



ImageJ for ASCOM: Tomography, Laue Diffraction

ImageJ-for-ASCOM is copyright but free; even if you don't have one of our cameras you can install it and try it with our camera simulator. It is best for the most difficult acquisitions, especially in low flux conditions, from Tomography to Laue diffraction, even with multiple CCDs. It rivals powerful commercial applications, but is open source with simple scripts that can be customised for particular needs. These scripts are hidden behind the GUI of ImageJ, which makes it easy for beginners, but they can also be extended with a simple text editor. With automatic noise removal and averaging over multiple exposures, this **software brings out details that might otherwise be missed**.

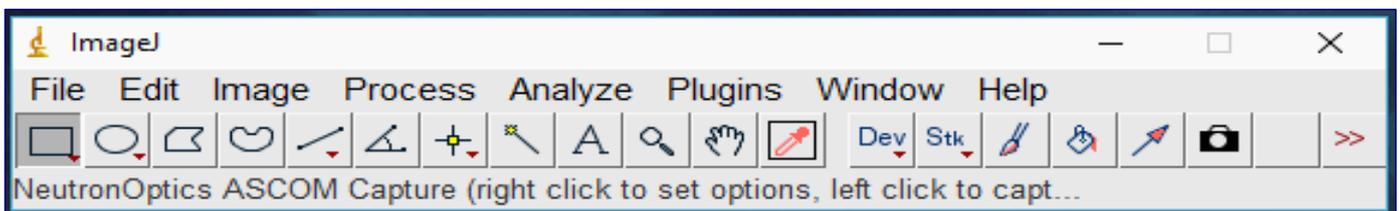
For example, a script such as Orient.vbs (or any other Windows application) can be called at the end of each image acquisition and used to re-orient the sample for Tomographic imaging. Or images from two CCDs in a Laue diffraction camera can be collected simultaneously, and automatically stitched together to provide a larger composite image.

ASCOM is an open AStroNomy Component Object Model for the Windows COM environment. **ImageJ** is an open Image processing application for the Java environment, and widely used by the scientific community. **FITS** (Flexible Image Transport System) is an image format for scientific applications.

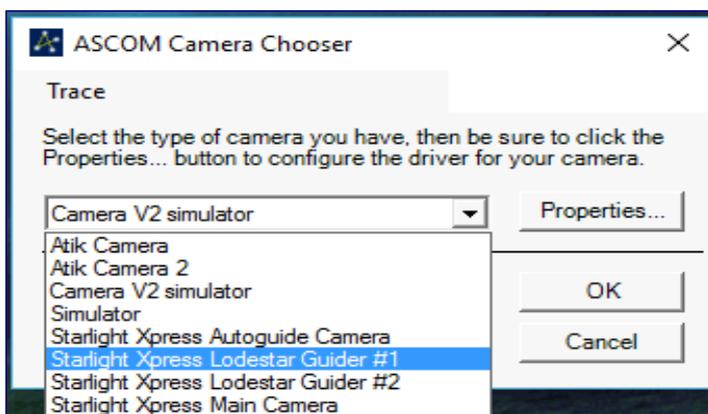
ImageJ for ASCOM: Installation and Programming

- Download and install [ImageJ bundled with Java 32-bits](#) for Windows to folder C:\ Prefer the more compatible 32-bit version even if you have a 64-bit computer Or just copy the ImageJ folder from the software CCD to your C:\ root directory
- Download and install the [ASCOM Platform 6](#)
- Download and install an [ASCOM Driver](#) or use the Simulator drivers in ASCOM
For slim USB NeutronOptics cameras use the [Starlight Xpress ASCOM driver](#)
For high-resolution NeutronOptics cameras use the [Artemis ASCOM driver](#)
ASCOM drivers are installed in C:\Program Files\Common Files\ASCOM\Camera
For 64-bit Windows, C:\Program Files(x86)\Common Files\ASCOM\Camera
Use Control Panel/Programs to remove it. This is NOT the camera device driver
The ASCOM Profile Explorer can also be used to remove ASCOM drivers
You must ALSO install the camera device driver that comes with the camera
You can test your setup for an ASCOM Camera with the [Nebulosity](#) application

- Download [FITS.DLL](#) to C:\Program Files\Common Files\ASCOM\Image\
- Open a command window by clicking Start and typing CMD in the Start search box then press CTRL+SHIFT+ENTER for administrator control.
- As administrator, register FITS.dll by typing in the command window:
REGSVR32 "C:\Program Files\Common Files\ASCOM\Image\FITS.dll" then **ENTER**
For 64-bit systems read "Program Files(x86)" instead of "Program Files"
- Download [ASCcap.vbs](#) and [Orient.vbs](#) to C:\ImageJ\VBScripts\
- Download [ASCcap.txt](#) to C:\ImageJ\macros\toolsets\ASCcap.txt
- Download [fork.class](#) to C:\ImageJ\plugins\fork.class (read [fork.java](#) for info)
- Re-launch ImageJ to pick up the newly installed ASCcap.txt Macro Toolset
- Click the red >> icon on the ImageJ toolbar and select the ASCcap tool
- Right-click the Camera Capture icon to select the camera & set capture options
Don't select a second CCD unless you have a dual-CCD camera
- Left-click the Camera icon to capture a FITS image and display it with ImageJ
If it doesn't work, check your image directory and see the [problems section](#).



