



MDRS Robotic Observatory

Quick Guide

Peter Detterline

Revised, Gary A. Becker, July 2020

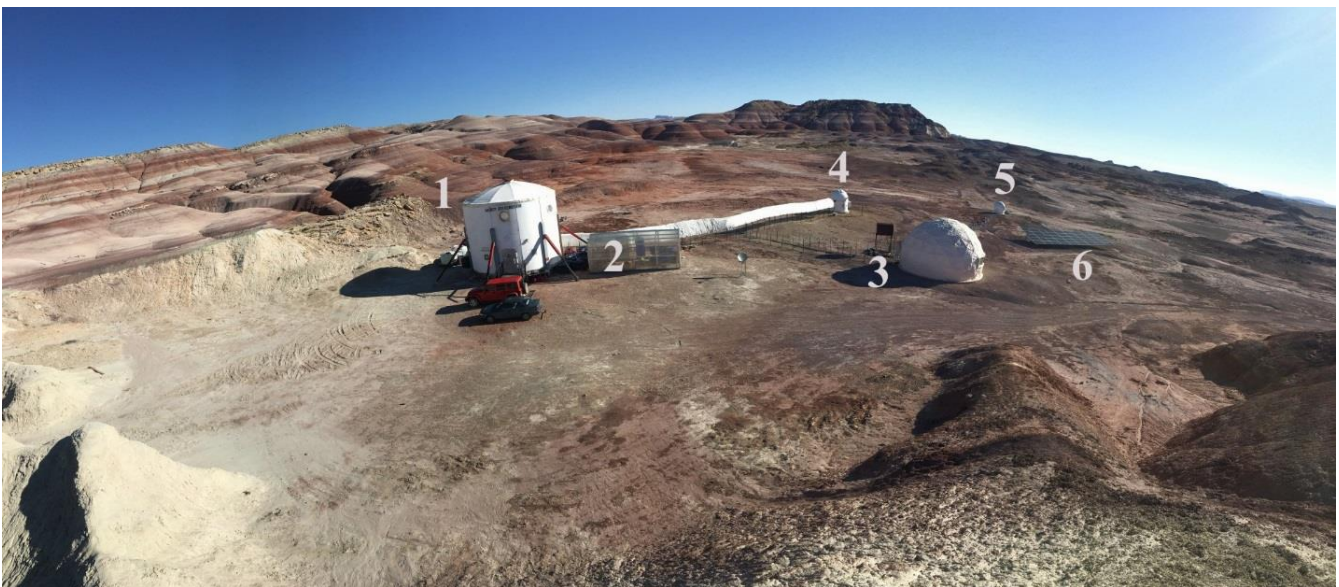
Observatory Director

pdetterline@moravian.edu

beckerg@moravian.edu



Mars Desert Research Station in 2012: Self-portrait of Gary A. Becker under moonlight. The Elon Musk Solar Observatory, dedicated to viewing the sun in Hydrogen Alpha, is in the foreground while the two-story habitat is on the right in the background near the setting moon.



Mars Desert Research Station, near Hanksville, Utah as it looks today: 1-Habitat, 2-Greenhouse, 3 Biology Lab, 4-Elon Musk Solar Observatory, 5-MDRS Robotic Observatory, 6-Solar Panels that power the station. Adam R. Jones photography...

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MARS DESERT RESEARCH STATION ROBOTIC OBSERVATORY

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OVERVIEW

Welcome to the MDRS Robotic Observatory, a fully automated observatory that can be accessed via the Internet. The observatory contains two instruments. One is a Celestron, Schmidt-Cassegrain, 14-inch (356 mm) reflector with Ultraviolet, Blue, Visual, Red, and Infrared (UBVRI) filters used for **photometric** research. The second is a wide field 70mm Stellarvue refractor with **Luminescence**, Red, Green, Blue, and **Hydrogen Alpha** LRGBH α filters used for **astrophotography**. The entire observatory is completely operated via the Internet. The observatory will open and close automatically, take all of the necessary images that are programmed into the system, including calibration frames, and upload them to the Internet where the participant can download them at his or her convenience. Once downloaded, the observer can then process the images.

WORD LIST DEFINITIONS FROM THE OVERVIEW SECTION

Astrophotography: the imaging of astronomical objects, day or night.

Hydrogen Alpha (H α) Filter: A device that only allows the passage of a specific wavelength of light from hydrogen in an emission state, 6563 Angstroms or 656.3nm. It is particularly important in bringing out the detail in emission nebulae (glowing clouds of gas containing hydrogen).

Luminescence Filter: A device that produces a black and white image of the object being photographed and is used to fill in background detail when more narrowband filters are used.

Photometry: The science which investigates the measurement of the intensity of light being emitted by an object, usually stated as a magnitude.

TELESCOPE SPECIFICATIONS

Fourteen-Inch Research Instrument: This instrument is not equipped to take color images.
Celestron, 14-inch, Schmidt-Cassegrain Edge HD Focal Length: 3910 mm
Aperture: 355.6 mm Focal Ratio: F/11

Camera

Moravian G4-16000 CCD camera with KAF-16803 CCD

Filters: UBVRI Astrodon photometric filters

Pixel size: 9x9; Array: 4096 x 4096; Binning: 1x1

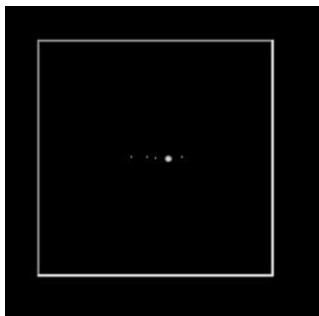
CCD Gain 1.60; CCD Readout Noise 11.00; CCD Dark Current 3.00

Chip Size: 36.9mm x 36.9mm

Image Scale: 0.48 arcseconds/pixel

Field of View: 32.9 x 32.9 arc minutes

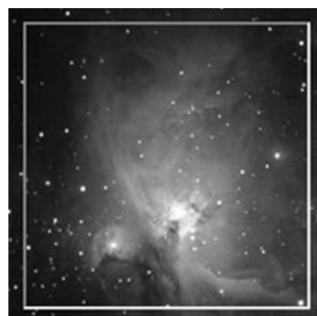
Field of View Samples: (simulation courtesy of New Astronomy Press CCD Calculator)



