

Kitt Peak → longitude = 7h 26m 28s W, latitude = 31° 57.2' N



**WIYN**  
0.9 M OBSERVATORY

## Start-up Check List and Handy Hints for the WIYN 0.9m

Koopmann & O'Donoghue, 4/7/2011

Updated by Durbala & Koopmann, 10/27/2016

Last updated by RIT folk, 1/6/2020

HDI:  
0.43 arcsec/pixel  
FOV 29' X 29'  
Saturation at 30000

Wind limit: 45 mph  
Humidity limit: 90%

### Useful websites/info:

KPNO General Overview: [http://www.noao.edu/kpno/observer\\_info.shtml](http://www.noao.edu/kpno/observer_info.shtml)

Weather: [http://www-kpno.kpno.noao.edu/Info/Mtn\\_Weather/](http://www-kpno.kpno.noao.edu/Info/Mtn_Weather/)

<http://observatories.hodar.com/kittpeak/index.html>

[http://rammb.cira.colostate.edu/ramsdis/online/goes-west\\_goes-east.asp](http://rammb.cira.colostate.edu/ramsdis/online/goes-west_goes-east.asp)

To start 4-m weather monitor, type in xterm on Sage computer:

vncviewer 4m-weather

password: (see whiteboard)

Astronomical Sky Calendar: <http://www.briancasey.org/artifacts/astro/skycalendar.cgi>

Hourly Airmass Table: <http://www.briancasey.org/artifacts/astro/airmass.cgi>

Beginning of the night -- Arrive at dome at least 2.5 hours before sunset

### 1) Walk through computer room

- i) Check preload voltages on 2<sup>nd</sup> rack to bottom left - voltage indicators should have + values
- ii) Check dry air ... at least one dial should have positive value

### 2) Check dome for obstructions, make sure platform is down & cables are hanging freely without tangling

### 3) In control room, on the Olive computer, start ACE/TCS by double clicking on the ACE icon

Log in as "Observer", password: (see whiteboard)

### 4) On the Emerald computer, set up data directory (you can start Step 5, preparing telescope for dome flats, at the same time)

- i) open web browser → HDI Command Shell

**observer Durbala** (only the first time)

Type "help" for help on different commands

"abort" & "cancel" don't work

**comment** filter

**object** name

**etime** 60 (time in seconds)

**etype** object/dark/bias/flat (for both dome flats & sky flats – include type in comments)

**oneamp ur** (only the first time, only if not already in one amp mode)

- ii) open a terminal window

- create a folder where you want to store all the data: /data/data1/durbala/20140423/

(e.g. `mkdir 20140423 in /data/data1/durbala/yyyymmdd`)

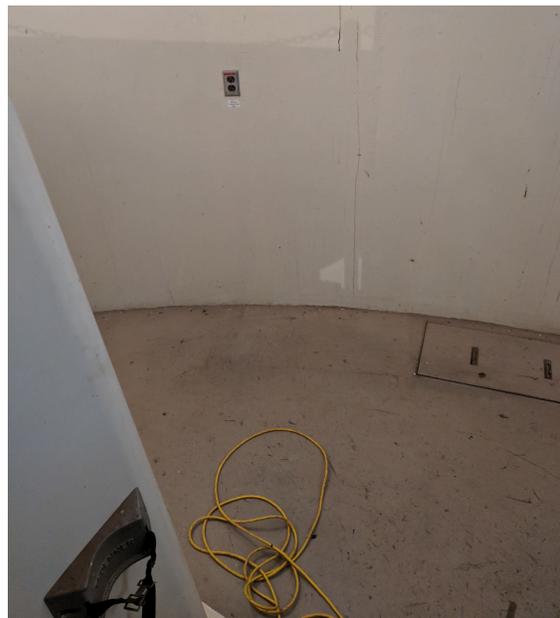
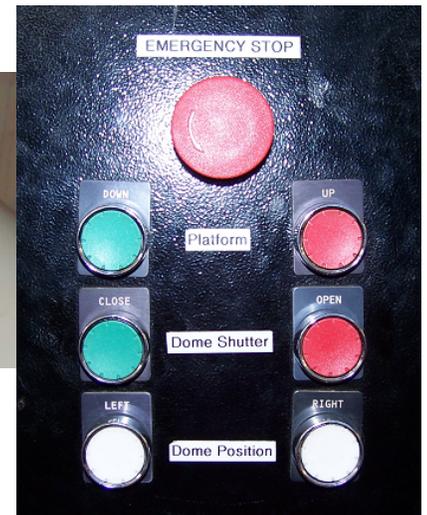
- run the command **hdi\_follow.pl savedir=/data/data1/durbala/20140423/**

