Pilatus 100k
Detector Pool Guide (v2.2)
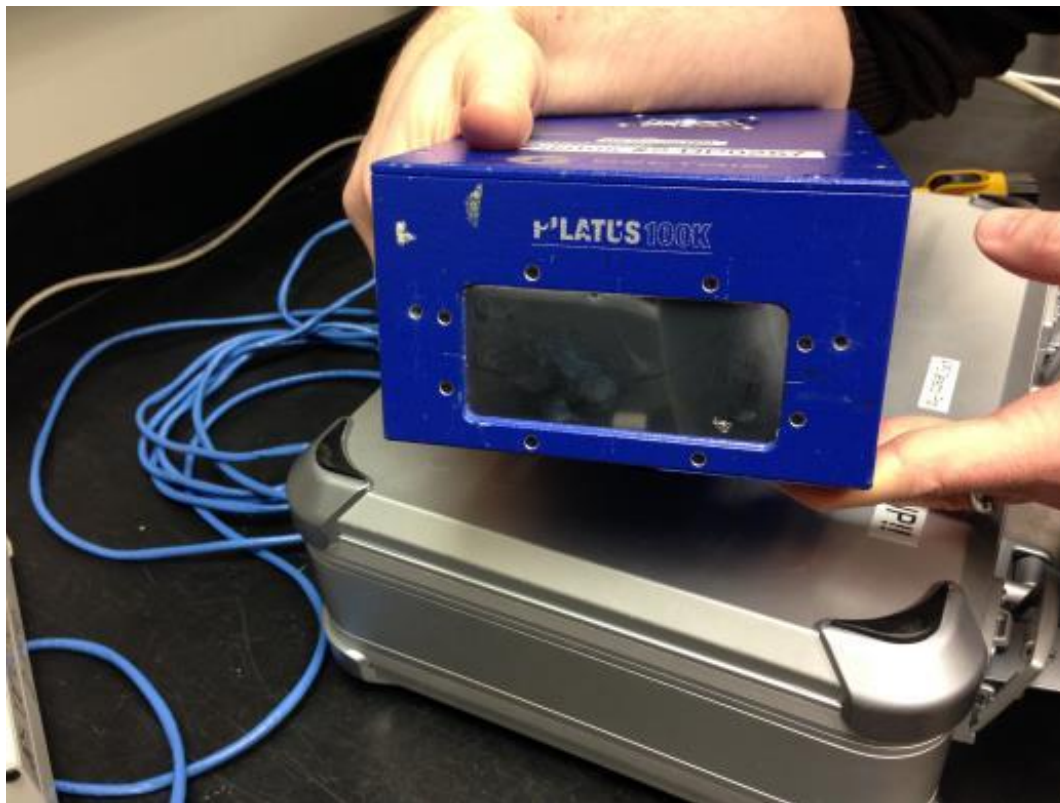
Contents

Quick Start

- Connect the cart power bar
- Connect Ethernet to port 'Gb1'
- Connect power and signal cables to the detector
- Turn on the power supply
- Turn on computer and Login
  - user name: det
  - password: (ask DP Staff)

- Start Software using **EPICS Launcher**
  - software will start automatically after login*
  - select 'Pilatus' and Load
  - select Model
  - start CAMSERVER, IOC, MEDM
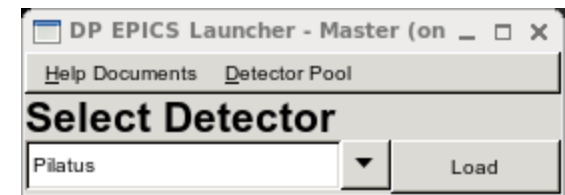- Optional
  - IMAGEJ
  - SAVE-RESTORE MENU

Pilatus 1 – back panel

Signal Ports   HV Power Connection

DP EPICS Launcher - Master (on _ □ ✕

Help Documents   Detector Pool

Select Detector

Pilatus   ▼   Load

DP Pilatus Startup (on pilatus-asd)   _ ✕

Pilatus 100k

CAMSERVER	Running	Stop
IOC	Start	Stop
MEDM	Start	Stop
IMAGEJ	Start	Stop
SAVE-RESTORE MENU	Start	Stop

*can also be launched
from this desktop icon

Common Problems/Solutions I

= The most common solutions to problems you may encounter!