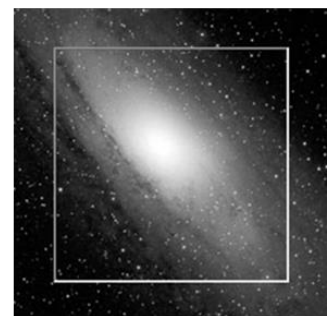
Jupiter



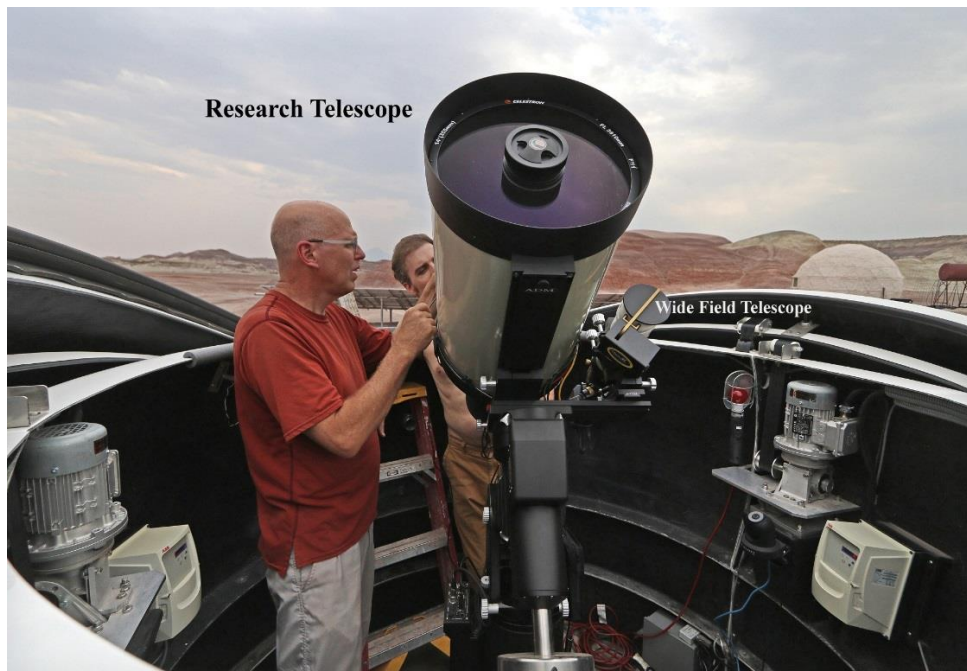
Moon



Orion Nebula



Andromeda Galaxy



Research Telescope

Wide Field Telescope

IMPORTANT:
Skynet will not switch back and forth between telescopes. That is something that the MDRS Observatory Director will do. Send a request to your Professor to specify which telescope you would like to use that night.

Photo on left by Gary A. Becker...

MDRS-Wide Field Astrophotography Instrument: This telescope is not equipped to take research images.

Stellarvue 70 Apochromatic Refractor Focal Length: 336 mm
Aperture: 70 mm Focal Ratio: F/4.8

Camera

Moravian G2-8300 CCD camera with KAF-8300 CCD

Filters: LRGB Astronomik photographic filters

Filter: H-Alpha 6nm narrow band (Astronomik)

Pixel size: 5.4 x 5.4

Array: 3358 x 2536 pixels

Binning 1x1

Chip Size: 13.7mm x 18.1mm

Image Scale: 2.65 arcseconds/pixel

Field of View: 111.9 x 148.2 arc minutes (There are 60 minutes of arc per degree.)

Field of View Samples: (simulation courtesy of New Astronomy Press CCD Calculator)



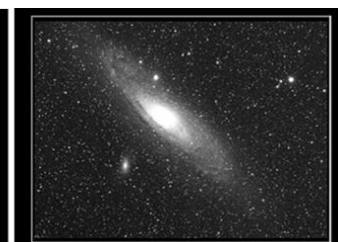
Jupiter



Moon



Orion Nebula



Andromeda Galaxy

A few things to remember:

- Planets are too small to image through either telescope.
- The Moon is too bright. Do not attempt to image it!
- All images are monochromatic (shades of gray). Images (RGB) need to be stacked with a software program to get color astrophotos using the **Stellarvue 70** Apochromatic Refractor.
- Calibration frames (**flat, bias, and dark**) are taken automatically, but you have to calibrate them with your image by using an additional software program.

Flat Frame: An image or multiple images usually taken at dusk, recorded by light reflected from a white screen or the sky to correct for inconsistencies of exposure caused by the optics of the recording system, such as vignetting or dust on the telescope.

Bias: An image taken with a zero second exposure to record the inconsistencies of sensitivity across the chip. It removes the (read) noise generated by the pixel as it receives data from the object while an exposure is being taken.

Dark: An exposure of the same length as the data collecting image, but taken with the camera in a closed configuration (lens cap on) to locate the hot (over responding, bright) pixels in the image for removal during image processing.

BRIGHT PLANETS AND THE MOON

Robotic observatories normally use wide-field instruments. This makes them great for star clusters, nebulae, and galaxies, but horrible for bright planets, such as Mercury, Venus, Mars, Jupiter, and Saturn because the images are much too small to see any details. Look at the sample images of Jupiter for each telescope shown in the *Quick Guide*. Planets, such as Uranus, Neptune, and the dwarf planet Pluto, are fine because they are too small or too far away to see any detail. They will appear like “stars,” but you will be able to follow their movements from night to night.

The Moon is big enough for imaging as the specification sheet shows, but unfortunately, the Moon is too bright under most circumstances. At MDRS, test photos of the Moon have only been successful using the 14-inch instrument. The shortest exposure (0.03 seconds) was used in conjunction with the hydrogen alpha filter. **DO NOT IMAGE THE MOON WITHOUT FIRST ASKING FOR PERMISSION FROM YOUR INSTRUCTOR.** During the partial phases of a lunar eclipse and through totality would provide an opportunity for imaging. Your Moravian instructors will give students specific guidelines, if such a situation occurs.