(this transfers the images as they are completed)

- iii) **double-click on ds9 icon to start ds9 window**
- iv) **to create a window for IRAF**, in Terminal window, type
  - `xgterm &`
  - in the new xgterm window, start IRAF by typing `(note you must be in home directory to start IRAF)`
  - `cl` **(note that this may hang – wait a few minutes)**
  - in the xgterm (IRAF) window:
    - `cd /data/data1/durbala/20140423` (yyyymmdd) (all data files are here)
- v) **Set up telemetry: Socket Server should run by default on Emerald when you log in (may be behind main screen)**
  - If Socket Server is not running: (kill socket server on Olive first)**
    - On **Emerald computer**: double-click on “Original ACE” icon
    - On **Olive computer**: Network tab → Stop Socket Server
    - On **Olive computer**: Network tab → Start Socket Server
  - Try again if it doesn’t work the first time.

**5) To prepare for Dome Flats: Take Mirror Cover off & Dome Flat Park**

- i) In control room, on **ACE/TCS: Dome** → “Home”. Confirm dome movement by listening to noises, & by monitoring the “Dome Azimuth” box in the ACE display. Position is roughly 74 degrees.
- ii) click **Telescope** → “Mirror Cover Park” → **Move telescope**”
- iii) When slew is finished, **go into dome**, **raise platform**, use ladder and **take cover off**
- iv) **Stow cover (blue holder on South side of platform), stow ladder (north of telescope, along railing), and move platform back down**
- v) **Start rear dome exhaust fan if Rel Humidity < 70%** (plug it in)  
Note, must walk through room to reach plug.



- vi) **turn on the power strip for camera** by the northern platform screw pillar. Red LED will light to indicate it is on.



- vii) **turn off dome lights** Then go back to control room
- viii) On **ACE/TCS** click **“Reset”** in the Safety Interlock window
- ix) On **ACE/TCS** click **Telescope** → **“Dome Flat Park”** → **”Park”** → **”Move Telescope”**

## 6) Take Biases

In computer room, on Emerald, in the browser’s **“HDI Command Shell”** tab:

- (i) **etype b** (Note: you can use semicolon to write all commands on same line, e.g. etype b; object bias)  
**object bias**  
**etime 0.001** (otherwise it will put 60 seconds in the fits header)  
**comment bias**  
**go 5** → take five exposures to clear the chip
- (ii) **check the counts** in ds9:  
**rfits filename.fits 1 bias** (filename will be something like c6771t0099\*b00.fits)  
**disp bias[1] 1**  
**imexam** → click l, c (line or column) or **imstat bias[1]**  
(counts should be around 2900 - 3000)
- (iii) **go 11** (if everything goes well)

## 7) Take Dome Flats

First, go into dome and **make sure the telescope is pointing at the reflective white spot**; use handpaddle to move dome if necessary.

Go back into control room.

i) In browser's "**HDI Command Shell**" tab:

