

# New Wifoe Camera Interface

Monday, May 12, 2014 (Corson, Reetz, Williams)

## GigE CCD Camera

The new camera is the Allied GigE GT3300 CCD made for rough environments. It is an interline brand device (no shutter but small fill factor - *photodiode size relative to pixel surface*) with ~50% QE at 500nm, close to V in color response.

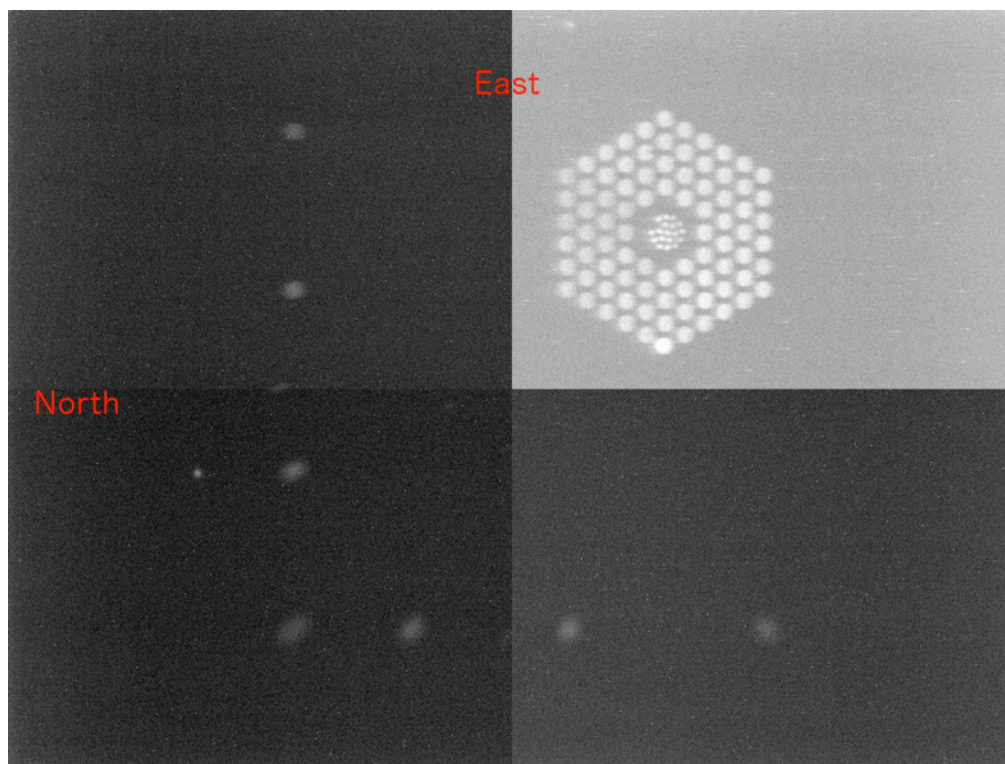
### Pixel size is:

- 5.5  $\mu\text{m}$  pixels , 0.0515 arcsec/pixel
- 11  $\mu\text{m}$  pixels binned **2x2**, 0.103 arcsec per binned 2x2 pixel
- (Default) 27.5 $\mu\text{m}$  pixels binned **5x5**, **0.258 arcsec/pixel** .