SKYNET

Skynet represents a group of astronomical observatories around the world that students can use to conduct research and image the sky. The two telescopes mounted tandem on the same mount at the MDRS Robotic Observatory are part of the Skynet family and operate under the protocols which are accessed through the Skynet website, <https://skynet.unc.edu/>.

CREATING AN ACCOUNT

First, a student must log into the system. Your professor will have you create an account in class or send you an invitation from Skynet with a self-registration key in your email. If you receive an email from Skynet, then follow the instructions to register. Please note that registration keys can only be used once. A typical invitation email looks like this.

From: **Skynet Robotic Telescope Network** <no_reply@skynet.unc.edu>
Date: Mon, Mar 23, 2020 at 11:37 PM
Subject: Welcome to the Skynet Robotic Telescope Network - Registration
To:

Hello,

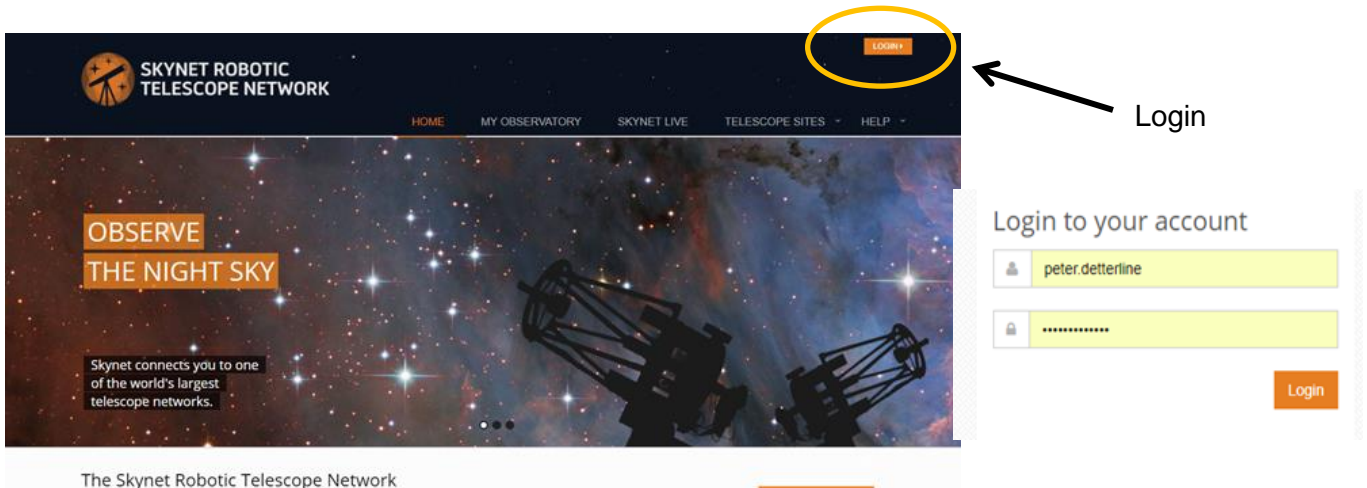
Based on your enrollment in an astronomy course or your recent visit to a Skynet observatory, you have been invited to join the Skynet Robotic Telescope Network. Your private registration key is: **d3690151d0h2**

[Click here](#) to complete your registration.

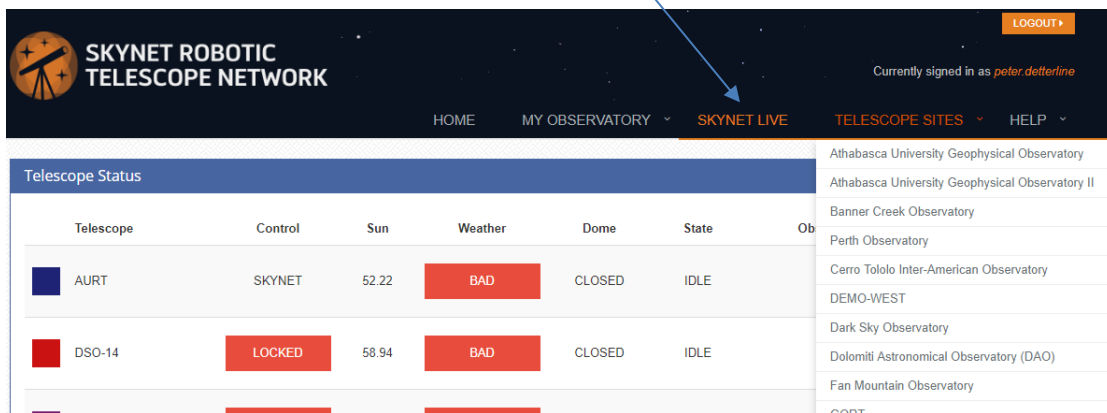
Or, visit our registration page by pointing your browser to <https://skynet.unc.edu/user/register> and including your registration key. This special key is unique and can only be used once. If you did not enroll in a course which uses Skynet or you have recently dropped the course, you may ignore this message.

If you have questions regarding this email, please contact your course instructor or T.A.
Skynet Robotic Telescope Network,

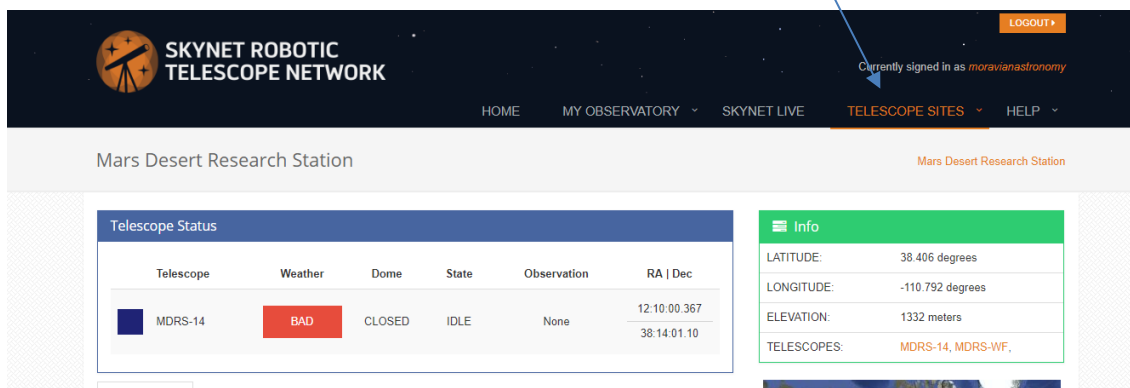
Now login at Web address: <https://skynet.unc.edu/>