**etype f**

**object dome flat**

**etime 4** (use 4 for R & 14 for all H $\alpha$ )\*

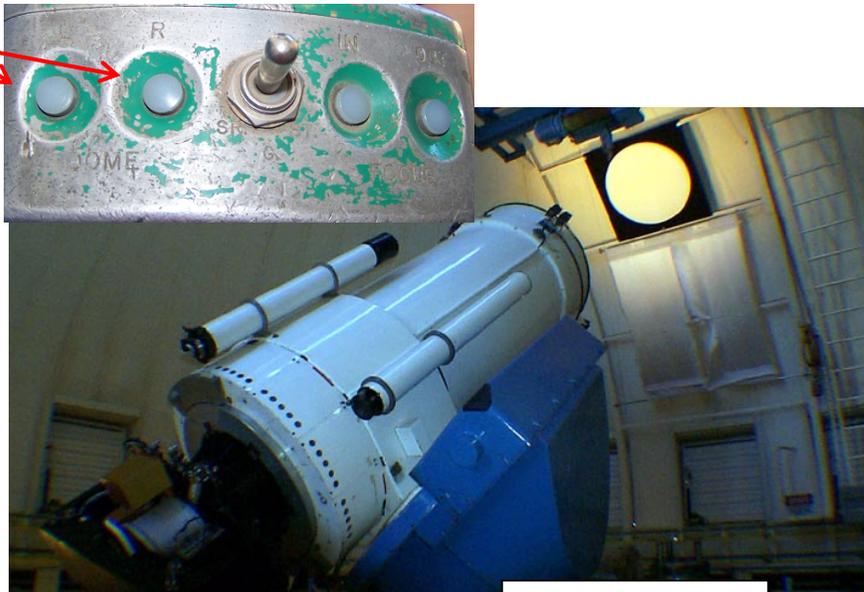
**comment dome flat 6660 ha8** (name of the filter)

ii) **change filter in Auxiliary Instruments window**

(if not present, choose Instruments → Filter Wheel) on Olive computer:

**Wheel 1: R & Wheel 2: Empty** -- if you observe R

**Wheel 1: Empty & Wheel 2: 6660** -- if you observe ha



H $\alpha$ filter names:	
6620	ha4
6660	ha8
6700	ha12
6740	ha16

iii) **Turn on lamps**

- in Computer room, on first rack, "Flat Field Illumination Control"

- **Flip switch THEN turn dial to appropriate setting** (reverse to turn off)

- Use following settings for flats

\*Lamps can be variable. Check the counts before doing a **go 10** sequence (e.g., if counts are too low, increase the

Filter	Lamp	Lamp Setting	Exposure Time
All H $\alpha$	High Intensity	50%	12 sec
R, r	Low Intensity	100%	4 sec
V	Low Intensity	100%	7 sec
I	Low Intensity	100%	4 sec
B	Low Intensity	100%	12 sec?
U	High Intensity	100%	25 sec

iv) Back in control room, **go** → to do one exposure

To check the counts use (in cl window): (counts should be below 30000)

**rfits name.fits 1 flat**

**displ flat 1** → look at the image to see if it's symmetric

**imexam** → click l, c (line or column) near center → look at the profile to see if it's flat

**If the image is not symmetric and the profile has a gradient make sure the telescope is perfectly aligned with the screen. Move dome either to the left or to the right. Donuts should be circular if well-aligned.**

v) **go 10** (if everything is well)

vi) **Change to other lamp** (turn dial, then flip switch to turn off) and **run flats for other filter(s)**.

vii) **Turn off lamps**

viii) Enjoy dinner! Plan to return to open dome half an hour before sky flats, i.e. ~45 min before sunset

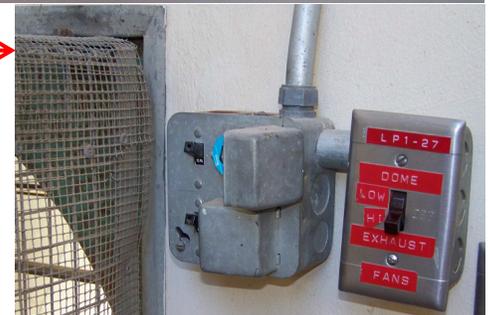
## 8) Preparing for the night (before sky flats)

**NOTE: See Appendix for wind/exhaust fan instructions!**

- i) In control room, put telescope in **Dome Flat Position** (if it's not already)
- ii) in dome, **plug in exhaust fan** at outlet CPI-21  
to do so, walk through room at top of main stairs and out door on far side south side of dome
- iii) **turn dome vents (circuit breaker) ON**  
make sure center toggle switch is ON together & open  
turn dome vents (ckt. breaker) OFF



- iv) **turn dome exhaust fans ON** (top of stairs) →
- v) **open dome** (see step 5, same panel as platform raise/lower)
- vi) **turn off dome lights** →



- vii) **turn loading dock fan ON** (across from the N<sub>2</sub> tanker - downstairs) →



