



The FLIR (Point Grey) IMX249 CMOS Camera

NeutronOptics x-ray or neutron cameras can be supplied with an optional FLIR (Point Grey) [IMX249 CMOS Camera](#) when high frame rates are required (up to 41 fps). The normal maximum exposure of the IMX249 camera with USB3 is 4 seconds (32 seconds for the GigE version); dark current noise is higher for CMOS cameras, limiting them to shorter exposures, but these times can be increased using SharpCap (below).

The IMX249 is a slower frame-rate version of the IMX174, and currently [the best Sony CMOS detector for low-light imaging](#). It is a relatively large sensor, with big pixels favouring light capture, with high Quantum Efficiency (QE) The USB3 camera is powered by a USB cable up to 25m long, and the GigE version by a powered GigE cable. Note the cooling fins added to the FLIR camera to limit temperature (and dark current) by air cooling, and the carbon fibre window for the x-ray version..



- **Sensor Type:** Pregius CMOS [IMX249](#)
- **Image size:** Diagonal 13 mm (Type 1/1.2")
- **Resolution:** 1920 x 1200
- **Pixel Size:** 5.86 x 5.86 μm
- **Binning:** on-chip binning not available with CMOS
- **High sensitivity** (QE~80% at 500-600nm)
- **High dark current** (~1 e-/pixel/sec @ 45°C)
- **Full well capacity:** >30,000 electrons (dynamic range)
- **ADC:** 12 bit scaled to 16-bit
- **Readout Noise:** ~7 e- (low readout noise in mode_7)
- **Readout Time:** ~0.025s (up to 41 fps full frame rate)*
- **Interface:** USB 3.1 High Speed with 5m USB-3 cable
Optional PoE GigE ethernet for long distances
- **Power:** power over USB (or Ethernet)
- **Maximum Exposure Length:** 4s USB3, 30s GigE
- **SDK:** FLIR (Pt Grey) FlyCapture and Spinnaker C++ SDK

* **Very high frame rates (41 fps) are only possible with short USB3 cables (5.0m).**

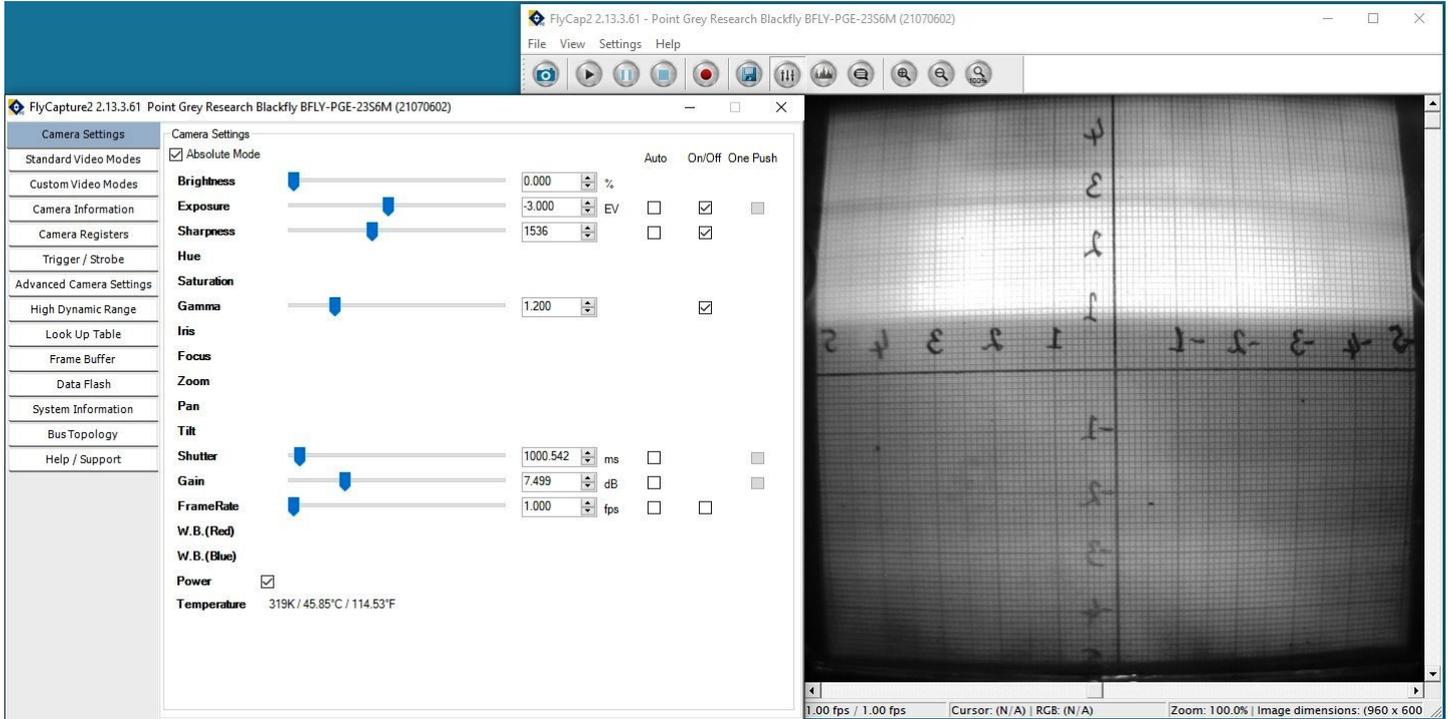
But rates of 9 fps (IMX249) can be obtained even with 10+ metre amplified USB2 extension cables.