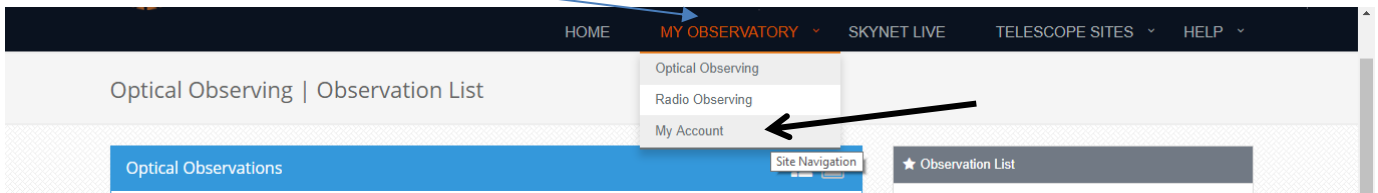
Let's explore the website. Click on **SKYNET LIVE** on the top menu. This shows the status of all of the observatories in the Skynet family. Scroll down and find MDRS. It will tell you if the telescope is currently open or closed.



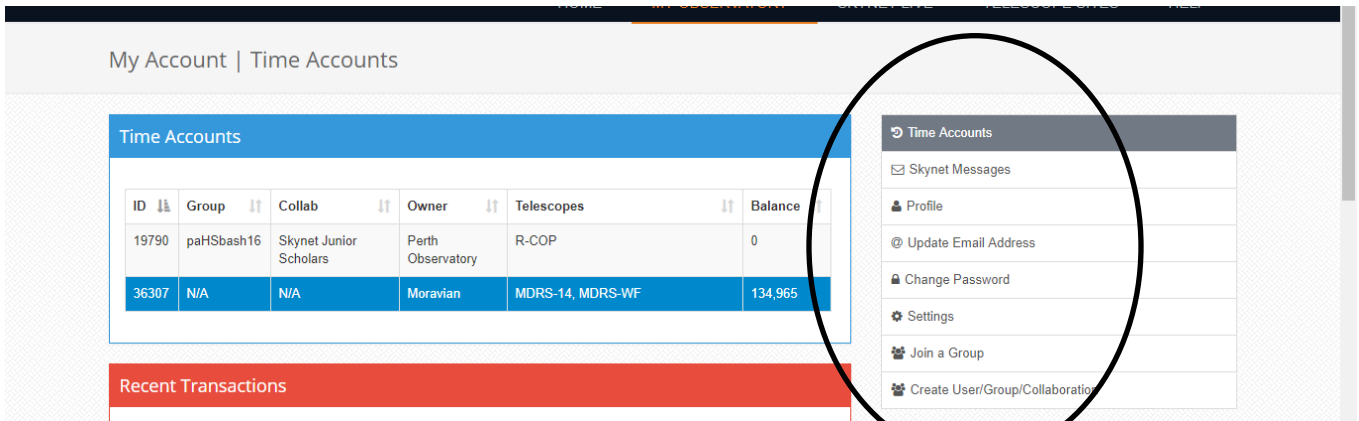
On the top menu, you can also select **TELESCOPE SITES**. From the drop-down menu select **Mars Desert Research Station**. This will give you detailed information and status on the MDRS Observatory. These sites are particularly useful because it is possible to see what object the telescope is currently imaging.



Now select **MY OBSERVATORY**, and from the drop-down menu, select **MY ACCOUNT**.



This is where you can change your password, and see how much time you have on the telescope.



REQUESTING MORE TELESCOPE TIME

If it is discovered that you have insufficient telescope credits (time), the easiest and fastest way to request more observing time on Skynet is to contact your professor. On Skynet you can also choose **MY OBSERVATORY**, and from the drop-down menu select **MY ACCOUNT**. Scroll down the page to request additional time on the telescope (credits). Complete the form and click **SUBMIT**. Be advised that it may take longer to receive requests using this method.

A screenshot of the 'Request Additional Credits' form. The form has a title 'Request Additional Credits' and contains the following fields:

- Time Account:** A dropdown menu with '35314 MDRS' selected.
- Amount (credits):** A text input field.
- Message:** A larger text area for a message.
- Submit:** An orange button at the bottom right.

FIRST LIGHT: MAKING YOUR FIRST OBSERVATION

The best way to learn the telescope system is to make a good observation before you get started with your project. Select **MY OBSERVATORY** again. From the drop-down menu, select **OPTICAL OBSERVING**. This is where you will set up, submit, and collect your observations. Looking at **OPTICAL OBSERVING | OBSERVATORY LIST** you can see the observations that you have already completed and those that are still active (not completed) in the left-hand column. Click on **ADD NEW OBSERVATION** in the right-hand column.

Optical Observing | Observation List | Page 1 of 3 Add New Observation

Previous Page **1** 2 3 Next Page

ID	Name	Telescopes	Last Activity	State
3080750	x dra	MDRS-14	2018-08-04 18:28:26	active
3080215	messier 33	MDRS-14	2018-08-04 07:48:02	active
3079829	messier 33	MDRS-WF	2018-08-04 06:49:53	active
3079335	messier 33	MDRS-WF	2018-08-04 06:23:24	anceled
3078898	messier 39	MDRS-14	2018-08-04 05:44:03	completed - 1/1
3078897	messier 39	MDRS-14	2018-08-04 05:44:03	completed - 1/1

★ Observation List

+ Add New Observation

Open Afterglow

My Observations Group Observations Collaboration Observations

Search

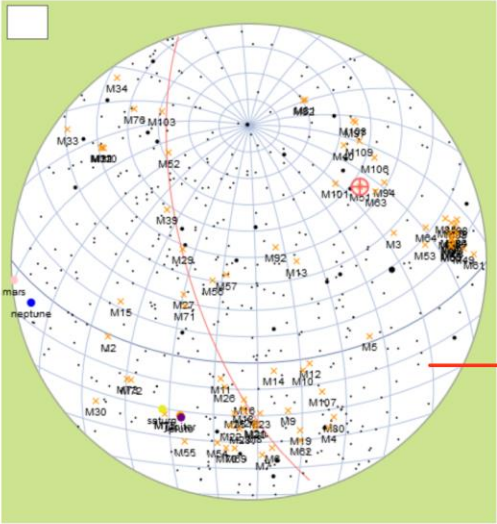
keywords:

Step one is to select your target. Select a target for one of the telescopes. Type the name of the object in the **TARGET LOOKUP** box; when done click **SEARCH**.