## 9) Take Sky Flats (be prepared to start 5 minutes before sunset)

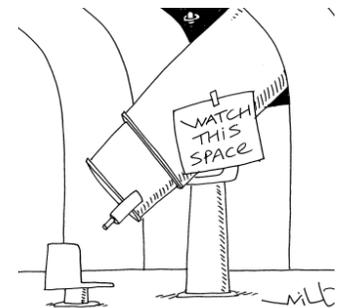
- i) In control room, Go to HA -2, Dec of 31 (pointing east) 6 minutes before sunset  
(OR go to HA 0, Dec of 25 or HA 2, Dec of 25 -- to go westward if it's getting dark)  
**turn on tracking right before starting (Telescope → "Track Enable")**
- ii) On Olive computer **ACE/TCS Dome → "Autodome"**
- iii) On Emerald computer in the browser's "HDI Command Shell" tab:
  - a) **etype f**
  - b) **object sky flat**

- c) **etime 1**
- d) **comment sky flat ha8** (name of the filter)
- e) **go** (start H $\alpha$ , try 1 second exposures)
- f) **check counts**  
aim for 25,000, don't go over 30,000  
- get at least 15,000 if possible
- g) aim for AT LEAST 3 good exposures in each filter (do 4 or 5)  
- **offset -120 RA** (westward) between exposures (ACE)  
- do only 2 H $\alpha$  filters/night if possible  
- don't need to come back to the original position when you start the next filter, just keep moving westward
- h) then do R (start around 1 sec)
- i) to check the counts use (in cl window):  
**imstat filename.fits[1]**  
**rfits filename.fits 1 skyflat**  
**displ skyflat[1] 1**  
**imexam** → click l, c (line or column profile)

If doing morning sky flats, follow same procedure but do R, then H $\alpha$ .

## 10) Check Pointing (about 25-30 minutes after sunset) & check focus + seeing

- i) In control room, choose a Bright Star from the catalogue on Olive ACE
  - a) Right click anywhere on the screen: → "Open Existing Catalog" → select **ACE\_BSC5.cat**
  - b) **click on RA column, choose star near zenith**
    - RA  $\approx$  LST, Dec  $\approx$  31° (latitude)
    - 5<sup>th</sup> magnitude star
    - **Double-click to select** → "Go to" to move telescope
- ii) Take a 10 sec test exposure (in R filter):  
**etype o**  
**object pointing**  
**etime 10**  
**comment pointing**  
**go**
- iii) **Check that star is near center of HDI** -- if not, find offset & enter before each exposure
- iv) **Check focus** (see step 11) & seeing (see step 13i)



## 11) Focus (in the same field as pointing) → could look at stars from pointing field

If temperature is similar to the preceding evening, hopefully the focus will be close. **Start with the focus equal to the initial value from the night before.** (If it is the first night, check the board to see if the previous observer wrote the starting focus.) Examine the pointing fields (as well as any sky flats that have stars) to check the focus. If not in focus, try adjusting on the fly. This can be done as the standard stars are observed.

**If focus is not close, you can run a focus sequence:**

- i) On ACE/TCS, **open focus control under "Telescope" pull-down menu** (if not already open)
- ii) **Decide what focus values to check. Start with the current setting**  
(current setting = the initial best value from the night before)

and determine 5-7 focus settings in steps of 50, e.g., 7 exposures with focus ranging from ~32500-32800

- iii) Set focus to starting point. Set jog+ to 50
- iv) Set etime to 10 seconds and write appropriate comment
- v) Enter 'go 7' to take a series of 7
- vi) As first exposure is reading out, jog focus
- vii) Repeat for 7 exposures
- viii) Examine images and determine best focus

Decide best focus, input in TCS, then Go to Focus ...

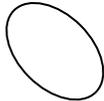
- a) after finding best focus run a Test exposure to test solution.