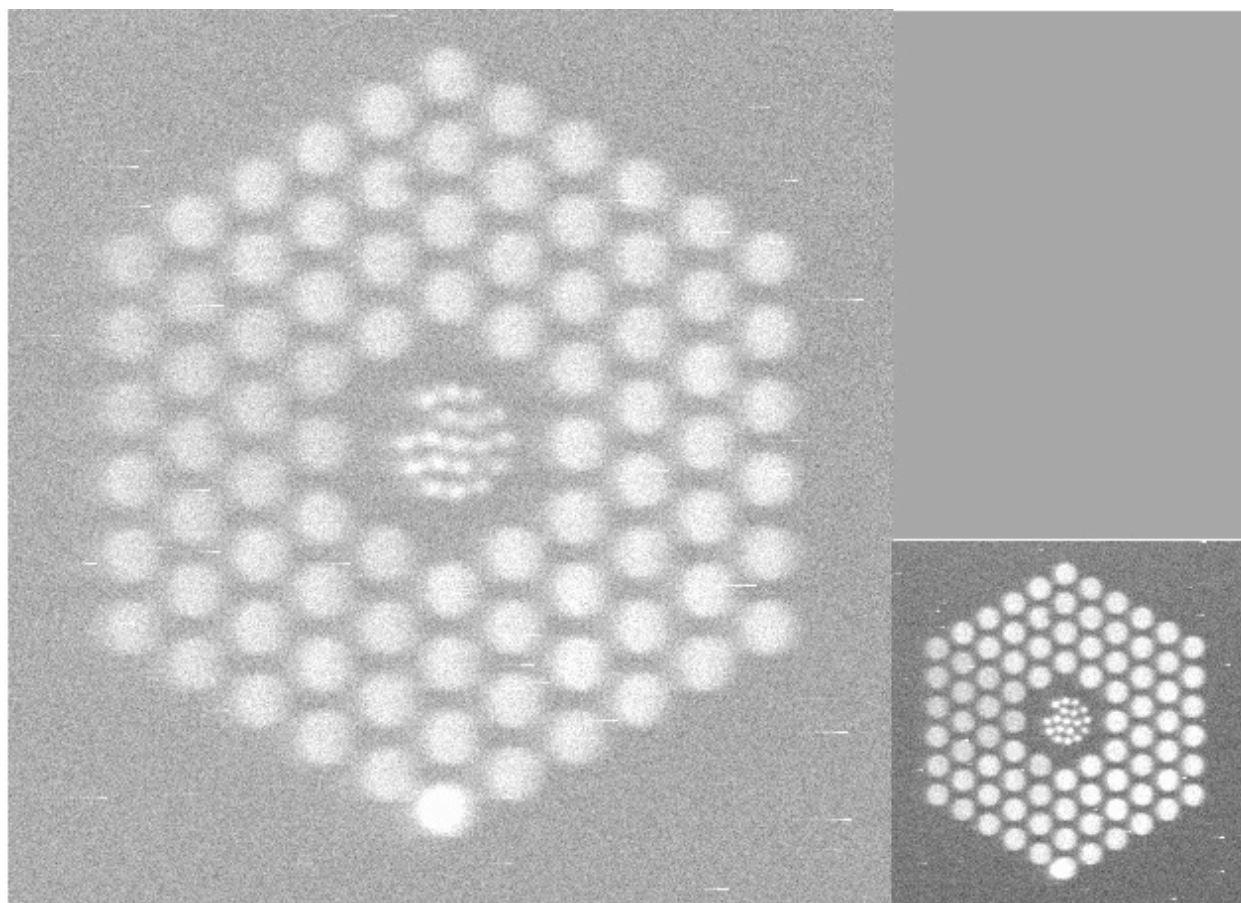
Tests on-sky confirmed the image scale for HexPak and should be the same for the other IFU's though, as the aberrations grow, sky fibers, this may not be as accurate.

### Faint limit criteria (clear skies and average conditions):

- 16<sup>th</sup> Vmag star, exp = 1.0 sec, ND = 0, SNR  $\approx$  10; easily visible on the camera
- 17<sup>th</sup> Vmag star, exp = 2.5 sec, ND = 1, SNR  $\approx$  10; (1 mag from 16<sup>th</sup>)
- 6<sup>th</sup> Vmag star, exp = .1 msec, ND = -10 SNR  $\approx$  10; (9 mags from 16<sup>th</sup>) for a SNR of  $\sim$ 10



**Figure 1:** The ds9 display of the WIFOE camera, binned 2x2, with no flip in X or Y. There is no rotation offset.



**Figure 2:** 2x2 versus 5x5 image of same object taken back to back. The star is on the bottom center fiber.

As noted, 5x5 binning can be used and one can still resolve the HexPak central fibers. Figure 2 shows a comparison side by side. The increase in peak signal from 2x2 to 5x5 is roughly a factor of 5.

Please note that the camera alignment is such that GradPak is reasonably centered on the CCD. All other IFU's fall where they fall.