Install the Driver and FlyCapture software

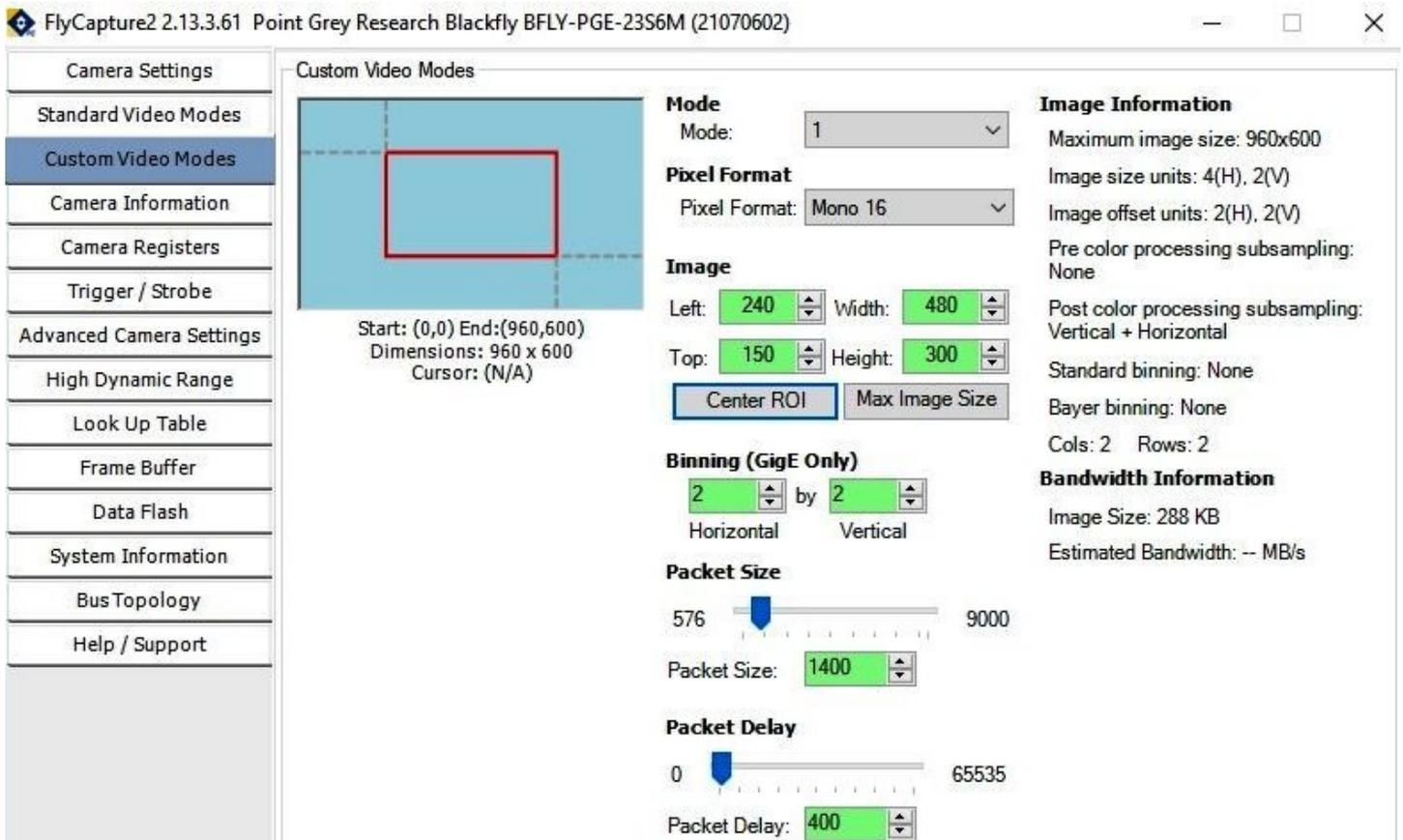
- Click on the [FlyCapture SDK download](#) then open the folders and download **FlyCapture2/Windows/FlyCap2Viewer...x86.exe** (The 32-bit version is more compatible)
- Installing FlyCap2Viewer also installs camera drivers for USB and/or GigE cameras