Target Finding Interface

Sky Viewer: Graphical display of observable targets

Clicking on a target in the SkyViewer will automatically fill in coordinates in the form below.



Mars Desert Research Station

MDRS-14

hour

midnight

Az/El Grid

RA/Dec Grid

Galactic Plane

Stars

Solar System

Messier Catalog

Large/Bright Galaxies

Bright Radio Catalog

Sky Brightness

2020/6/26 03:17:45 AM US/Eastern Time Zone 7.5 hour(s) in the future

Observation Name: messier 51

Right Ascension (J2000): 13:29:52.6

Declination (J2000): 47:11:42.9

Max Sun Elevation: -18.0

Min Target Elevation: 30.0

Min Visible Hours: 1.0

Observation List

+ Add New Observation

Campaign List

+ Add New Campaign


Open Afterglow

Target Lookup

keywords: M51

Search

Name	Description
● messier 51	GinPair ~



Type in your TARGET and click SEARCH, or use the map on the left.

USING THE MAP: You can also search the map on the right and choose an object by simply clicking on it. Make sure you spend a little time researching the object so that you know whether it is a galaxy, globular cluster, open cluster, planetary nebula, etc. You should be able to do this in Google without too much difficulty. If the images appear too crowded, you can create a box with your mouse to enlarge that section. If you need to return to the original map, click on the **Add New Observation** tab and restart the process. You can look at objects at any time of the night by advancing the **hour** tab. This is important if bright moonlight will interfere with an observation. In a situation where moonlight may wash out your image, find an object that will be visible after moonset or is positioned far enough away from the moon to avoid its detrimental effects from the sky glow which Luna creates.

For comets, put in the designation and name with no spaces. Click **SEARCH**.

For asteroids, just put in the name. Click **SEARCH**.

For variable stars, put in the designation. Click **SEARCH**.

Comets

Target Lookup	
keywords:	<input type="text" value="46P/Wirtanen"/>
	<input type="button" value="Search"/>
Name	Description
<input checked="" type="radio"/> 46P Wirtanen	Comet

Asteroids

Target Lookup	
keywords:	<input type="text" value="eunomia"/>
	<input type="button" value="Search"/>
Name	Description
<input checked="" type="radio"/> Eunomia	Asteroid

Variable Stars

Target Lookup	
keywords:	<input type="text" value="HK Lyr"/>
	<input type="button" value="Search"/>
Name	Description
<input checked="" type="radio"/> hk lyr	C* ~

IMPORTANT: For moving objects, such as comets or asteroids, it is best to have them completed the night that you submit them, and with the specific positional coordinates. If Skynet did not take those particular images that night, cancel the observation and resubmit with the new positional data.

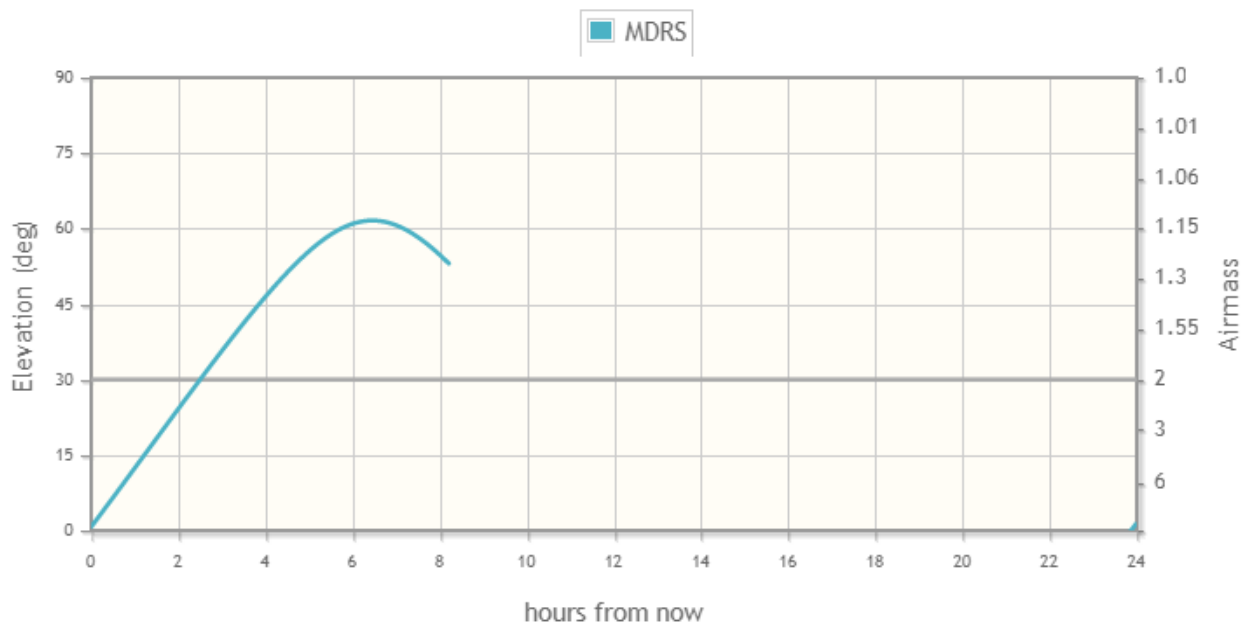
OPTIONAL: Scroll down and you'll see the coordinates of your object. You don't have to select a target, if you prefer you can just put in the coordinates. You will have to name it however. In this example I'm calling it Search Pattern 1.

