Users Guide for the GE amorphous Silicon "Angio" Flat Panel Detector

BTS group

Revision 3 (Last update 02/20/2009)

Content:

This document is designed for public use. Please contact BTS personnel if you need additional assistance.

I) General Description

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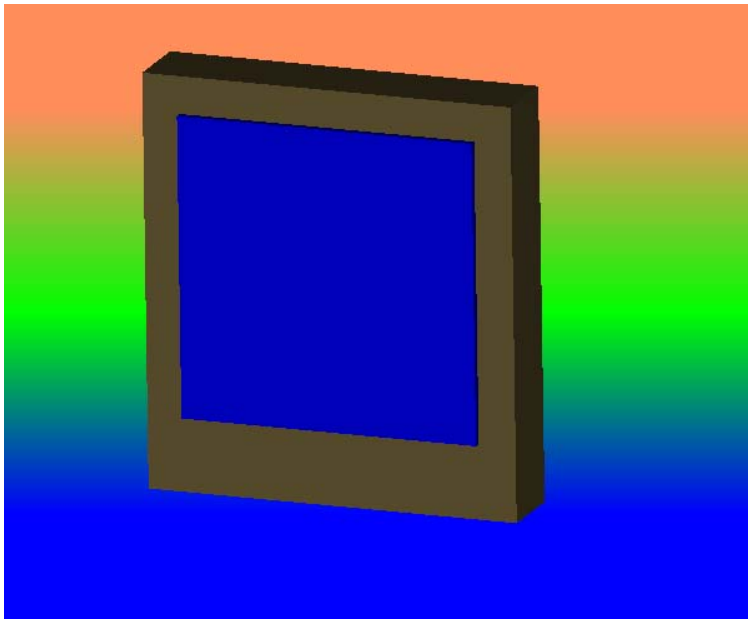
The GE detector, designed for medical X-ray machines, uses a plate of amorphous silicon to detect X-rays of high energy, on the order of 60keV to 80keV. The X-rays are converted to optical photons with a 500um thick CsI phosphor screen. The screen is about 70% efficient for 60keV X-rays. Note that direct conversion of X-rays to electronic charge is not done.

The detector is an array of diodes reversed biased at 9V. The diodes are initially charged to 9V, being used like capacitors. When light hits the diode, the charge drains proportionally to the number of photons. When the diode is recharged, the amount of charge needed to recharge is recorded as the amount of light which hit that pixel. One 80keV X-ray puts about 1400 electrons into a pixel. The read noise of each pixel is about 1400 electrons, making one 80keV X-ray giving an SNR of near 1, which is barely visible.

The detector has 2048*2048 pixels, to make a square 410mm*410mm detector. The pixel size is 200um. A simple drawing of the detector is shown below.



The readout electronics include readout modules with a total of 4096 A/D converters (2048 for each half of the detector). GE has developed ASICS with 32 A/D per chip arranged in 256-channel modules, allowing for the required miniaturization. The detector is read two rows at a time (one row from each half), so that at each conversion cycle 4096 pixels are read simultaneously. The detector electronics dissipate about 90W of heat, so the detector is water cooled to maintain stable Silicon imager temperature..

The images can be read out in 125ms for a 2Kx2K image and 23ms for a 1Kx1K image, binned 2x2 or the center 1Kx1K without binning. The 2K images read at a maximum rate of 8Hz, and

1K at 30Hz. The data are read with 14 bit precision. Gains of the camera range from 275e-/ADU to 8000e-/ADU.

An EPICS interface communicates with the GE custom software, which runs on a Windows machine.

II) How to start the software.

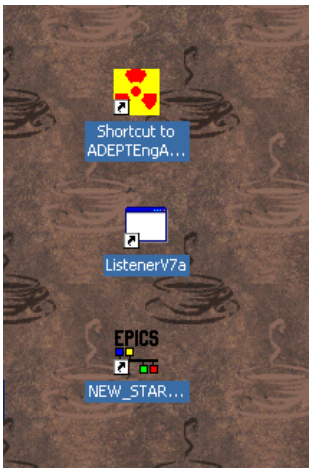
All critical programs have icons on the desktop in the upper right corner. ***Please do not move them.***

User: **dpadmin**
Password: XXXXXX (Please ask for password)

There are currently 3 software packages that need to be started to run the GE a-Si detector. They include:

- AdeptCore Engineering Application ("AEA")
- Listener (currently version = V10)
- EPICS.