FLIR Point Grey FlyCap2 for Camera Control and Acquisition

[FlyCap2](#) was designed for high frame rate and video capture in daylight and contains additional features you won't need for slower x-ray or neutron imaging. The camera will be automatically recognised when plugged in (FlyCap2 is designed to control multiple cameras simultaneously). A window will open displaying the image using default exposure, gain etc. as shown to the left below.



To change these, click the “**Settings**” menu and “**Toggle Camera Control Dialogue**” to open the control window (insert above). Uncheck **Shutter**, **Gain** and **FrameRate**. Also switch the **FrameRate** “**Off**”. You can now increase the Shutter (Exposure) to a maximum of 4 seconds (USB model). You can increase the **gain** from “**0.0**” but this will also increase noise in the image. Increasing the **Intensity**, **Exposure**, **Sharpness** and **Gamma** only changes the display, not the saved image.

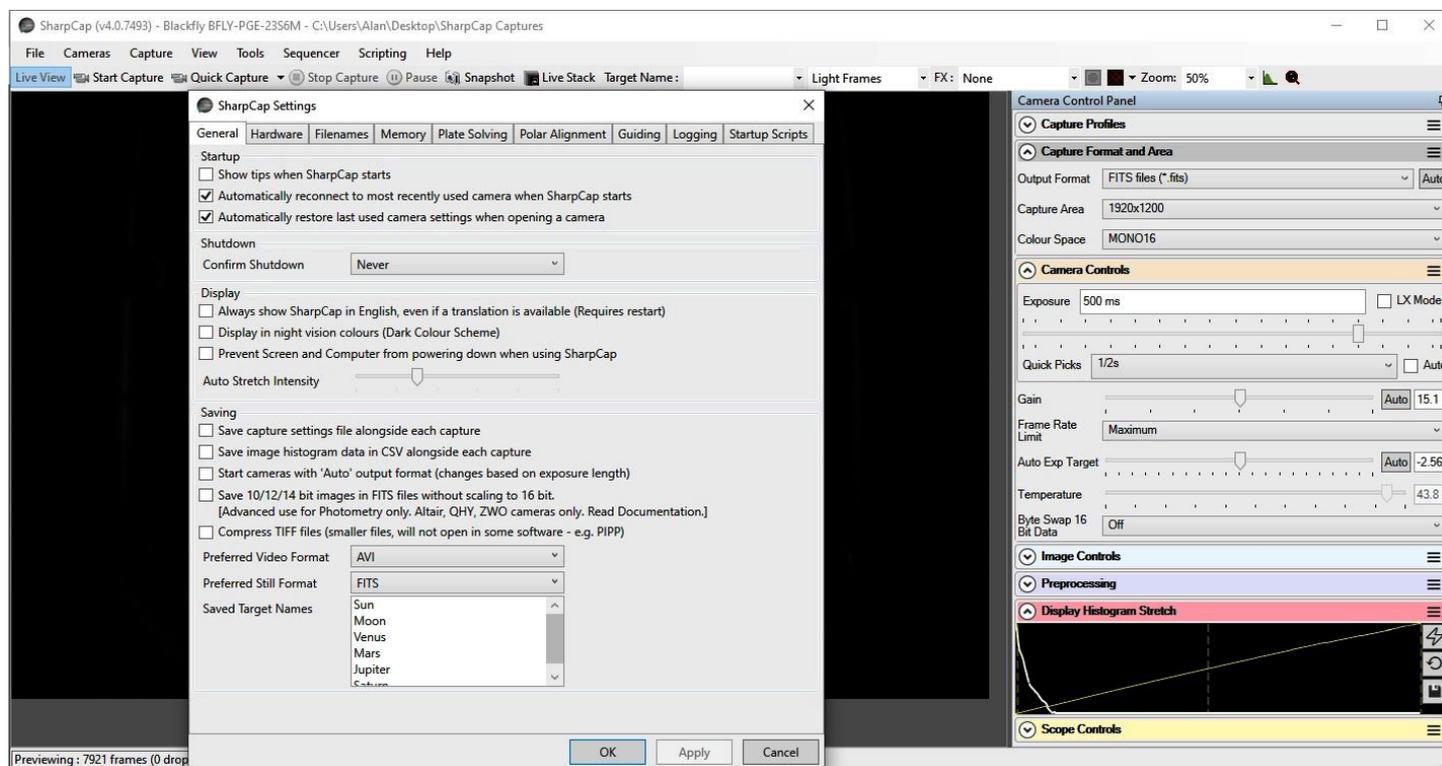


In the Settings window, click on “**Custom Video Modes**” and select “**Mode 1**” and “**Mono16**” rather than “**Mode 0**” with “**Mono8**”. You can restrict the image to a “**region of interest**” to increase frame rate. You can only apply “**binning**” to increase intensity at the expense of resolution if you have a GigE camera, but you can do binning off-line in imageJ. **Binning of 2x2** is recommended with this high resolution detector. Finally, In “**Settings/Advanced Camera Settings**” toggle “**Mirror Image**”.

Of the remaining control dialogues, only “**Camera Information**” is of much use, but there is a control for hardware synchronisation via GPIO.

Alternative SharpCap Viewer

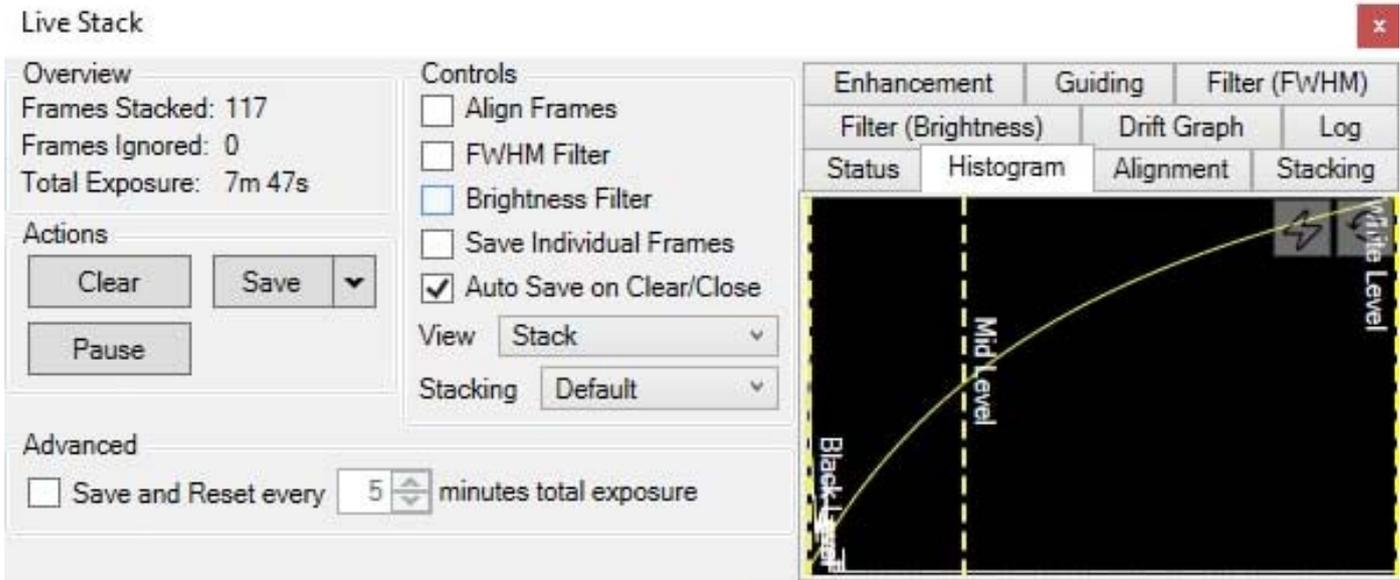
Instead of FlyCap, you can use [SharpCap4](#), which was designed for low-light imaging by amateur astronomers, with more complete controls, including many you will not need for x-ray or neutron imaging. Again, prefer the 32-bit version for compatibility. You must first install and run FlyCap2 (above) to install the drivers and set Mono16 and eventually binning with the GigE camera. The camera will be automatically recognised if it is plugged in, and you just need to choose it from the “Cameras” menu. A window will open with the image and camera controls on the right. You can arrange the order of controls by dragging the 3-line icon. An exhaustive [SharpCap User Manual](#) is available, but the instructions below may be sufficient to start with.



