# How to Use the Harken Observatory



Harken Observatory at the Pewaukee Public Library May 10<sup>th</sup>, 2025



If our eyes worked like an electronic camera ... this is what M31 would look like compared to the Moon!

In reality, its not likely you would even see a starlike core of this galaxy at dawn or dusk.

#### Fun fact - the Andromeda galaxy might be the furthest object you will ever see with your naked eye!

M31 spans about 220,000 light-years across and contains approximately one trillion stars. The galaxy is approximately 2.54 million light-years away from Earth and has an apparent magnitude of 3.4, making it visible to the naked eye under dark skies. But your eyes are not very sensitive to light. To them it appears as a diffuse, oval shape, with a slightly brighter center that may resemble a star. Even looking through a telescope you would not see much more than a fuzzy oval. Nothing like the incredible arrangement of swirling arms of stars and dust lanes that it actually is.





Still, human eyes are pretty incredible. The iris changes size to adjust to the relative brightness of a situation. In a very dark sky location, the human eye can see stars down to the 5th or 6th magnitude. But our eyes can only work over a limited range at a time. Our iris will narrow and our optical nerves respond to brighter light. They only handle a 100:1 ratio of brightest to darkest at any one time. It takes time for our eyes to "adjust" to the darkness.

We cannot perceive tiny differences or perform "time exposures" with our eyes.





Our electronic cameras are very different than our eyes! The camera sensor responds to individual photons of light and adds up the tiny amounts of charge that they deposit in each pixel of the electronic device.

A huge advantage of electronic imaging like this is that multiple frames of the image may be combined together by addition. As long as the numbers added were not saturated, the sum total will be an accurate "charge count" for the combined exposure time. Total exposure time can be extended to hours and days if desired.

We never "look through the eyepiece" of our telescope. It is setup for electronic imaging to make pictures to show all.

# Electronic imaging reveals incredible details in the sky above.

Multiple images will need to be aligned/registered pixel by pixel if an accurate summation is to be made. Camera sensors have their own sources of "noise" that need to be dealt with.

The telescope and optics may have subtle defects that previously would have gone unnoticed by the human eye. Calibration techniques are necessary to achieve the best image quality.

A final step, perhaps more art than science, is that the beauty of the objects needs to be displayed or printed in such a way that our limited eye CAN discern the details in form and color as the astrophotographer tried to convey.



### YOU can learn to use the equipment here to study celestial objects in the night sky!

Our scope is a 5" refractor Stellarvue SVA-130, it gathers about 400 times more light than the smaller human eye.

**IUE** 

STELLAR

Abovysound

TRIPLET

STELLAW VCK 130MMH44

#### ZWO ASI2600MC PRO Color Camera with 2-stage thermoelectric cooling



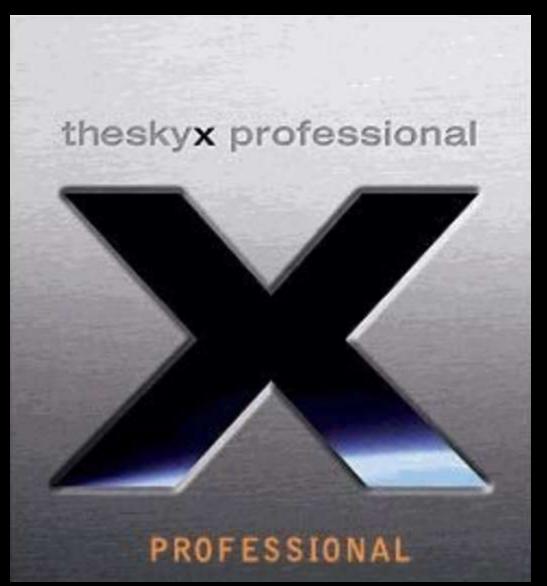
#### FOV 88.6 x 59.2 arc-min (about 1.5 x 1.0 degrees)

Sensor	SONY IMX571 CMOS	
Diagonal	28.3mm	
Resolution	26 Mega Pixels 6248*4176	
Pixel Size	3.76µm	
Image area	23.5*15.7mm	
Max FPS at full resolution	3.51FPS	
Shutter	Rolling shutter	
Exposure Range	32µs-2000s	
Read Noise	1.0-3.3e	
QE peak	Above 80% (OSC) Around 91%(mono)	
Full well	50ke	
ADC	16bit	

# Paramount MYT

unsurpassed pointing and tracking performance

#### Software Bisque (software publisher)



ASCOM (Astronomy <u>Common Object Model</u>) a set of API specifications for astronomical devices and applications



The SkyX software integrates control of all of the observatory components using ASCOM standard drivers running on a 64-bit Windows computer.

# **Getting Prepared!**

When you come to the Harken Observatory, you will use the telescope and camera to gather images of your choice. There are step-by-step procedures for opening the observatory dome, starting up the equipment and commanding the telescope to point to your desired target in the sky.

But what will you image? Prior to coming to the observatory, you might wish to do a bit of planning. Is the object of interest in the current night-time sky? When does it come up over the eastern horizon? Is it high enough over the horizon to be above the trees and buildings of Pewaukee? Is it now so late that your desired object has fallen *below* the western horizon?

There are many resources available to you on your PC or phone to simulate what is up in the night sky with you. Popular free planetarium software includes Stellarium, KStars, and Cartes du Ciel. Stellarium is known for its well-structured interface and wide use. KStars is another free, open-source option with a strong focus on accuracy and simulation of the night sky. Cartes du Ciel is another popular option available on various platforms.

Each RAW image file that you will take requires about 51 megabytes in storage space! You will be going home with Gigabytes of data! You will need to have your own, personal flash drive/memory stick to take your image data home with you for image processing. Free image processing software will be demonstrated in this presentation.

There is an observatory start-up and shut down checklist that has existed for a few years. We will endeavor to expand that to an illustrated "operations manual" over the next few months. Pictures of the equipment and screen shots of the observatory computer screen for each step will be helpful. At this point in time, club members all have some familiarity with these processes. A club member who is also a library key holder must be present to use the equipment.

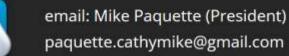
We don't currently have a defined process for scheduling use of the observatory. Appointments will be necessary to ensure that a trained club member/key holder is available. Of course, the weather needs to be cooperative!

We are organized as the he Pewaukee Astronomy Club (<u>http://pewaukeeastro.com</u>). Its free for anyone to join. The club meets the second Monday of each month (next meeting is May 12<sup>th</sup>) at 6:30PM in the conference room of the library. Contact Mike Paquette at the email address below.



#### Pewaukee Astronomy Club Pewaukee Public Library 210 Main Street Pewaukee, WI 53072





paquette.cathymike@gmail.com

# Steps to Take Images (after physical opening of the dome)

The computer, display, keyboard and mouse are located within a rolling wooden cabinet that is parked beneath the spiral staircase that leads to the dome. Observing sessions are typically done from the Pewaukee public library multipurpose room which is handicapped accessible. The spiral staircase and the ship's ladder to the dome are not handicap accessible. There is no reason why anyone who wants to use the observatory would need to make those climbs. Keyholders are expected to facilitate the public in this regard.

Roll the cabinet out from storage into the multipurpose room. Plug the power cable into the nearest library electrical outlet. Be careful not to "run-over" the data cables that attached to the cabinet. The cabinet must be unlocked by a keyholder.

Turn on the computer and wait for it to startup. Find and open the powerUSB app on the computer desktop. Click on the checkboxes labelled Outlet 2 and Outlet 3.

Outlet 2 turns on a service light up in the dome that is useful to see if the telescope is pointed at the open dome shutter.

Outlet 3 turns on power to the telescope mount, cameras, dome control and communication hardware that is in the dome. This must be turned on before starting The SkyX program.



# Steps to Take Images (continued)

Next startup the iSPY app on the desktop. front of the telescope facing the dome.