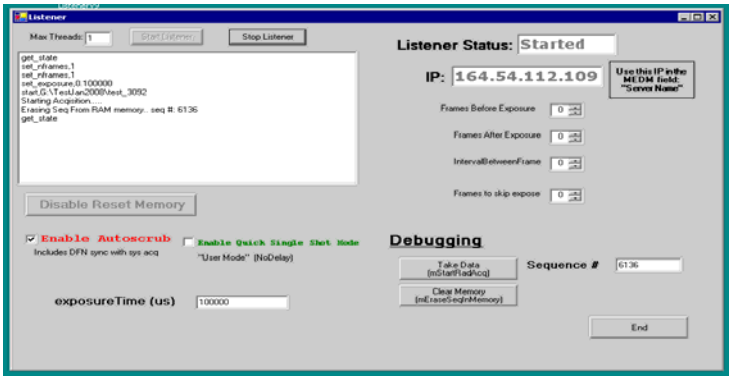
The three icons are shown below.



1) First, start the **AEA**. It will start 2 windows: the AEA and the AdeptCore terminal window.
   – AdeptCore gives low-level information about what is going on. You normally do not need to use the AEA window, so you can just **minimize** it. (***Don't close it.***)

2) Start **Listener**. (May take up to 2 minutes to start. ***Make sure it is started!***)
   – This window allows you to turn on and off the Autoscrub. We recommend that you leave it Enabled.
   – We also recommend that the Reset memory is Enabled. This deletes a sequence of images from RAM memory at the end of the sequence.

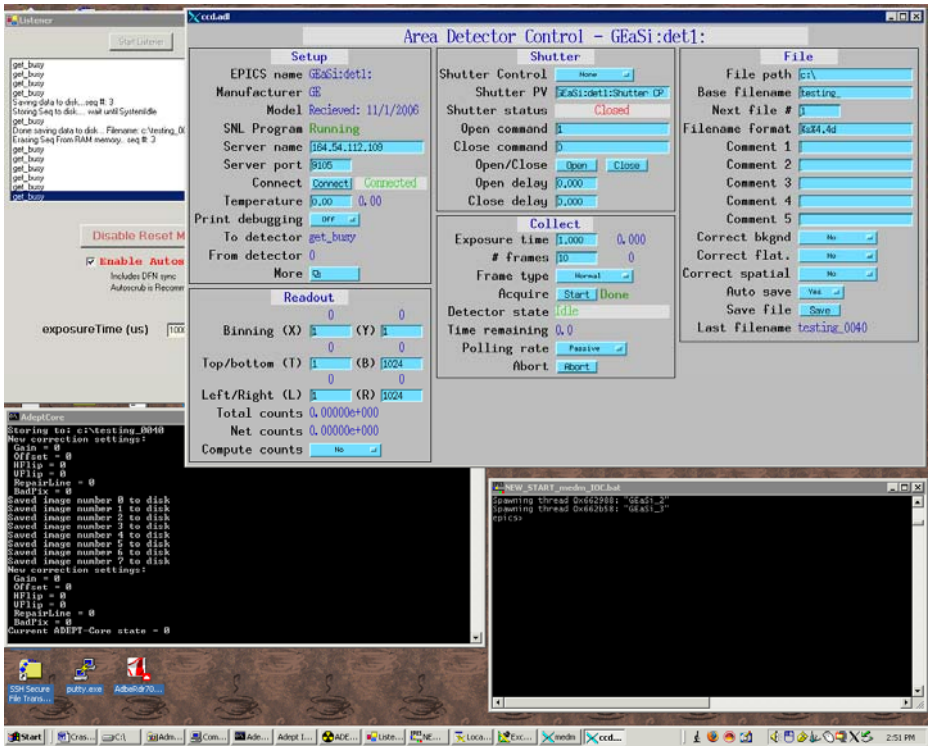
- Under normal operation the “Enable Quick Single Shot Mode” checkbox should be left unchecked. See Appendix E for its usage. Please note that only one single frame per sequence will be taken if this box is checked.
- The Listener functions as a link between EPICS and AdeptCore. You will see commands that are sent from EPICS to the detector/AdeptCore. (Note: Listener will not start until the “Settling time” is zero. This is at the bottom of the Config Window of the AEA.)
- The software allows you to change the number of before and after frames, but typically these are set to zero and the “during” or real data frames are set in the MEDM screen below.