## Future improvements and possible development

- (1) Any future changes and/or development will depend on feedback from you and users.
- (2) It is possible to have a 'built-in' function for the user interface that uses a desired pixel location and a current location and then offsets the telescope to the desired location . It is now possible to perform accurate offsets from any pixel location to a specific fiber pixel. This is shown to be good to  $\sim 0.1$  arcsec in 2x2 binning mode, 0.103 arcsec/pixel. 2x2 binning works well for this purpose.
- (3) Rotation can be easily calculated by knowing the centroid of the star for two positions where the difference in location is purely a function of a N/S or E/W offset (keep it to a modest offset, not much more than the size of the science bundle). The angle can then be automatically applied as a 'mnir offset set #####degrees', or whatever unit is chosen. This can be handy for a number of observing scenarios.
- (4) We can have predefined ROI's (**R**egion **O**f Interest) for each bundle (radio check buttons). There will have to be a generous boundary surrounding the bundle as the repeatability of the wheel etc. Is not high precision. (we can now characterize this repeatability)
- (5) The sensor width & height could be reported in arcsec based on binning mode instead of pixel dimensions.

## Connecting to wiyn-guider

The interface runs on the computer wiyn-guider (140.252.61.72). A VNC viewer should be used to gain access to the computer.

```
vncviewer wiyn-guider:1
```

or use the vnc icon on say wiyn-2

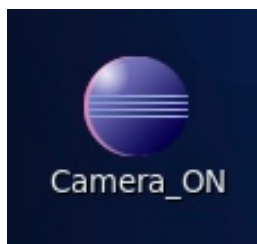
One could ssh into wiyn-guider, login is wiyn with wiyn password, and ssh -Y the session directly to your machine but others will not be able to see/use the interface. You can start the interface as such:

```
/home/wiyn/startcamera
```

**Note:** If the camera power is off, or has just been powered up, the interface will crash on startup. We cannot currently give to the general user the login/password to the POE switch that controls the camera power. The OA/Staff can do this. **The camera is on port #3** of the switch. Power On/Power Off buttons have been implemented (Mar 26, 2014) in the camera control gui so that the user can now turn the camera power on and off from the gui rather than from the PoE port setup web interface (see figure 4).



**Figure 3:** IFU Viewer Icon as seen on the wiyn-guider desktop

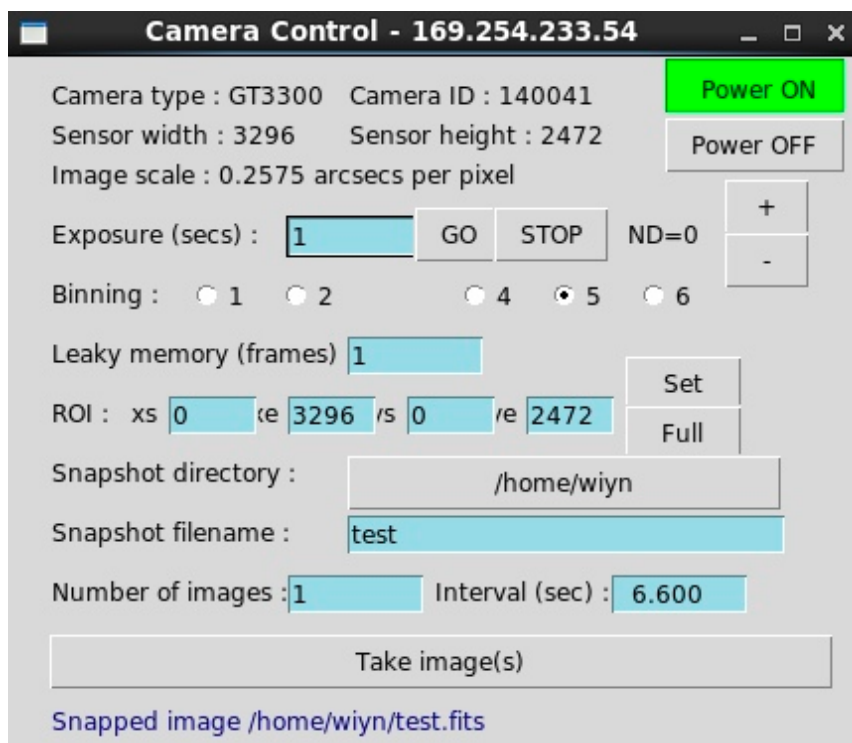


**Figure 3.1:** Camera Power On Icon as seen on the wiyn-guider desktop

## Run Interface Program

There is an icon on the desktop labeled **IFU Viewer**, *figure 3 above*, select this and a terminal, gui, and ds9 will automatically start. The interface will default to 1sec exposures and full field of view (reads entire chip). Acquisition will then stop and wait.