This program will connect a web camera that is attached to the With the service light on, this camera will show that the telescope

and dome are rotating when they should be and that the telescope s pointing out of the dome through the open shutter.



You may size and drag ths window as you wish.

Remember to turn Outlet 2 (service light) OFF again before you image.

You are now ready to startup the SkyX program. Click on the desktop icon.



# Startup the Telescope using SkyX

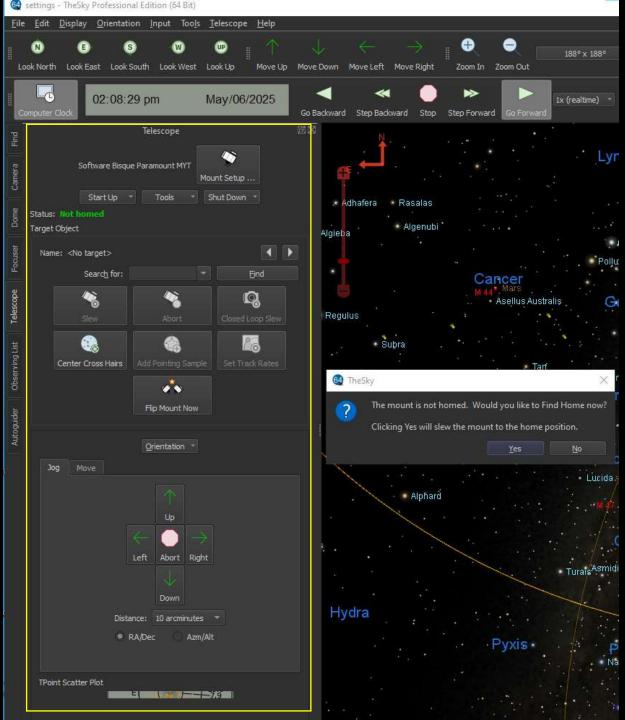
The upper left corner of the SkyX desktop is shown here  $-\rightarrow$ There are tabs down the left side of the screen. Locate the tab labeled "Telescope" and click on it. Under it, you will see three tabs: Startup, Tools and Shutdown The enclosed area will change to show telescope items. At this point, the scope is not yet connected. Click the "Startup" button.

The status is probably "Not Connected". We need to connect the software to the telescope, so click on Telescope > Connect.

After a few seconds, status should change to "Connected".

Another message will likely pop up saying that the telescope is not "homed" and ask if you want to find home. Answer yes to this question. This directs the telescope mount to move to its internal, factory calibrated mechanical position. The mount contains a GPS receiver and is capable of pointing to any visible object in the sky after that.

After finding home position, status will read as "Tracking at sidereal rate" (appropriate for stellar objects)

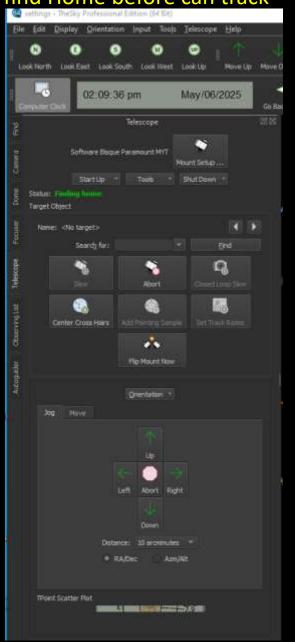


#### Telescope *not* connected

	Sky Professional Ed lay Qrientation		elescope Help	
٥	0 S	۲	🐵 🛔 个 sok Up Move U	, Ho
Curros Tar Curda	02:07:31 p	im M	lay/06/2025	۵.
Ē	1	lescope	100	
	Software Baque Par	Mo	ant Setup hut Down <	
Status:				
Nome: <1	to target>		1	Þ
	Search for:	-	Erd	
	100	Abert	Q Doore Linco Serve	
Batus III Farget Object Name: -1 Cente	Constituen An		Test Death Reflec	
		Rp Maunt Now		
109		Plentation +		
	¢ Left	Up Abort Down		
	Distance RAD	10 arcnew,tes ec Aam/Alt		
TPokit Sca	tter Plot Etheral 1			

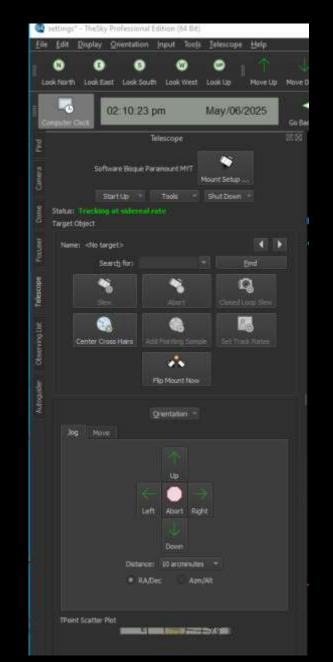
under Start Up: Telescope > Connect

#### Telescope is connected but needs to find Home before can track



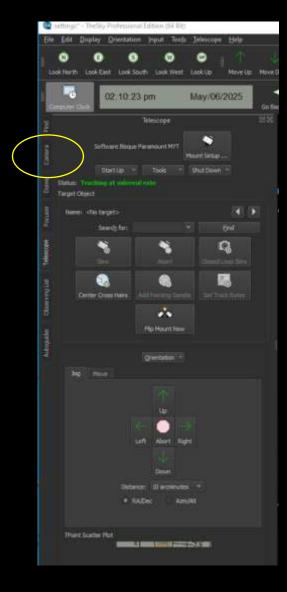
#### under Start Up: Telescope > Home

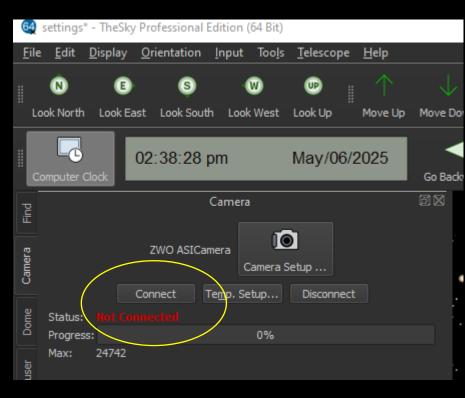
#### Telescope is connected and tracking



#### Ready for object selection

# Connect the Camera to the SkyX software





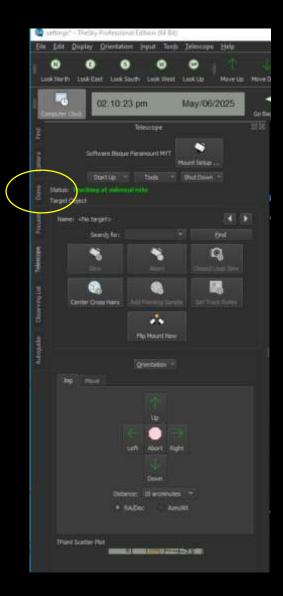
Click on "Connect"

Camera Status will change to Connected

Our ZWO ASI2600MC is a thermoelectrically cooled camera. The temperature of the imaging sensor will be regulated to about 0 degrees C automatically. Actual temperature values will be included in the FITS image file header.