*For more detailed AreaDetector notes, see Mark Rivers' documentation:
http://cars9.uchicago.edu/software/epics/pilatusDoc.html

Common Problems/Solutions II

- **Plugins**
  - Under 'All', make sure that 'Image1' is enabled
  - For tips on using other plugins, see the Detector Pool info page:
    https://wiki.aps.anl.gov/bts/index.php/Detector_Pool_Computing_Information
- **Detector**
  - Set the photon energy Threshold (keV) - YOU MUST SELECT 'Yes' & CLICK 'Apply'
  - Choose the appropriate Shaping Time/Gain
- **Collect**
  - Check that 'Array Callbacks' is enabled
- **File**
  - Check that the current 'File Path' exists
  - Check that the 'Filename format' is correct

- **ImageJ**
  - Click the 'Start' button to activate the EPICS AD Viewer Plugin
  - Check that the PVprefix matches the MEDM screen
    - If you edit this text, you need to type 'Enter' to reconnect with the new PV
    - The box will appear green when connected (red if the PV is unreachable)
    - If the box is white, you need to click on it, and type 'Enter'
  - You can close the plugin and restart it from the 'Plugins' menu of ImageJ

Common Problems/Solutions III

- If the GUI does not start up, it's likely that APSshare did not auto mount correctly. These are a few ways to get around this problem:

  - Solution #1 - Restart the computer with Ethernet cable connected!

  - Solution #2 - Mount APSshare manually
      *$> sudo mount –t nfs s**X**dserv:/APSshare /APSshare*
      $> /home/det/start_gui

    where **X** = APS Sector number, and the sudo password is the same you used at login.

  - Solution #3 - Start Software manually
      $> /home/det/start_camserver
      $> /home/det/start_ioc_pilatus
      $> /home/det/start_medm_pilatus **PVPrefix**
      $> /home/det/start_imageJ **PVPrefix**

    alternatively, *start_camonly* should also work

    where **PVPrefix** = the PV Prefix used by the IOC. You can find it by looking in the terminal running the IOC

Remote Control of the Pilatus DAQ

- **You have 2 different options:**

  (1) ssh login
  - You will need the IP address of the Pilatus computer
    - Open a terminal, run command: */sbin/ifconfig*
  - On the remote computer:
    - open a new terminal
    - Run the command: *ssh –Y det@[pilatus IP address]*
      - (For example: *ssh –Y det@164.54.101.69*)
    - The password is the same you logged in with locally!
    - Run the command: */home/det/start_gui*

  (2) run MEDM and ImageJ remotely
  - You will need the correct EPICS PV prefix (eg. dp_pilatus1, dp_pilatus2, dp_pilatusASD)
  - You will need access to the APSshare network disk from the remote computer:
    - You can mount it from your sectors local dserver
      - (eg. At sector 2, look for *s2dserv.xray.aps.anl.gov:/export/APSshare*)
    - Within *APSshare/DetectorPool* you will find the appropriate startup scripts
  - NOTE: Camserver and the IOC cannot be remotely started or stopped using this method.

Data Storage:

- It is strongly recommended that you write your data to network mounted disk space. Locally mounted /disk2 is a large HDD that can be used for storing your images, however, DP computers see a lot of heavy use. We cannot guarantee that you will not have a disk failure.

- Network disk space is a more stable option. The transfer of images over the network is fast enough to keep pace with the highest Pilatus frame rates.

- Other disk resources may be available at your sector (consult beamline staff), and users are always welcome to mount their own media (large flash drives, USB-HDD, etc).

NOTE: If you do choose to save data locally, please copy (and delete) files before returning our equipment so that disk space is available for the next user.

Thresholds & Shaping time/Gain:

- Lower level thresholds are currently set via EPICS.
- The threshold should ideally be set at 50% of the beam/scattering energy. If you set it closer to the beam energy, your efficiency will be reduced; in effect you are making the pixel size smaller. 50% minimizes the number of missed photons from split between two pixels. In order to reach this 50% point you need to pick an appropriate gain.

> **NOTE**: If you want to suppress fluorescence from a sample, Dectris recommends setting the threshold about 0.5keV above the fluorescence line.)

- General guidelines:

  Beam Energy: 4.0 - 9.0 keV → High Gain/Slowest Shaping time
  Beam Energy: 5.0 - 12.0 keV → Mid Gain/Medium Shaping time
  Beam Energy: 7.0 - 18.0 keV → Low Gain/Fast Shaping time

  For example, if your beam energy is 10keV, then use Mid Gain with threshold at 5 keV. (If you use Low Gain, you are close the hardware limit of the comparator level. These ranges are overlapping; picking the lower gain is usually better.

