U. Darmstadt** converted a Huber Image Plate Laue camera (left) to use the NeutronOptics 1-CCD Laue camera (right).



**Left photo:** The Huber IP camera is the circular disk mounted on a blue support on a guide rail. The collimator is locked and the beam shutter opened with the two black knobbed levers on the double-metal plates that form the [Huber-800](#) alignment mechanism, which is mounted on a 1960's Philips X-ray generator. The screw at the top, and two at the bottom, adjust the height and tilt of the collimator.

**Right photo:** The Huber-800 unit is retained, together with the blue camera support, when the Huber IP camera is replaced by the 1-CCD camera. An additional support bolt on the rail under the bottom left supports the heavier camera. The new collimator is aligned in the Huber-800 mechanism for maximum intensity, and the camera is then bolted on using an aluminium plate and four M4 bolts.

### 3mm Collimator-tube adapter



**1mm Collimator nose**

Mount the camera as close to the source as possible using the 4mm bolt holes at the back; minor adjustments to position and orientation are necessary. Before inserting the 1mm collimator tube into the camera, check that it fits the source exit and allows no x-ray leakage. You will need to make a **small adapter** (top left) to take the 3mm collimator tube, depending on your source. The 1mm collimator slides into the 3mm tube (bottom left), with the nose extending toward the crystal ~30mm from the window.

The carbon fibre window & scintillator are not fragile.

The camera and collimator must be precisely aligned, and the source voltage and current set for maximum x-ray intensity through the collimator. Our [mini i-Cam camera](#) could be used to align the beam and position the sample, otherwise use the Laue camera itself to check beam transmission.

Typical exposure times for backscattered Laue are ~300 seconds. But first try a shorter exposure with no beam to check that everything is working - you should see background noise. **You can also try forward scattered Laue, where exposure times are much shorter.**

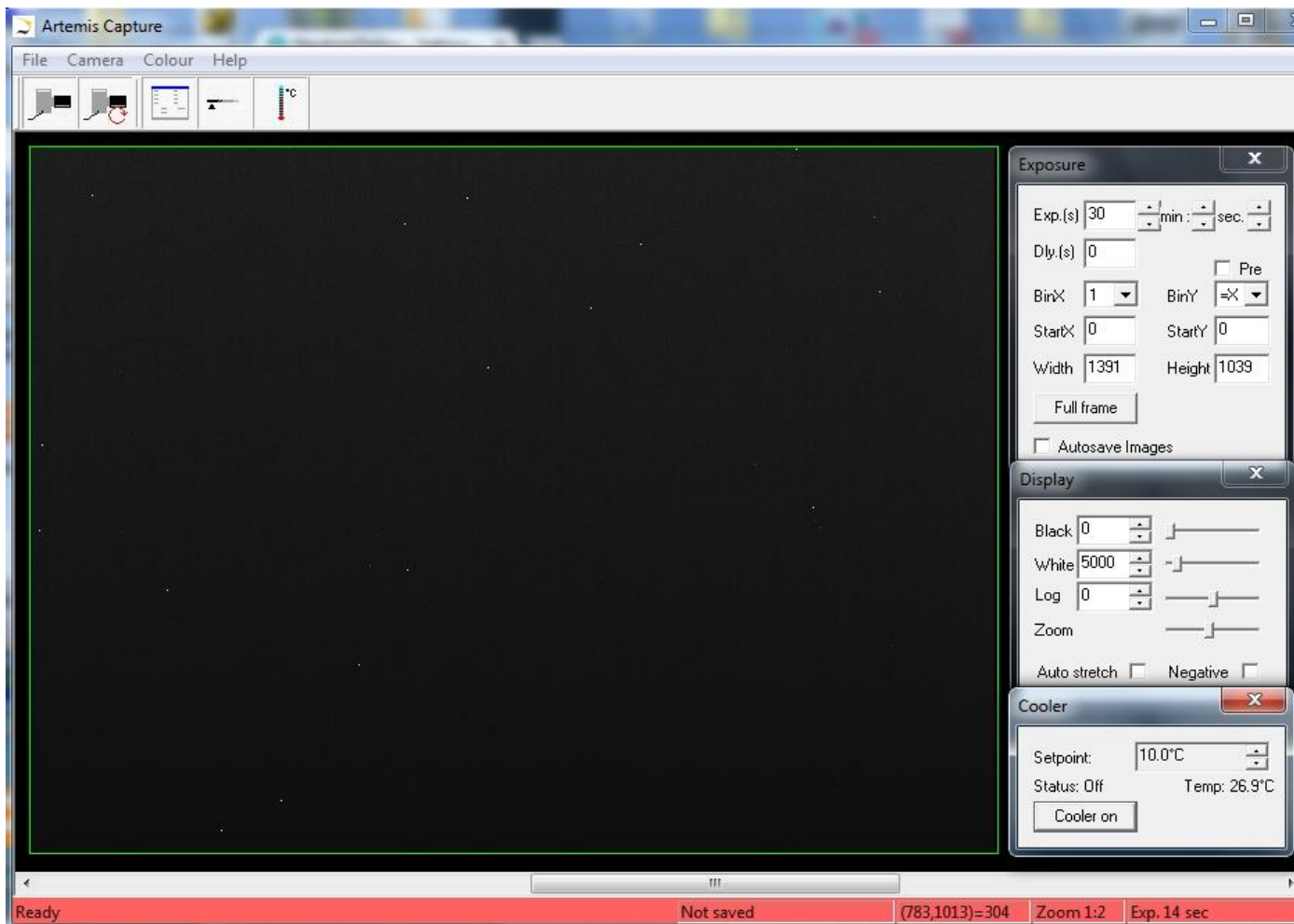
**Binning is important** for faster exposures with backscattered Laue, since very high resolution is not needed. Typically binning of 4x4 increases efficiency by a factor of x16 !