Select the Camera using the ASCOM Chooser



If no camera has already been selected, the ASCOM Camera Chooser will open.

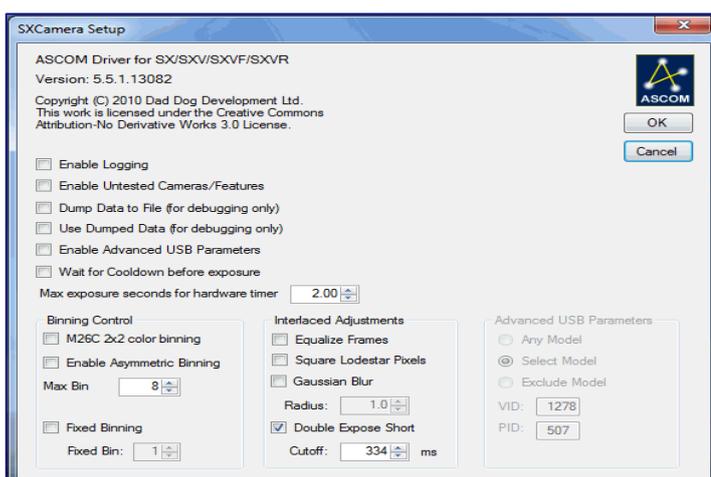
Select the Camera (or the Simulator).

Don't forget to click on "Properties" if you want to re-configure the camera.

To select a different camera, reload the ASCap script and right-click icon.

[Click the images to enlarge them](#)

If necessary, set the Camera Properties



Camera properties depend on camera

You usually won't want to change them

This example is for the thin CCD

Logging and dumping are for debugging

x2 binning to resolution for x4 intensity

Equalise frames for interlaced cameras

Do NOT use Gaussian Blur !!

If you do, Despeckle filter won't work

Use ImageJ for all image manipulation

As a general rule, collect raw data !

Set the Capture Options such as Exposure Time

Capture Options

V.170208-http://neutronoptics.com/ASCap.html

Please specify the following capture options:

Directory for images: C:\temp\
Image file root name: Tomo
Set CCD temperature: -20.0 (or blank)
Bin adjacent pixels 1-8: 1 (eg 1)
Exposure time (secs): 1.000 (eg 1.0)
Number of Exposures: 360 (eg 1)

Continuous exposure loop (ESC to stop)
 Rotate Left
 Flip Vertical
 Flip Horizontal
 Despeckle to remove isolated white pixels
 Deinterlace if you have an interlaced CCD
 Calculate Background or input File name

Background File name:
Turntable File name: C:\ImageJ\VBScripts\C

Set K1=0 to skip Barrel/Pincushion corrections
Barrel/Pincushion Corr K1: 0.000 (0.13)
Barrel/Pincushion Corr K2: 0.000 (0.00)

To change CCD selection, reload the macro

Click OK, left-click the camera icon to expose

OK Cancel Help

Right-click the camera icon to input:

- The Directory to store FITS images
- The Image file root name
- The temperature (C) for cooled CCDs
A blank temperature disables cooling
- The number of adjacent pixels to bin
2x2 binning gives a x4 intensity gain
- The Exposure time (in seconds)
- The number of consecutive exposures
- Continuous exposure (ESC key to stop)
- Flip options for the image
- Despeckle filter removes hot pixels
- An automatic background correction
- Or Subtraction of a background image
- An optional turntable control file eg.
to rotate the sample after each image.
- Set K1,K2 to correct for lens distortion
- K1=0 will disable lens corrections

To enable optional lens corrections, install [SplineDeformationGenerator](#). (see the [documentation](#)). Double click **mySplineDeformationGenerator.zip** & drag mySplineDeformationGenerator folder to the **C:\ImageJ\plugins** directory.

SplineDeformationGenerator will appear in the Plugins menu when you restart ImageJ. It will only be used if parameter K1 is set.

The latest version of ASCap.txt retries acquisition if an error is encountered. You can even unplug and replug the USB data cable and sequential image collection will usually continue.

Capturing Images by left-clicking the camera icon

After the camera and capture conditions are set by right-clicking the ImageJ camera icon, images may be repeatedly captured and displayed simply by left-clicking the camera icon. If a number of images are captured sequentially, they are stored in a TIFF array and averaged. A sequential exposure loop continues until the image window is closed or the Esc key is pressed. If the Alt key is held down, the sequence terminates after averaging.

