NESSI - NN-EXPLORE Exoplanet Stellar Speckle Imager

Login info

PC name: ghost
Windows password, user NESSI: speckle
~~Ip address at WIYN: 140.252.61.249 (or .157 last number could be any <255, "ping ghost" or "arp -a" to find out ip)~~
Static IP Address: 140.252.61.128 DNS Name: wiyn-nessi.kpno.noao.edu
~~VNC password: nessi~~

Software

Windows 10 key: NMRF6-YQB9Y-668B7-PFGTC-V8Q96
~~VNC license: M743H-7BNEL-4MEDH-RHERC-C5PMA~~ defunct now - switched to tightVNC server
VNC password: speckle
Andor solis runs cameras
Zaber console runs stages
AWD-Utility runs filter wheels
syncthing syncs the data folder on ghost with a local folder of your choosing (typically a subdirectory of 'data' with the UT date as its name)

Camera Settings

Be careful with using high gain!

- Gain > 300 will lead to premature aging of the chip

Don't use auto shutter for any short exposures

- Use "Open during any series"

Prefer pre-amp gain 2

- it has a deeper pixel well

Vertical shift speed, 4.33

- 4.33 usec is native, other shorter ones are "overclocked", they allow faster rates and lower clock-induced charge, but shallower pixel well depth.

CCD mode:

- For conventional CCD amp use 1Mhz readout for exp < 11 sec, 100kHz readout for >11s exposure

The cameras need to be plugged into opposite sides of the pc, that way they go into separate USB buses. If they are on the same side, in high rate full-frame mode there will often be an error

message. However, due to a flakey USB port on the PC we have plugged both on the same side. It seems to work ok.

Cameras

Andor IXon Ultra	Serial number	channel
	X-10331	blue
	X-10330	red

Filter Wheels

AWD-Utility: Connect (either to 1 or 2), click to set filter, disconnect to change to other filter wheel.

filter wheel	slot	filter (wavelength/FWHM)	filter wheel	slot	filter (wavelength/FWHM)
1	1	SDSS/u (354.3/32.7)	2	1	SDSS/i (765.4/146.4)
blue	2	SDSS/g (480.0/151.1)	red	2	SDSS/z (943.3/242.7)
A	3	SDSS/r (620.0/143.5)	B	3	716.0/51.5
	4	467.1/44.0		4	832.0/40.4
	5	562.3/43.6		5	empty
	6	empty		6	empty

Narrow filters: longer wavelength -> less dispersion, shorter wavelength -> higher resolution
The AWD program frequent gives an error on the first or second run (It says to power cycle or reconnect USB). Ignore this and restart the program until it works. This only occurs at the beginning of the night at the first attempt to connect to each filter wheel.

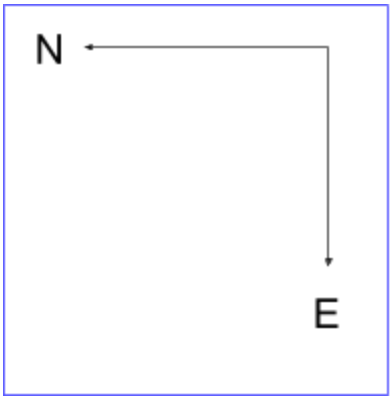
Zaber position

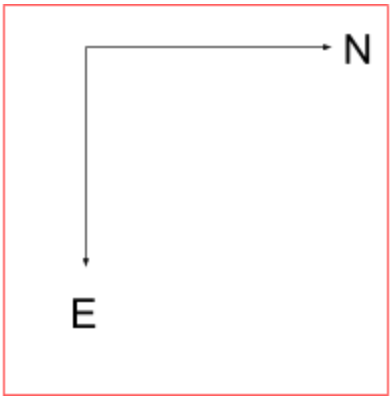
Zaber Console: at first start of the night click open: “COM3” list should populate. To move a stage, highlight it, then under “Commands > absolute move” enter the number from the table below for the desired position and click “Send”. You can check the current position by going to “Settings>pos” and clicking “Read”. This works simultaneously for all stages if you have All Devices highlighted.

previous	Device #		WF	Speckle
	1	Red arm reimager stage	694000	28000

	2	Blue arm reimager stage	654026	0
	3	Input stage	1066667 (max)	5000

5/10/2017	Device #		WF	Speckle
	1	Red arm reimager stage	694000	42700
	2	Blue arm reimager stage	675026	0
	3	Input stage	1066667 (max)	5000





General notes

- If the star isn't in the field in speckle mode, it is possible to move the input lens to the WF position, while leaving the others in speckle mode. This gives you a wide field of view and you can center the star in the field for speckle (Note: the star will be out of focus if only the input lens is moved, but this is ok for general pointing corrections). Then move input back to speckle mode.