You can also turn on the camera power before bringing up the GUI by selecting the **Camera\_ON** icon, *figure 3.1*.



**Figure 4:** WIFOE CCD user interface, IFU viewer indicating Power ON (March 26<sup>th</sup>)

## Configuring the Camera

You do not normally use leaky averaging, middle of the interface. You want fast updates. Leaky average only when you want to detect fainter things or average out seeing effects or if you are using sub-second exposure times. Comment: you have to use considerable averaging to see noticeable increase in signal to noise and this will decrease significantly the 'realtime' nature of the camera's utility. You have to balance the tradeoffs.

Normally, you use the interface only with **continuous readout**. This is the top half of the interface "GO / STOP" and ND increment adjustment.

The default **exposure time** is 1sec. You can easily change the exposure time by using the ND +/- buttons. For each ND increment, the exposure is increased or decreased by a factor of  $\sim 2.5$ . This equates to one stellar magnitude fainter (+), or brighter (-) detection relative to the 1sec exposure. This makes for easy exposure time setting, you don't have to guess what might be a good change for the exposure time.

When using the back-illuminator, brighter settings are typically needed, or works best, than say what was typical for the old ICCD.

**Binning** is currently 5x5 by default (March 23th). This setting results in 0.26 arcsec/pixel, fainter detection and/or faster readout, but lower resolution - fine for viewing SparsePak fibers. You can lower the binning mode to say, 2X2 (0.103 arcsec/pixel) for higher resolution in the smallest fibers that are in HexPak, but have a slower readout time. Do not forget to 'STOP' acquisition before changing the binning mode. Selection of binning is just below the GO/STOP buttons, top half.

**ROI (Region Of Interest)** is generally not used but it can be for having images only of the IFU fibers, not a bunch of empty pixels. Be careful though. You must 'STOP' all acquisition before you change the ROI. The interface will ask you to use the ds9 cursor to 'select' the region of interest on the ds9 display. Should you want to go back to full ccd readout, just select the 'Full' button.

## Saving images, snapshots.

You can stop continuous acquisition and use ds9 to save out a file, say as jpeg, but you **will not have access to header information**. We are striving to add a feature to be able to save the last image readout from the continuous acq mode.

**If you want to retain header information**, save images by doing the following (**recommended**):

Stop continuous acquisition and use the 'Take image(s)' button at the bottom half of the interface. This creates an image with header information (as long as it's a fits file that is saved, whether test or other). Configure your snapshot directory, set you desired filename, and take an image or more. The file will be saved to disk and one can ftp from wyn-guider to retrieve the file. **Caution:** Header content was verified but users should periodically check the header content for validity. Header content is complete, sufficient for each and every observation with all relevant telemetry (az/alt, target ra/dec, airmass, exposure..).

Note: If you are using leaky averaging, the image written is a leaky image, not an individual exposure.

## Sensitivity and faint limit

A 16th Vmag star will have a  $\text{SNR} \approx 10$  given clear skies and average conditions.

The CCD does not perform as good as the old intensified CCD (ICCD) *in very low light* levels but for general purposes, the new CCD way out performs.

With the back illuminator set at 4, a standard 1sec exposure will just detect the back illuminated fibers (HexPak, requires zscale display on ds9) You can adjust the back illumination or increase your exposure time (use ND increments).

In order to have the best response for focusing and positioning one's object on a fiber, do not use leaky averaging if you can help it. That said, leaky will help to increase your detection but you may also gain better results by changing the binning, 2x2 to 5x5 or more for example. This has the benefit of also speeding up readout time.

## Camera Power ON/OFF

The camera is powered via a POE network switch (power over the ethernet). This is controlled via the Power On/Power Off buttons on the user interface, see figure 4 above.

When powering on, the camera will have to boot up so, there will be a delay until the camera is ready. On power up, the interface will attempt to set the mode of the camera to the current settings as indicated on the interface. **If there are any doubts, or you are having no success in imaging any stars**, set the ROI to FULL and try again.

## Camera OFF when observing

The camera should be turned off for real - 'you want this data' - observing. There are several factors at play here that you must be aware of:

- (1) The camera has LED's, though they are painted black and taped over. We cannot turn the LED's off. It's likely that the LED's will not be detected, system is baffled, but if you are concerned or curious, a test should be ran with your particular configuration. (WIFOE has light leaks so, daytime testing probably isn't of use in this LED testing)
- (2) HEAT. The camera does get warm though it only consumes 5 watts or so. It's best to have it OFF when not in use.
- (3) The camera power and readout creates significant noise pickup on WHIRC. If one observes with WHIRC, this WIFOE camera must be turned off.