## Installing the Driver and Artemis Capture software

- Browse the CD & launch "SetupArtemisUniversal.exe" or "artemisinstaller.exe"
- Install the driver & "Artemis Infinity" and "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, 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 "Artemis Infinity" or "Artemis Capture" to control the camera (next section)
- Read the [manual for the Hi-res camera](#) for more details and troubleshooting

## Artemis Capture for long exposures (~300s) in backscattering

Launch Artemis Capture and "View" Exposure, Display & Cooler. The "File" menu is used to save images, the "Camera" menu to connect the camera, and the "Colour" menu should be set to "Raw".

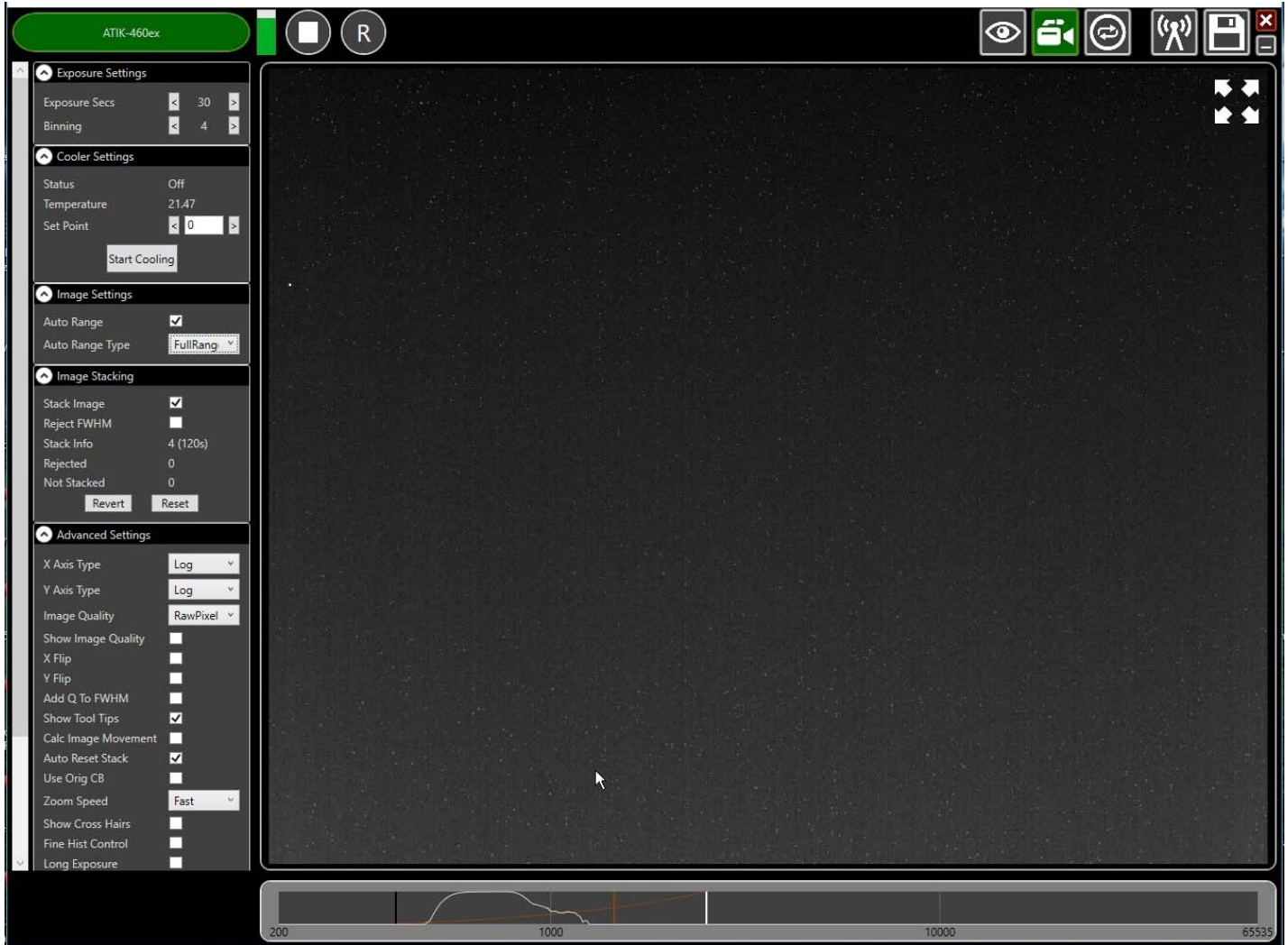


The camera icons launch a single exposure or continuous loop exposures. "Tracker", "Marker" and "Filter" icons are not used. **IMPORTANT: Zoom out to see the green outline of the full CCD.**

- Set exposure time with **BinX=4 and BinY=X** for 4x4 binning and **Dly(s)=0** delay
- Check the **"Auto stretch"** option to select the best 8-bits out of the 16-bits.
- **"Zoom"** (or the wheel mouse button) zooms the display window
- Set the temperature to **-20°C** below ambient to reduce noise
- **If the CCD is cold, click "Warm up" and wait a few minutes before disconnecting power**

## 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** before it has finished.



- 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**

## Hints on getting Optimal Performance

- Use a Windows-7 or -10 computer with 2GByte of memory eg an [Intel NUC](#)