- Andor software defaults to 32-bit, you can change the type of fits file (unsigned, signed, 32-bit, 16-bit) by going to save as -> and setting it to the type of file you want (give it some filename, it doesn't matter it will be overwritten by the autosave). Then save a file. All subsequent files will be autosaved as that type of fits. For speckle, we want unsigned 16-bit.

- Similarly, gains above 300 have to be enabled. You have to go to "Advanced" under camera settings and check a box. If the software is restarted you will need to check this.

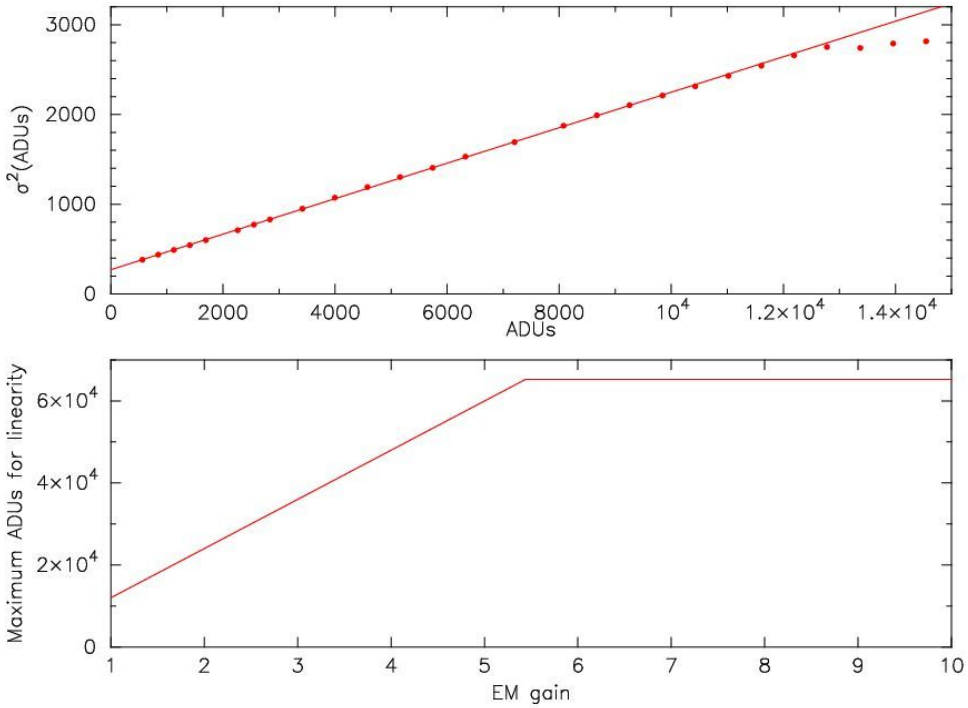
- For counts above ~40k, you don't want to use high gain (>300) otherwise you'll be in a non-linear regime, also it doesn't gain you much signal over the noise, and it can lead to prematurely aging of the chip. Only use high gain for faint stars.

- At beginning of night (or anytime the camera software is restarted) make sure your camera configurations are correct. Check that the files are being saved with the correct names and file sizes (nb and nr for nessi blue and nessi red, 128Mb for 256x256 ROI 1000 frames unsigned 16-bit). If the file sizes are off, you need to go to 'save as' and save a file as the desired file type, after that all autosaved files will be the that same file type (unsigned vs signed, 16 vs 32 bit fits). It's a good idea to have the data directory up and watch the new files come in.

- Data collection can easily yield 300-400 Gb/night (typical is around 100+). A kinetic series of 1000 full-frame images is 4Gb (for each camera, 32-bit fits). 1,000 frames with ROI256x256 (speckle mode) is 128Mb (for each camera, unsigned 16-bit fits). Be prepared to store a lot of data per run!