#### Click on the Camera Tab

# Connect the Dome to the SkyX software



Click on the Dome Tab

64 s	ettings* - TheSky Profession	nal Edition	(64 Bit)			
<u>F</u> ile	<u>E</u> dit <u>D</u> isplay <u>O</u> rientati	on <u>I</u> nput	Too <u>l</u> s	<u>T</u> elescope	<u>H</u> elp	
	0 0 0					
	k North Look East Look S	South Loo	k West	Look Up	Move Up	Mo
II Cor	D2:12:2	28 pm		May/06/	2025	Go
Find		Dome				Ð(
Dome Camera	ASCC Connect Status: Ready Azimuth: 83.00 Slit state: Antoniom	M Dome	Come Set	up Disconn	ect	
Focuser	Go To			Find Ho	me	
۳.	Open Dome			Close Do	ome	
cope	Park Dome			Unpark D	iome	
Telescope	Sync Dome			Abort		
	Show Log					
erving List	Result: <sup>(Connecting' complete</sup>	e. No error.	Error =			

e Do

Bad

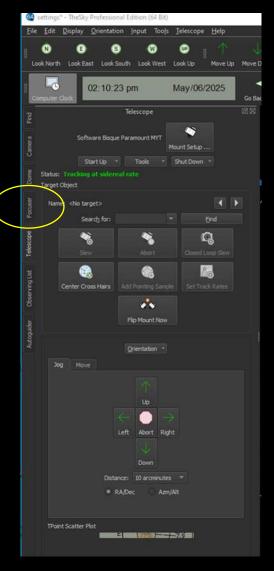
Click on Connect, wait for status to change to Ready. If Azimuth is *not showing* 83.0, you should click on "Find Home". (may take a while as the dome may rotate up to 360 deg)

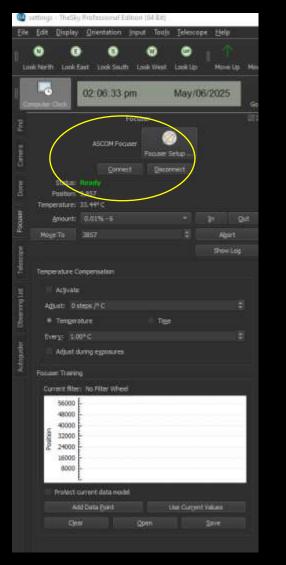
64 :	settings*	- TheSk	y Prof	essional	Edition	(64 Bit)					
<u>F</u> ile	<u>E</u> dit [	<u>D</u> isplay	<u>O</u> rie	ntation	<u>I</u> nput	Too <u>l</u> s	<u>T</u> eles	cope	<u>H</u> elp		
	N	E	Þ	S		W	UP				
Lo	ok North	Look E	ast I	Look Sou	th Loo	ok West	Look U	P	Move Up	Mov	e Do
	mputer Cl	ock	02:1	15:27	pm		May	/06/2	2025	Gol	<b>Back</b>
Find					Dome	2				đ	3
Camera				ASCOM [		Dome Se	tup				
<u> </u>		С	onnect				Dis	sconne	ect		
Dome	Status: Azimuth:										ų
e	Slit state:										A
Focuser		G	о То					i			
<b></b>		Op	en Don	ne		Close Dome					
cope		Pa	rk Dom	e							
Telescope		Sync	c Dome			Abort					
		Sh	now Log	g							
Observing List		Finding h = 0.	nome' c	omplete.	No erro	or. Error					
ē	After No ei					Statu	ıs sh	oul	ld be	Rea	dy

Need to check that dome is sync'd to scope -RB

### Connect the Focuser to the SkyX software

The observatory has computer controlled, automated focusing and a motor to adjust the focus knob (Microtouch)





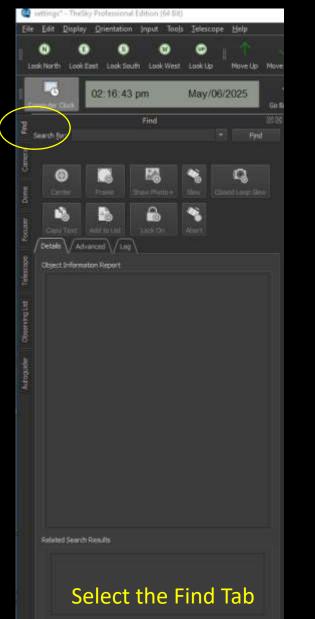
Click on "Connect"

The Focuser Status will change to Ready and the position of the focuser will be displayed.

The process of starting an automated focus adjustment will be described later. Generally, for a given observing session this only needs to be done once at the beginning of your session. The focus of the telescope on stellar objects is not dependent on the object as much as the temperature of the telescope. Focus will be different in the summer than on a cold winter's night when the length of the scope has contracted a fraction of a millimeter.

#### Click on the Focuser Tab

# Ready to Select an Object to Image – Find by Name



One way to find an object is to enter its *name* (e.g. Aldebaran) in the *Search For* text input. You can enter the names of comets, minor planets, and auxiliary objects that appear in any active Sky Database. You do not have to know the correct spelling. The Find command shows you matching names.

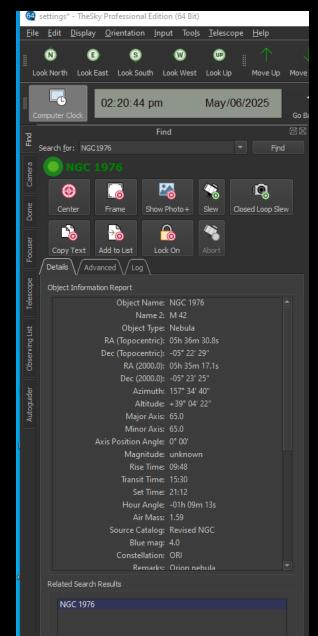


# Ready to Select an Object to Image – Advanced Searches

Finding by Object Type

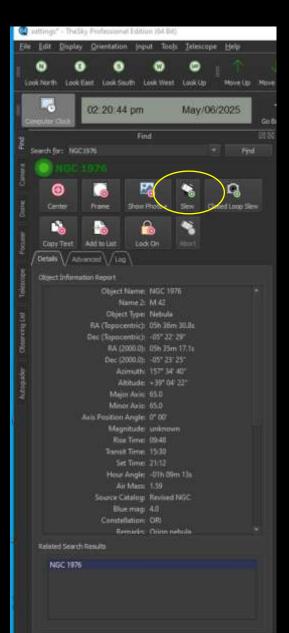
Objects are categorized by type in the Find by Name or Catalog Number list on the advanced tab of the Find window. Example: type NGC1976 or M42 in search for line... and click on Find.

Object Type	Catalog/Cross Reference	Description					
Non-stellar Objects		Lists databases of non-stellar objects.					
	Caldwell	Caldwell Catalog objects.					
	Common Names	Names of common non-stellar objects.					
	Herschel	Herschel 400 catalog.					
	IC	Index Catalog.					
	Lorenzin	Tomm Lorenzin Catalog.					
	Messier	Messier Catalog.					
	NGC	New General Catalogue.					
	PGC	Principal Catalog of Galaxies.					
	PGC cross reference	Cross references to the Principal Catalog of Galaxies.					
	PLN	Planetary Nebulae.					
	SAC*	Saguaro Astronomy Club Deep Space Object catalog.					

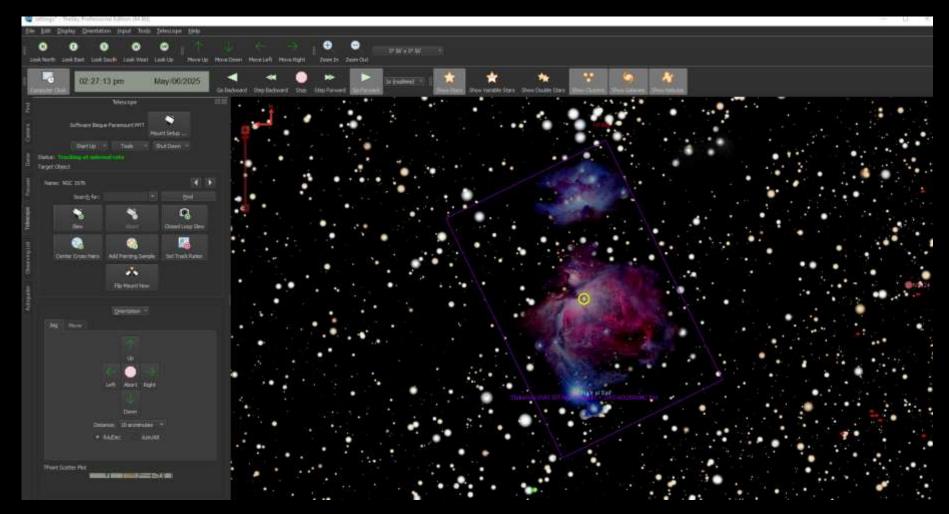


Found object info is displayed. Confirm it is visible now.