Adjust as necessary

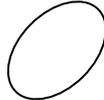
focus is perfect  
happy circle



make focus higher



make focus smaller



- b) In the browser

etype o

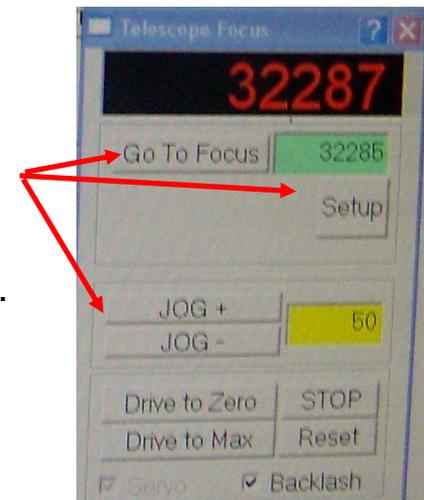
etime 10 (exposure time)

object focus

comment focus R

go

On Olive computer



When raising or lowering the focus use a minimum of 25.

Use displ and imexam ("r", "e") to display the image & measure the seeing (FWHM). Note you may need to run rfits on the image first. For Dr. Richmond's focus routine procedure, see appendix.

IF it's Photometric (no clouds...):

## 12) Observe Standards (if needed)

may be done in astronomical twilight beginning and end

can also be done in middle of night (adjust according to target schedule and airmass)

- i) 2-3 Landolt Standards, R only per night, at range of airmasses
- ii) 2-3 spectrophotometric standards in each filter per night
  - beginning of the night -- Do R before H $\alpha$  filters
  - end of the night -- Do H $\alpha$  before R filters
- iii) In the Browser tab:
  - etype o; etime 10; object star's name; comment R; go

Identify the stars in the field, check if they're saturated & the counts are < 30,000

Beginning of the night – do Landolt before spectrophotometric standards

End of the night - do spectrophotometric standards before Landolt

IF it's Photometric or not ... as long as you're open:

## 13) Observe Targets (Can start R in astronomical twilight)

- i) Point to target, confirm field, check focus & seeing
  - a) Write RA & Dec in ACE/TCS → slew telescope to your target;  
OFFSET RA -400 DEC 0 (in January 2020 but this may vary)

- b) do an exposure of appropriate length in R to **confirm field**:

On Emerald computer in the Browser's "HDI Command Shell" tab:

**etype o**

**object** *name of the galaxy*

**etime** 60

**comment** R

**go**

- c) **confirm field, use SDSS or Skyview to compare**  
(Skyview: north - up, east - left; Emerald: N - up, E - left after doing *invert X* in ds9)
- d) **check focus (see step 11) & seeing:**

**rfits** filename.fits 1 target

**displ** target[1] 1

**imexam**

click "e" → contour & click "r" → radial profile

**You can do steps i (b-d) while you search for guide star.**

- ii) **Start Guider**: (Guider can be started earlier!)

On Moss computer **set up Guider in MaxImDL**:

**Setup tab** - click **Connect** → **Cooler ON**

(Check setpoint; if cannot reach setpoint, click on **cooler**, and raise.

Pick a temperature so the cooler works no higher than 80%.)

**After Cooler is ON, wait about 5 minutes to click Track in step 13-iii!**

- iii) **Find a guide star**:

a) On Moss computer in **MaxImDL**:

- **Guide tab** → Check **Expose**, Exposure = 5 (or 1 depending on how bright the star is; can range from 1-10, better not to exceed 5-6 s) → **Start**

- Guide star automatically selected by Maxim. **Use cursor to find star in the image** according to pixel coordinates (x & y). If you prefer a different star, double-click on it.

- If guide star is faint, **can increase binning** – click Settings, then change binning to 3

- **Offset as necessary** if needed to find star:

(e.g., increase Dec to go northward, increase RA to go eastward)

**Offset Dec -10 or 10 (or RA -10 or 10) if you cannot find a guide star**

S      N                  W      E

(North is up & East is on the left on the Moss computer)

- **Track**, click on star (optional), then click **Start** (**Never Calibrate!**)

Note: You could change the focus by 200 if the guide star is out of focus, then **GO TO**

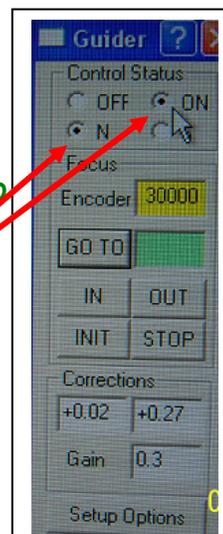
F=10000 (Camera 1 - N), F=17000 (Camera 2 - S) suggested, but 2015 values were different