Analog output as a function of gain/shaping time
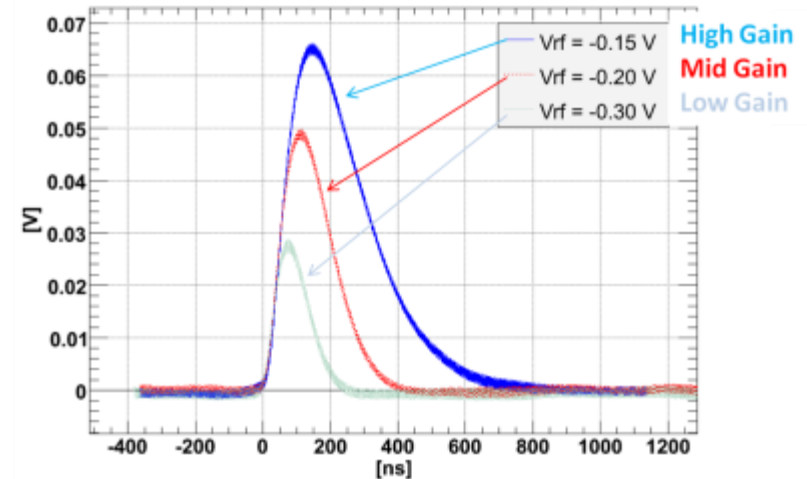
Thresholds for different gain settings
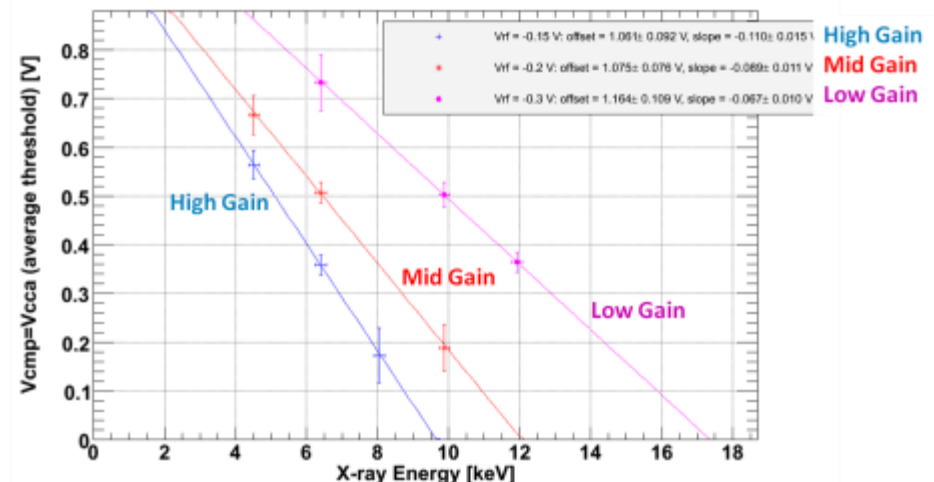
Deadtime corrections

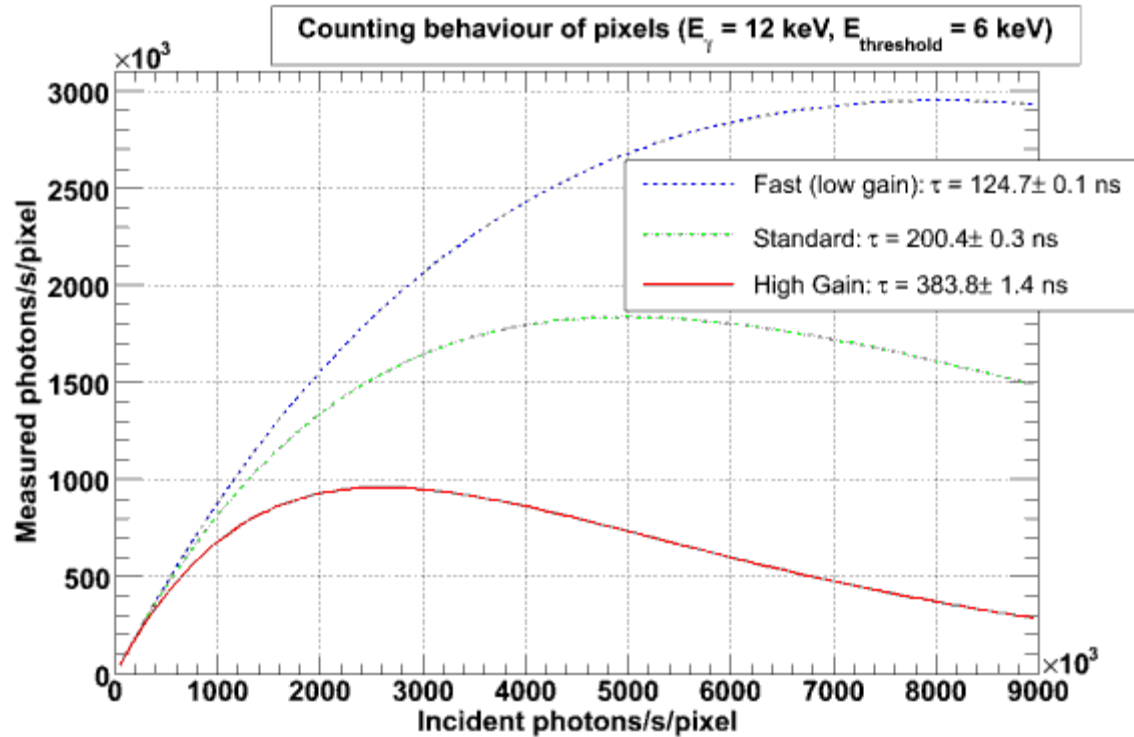- The low gain is the fastest shaping time, so for highest count rate throughput you would like use this, if you can afford given the energy threshold discussion in the previous section.