<input type="text" value="Search Pattern 1 "/>	<input type="text" value="19:59:36.3"/>	<input type="text" value="22:43:16.3"/>
<input type="text" value="-18.0"/>	<input type="text" value="30.0"/>	<input type="text" value="1.0"/>

At the bottom of the page, you will see a graph showing when your target is visible. The graph needs to be above the 30-degree elevation line.

IMPORTANT: If the object line is below 30 degrees or not on the graph, the image will not be taken. Another target needs to be selected. Select, **SAVE AND CHOOSE TELESCOPES.** This will direct you to the next page.

Target visibility over next 24-hours when sun is below -18 degrees



Save and Choose Telescopes

Save and Choose Filters

Select the MDRS telescope that you want to use by checking the box. On the right side you will see how much available time you have on this instrument. Click **SAVE AND CONTINUE** to and proceed to the **FILTERS** page.

The screenshot shows the 'Add Observation' page for the MDRS telescopes at Hanksville, Utah USA. The page is titled 'Optical Observing | Add Observation' and includes a breadcrumb trail: 'Target → Telescopes → Filters → Exposures → Review'. A blue arrow points to the 'MDRS-14' checkbox in the telescope selection table.

Name	Diameter	Field of View	Pixel Scale
<input checked="" type="checkbox"/> MDRS-14	0.36 m	32.4' X 32.4'	0.47 "/pixel
<input type="checkbox"/> MDRS-WF	0.07 m	185.5' X 140.1'	3.31 "/pixel

Below the table is a 'Save and Continue' button. To the right, there is an 'Observation List' section with a '+ Add New Observation' button and an 'Open Afterglow' checkbox. Below that is an 'Available Time Accounts' table:

Sponsor	Balance	Available
Moravian	134,140	<input checked="" type="checkbox"/>

At the bottom right, there is a link for 'MDRS-14, MDRS-WF' with a circular icon.

Filters: Select the filters you want to use for your observation. Make certain the filters match the telescope that you have chosen. For black and white images, select either “V” for visual or “L” for luminescence.

Click **SAVE, AND CONTINUE** to advance to the next page.

Click here for the filter drop down menu.

Optical Observing | Add Observation

Target → Filters → Telescopes → Exposures → Review

Generic Use if you don't know the specific filters offered with a telescope. ▾

HiThru
 LoThru
 GenR
 GenG
 GenB

A generic filter is a collection of multiple filters which have similar characteristics. By selecting a generic filter, Skynet will use any of the available filters from the collection. This will maximize the number of telescopes which can complete your observation.

- **HiThru:** Open, Clear, Lum, UHC - for faint objects or when not concerned with color
- **LoThru:** OIII, SII, Halpha, U, uprime - for bright objects
- **GenR:** Red, R, rprime - reddish filters
- **GenG:** Green, V - greenish filters
- **GenB:** Blue, B - bluish filters

Maximum Light Available with the widefield/Use Visual (V) with the 14-inch ▾

Lum

These filters are great for when you want to shorten your exposure lengths and you don't care about color. In many cases, you won't be able to see a difference between 'Open', 'Clear', and 'Lum'. Read below to learn more.

- **Open:** no filter. All light passes directly to the camera
- **Clear:** similar to 'Open' except light passes through a clear piece of glass
- **Lum:** similar to 'Clear' except ultraviolet and infrared are blocked
- **UHC:** similar to 'Clear' except light pollution wavelengths are entirely blocked

Johnson/Cousins Specific filters for the 14-inch Schmidt-Cassegrain ▾

U
 B
 V
 R
 I

These are filters for the UBVR photometric system. The UB filter system established by Johnson and Morgan has been the main means of measuring brightness and color in astronomy since 1953, but there have been some modifications. A major one was the addition of R and I filters by Kron and Cousins.

Astrophotography Specific filters for the 70mm Stellarvue refractor ▾

Red
 Green
 Blue
 Lum
 Halpha

Most astronomical cameras are black-and-white. In order to create a color image, we must take three separate exposures using filters designed to only allow red, green, and blue light to pass. We then combine the three images into a single color image. The Lum filter can also be used to enhance the fainter details in the final image.

Note: It is also possible to create color images using other reddish, greenish, and bluish filters. Feel free to experiment with the generic filters such as GenR, GenG, and GenB.

Narrow-band Use with the 70mm widefield or Infrared (I) with the 14-inch. ▾

Halpha

Atoms may emit or glow with light of very specific wavelengths. These filters are designed to pass a very narrow range of light around these wavelengths. They are useful for observing H II regions (Orion Nebula), planetary nebulae (Ring Nebula), and supernova remnants (Crab Nebula).

★ Observation List

+ Add New Observation

★ Campaign List

+ Add New Campaign

🔗 Open Afterglow

Available Telescopes

Name	Filter Match
MDRS-14	✔
MDRS-WF	✔
MLC-RCOS16	✔

Save and Continue

Exposures: Next is the exposure page or the length of time that the astrophotos will be taken. Set the exposure time and the number of pictures that are to be taken. In this example I'm taking one exposure of 60 seconds duration with a blue filter (B), two exposures of 30 seconds in length with a visual filter (V), and one exposure of 40 seconds with a V filter. This accumulates to a total of 2 minutes, 40 seconds of observing time or 160 credits. Each credit represents a second of imaging time through the telescope. Note how much time this observation will "cost," and also how many credits of time you have left for future imaging.

☰ Add Exposures

⚠ This field contains a very bright star (magnitude 6.79). To prevent saturation, we have set maximum exposure lengths shown below. Please note that this is an upper limit and not necessarily a recommended exposure length. The shortest allowed exposure length is 0.03 seconds.

	Filter	# Exps	Duration (s)	Max	Total	
+	B	1	60	200	1.0 min	✖
+	V	2	30	171.43	1.0 min	✖
+	V	1	40	171.43	40.0 secs	✖

Total Observing Time: 2.7 mins Add Row

Preview adjusted exposure lengths by hovering over a telescope name below

MDRS-14

\$ Credits Required

Total Observing Time:	2.7 mins
Total Observing Credits:	160 credits
Observation Repeat:	1.00x

160 credits required

Scroll down and note the **Advanced Options** box. This allows you to repeat observations which is a huge time-saver for variable stars. Click **SAVE AND CONTINUE**.