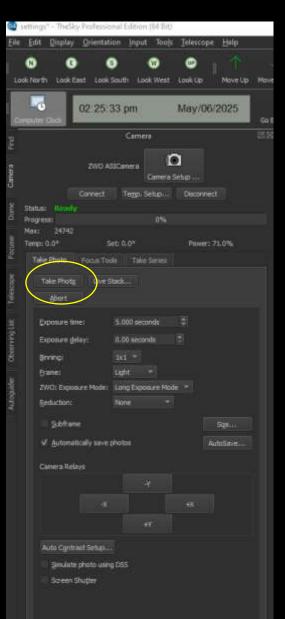
# Target Selected – tell the mount to point the telescope there



Click on the "Slew" button and the telescope will point to the catalog coordinates. The skychart of the program will update as the telescope is moving. The pointer on the chart will show where the telescope is looking. The mouse wheel allows one to zoom out and in. When zoomed in far enough, a box representing the camera field of vew will be displayed.



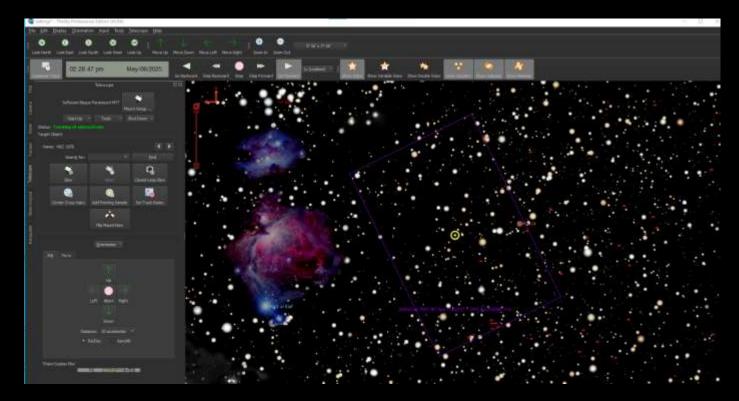
# Target Located – Take a trial camera exposure to confirm and prepare for optimal focusing



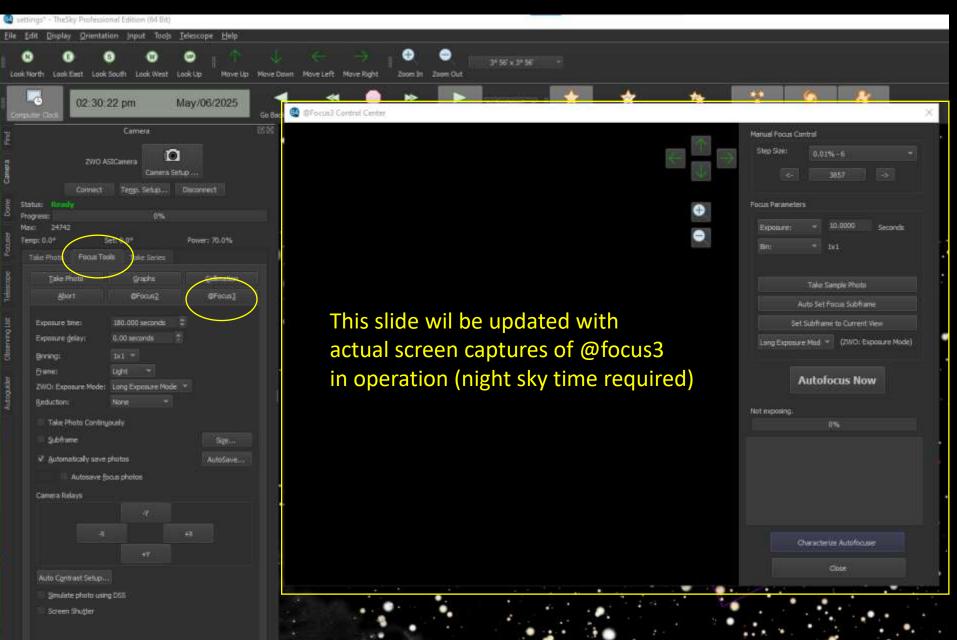
Back on the Camera Tab, on the Take Photo sub-tab, enter an appropriate short exposure time. Make sure the frame type is set to "Light". 1x1 Binning is normal. Click on "Take Photo".

The progress bar will fill during the exposure duration. Shortly after that an image will be shown. Is it what you want to image? Is the focus good? This may be a good time to perform an auto-focus operation. SkyX can automatically make the stars as sharp as possible, but it might be confused when looking at a diffuse nebula such as NGC1976. I often nudge the scope a little to the side to a star-only frame for the focus step.

Use the "jog" buttons on the Telescope tab and additional trial exposures until only stars are visible.



#### Using @focus3 on the Camera Tab -> Focus Tools sub-tab opens @focus3 Control Center Window



Select an exposure time for focus images and take a Sample Photo

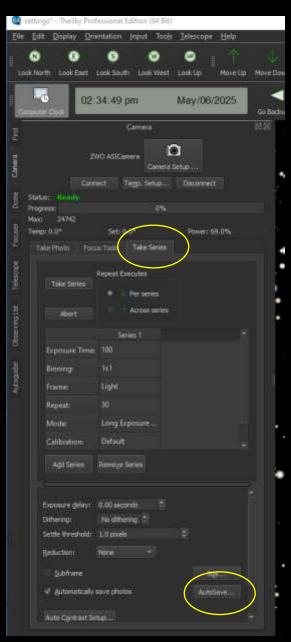
Click Auto Set Focus Subframe

**Click Autofocus Now** 

This process will take some time to complete. A range of focus settings will run and sharpness will be optimized.

Allow this process to complete. The best focus setting will be retained and used going forward.

# Take your Final Target Images – Take Series and AutoSave the Image Files



"Take Series" is the third tab under the Camera Window. Multiple series may be defined.

<u>Exposure Time</u> – it is important that nothing of interest is saturated. For brighter objects (like the moon) this time may be milliseconds. 180 seconds is a practical max in Pewaukee.

Binning – 1x1 means every pixel is used, 2x2 means 4 pixels are combined to one

<u>Frame type</u> – Light used for images, Bias, Dark, Flat are used to tag calibration frames. The type flag is stored in FITS header. Programs like SIRIL can read these and automatically process the calibration data and apply calibrations to the Light frames.

<u>Repeat count</u> – How many times to take the same frame. For Light frames, your total exposure time is <u>Repeat count</u> x <u>Exposure Time</u>. (40) three minute exposures is 120 minutes. For Dark, Bias and Flat frames where the goal is to characterize the noise <u>statistics</u>, 30 frames is sufficient. More on calibrations later.

The AutoSave button is used to setup how the frames are to be named and where they are to be save. Our convention is to put all images under the PAC folder, under a calendar date sub-folder. File names are automatically created from the Object name and Time.

To start the Series, click on "Take Series" button under "Repeat Executes".