You can zoom the image with Ctrl-mouse-scroll or by using the zoom selection at the top right. In the “**Camera Controls**” you can set the Exposure (toggle LX mode for long exposures), set a high **Gain** to increase efficiency (at the expense of noise) and you can read the sensor temperature. In the “**Capture Format**”, select TIFF or FITS and Mono16. In menu “**File/Settings**” turn off “**Auto Output Format**” and set the “**Default Zoom**” to fill your screen. You can drag the vertical line in the “**Display Histogram**” to stretch the intensity display to emphasise the lower intensities (and see the noise). If the histogram shows vertical lines rather than a curve, toggle “**Byte Swap**” off for Mono16 data. **Tip:** set a “**Default Profile**” and the camera will be opened with those settings on startup..

Stacking short exposures in SharpCap 3.2 and 4.0

An interesting feature of SharpCap is real-time stacking of a series of short exposures. This allows you to judge when you have sufficient intensity (and to overcome the maximum exposure limit of the FLIR camera). Click on the "**Live Stack**" icon above the image display to open this stacking window. You can drag this window so that it does not cover the image. Switch off "**Align Frames**" which refers to alignment based on stars. Most of the controls to the right are also for astronomers; only the live histogram is useful, but normally you might save the summed stack as a 32-bit image and filter noise from it with imageJ.



You can also use imageJ to stack a series of short exposures, which allows filtering of noise from the individual images before averaging. For very short exposures this may be better than averaging first and then filtering. Use the SharpCap menu **Capture/Start_Capture** then enter the number of images to be saved. After capturing those images, use the ImageJ menu **File/Import/Image_Sequence**, open the first image, and then OK to import all images in that directory into a displayed stack. Use **Image/Adjust/Brightness-Contrast** to examine the noise, and apply **Process/Noise/De-speckle** to all images. You may need to **De-speckle** twice. Finally sum or average the stack using **Image/Stacks/Z-Projection**.

For long stacked exposures you may see a diffuse background patch due to amplifier glow. Depending on the speed of your computer, frames may be dropped for frame rates >8 fps.

FireCapture Imaging Software

[FireCapture](#) is another image capture application developed for amateur astronomy that you might also use for neutron and x-ray imaging with our FLIR (Point Grey) camera. FLIR has not yet developed an ASCOM driver for their cameras.

Hints on getting Optimal Performance

- The center of the image may not correspond to the centre of the window
- because the CCD chip is not centred to better than 0.5mm in its housing
- The exposure time depends of course on the intensity of your beam
- Exposure time and frame rate can be controlled separately for short exposures
- Use "Process/Noise/De-speckle" in [ImageJ](#) to remove noisy pixels from saved files

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