- If necessary, close other applications and windows that may use memory
- Try a short exposure to check that it works before starting a long exposure
- Check the files that are created in your image directory
- Image display is for guidance. Open the saved image with ImageJ for measurement
- Note that the ImageJ lens distortion correction is not perfect far from the centre
- The CCD can be cooled to reduce noisy pixels. Also use ImageJ's despeckle filter
- Fogging may occur if you cool below 0°C (the CCD chamber contains a desiccant)
- The desiccant can be replaced by removing the large screw on the camera shaft
- Try unplugging and re-plugging the USB cable or re-booting your Windows computer :-)
- The centre of the image doesn't correspond to the exact centre of the window

## Indexing and orienting the Laue pattern

You may first want to use ImageJ's "**Process/Noise/Despeckle**" to [filter out electronic noise](#) and "**Process/Subtract Background**" with "rolling ball radius 25-50 to [remove some of the diffuse background](#)". After noise filtering, you might also try "**Process/FFT/Bandpass filter**" with "autoscale" and "saturate" to [emphasise the peaks](#), before using imageJ to convert to the various formats used for indexing. A number of Laue indexing applications are freely available. The [Cologne Laue Indexing Program \(CLIP\)](#) is one of the best, along with the [QLaue Indexing Program](#). Older applications such as [OrientExpress](#) and the ambitious new [ESMERALDA Laue suite](#) might also be tried.

For the latest information, please check our web site <http://neutronoptics.com/laue-1CCD.html>