Listener ***(Make sure it is started!)***

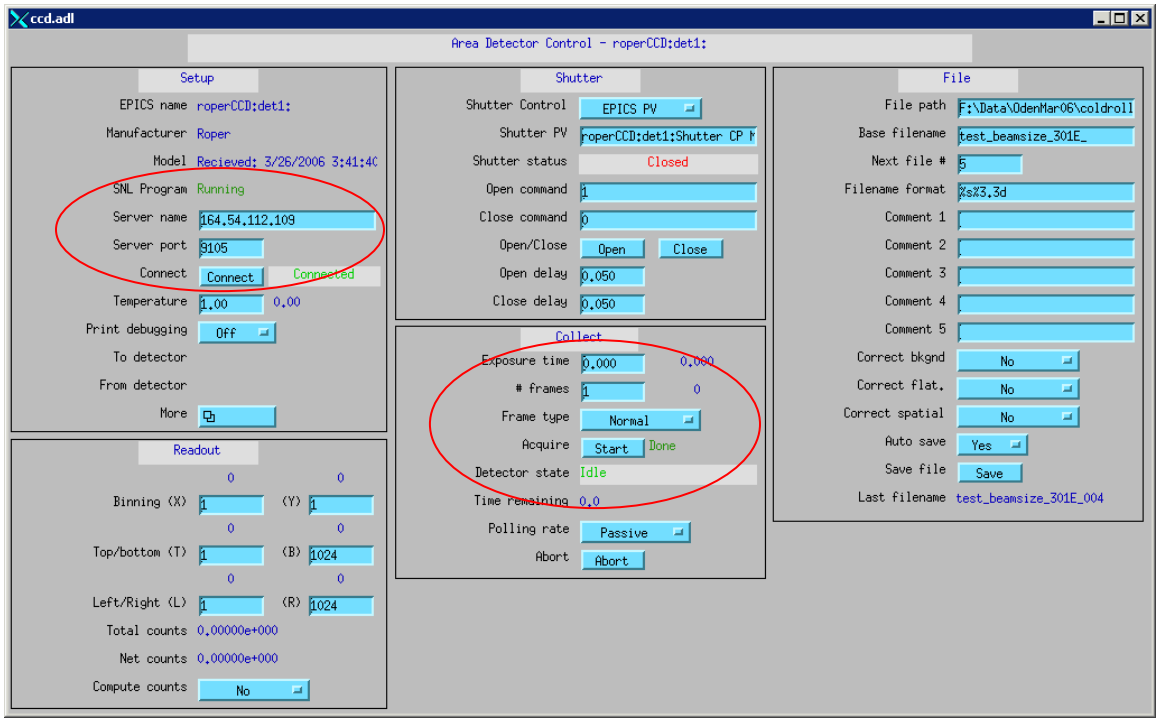
3) Start **EPICS**. Make sure the Server Name matches the IP address from the listener. The EPICS shell terminal can be minimized but make sure you do NOT start more than one, e.g. if you have to re-start.

MEDM control window & epics terminal
You can minimize the epics terminal.
Be careful to have only one instance of EPICS



Recommended Desktop Layout

III) Control PVs.



MEDM ccd.adl control screen (from Mark Rivers)

- Most commands are not implemented for GE detector (yet). Ones that work are circled.
- The "Connect" button is used to reconnect if the Listener or Adept program crashes.
- The first time that the Detector moves to the new subnet (i.e., a new sector), you need to change the Server name to match the IP address of the computer. The Listener will display this. You need to enter this IP address into the MEDM screen and click on the "Connect" button. The EPICS autosave application will save this value from here after.

1) **Exposure Time**: This is for each frame/image and is in units of SECONDS, here. [In GE's language, it's the "time between frames (TBF)".]

2) **# Frames**: The number of images you want in your sequence. ***Must be less than 300 or the system will crash!***

3) **File Path**: ***Make sure that this path actually exists!*** It is recommended to keep the file path fixed during the run and only change the filename. Also, include a \ at the end of the path (e.g., **C:\Data**)

4) **DetectorState:**
   - /* The following must agree with the states in the CCDState PV */
   - #define DETECTOR_IDLE 0 "Idle"
   - #define DETECTOR_ACQUIRE 1 "Acquire"
   - **NOTE**: If you do a pv_get of DetectorState, you will get a string back (i.e., Idle or Acquire). I think there is a way to get an integer, but I don't know, yet.
   - **NOTE**: In "Rad" mode, detector is 2k x 2k (no binning) with a 125 ms readout (8 fps). This speed is for no acquisition time, so real usage can only be slower. "The Angio" is 1k x 1k (2 x 2 binned) 0.033 ms readout (30 fps), and a 1k x 1k image is also possible in a ROI mode. The instructions below are for "Rad" mode.

IV) Known Problems:

1) Occasionally the real-time image display on the second monitor will disappear. You will see errors after each image/frame is read into the RAM memory buffer (e.g., "**_processthread1**"). The data are still valid. To fix this, you need to restart AdeptCore, and thus EPICS and the Listener. We have reported this problem to GE, but they are unsure of the cause.

2) From the EPICS interface…. the ***very first time*** that you try to acquire a sequence of images, the exposure time and number of images are NOT those which are specified in the EPICS screen. Rather, the EPICS screen uses the parameters last in the Adept AEA Config window. But all other acqusisitons from EPICS seem to work and you can change the exposure time and number of images without a problem.