### Take your Calibration Frames – Take Series and AutoSave the Calibration Files

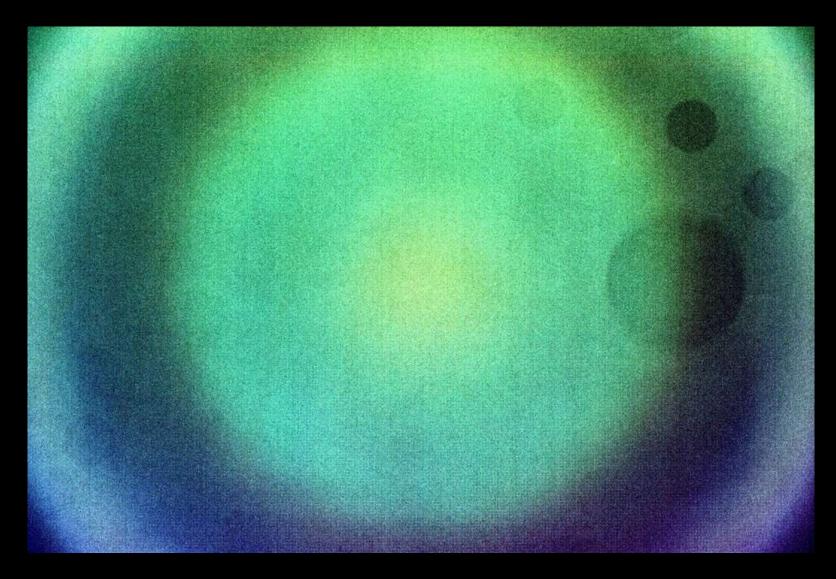
You now have waited for your image series to complete. Depending on what you are doing, it may take hours! Hopefully, no clouds have drifted across your target in the sky. Don't be surprised if a satellite or airplane has painted a bright line across some of your frames. If the dome is setup to slave to the telescope tracking correctly, it should have moved to keep the slot aligned. You are getting sleepy and thinking about skipping those calibration steps.....

#### DON'T! They are necessary!

Flats and Bias Frames don't take too much time to complete. Flats correct for "dust devils" which can change day by day. Dark frames correct for temperature and time dependent noise from the camera chip. It helps that our camera is temperature regulated. Your dark exposure time must match the light exposure times. Compromise in number of repeats only if you must. Standardized exposure times will increase the probability that a recent, useable dark frames could be found on the computer.

In the same way that you setup a Series of Light frames in "Take Series", setup and execute a series of 30 repeats for Darks, Bias and Flats. A fixture has been created to attach to the front of the telescope to facilitate calibrations. It is a "lens cap" to which a flat light source has been added on the inside surface facing the lens. When powered, it produces a very uniform illumination for the flat field frame creation. Flat exposure time using it is only 0.1 second.

# Flat Calibrations are the most important as these defects are the most serious



Vignetting is a gradual darkening towards the edges and corners of the image, considerably different from the center of the image. It is caused by limitations of the telescope lens/optical path.

The dark circles are caused by dust specs and sometimes are referred to as dust devils. It is almost impossible to remove all the dust that may fall on any of the optical surfaces.

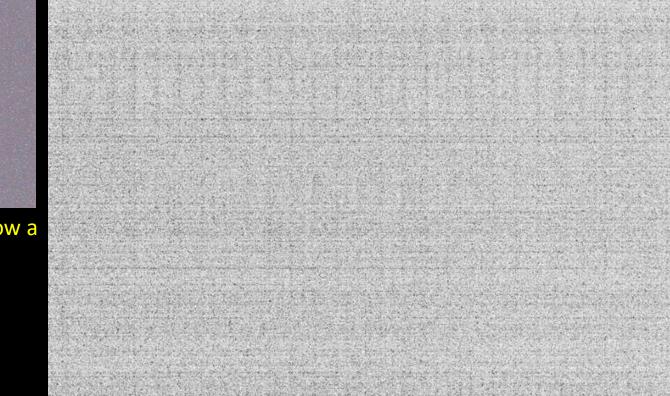
Creating a master flat and applying it to the lights will get rid of these artifacts.

# Dark Noise and Bias (Readout) Noise are less noticeable, but detract from the image.



Above: Example of "Dark" Noise – exaggerated here to show a grey baseline "average" level that could cover up faint details. Also see "hot pixels" that could be mistaken for stars. This noise is a function of temperature and time.

Below: Example of "Bias" Noise – exaggerated here to show spatially periodic structure. It is caused by the electronic readout of the imaging chip. Readout noise has been greatly reduced in today's newer devices.



# Newly built calibration tool fits on scope in place of the lens cap of the telescope.

STELLARVU



Electroluminescent panel mounted inside of a replacement dust cover. Silver box is its power supply. Turn it on by plugging in 12VDC power cord coming from the Paramount accessory outlet into the silver box.

Power is connected for flat generation, un-plugged for darks and biases.

Handle this tool carefully!

When gathering Light images remove it from the front of the telescope as you would remove the lens cap.

It may be carefully stored in its bag.

Original telescope dust cover is permanently replaced



Galaxy S2

Taking the Bias, Flats and Dark Series may be done even before the sky is dark enough to image. Just take them with the calibration fixture in place (but unplugged for darks and biases). You must have decided what your exposure times will be for imaging later and stick to that for the darks.

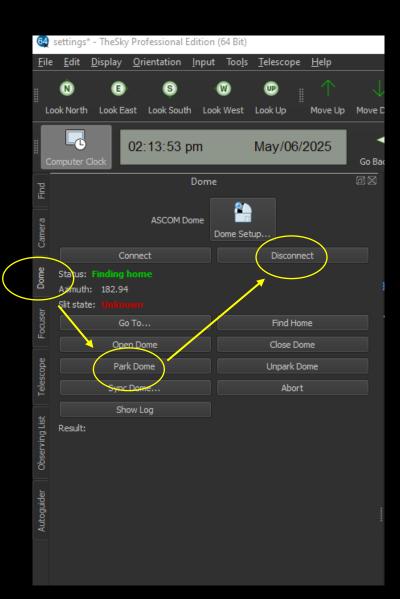
For flats, just plug in the 12VDC aux power into the calibration fixture. Set the exposure time for the flats series to 0.100 seconds and complete the Take Series operation.

If you properly set the frame type flag for each calibration series they will be properly identified in the FITS header for image processing. Be sure to copy your image and calibration data from the specific PAC folder you had created to your USB flash drive to take home. Our computer runs the Windows operating system, so the standard "File Explorer" utility will be used. I usually open two windows – one for the PAC folder and another for the USB drive. Drag and drop folder or groups of files from one to the other.