- **Guide tab** → **Options** → check **Tracking Error Graph**

- b) On Olive computer, on **Guider** click correct camera then **ON**

(N is Camera 1, S is Camera 2)

The big picture on Moss will become tiny & will show only the star in the middle.



iv) **Do exposure** On Emerald computer in the browser's "HDI Command Shell" tab:

etype o  
 object *name of the galaxy*  
 etime 180 (180 s for R & 1200 for H $\alpha$ )  
 comment *filter*  
 go

v) **Do the other filter** -- repeat step ii-iv (You don't need to turn off the guider if you don't offset)

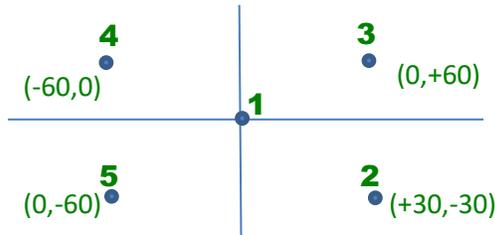
- decrease the Focus by 100-ha4, 88-ha8, 80-ha12, 110-ha16, when you go  
 from R to H $\alpha$ !!! → Go To Focus (on Olive)
- monitor focus & seeing & adjust focus if necessary (section 11-viii)

vi) **Turn the Guider OFF to offset to new dither or move to new target**

- On Olive computer, on **Guider** click **OFF**
- On Moss computer under "Guide" → click **STOP**
- Offset or move telescope, then repeat steps ii-v for new field

### NEW Dither pattern - HDI (or adjust for needs of field, e.g., avoid bright stars):

Dither 1	0	0
Dither 2	+30	-30
Dither 3	0	+60
Dither 4	-60	0
Dither 5	0	-60



14) **Disconnect guider at the end of targets:** Setup tab → Cooler OFF → Disconnect

15) **Take the remaining standards - OK in astronomical twilight.**

16) Fill out **night log** at end of every night

At the end of the observing run (e.g., 5-day observing run) fill out the **Observing Run Evaluation**

Both forms found at: <http://www.noao.edu/0.9m/observe/observing.html>

Username: wiyn09m Password: (look on the whiteboard)

17) If 4m doesn't call, call them & **report before leaving.**

18) **Shut Down (no morning sky flats)**

- i) **Dome → Homedome** (UNLESS windscreen is up, then Dome → Azimuth → 270)
- ii) **Move telescope to "Mirror Cover Park"**
- iii) **Turn off dome fans** (including rear fan)
- iv) **Close dome shutter, lower windscreen**
- v) **Close vents if open**
- vi) **Place cover back on telescope**
- vii) **Reset the Safety Interlock in ACE**
- viii) **Move telescope to "Zenith Park"**
- ix) **Move dome to "Home" if necessary**
- x) **Log off ACE (User tab)**
- xi) **Turn off the lights** as you leave!  
 Dream of photometric skies!!



**19) Take Darks → this can be left running after shutdown**

In Browser's "HDI Command Shell" tab:

**etype d; object dark**

**etime 1200**

**comment dark** (counts should be around 2900 - 3000)

**go 11**

**20) Transfer the data**

i) open Filezilla

host: emerald username: 36inch password: (see whiteboard)

Go to /data/data1/durbala/20140423

or ii) `scp -r 36inch@emerald:/data/data1/durbala/20140423 .`

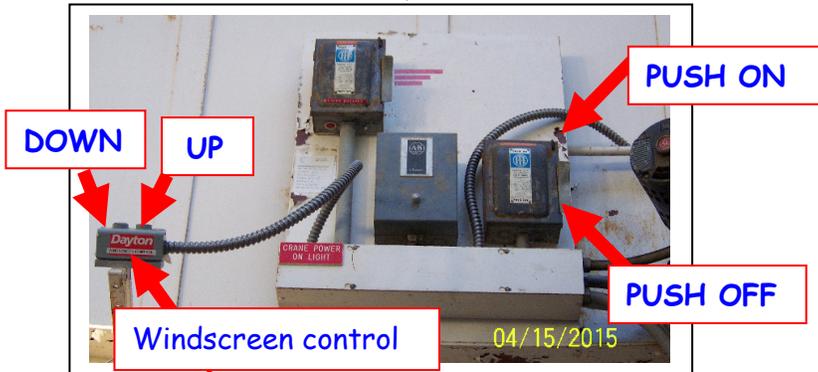
or iii) `rsync -av -e ssh 36inch@emerald:/data/data1/durbala/20140423 .`