🕒 Advanced Options ▼

Sequential Filters (Red,Red,Green,Green,Blue,Blue)
 Interleaved Filters (Red,Green,Blue,Red,Green,Blue)

Delay the start of this observation until UTC

Repeat this observation times with at least days between each.

Continue on next available telescope if interrupted

Cancel exposures not taken before UTC

Save and Continue

The last page is the summary of the observation submitted. Examine everything carefully, and when satisfied, scroll down and click **SUBMIT**. Congratulations, your first light image is in the queue!

Optical Observing | Add Observation Target → Telescopes → Filters → Exposures → Review

OBSERVATION NAME:	dx and
SOLAR SYSTEM TARGET:	dx and
MAX SUN ELEVATION:	-18.0 degrees
MIN TARGET ELEVATION:	30.0 degrees
TELESCOPES:	MDRS-14
PRIMARY TELESCOPE:	MDRS-14 (1.0x)

★ Observation List

+ Add New Observation

🔗 Open Afterglow

DOWNLOADING AND SUBMITTING AN IMAGE TO YOUR INSTRUCTOR

1. **Do not use your mobile phone to send screenshot images. Use your MacBook or Windows Operating System.**
2. **Go to Skynet**, <https://skynet.unc.edu/>
3. **Log into Skynet**. That should take you right to your observations. If it does not happen, then go to the top of the screen and click on **my observatory/optical observations**.
4. **Send a screenshot of your observations page to your instructor. That way your instructor can see the pictures that you have taken.** Make sure that your name appears on the picture so that it can be determined that it is your page. The following image is an example of what should be sent. Your name must appear on the screenshot.

SKYNET ROBOTIC TELESCOPE NETWORK

Your name will appear here. → Currently signed in as peter.detterline

LOGOUT

HOME MY OBSERVATORY SKYNET LIVE TELESCOPE SITES HELP

Optical Observing | Observation List | Page 1 of 47

Previous Page 1 2 3 4 5 6 ... Next Page

ID	Name	Telescopes	Last Activity	State
4966422	Y4 Atlas	MLC-RCOS16	2020-04-10 03:48:59	completed - 4/4
4966414	Y4 Atlas	MLC-RCOS16	2020-04-10 02:59:14	completed - 4/4
4962717	Y4 Atlas	MLC-RCOS16	2020-04-09 04:26:12	anceled
4962716	Y4 Atlas	MDRS-14	2020-04-09 04:25:37	completed - 1/1
4951852	messier 3	MDRS-14	2020-04-06 05:01:56	completed - 1/1
4951850	ngc 6058	MLC-RCOS16	2020-04-06 05:25:04	completed - 12/12
4951849	ic 3568	MLC-RCOS16	2020-04-06 04:24:16	completed - 12/12

Observation List

- Add New Observation
- Campaign List
- Add New Campaign
- Open Afterglow

My Observations Group Observations Collaboration Observations

Search

keywords:

- If under the **status column** (far right) of your observations, your images are indicated as **ACTIVE**, if they are still waiting to be taken; **COMPLETED**, if they are ready to be downloaded; and **CANCELED**, if for some reason they will not be taken. See the image above and below.

SKYNET ROBOTIC TELESCOPE NETWORK

Currently signed in as peter.detterline

LOGOUT

HOME MY OBSERVATORY SKYNET LIVE TELESCOPE SITES HELP

Optical Observing | Observation List | Page 1 of 3

Previous Page 1 2 3 Next Page

ID	Name	Telescopes	Last Activity	State
3080750	x dra	MDRS-14	2018-08-04 18:28:26	active
3080215	messier 33	MDRS-14	2018-08-04 07:48:02	active
3079829	messier 33	MDRS-WF	2018-08-04 06:49:53	active
3079335	messier 33	MDRS-WF	2018-08-04 06:23:24	anceled
3078898	messier 39	MDRS-14	2018-08-04 05:44:03	completed - 1/1

Observation List

- Add New Observation
- Open Afterglow

My Observations Group Observations Collaboration Observations

Search

keywords:

- Click on the **object's name** (colored orange) of a completed observation. That will bring up the particular set of individual photos that were taken for your object.
- Find the jpg images:** Under the **status** column of that object's images, there will be three small icons. The far left one looks like it has a mountain and a black dot in it. Those are the jpg images.

Exposures

ID	Length	Telescope	Filter	Time Taken	Status
0	23527974	300.0s	MDRS-WF	Lum	Jan 09, 2019 01:55:38

jpg fits data file

SKYNET ROBOTIC TELESCOPE NETWORK

Currently signed in as *moravianastronomy*

HOME MY OBSERVATORY SKYNET LIVE TELESCOPE SITES HELP

Optical Observing | Observation 4968242

My Observations / 4968242 / View

Exposures

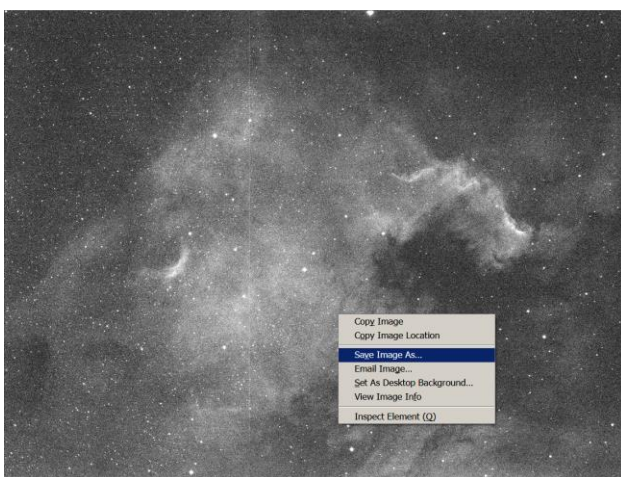
ID	Length	Telescope	Filter	Time Taken	Status
0	28686170	60.0s	MDRS-WF	Lum	Apr 11, 2020 09:50:45
1	28686171	60.0s	MDRS-WF	Lum	Apr 11, 2020 09:51:57
2	28686172	60.0s	MDRS-WF	Lum	Apr 11, 2020 09:53:10
3	28686173	60.0s	MDRS-WF	Lum	Apr 11, 2020 09:54:21
4	28686174	60.0s	MDRS-WF	Lum	Apr 11, 2020 09:55:33
5	28686175	60.0s	MDRS-WF	Lum	Apr 11, 2020 09:56:45
6	28686176	120.0s	MDRS-WF	Halpna	Apr 11, 2020 09:58:00