  Unsigned 16-bit: 2 bytes/pixel * number of pixels (256x256 or 1024x1024) * # of frames
  Signed 16-bit: 2 * 2 bytes/pixel * number of pixels (256x256 or 1024x1024) * # of frames
  Unsigned 32-bit: 4 bytes/pixel * number of pixels (256x256 or 1024x1024) * # of frames
  Signed 32-bit: 2 * 4 bytes/pixel * number of pixels (256x256 or 1024x1024) * # of frames

Choosing an EM gain



Upper plot shows the departure from linearity for EM gain=1 at ~12,000 counts.
Lower plot shows where that break from linearity is for various EM gain settings.

EM gain	Saturation level (counts)
1	12,000
2	21,000
3	35,000
4	45,000
5	60,000
>5	65,000

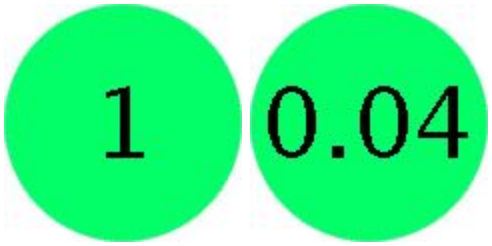
For EM gain >5, limited by ADC 16 bit-limit/saturation at 65,000 counts

Scripts

These scripts replicate human input in the Andor Solis GUI

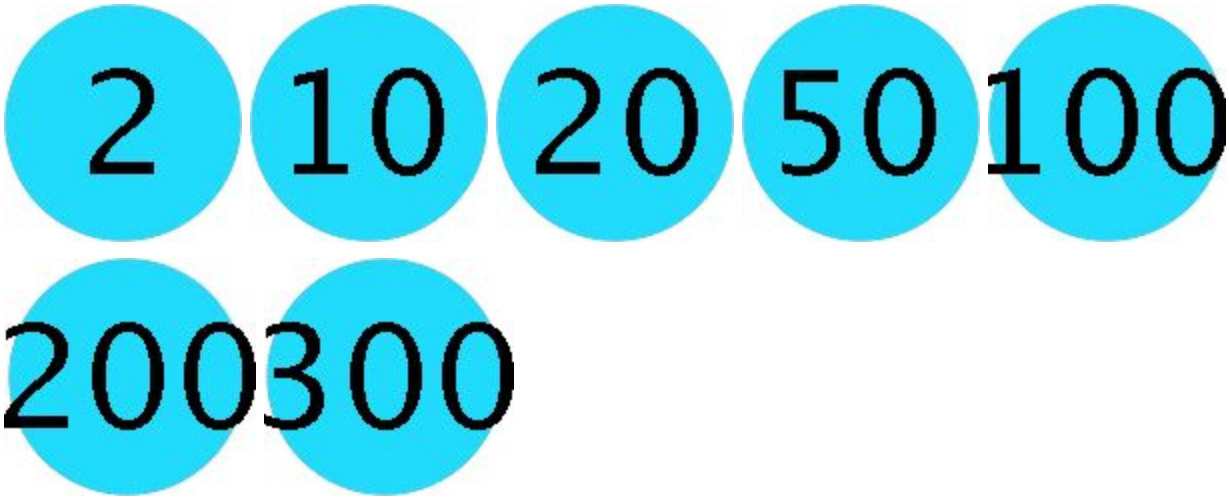
Change exposure time

These buttons stop the video (if playing), then set the exposure time to either 1 second or 40 ms



Change gain

These buttons stop the video (if playing), then change the gain to either 2,10,20,50,100-1000 (in 100 increments) and then start the video

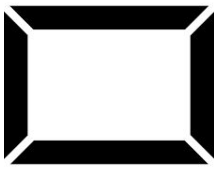


Display

This button stops the video (if running) then changes the ROI to full frame (1024x1024) and starts the video display. It does this for both cameras.

This button just starts the video running for both cameras.