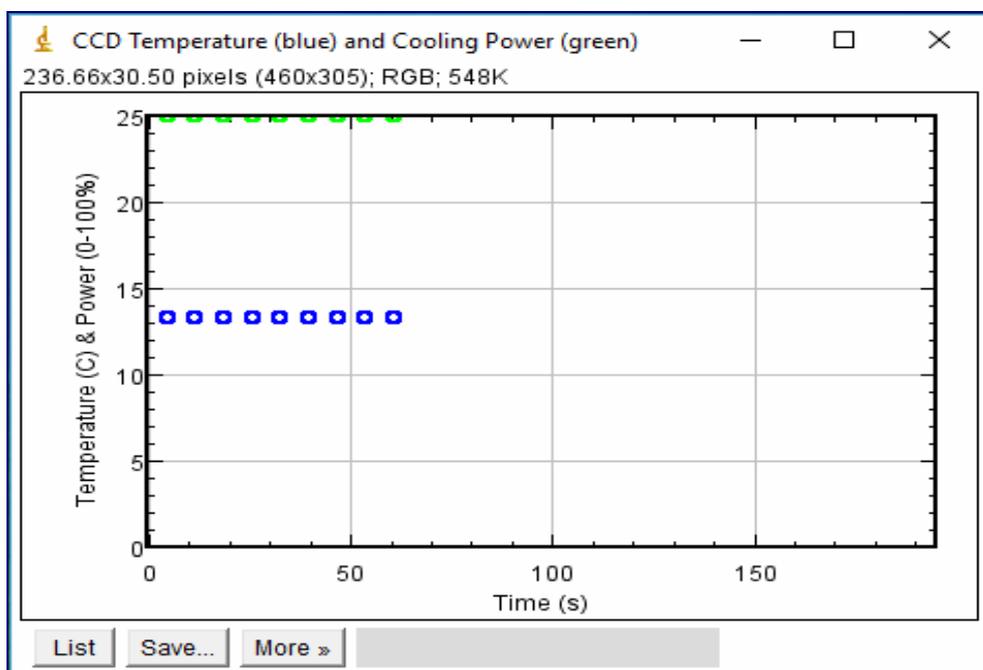
You can change the Capture Options by right-clicking the camera icon without re-selecting the camera, and this is usually possible even during a sequential acquisition. ImageJ can of course be used to enhance the images in many ways. Read for example [An Introduction to Astronomical Image Processing with ImageJ](#).



The above image is for the Camera V2 simulator. For illustration purposes, the 16-bit FITS image is compressed here to a simple JPEG screen capture

Temperature Control and Plotting

If you have one of our cooled CCDs, you can set the temperature and plot it for each acquisition, along with the cooling power. The menus at the bottom of the plot display a List of temperatures and allows you to Save them. The More menu allows you to change the plot scale, the axis labels, zoom to a particular region etc



Tomographic and Remote data collection

At the end of each image acquisition, a Windows routine like [Orient.vbs](#) will be launched automatically (if it exists) to re-orient the sample. You can test the example [Orient.vbs](#), but in practice you must edit it, or replace it with some other Windows application, depending on the control software for your particular sample table, such as LabView.

Although our cameras are supplied with 10m amplified USB extension cables, which you can chain up to 30m, you can also control your image acquisition using a Remote Desktop, from another computer or even your mobile phone. Download and install your preferred Remote Desktop from Google, Microsoft or Apple; we prefer [Chrome Remote Desktop](#).

A few useful ImageJ Commands

To emphasize a specific image area, select it with the rectangle tool and click "auto" Brightness/Contrast (Ctrl+Shift+C).

- **+/- keys** to zoom in or out
- **Image/Transform/** to flip or rotate the image or bin adjacent pixels
- **Image/Adjust/Brightness/Contrast (Ctrl-Shift-C)** Brightness, Contrast, Min/Max
- **Image/Stacks/Z-project** to sum multiple images in a stack
- **Process/** to Smooth, Sharpen or find Edges etc
- **Process/Noise/Despeckle** to remove isolated hot pixels
- **Copy the de-interlace filter [Deinterlace .class](#)** to ImageJ\plugins & apply it
- **Edit/Invert (Ctrl-Shift-I)** to invert the image bright<->dark
- **Image/Lookup Tables/16_colors** to represent intensity levels by 16 colors etc...

Potential problems running ImageJ for ASCOM

Thanks to Michael F. Toups who on 6 June 2016 pointed out that for recent versions of Windows the image must first be written to an intermediate dimensioned image file before being read into an ImageArray. **All versions of Windows are then supported.**

Close other applications. If you find acquisition failing, close other applications and disconnect from the internet to improve system response on slow computers.

Eject the USB camera before disconnecting it. Even Windows-10 can sometimes lock access to a device if it has not been formally ejected before being re-connected.

Windows Defender, a Microsoft anti-virus application, can cause problems, especially if it is running with another anti-virus application such as [Microsoft Security Essentials \(MSE\)](#). If MSE is installed, uninstall and re-install it. It will then automatically disable and/or uninstall Windows Defender. Microsoft [recommends using MSE](#) instead of Defender.