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## Appendix

- **Wind Instructions:** < 10 mph -- open all vents  
 10 - 15 mph -- open all vents half way (or open every other vent)  
 > 20 mph -- close all vents  
 > 25 mph - raise wind screen →  
 45 mph -- close the dome

Dome azimuth 270°



- **Exhaust Fans:** no wind -- exhaust fans on High  
 < 15 mph -- exhaust fans on low  
 > 20 mph -- exhaust fans OFF

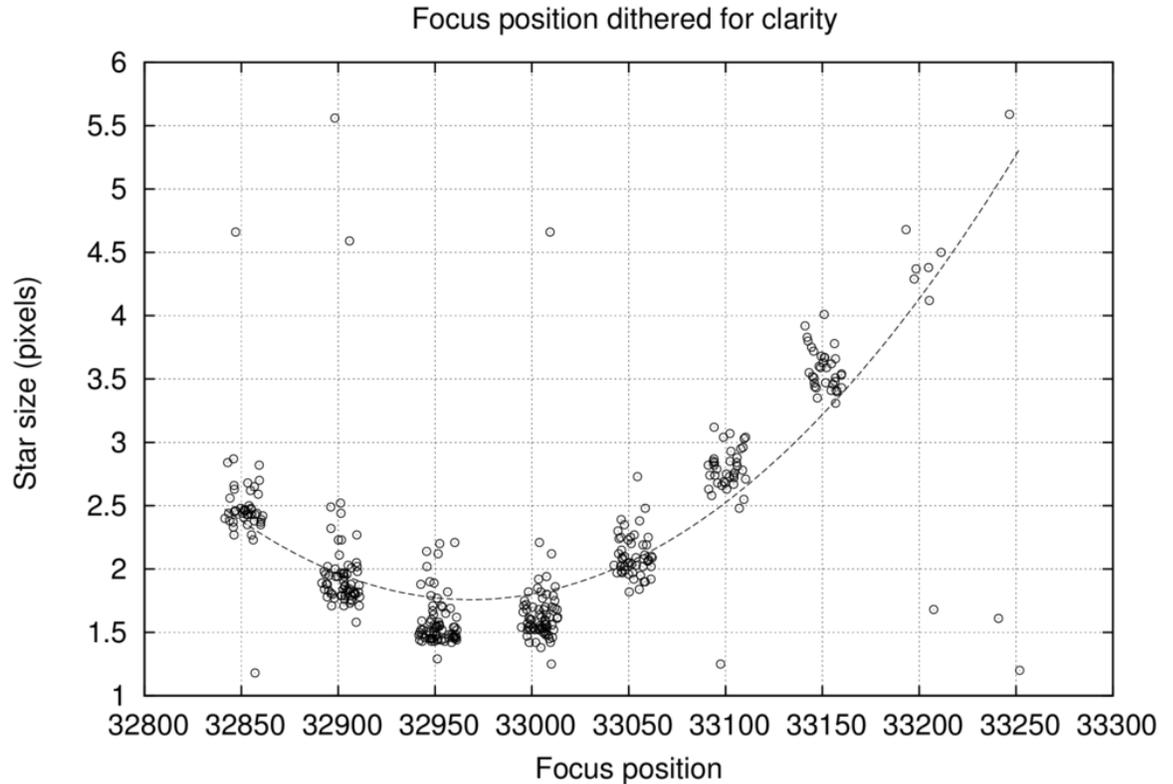


- **Michael Richmond's focus procedure:** see [http://spiff.rit.edu/richmond/wiyn/technotes/tech\\_16/tech\\_16.html](http://spiff.rit.edu/richmond/wiyn/technotes/tech_16/tech_16.html) for full details
  1. make sure you are logged into **emerald** as the user **36inch**.
  2. Next, type these two commands, one at a time, in the terminal window(s) you plan to use for all subsequent steps.  
**bash**  
**heainit**
  3. make sure that all the focus images are in your current directory. You can read [this section of the HDI manual](#) to learn about the scripts
    - **hdi\_follow.pl**, which will copy images from the HDI computer to emerald as they are acquired
    - **hdi\_grab\_set.pl**, which will copy a set of images taken between a specified starting date-and-time and a specified ending date-and-time
  4. run the **do\_focus.pl** script. Usage is  
**do\_focus.pl image1 image2 image3 ....**

First, since these are raw HDI images -- meaning that they have multiple FITS extensions -- the script first converts each file into a "simple FITS image." These simplified images will be used for processing, and then (by default) deleted afterwards.