ROI / binning

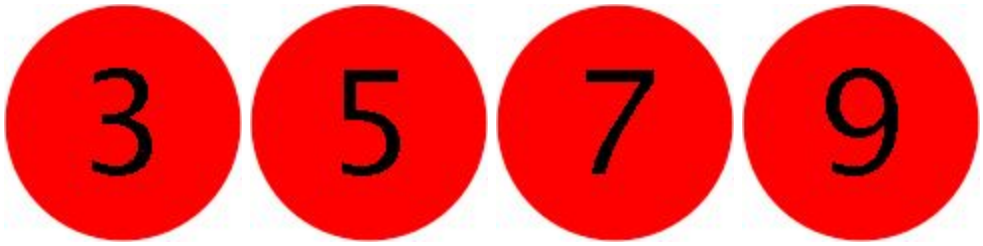


This button stops the video (if running) and opens the ROI / binning tab in the camera software. It then selects the 256x256 ROI and does the same for the second camera. After this screen is pulled up for both cameras the script is complete and the user can drag the ROI to the star position and click “ok” for both cameras.

Record Data

Starts the record sequence for both cameras.

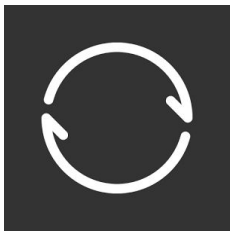
The numbered buttons repeat the sequence (based on a wait time) 3, 5, 7, or 9 times. At the end of a repeated sequence a popup window notifies the operator that the sequence is complete. Do not interrupt the sequence before the popup is shown, there may be several seconds between recording starts again (this is a buffer to give the data time to be saved). If there is an error and you want to restart the sequence: Right click on the Windows start button, select task manager, scroll until you find the record sequence process, right click on it and click “End task”. Then you can abort the record in Andor Solis. Note: you will probably have to reset the file numbering in auto-save.



Syncing the data

Data is saved in “C:\data” on ghost.
This may be mounted as a network drive.

Resilio sync is depreciated, replaced by Syncthing
~~Also, Resilio sync automatically runs in the system tray~~



~~This program uses bittorrent to sync two or more drives. The data directory on ghost has been added to sync. To sync the data to your machine, download and install sync (getsync.com, available on any platform). After installing sync on your machine, on ghost open sync and right click on the data directory. Click on “Copy read only Key”, this goes to your clipboard, or you can email it to yourself as a link. On your machine, open sync, click on the down arrow to the right of “Add Folder” then “Enter a key or link”. Enter the key you copied. This will then ask you to pick where you want the data directory synced to. After this is done you should start receiving the data.~~

~~Bandwidth:~~

~~To limit the sync bandwidth, click on the gear icon in your local copy of sync, then go to “Preferences” > “Advanced”. Here you can limit the bandwidth.~~

File syncing:

https://syncthing.net/

runs on any platform, you need to just share the device ID and set the folder
https://docs.syncthing.net/intro/getting-started.html

Starting up WIYN/queue software:

1. on local computer:

ssh -X wiyn@ivory (password=Gi#ra55E)

2. on ivory:

cli -c bone (new CLI window should pop up)

3. in CLI window:

clias> source local.tcl
clias> source speckle.tcl

4. on ivory:

ssh -X wiyn@moby

5. on moby:

record_spkl_time.pl &

To set up, add a *unique* string for each PI (e.g., Howell16B)
Check the boxes to make the PIs for the current queue active.

Viewing/downloading speckle time stats:

http://www-kpno.kpno.noao.edu/cgi-bin/kpno-misc/get_speckle_times.pl

Slewing to target

In clias on ivory:
“ldstar H (or HR) ####”
Should display “coords loaded for”

“Slew” slews the telescope to the loaded coords

Setting the clock

We want the clock set to UT. Accurate time is best, especially for a light curve.
Windows doesn’t make setting time easy. The “Change” button in the Time & Language section of the Settings utility doesn’t really work, but with ghost behind a firewall, this

window is where you can turn off the timeserver lookups.

To set time, click “Additional date, time, & regional settings” near the bottom of this window. This brings up a new window. Click the “Set the time and date” link. This brings up a window with a clock. Click the “Change date and time…” button. This brings up another window with a clock and below it a fill-out box where you can set the time to seconds (to match the observatory’s time). Also set a time zone that doesn’t use daylight savings time, e.g., the UT is available as a time zone.

It appears the the clock on the “new” ghost is ~5 seconds fast per day.