Test Tests They may				- D			- 0 ×	📑 : 😥 📑 • 1 Sept nimmape				
A B B Attante					* 14 1	Ra Etimophy - X	Com + Intert all	Heres Dour New		andan • 😥 🔒 then any arms • 😥 🖓 the	Seren at	
ingine a	Depende Mar	then.	land.		Hotolbert Logy		instay investoredian	Ante Gall Case Ante di Dele statutes	Marri Capi Debis Romanne Marrie Cal	Property of Hotel		
+ - + This PC + Windows 10	(HD)D) + HM longer + May/OrdDD + oplications			+ , 6 / 2 Sectorione	.Clark	6% complete и к	aler .	Optomi	Organize In	r Open	Salect	
# Darit score	Theme	Rest saidled	San San		+ + -		Report May 20 2021	+ + D - D/ECENTED + #	stronowy + Renys actic images +			- D
	TSI 000000 SXXarFwhatte											- 0
Debter	* Til committeet walls	0.000001000004		611	Desitop	Speed Kill MD/v	Ods resilied	N	There	Date (condition)	Ture	Gie
4 Torritante	<ul> <li>Cal consistence field in</li> </ul>	100000000000000			& Desembando			# Quick acces				
W. Borwenn.	In The concount reaction for	AND DURING A COMPANY		07-10	5442 C 11 C 12	Name (0000005FadField)9	WERE LEVEL	Decitura .	aikides:	5/6/0252/02794	Wite Solder	
all Policies	# fui commitmetantre	1/10/02/15/11/44		an air	Elocativents	Terre termativing: About 1 minute and 30 seconds			Contraction of the second			
Supplication Trac	Pail 000000110 Harf land the			w 18.	Pictures	terrareneousling \$7.02.75.08		Downam				
DisC Proger	THE COODDOT TO PLAT WALFIN	TAURUS CLUM		vi var	Application/ite	D COMPANY OF CARES		E Documents				
meging System Andres	7,0 00000000 Plaining Plaining			ee sa		Tever fittalla		ET Fatures				
March 19-1021	Full condition (PharPalace)	2010/22/1411098		0.98	PLC images	Children arrive 1						
Machiner K. ev. 11FW	Fail 000000000 Plant Pant Ph	WHERE A PERMIT		oo ka	📙 imaging System	n Pasfees	40 F	ApplicationFilm				
	Tyl commol/start-starts Tyl commol/start-analis	1/102002-1-01444			March-15-2023			FAC Images				
il man	Tai commune Parties in	Waller Lerred		er 18	the second se	20122 C		I I Imaging System Profiles				
Condition	Tui contracto Puerfectore	AND DO NOT		00.40	Netbers;1,1							
	Pui coordiga Pui ran Pui	Internet Services		97-10 00.40	E snes			March 10-2025				
Carlos Ca	PS 00000000 Hariwarts			00 FB				MasDarpe_C.en. 11Fill				
Jahonse .	Tu consider Flat was to			NO. NO.	CoeDrag			teript				
	The community of the Part of the			00 Mg	CO Sto PC							
	52 00000001125wA.re	WHIRE FORM		10.11	and and the			CitysDrive				
	Fal 00000002.0w/s /m	window with And		on ka	E EMEC BITH ID.							
	Tai constituti tava m	WHERE A REPORT		00.10	ethonemy			De PC				
	Tai commutation na	0.00003100444		w 11				DVTC BITS CO.				
	Cui communa thais de	to manager 1.44 shad			antio_pe			A DESCRIPTION OF A DESC				
	Till constitute own ris	WINESS MARK		00.40	thores details			APROVENY				
	Cui 10000007 Due rie	Information to sea made		er vez				El word				
	The common transmit			10.13	Recupirean Acg	e i la state a						
	Full constant Dwelling			09.02	Focusienas 108			22 milli Contrad_driver				
	The community of the	warmen conversa		ee kil	frame united			10 Metwork				
	Tyl community parts of			10 HB				a contraction of the second se				
f-basis (				itil at	images							
				100 °								

# Finishing your Observing Session – shutting down the equipment again

Parking and Disconnecting the Dome



- Go back to the Dome tab on the left.
- Click on Park Dome (the dome should move to Home at Azimuth 83 degrees)
- When complete, click on Disconnect

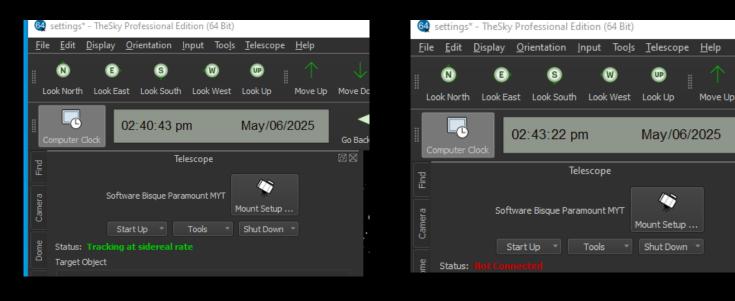
The home position is the proper place for the dome tie-downs to be applied to secure the dome from strong winds. Swing the hook end of the turnbuckle into the dome bracket and tighten as far as it will go (CCW rotation tightens) Secure both the North and South tie downs.

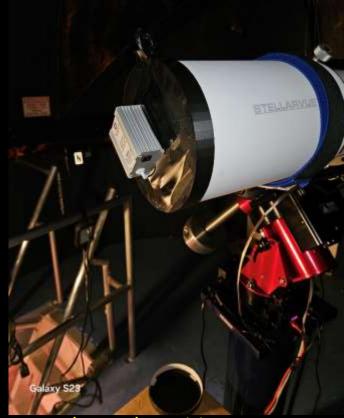




#### Close and re-latch the shutter on the dome

# Finishing your Observing Session – shutting down the equipment again Parking and Disconnecting the Telescope





- Go back to the Telescope window
- Under the Shutdown tab, select "Park Telescope". The telescope mount will move to the Park position.
- When complete, click on Disconnect (also under the Shutdown tab)

In the Park position, the front of the telescope is pointed to the West with a horizontal orientation. It is now very easy to re-apply the calibration fixture/lens cap to the telescope. If you still haven't taken your calibration frames, now would be a good time to do them!

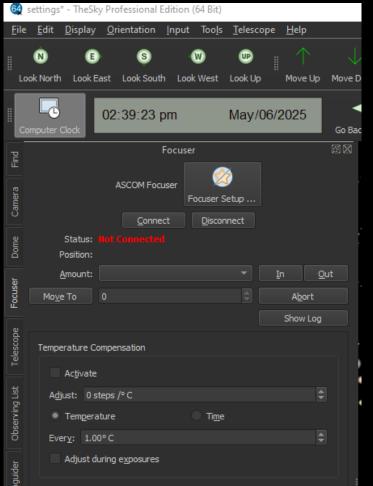
Go Ba

# Finishing your Observing Session – shutting down the equipment again (continued) Disconnecting the Camera and Focuser

64	settings*	- TheSky	Professional	Edition (	(64 Bit)				
<u>F</u> ile	_		<u>O</u> rientation			<u>T</u> elescop	pe	<u>H</u> elp	
	N	E	S		W	UP			
	ook North	Look Ea	ast Look Sout	h Look	West	Look Up		Move Up	Move Do
	Computer Cl		02:38:28	pm		May/0	6/2	025	Go Back
Find				Camera					đX
<u> </u>			ZWO ASICa		I				
Camera			ZWO ASICA		Camera S	etup			
<u> </u>			Connect	Temp. Se	etup	Disconn	ect		
Dome	Status:								
å	Progress	:			0%				
lser	Max:	24742							

- Open the Camera window
- Click on Disconnect

#### Status should change to Not Connected



- Open the Focuser window
- Click on Disconnect

#### Status should change to Not Connected

# Finishing your Observing Session – shutting down the equipment again (final steps)

Double check !

- Did your file save/transfer to your flash drive finish? You may have gigabytes of data!
  - Are all the files that you need on your flash drive? All Objects you imaged? Calibrations?
- Properly "Eject" your flash drive from Windows and Physically Remove It to take it with you
- On the SkyX desktop, Select Exit under the File Tab to Shutdown the program
- Close the iSPY camera app by clicking the "X" in the upper Right corner of its window
- Turn off the power to scope/dome by removing the checks next to Outlet 2 and Outlet 3 in the PowerUSB
- Close the PowerUSB app by clicking the "X" in the upper Right corner of its window

There should be no open windows left on the Desktop.

Shutdown the Windows PC

LCD screen goes blank and Fans stop making noise

Lock up the cabinet and re-store it under the spiral staircase

Make sure that the cabinet is atleast 3 feet away from the library circuit panels

# Image Processing Using SIRIL – what to do with your image data now!

SIRIL is a powerful and versatile software package for astrophotography image processing. This free astrophotography processing software is capable of supporting the entire workflow, from stacking data to managing background gradients and color saturations afterwards. A good introduction may be found here: <u>https://www.skyatnightmagazine.com/astrophotography/siril-stacking</u> by Iain Todd Published: August 14, 2024 at 4:35 am BBC Sky at Night Magazine Where to get SIRIL software?