Second, the script tries to detect stars in each image and measure the properties of those stars. It prints one line per image as it goes, describing the number of stars detected and the "size" of each one (details on "size" in a moment)

The script will produce a graph like this:



The script will also display a few lines of text in the terminal window:

```
find_best_focus: best_foc 32634 size 2.23
You may refit using only a range of focus values. Example: 32200 32600
or enter Q to quit
```

The numbers here are a guess at the best focus position, based on a parabolic fit to the "star size" as a function of focus position. Where does it get the numbers?

- the "focus position" comes from the FITS header of each image
  - the "star size" is based on the median value of the "sizes" for all stars detected in an image. The "size" is the intensity-weighted second moment of pixels belonging to the star, after subtracting a local sky value. The units of this "size" are pixels, not arcseconds. It is NOT a Full-Width-at-Half-Maximum.
5. So, at this point, if you are happy, you can simply type "Q" in the terminal window, and the script will terminate. Enter your new focus position and you're done.

However, you may notice that some of the data on the graph are bogus; in the example above, for example, the measurements for images with focus position greater than 33200 look pretty sketchy. If you wish, you may type a pair of numbers, specifying a new range of focus positions to be used in the parabolic fit.

e.g. **32800 33170** and press the return key

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### Other Useful websites:

- [http://www-kpno.kpno.noao.edu/observer\\_info.shtml](http://www-kpno.kpno.noao.edu/observer_info.shtml) : LTO reports, WYIN night logs, Know Your Observing Assistants (under *Site and Weather Information*) & Observing Assistant Calendar (under *Calendars*).
- SDSS: <http://skyserver.sdss3.org/dr9/en/tools/chart/navi.asp>
- Skyview: <http://skyview.gsfc.nasa.gov/cgi-bin/query.pl>
- Printable log sheets: <http://www.noao.edu/0.9m/observe/observing.html> (WIYN 0.9 m website at bottom of page)

Phone numbers: Observing room WIYN 0.9m telescope → 520-318-8637  
 Observing room 4m telescope → 520-318-8620  
 WIYN 0.9m house - 520-318-8714

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### Troubleshooting:

- If Emerald computer restarts and some of the images are not transferred, use:  
**hdi\_grab.pl 2014-04-25 02:20:00** -- in order to copy all images taken more recently than UT2014 April 24 02:20:00.
- If IRAF crashes on Emerald: **ctrl C**, then type **flpr** twice in the cl window.
- If telescope drive refuses to move, cycle power on breaker, to left on wall of computer room (immediately after entrance)
- Lightning shutdown procedure is posted on bulletin board
- If Emerald crashes (e.g., arrive in control room to find it showing "power-saving" mode), cycle power on Emerald box in computer room. Emerald is black computer on bottom shelf. **DO NOT CYCLE POWER** on HDI server, which is second flat server on second shelf (on top in 2016)
- If staff tests HDI, they may leave it in 4-amp mode. Use command "oneamp ur" to get back to 1 amp.
- Sometimes the dome is unresponsive. Wait ~20 minutes and it usually returns to normal.

### October 2016 - Note from Flynn:

- So, we are using the old Emerald that was in use as of a few years ago.
- **All icons you need are in the lower left corner of the desktop.**
- **The socket server was tricky to get working, but it is working.** The catch is that when you start up Emerald's side ("Original ACE" icon), you will NOT see the telemetry displayed to the screen even though it is transferring into the headers.
- Since this is the old Emerald machine, it is a bit prone to crashing (this is why we replaced it), so just be aware you may have to deal with this. **The box for this pc is the mid-sized black tower on the bottom of the far computer rack in case of needing a hard shutdown/restart.**