## Appendix: Allied Camera GT3300



### GT3300/3300C



#### Description

##### 8 Megapixel CCD camera for extreme environments - GigE Vision®

The Prosilica GT3300 is a 8 Megapixel camera with a Gigabit Ethernet interface (GigE Vision®). The GT3300 is a rugged camera designed to operate in extreme environments and fluctuating lighting conditions. It offers Precise iris lens control allowing users to fix the aperture size to optimize depth of field, exposure and gain without the need for additional control elements.

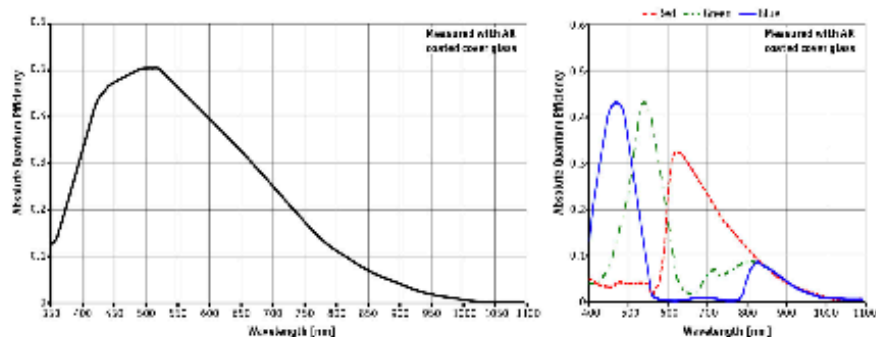
- Truesense KAI-08050 sensor
- Auto Iris (P-Iris and DC)
- Power over Ethernet (PoE)
- Ethernet surge suppression
- Gamma, multiple LUT, color correction
- Metadata (Chunk data)
- Clock synchronization (IEEE1588)
- Wide operating temperature range
- Global shutter (digital shutter)
- **Models:**
  - GT3300, 3296 x 2472, 14 fps, CCD mono
  - GT3300C, 3296 x 2472, 14 fps, CCD color



## Specifications

Prosilica GT 3300	
Interface	IEEE 802.3 1000baseT
Resolution	3296 x 2472
Sensor	Truesense KAI-08050
Sensor type	CCD Progressive
Sensor size	Type 4/3
Cell size	5.5 µm
Lens mount	F-Mount
Max frame rate at full resolution	14.7 fps
A/D	14 bit
On-board FIFO	128 MB
Output	
Bit depth	8/14 bit
Mono modes	Mono8, Mono12Packed, Mono16
Color modes YUV	YUV411, YUV422, YUV444
Color modes RGB	RGB24, BGR24, RGBA32, BGRA32
Raw modes	Bayer8, Bayer 12Packed, Bayer16
General purpose inputs/outputs (GPIOs)	
TTL I/Os	1 input, 2 outputs
Opto-coupled I/Os	1 input, 2 outputs
RS-232	1
Operating conditions/Dimensions	
Operating temperature	-20°C ... +60°C
Power requirements (DC)	PoE, or 7-25 VDC
Power consumption (12 V)	5.6 W@ VDC
Mass	314 g
Body Dimensions (L x W x H in mm)	121 x 59.7 x 59.7 (including connectors, w/o tripod and lens)
Regulations	CE, FCC Class A, RoHS (2002/95/EC)

[Download Prosilica GT3300 Technical drawing](#)



## Smart features

The Prosilica GT3300 features include:

- Auto exposure
- Auto gain
- Auto white balance
- Flexible binning
- Region of Interest (ROI) readout
- StreamBytesPerSecond (easy bandwidth control)
- Stream hold
- Asynchronous external trigger and sync I/O
- Auto Iris (P-Iris and DC)
- Power over Ethernet (PoE)
- Ethernet surge suppression
- Gamma
- Multiple LUT
- Color correction
- Metadata (Chunk data)
- Clock synchronization (IEEE1588)
- Recorder and multiframe acquisition modes

## White Paper

Remote lens control with Prosilica GT cameras