- 1) May be included in this distribution disk/flash drive
- 2) At this URL on the web: https://siril.org/tutorials/tuto-scripts/
- 3) https://siril.readthedocs.io/en/stable/Installation.html



Siril is an astronomical image processing tool

#### Installation

Each version of Siril are distributed for the 3 most common platforms (Windows, MacOS, GNU / Linux) and can be downloaded on the Siril website. https://siril.org/download/

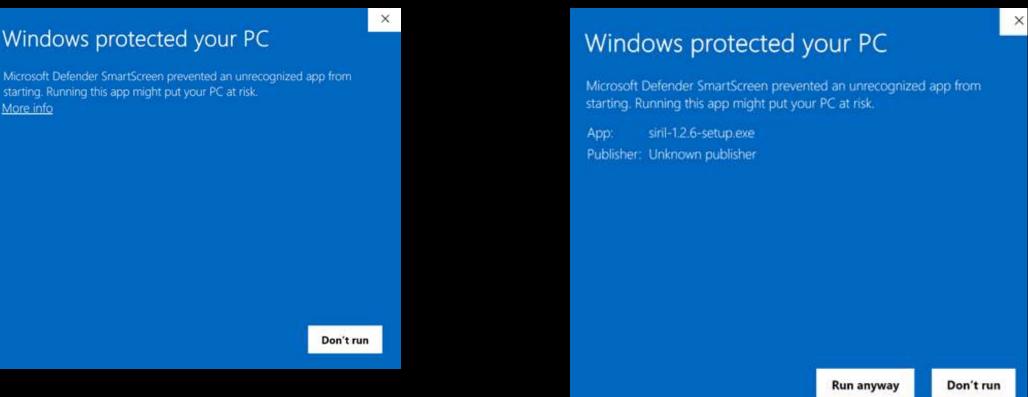
I have downloaded the latest version that was available: Siril 1.2.6 January 22, 2025. I downloaded the release for 64-bit Windows. MacOS and Linux builds are available.

Siril is free, but if you like it and would like too make a donation towards its future enhancements, follow ths link: Siril - Donate https://siril.org/donate/?dl=1

Look for the downloaded file in your Windows downloads folder. To install, double click on the exe file.

"C:\.....\Downloads\siril-1.2.6-setup.exe"

# You may see a Windows Security Message ... click More info,



Then allow it to Run Anyway

Say YES to allow it to run on the next screen.....

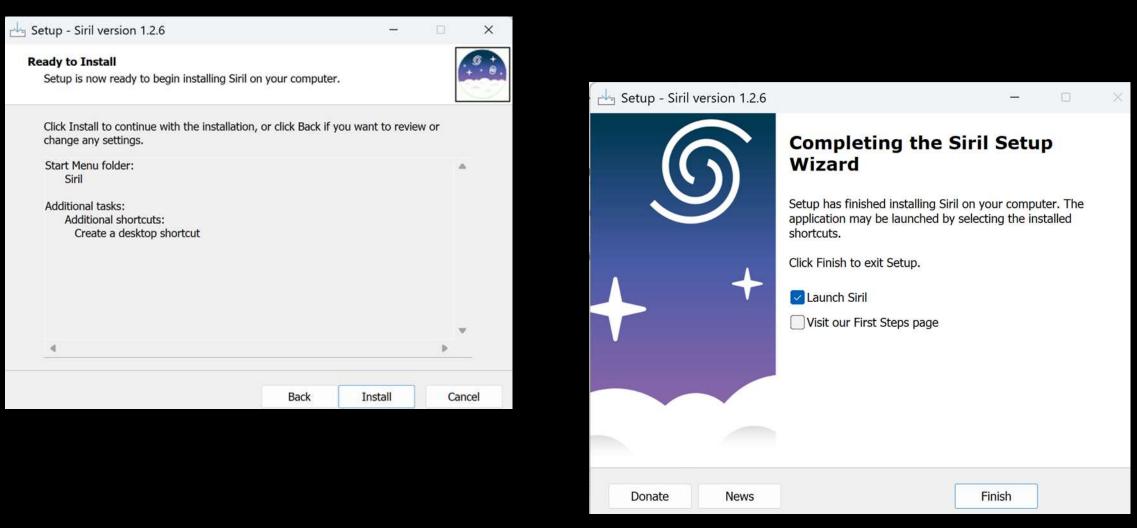
I selected English as my language choice.....

Accept the GNU General Public License Agreement..... Next

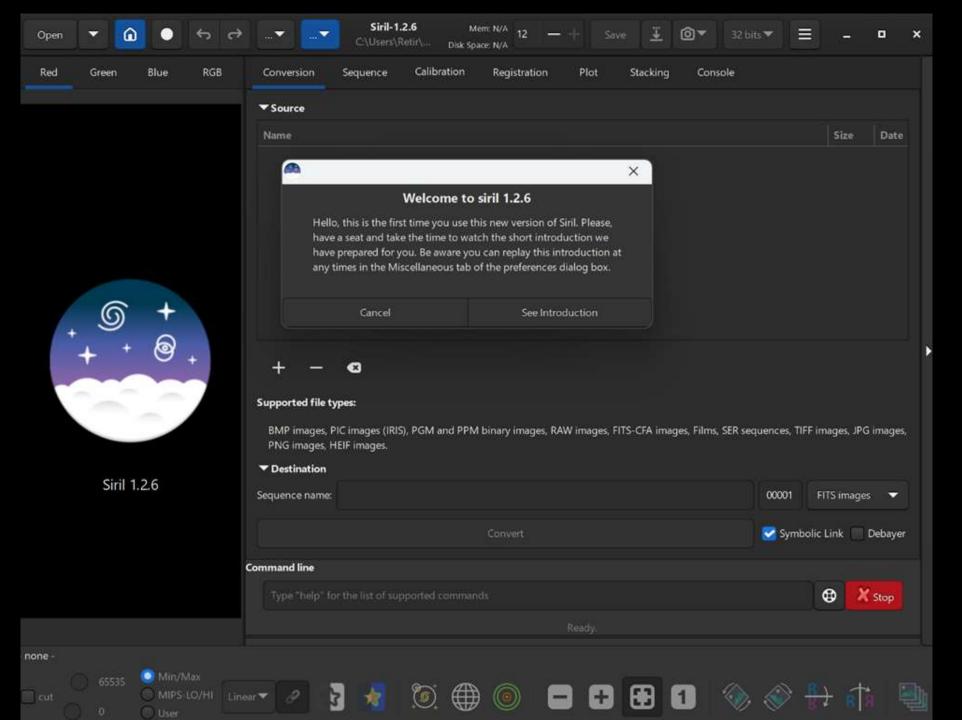
By default, the installer will create the program's shortcuts in the Windows Start Menu...

(if you change this be sure to remember where you told the installer to place it) click Next <u>Create a desktop shortcut too if you want to .... Click Next</u>

#### You should now be ready to install Siril.... Click Install



If all goes well, installation completes and you will be ready to start using Siril! Click Finish and the program will startup.



It may be worth your time to watch the short Introduction video that is included.

It highlights the functionality of the many control buttons on the GUI.

# **Using SIRIL**

Open Siril and set the working directory (the location where our image data would be stored) to ensure that when you run the stacking script, Siril knows where to collect the data from.

To do this, clicked on the home icon (see image below), navigate to the image folder on our computer and click 'Open'.

Put lights, darks, flats and biases in separate folders, under a common folder with the name of the object

Example: Pictures -> Siril\_images -> NCG1976

We have to ensure that our image folders are stored and named in a way that Siril's stacking script will recognise each set of light and calibration images.

The image below shows the correct layout of this folder system: the main target images are stored in a 'lights' folder, bias frames are in a folder called 'biases', dark frames in 'darks' and flat frames in 'flats'.

Select Folder
 Select

0000 💌 🙆 🚳 53 ct 🛥 🔜 50001224 - 0000000112 --- 6ct E (2010)0000 - -- 8

Once you've set your working directory, put all your frames from your flash drive into the correct folders.

These <u>must</u> be named 'lights', 'darks', 'biases' and 'flats' for the program to work properly and should be the only folders present in the working directory, or the script won't be able to execute.

Once done, we ran Siril's stacking script by clicking Scripts > OSC\_Preprocessing (see image below).