- If you assume that the x-rays are not pulsed, then the deadtime curves will follow a paralyzable model (see figure below).

- If you are using a synchrotron with a non-symmetric fill pattern (e.g. hybrid singlet), your deadtime curve will be different.

Counting behaviour of pixels (E_γ = 12 keV, $E_{threshold}$ = 6 keV)

Fast (low gain): τ = 124.7± 0.1 ns
Standard: τ = 200.4± 0.3 ns
High Gain: τ = 383.8± 1.4 ns

Measured photons/s/pixel vs Incident photons/s/pixel

Proper deadtime corrections in the 3 APS timing modes will be published soon.
Refer to this paper for some help: Walko et al, *J. Synchrotron Rad.* (2008). 15, 612-617
(http://scripts.iucr.org/cgibin/paper?S0909049508022358)

Trigger Modes

- **Internal** – If this is the software triggered mode. Specify *Exposure Time* and hit acquire. You can also specify *Number of Images.* Ignore *Exposure Period* and *Exposures/image* parameters.

- **External Trigger** – If you want to synchronize your exposure sequence with an external event (e.g., some sample reaction), use this mode. You specify *Number of Images*, *Exposure time*, and *Exposure Period*. You arm the detector by hitting the acquire button. The Pilatus will wait until it sees a TTL rising edge on its external input LEMO. It is best to use a base filename which does not end in an underscore. It will produce individual files that are indexed properly. For example, use a base filename, like: image   It is best to save data to the local disk in this mode. (Typical Application: time-resolved SAXS)

  > **NOTE**: The *Exposure Period* must be greater than (*Exposure Time* + 4ms) to allow for readout.

- **Multiple External Trigger** – Uses the programmed ExposureTime, in addition to NImages and NExposures. Each external trigger pulse causes the Pilatus to collect one image at the programmed exposure time. This mode works well with a trigger source like the Newport motor controllers or the SIS380x multichannel scaler, that put out a short trigger pulse for each image.

  > **NOTE**: The time between external trigger pulses must be at least 4ms longer than the programmed exposure time to allow time for the detector to read out before the next trigger pulse arrives. (M. Rivers)

- **External Enable** – This is for gating the detector (e.g., on a single-bunch for pump-probe studies such as at 7-id and 20-id). You specify Exposure/image (e.g., 65000) and it will gate for this many times (LEMO Input: Extern In). So, set the exposure period to the period that the external triggering is coming in at. (This is only need to that the detector can calculate an internal timeout time.) This feature essentially does on-chip summing.

  > **NOTE**: If using the SRS SDG 535, use TTL Normal High Z. T is usually P0 or laser signal.
  >
  > A = (T + delay) and B = (A + 30ns).

- **Alignment** – Takes images over and over again and saves to the same file. It overwrites to the same file. This is useful for alignment!

Additional Notes

- ImageJ
  - To change contrast, use the shortcut **Ctrl-Shift-c**
  - To generate a line profile, use the 'line' drawing tool from the toolbar, then type **Ctrl-k**
  - To get statistics on the full image or a box, type **Ctrl-m**
  - For additional information, see http://rsbweb.nih.gov/ij/

- Data Format
  - Images are saved as TIFF files, 32-bit unsigned integers, little-endian.
  - Each pixel is $172 \times 172 \ \mu m^2$
  - Each pixel can count to 20-bits and will rollover if it goes beyond
    - Approximately 10^6 photons/pixel/trigger before saturation!

Save-Restore Menu

- This tool allows you to save different areaDetector PV configurations as named .cfg files, and restore from these files.

- **To Restore PVs…**
  - Select a previous 'config' from the menu
- **To Save PVs to a profile…**
  - Click on 'More'
  - Click 'Save' to an existing config name, or add a new Name to the list and click 'Save'

- Additionally, each Sector of the APS now has a dedicated AutoSave folder. When the IOC is started, a detector will automatically be restored to its previous state at the current sector.