Open	•		¢	¢	Image I	Processing 🔻	Scripts 🔻		\Retir\O		<b>ril-1.2.6</b> tures\Siri	l_images\NGC	1976 D	Mem: 22 lisk Space: '
Red	Green	Blue	RGB				OSC_E	Preprocessing ktract_Ha ktract_HaOIII		Conve		Sequence	Calibr	ration
							OSC_P	reprocessing		Name				
								reprocessing_ omposition	_WithDrizzle					
				2	Siril 1.	2				BMP PNG <b>▼ Dest</b>	images, I <b>ination</b> ce name:	PIC images (IR HEIF images.	IS), PGM (	and PPM
													pported o	command
- none -								is 💿 Min/					~	
Cut C									S-LO/HI Lir	near 🔻 🛛 🤞	9	3 🔺	Ö	

#### You may see this message the first time you run this. Go ahead and click on "Run Script"

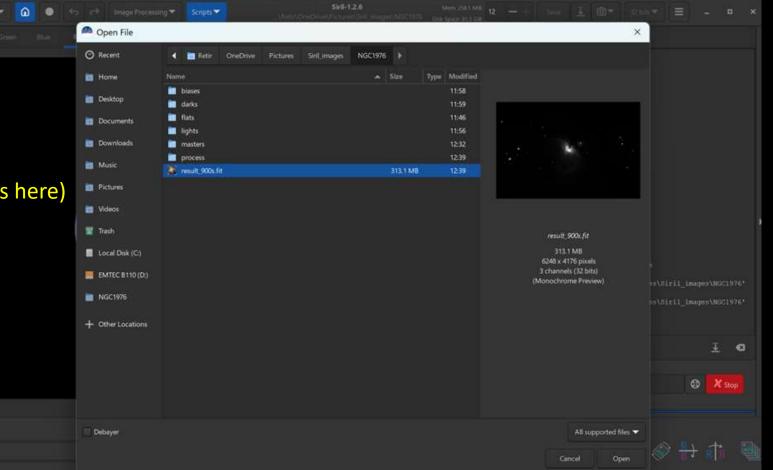
-			×
1	Please read me be	fore using scripts	
	You are about to use scripts. Runn that is easy and generally it provid have to keep in mind that scripts a are made where human decision w every commands used in a script a better parameter control. Do not show this dialog again	es a nice image. However you re not magic; automatic choices ould probably be better. Also,	
	Cancel	Run Script	

You'll see the script start to run in the Console on the right-hand side of the screen. Many lines will be displayed one after another as the script runs. Siril first creates Master files for each of the calibration frames before aligning and then stacking with the light frames by subtracting the noise and vignetting.

Once complete, the Console read 'Script execution finished successfully' and will show the total execution time. The time taken will depend on how many light frames and stars there are. For the NGC1976 nebula image, it took over 7 minutes to finish on my laptop.

Stacking complete, now for the final adjustments We then open the stacked file in our working directory, titled 'result\_[number]s.fit', where [number] refers to the total exposure time in seconds taken for all stacked images (900 seconds here)

Click "Open" in the bottom right corner.



Opin	* 0	•	fs et ingeNecening▼	Sept. 2	SH9-12.8 liter/UneOren/Fellow/Litel	imperASCITI		Name, Salt & Add. Their Taylor at 1 Gib	12. — + Se	* <u>I</u>	<b>0</b> • 200	• =	2 • ×
Red	Green	Ret -	101-				Conversion Sequence	Calibration Reg	stration Flat	Stacking	(Conste)		
							12:30         45         Reading fitt: 1           12:30         45         Reading fitt: 1           12:30         45         Reading fitt: 1           12:30         52         Reading fitt: 1           12:30         52         Reading fitt: 1           12:30         S2         Reading reading fitt: 1           12:30         Reading reading reading         Reading reading           12:30         Reading reading reading         Reading reading           12:30         Reading reading         Reading           12:30         Reading reading         Reading	<pre>114 s pp 114bt 200 114 s pp 114bt 201 114 s pp 114 s pp 114 114 s</pre>	00.111, 3 Layer(s) (5.111, 3 Layer(s) 94.111, 3 Layer(s) 94.111, 3 Layer(s) 94.111, 3 Layer(s) 94.111, 3 Layer(s) 1944 - 0.014 1015 - 0.7774 1015 - 0.7544 1015 - 0.7544 1016 signs clippi 1016 signs clippi 1011 5.015 (1.7756 1011 5.015 (1.7756) 1011 5.015 (1.7756) 1011 5.015 (1.7756) 1011 5.015 (1.7756) 1011 5.015 (1.7756) 1011	<pre>. 62483417 . 62483417 . 62483417 arthing. a</pre>	<pre>9 pinels, 35 p 9 pinels, 32 p 9 pinels, 32 p 9 pinels, 32 p 10 pite 2 pite 2 pite 2 pite 2 pite 2 pite 2 pite 3 pite</pre>		
													I O
							Command line						
	ne stad	cked	l image will lo	ok dark and flat; it now need	s stretching.							¢	X Step
in age on a	1.900Lfit					. 81. 1995 (yr. 2114							
T est					0 mm	Mov/Max MPS-LD/HI Lat		<b>(</b> )	) = +		1)	🖉 🕂	(1)

#### We do this initially by clicking on the 'linear' dropdown box and selecting 'AutoStretch'

Open 💌 🙆 🗢 tha of theeje Processing 🕶 Songer 🔨	599-12.0 Uland Deathive Personal Serie program (NGC 1076	New York U.S	• I 🛛 • ×
Rid Green Blue RGB	Convention Sequ	ence Calibration Registration Plot	Stacking Conucle
	12:38:43 Heading F 12:38:53 Heading F 13:38:53 Heading F 13:38:53 Heading F 13:38:53 Heading F 13:38:52 Heading F 13:38:53 Heading F 13:38:55 Heading F 13:38:	ection is channel \$0: 0.499% - 0.674% stion is channel \$1: 0.012% - 0.77% stion is channel \$1: 0.012% - 0.77% stion is channel \$1: 0.013% - 0.754% of 15 Daaper m 15 of the sequence: Binstion swerzage multistion swerzage multistion swerzage multistion subject pissesterr fun-5.000 high-3.000 rejection Bags an phring enabled d noise value (channel: \$011 5.613 (1.37%- d noise value (channel: \$011 5.75%- d noise value (channel: \$011 5.75%- d noise value (channel: \$011 5.75%- d noise value	<pre>closeling: . 424004170 place18, 32 bits soking: </pre>
			I O
	Command line		
Siril performed a preliminary histogram stretch, allowing	Appendix of the second s		D Xstee
bin performed a preminary histogram stretch, anowing			

Mon/Mas

MPS-10/HI AutoStretch - P

3 🕷

= + 😌 1 📎 🔗 🕂 🏦 🍓

us to gauge how much signal versus noise was present within our stacked image.

### There is Much More that SIRIL Can Do! (and always much more that we can learn)

What has been described so far just scratches the surface asto what SIRIL can do. You have just begun to learn about image processing, now able to perform calibrations and stacking. The art comes as you learn to enhance your images. Enhancement is the art of refining the image data, putting it in a form that our human eye can perceive.

Beyond SIRIL, there are other tools that can help you to get the most out of your images.

Often people turn to Photoshop or GIMP. PixInsight is a tool that has been designed to solve the problems specific to astrophotography. There exists software that uses artificial intelligence (AI) to remove noise, sharpen images, and enlarge images without the expected detail loss. Many such programs are available and they come as plug-ins to other programs or as standalone programs in some cases. Some programs tackle one of these issues (denoise, sharpen, enlarge), enhance) and some tackle them all. They don't eliminate the need for a general image processing program like Siril or Gimp or whatever you use.

There are now AI based training tools to teach you advanced skills. AI Astrophotography Coach is astrophotography course, powered by AI and available for iPhone <u>https://www.astronomy.com/observing/let-ai-teach-you-how-to-take-great-astrophotos/</u>

Like you, I have only begun to explore this field.

# Thank you for coming to the Harken Observatory tonight!



# http://pewaukeeastro.com/