Observation List

- View
- Manage Notes
- Resubmit
- Add New Observation
- Campaign List
- Add New Campaign
- Open Afterglow

Observation Info

- Left click on each of the jpg icons and pick the photo that looks the best to you.** Only the best image is to be sent, not all of them, unless more are requested.
- Left click on the jpg image icon which has been chosen as the best,** and it will enlarge to show you a full-sized photo of your object, fit to your particular computer screen. See the image below.



- Save your image to your Desktop or to a special file that you have created.** Then send the image to your instructor as an attachment with an email. The data of your image will be contained with the photo. **Send it any other way, and it will not be accepted for credit.**

STOP RIGHT HERE IF YOU HAVE ONLY BEEN ASKED TO SUBMIT AN UNPROCESSED IMAGE. CONTINUE, IF YOU ARE TO PROCESS YOUR IMAGE.

PROCESSING AN IMAGE

For more advanced processing you will be downloading the fits files, not the jpeg images. Download the fits files for each image, by clicking on the photo icon in the middle, directed to by the arrows. You will also need to download the calibration frames. To do this, you'll need to click on each image. These files are huge! At MDRS this can be problematic for Internet time allotments. There is a faster and better way to do this if you have multiple images such as these. Please see below.

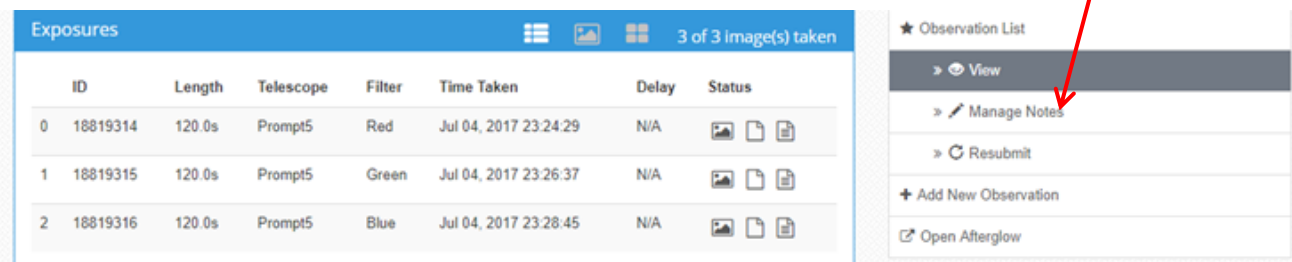
The screenshot displays the MDRS observation interface. It features three main panels:

- Exposures:** A table with columns for ID, Length, Telescope, Filter, Time Taken, and Status. It shows three rows of data for exposures taken on Jan 01, 2019. Arrows point to the photo icons in the Status column.
- Master Calibration Images:** A table with columns for ID, Type, Time Taken, Exposure Length, Filter, and Binning. It shows two rows of data for calibration frames. Arrows point to the photo icons in the Status column.
- Observation List:** A sidebar menu with options like View, Manage Notes, Resubmit, Add New Observation, and Open Afterglow.
- Observation Info:** A panel showing details for observation 'messier 36', including RA/Dec coordinates, target name, priority, and primary telescope.

Scroll down that page and look on the right-hand side until you find **DOWNLOAD OBSERVATION**. Click that button, and it will download all of the target fits observations as a zip file. YOU NEED TO HAVE A PROGRAM THAT CAN OPEN ZIP FILES ON YOUR COMPUTER. Keep in mind that it will NOT download any of the calibration frames; you will still have to do that one at a time.

The screenshot shows the 'Download Observation' dialog box. It has a title bar with a download icon and the text 'Download Observation'. Below the title bar, there is a section labeled 'Download Format:' with a dropdown menu currently set to 'FITS'. At the bottom of the dialog, there is a prominent orange button labeled 'Download Observation'.

Resubmitting an Image: If you need to make further observations of this target, simply click **RESUBMIT** (red arrow), and it will take you to the summary page without having to go through all of the other filters and exposure choices (although you can go back to those pages if you wish). On the Summary page, scroll down and click **SUBMIT**, and your observations will be back in the queue.



The screenshot shows a web interface for astronomical observations. On the left, there is a table titled 'Exposures' with columns for ID, Length, Telescope, Filter, Time Taken, Delay, and Status. It lists three exposures with IDs 18819314, 18819315, and 18819316, all taken on July 04, 2017. On the right, there is a sidebar titled 'Observation List' with buttons for 'View', 'Manage Notes', 'Resubmit', 'Add New Observation', and 'Open Afterglow'. A red arrow points from the 'Resubmit' button in the sidebar to the text in the paragraph above.

ID	Length	Telescope	Filter	Time Taken	Delay	Status
0	18819314	120.0s	Prompt5	Red	Jul 04, 2017 23:24:29	N/A
1	18819315	120.0s	Prompt5	Green	Jul 04, 2017 23:26:37	N/A
2	18819316	120.0s	Prompt5	Blue	Jul 04, 2017 23:28:45	N/A

There are various software packages that can be used for processing your images, some of which are mentioned at the end of this manual under the software section. Obviously, I can't go through the specific procedures for all of these programs, so it is expected that the user be familiar with the techniques for their particular software. In this guide I will give specific procedures for processing, using AstrolImage J.

Download the user guide for AstrolImage J here:

http://www.astro.louisville.edu/software/astroimagej/guide/AstrolImageJ_User_Guide.pdf

If you have a Mac computer, this link will help you with the installation.

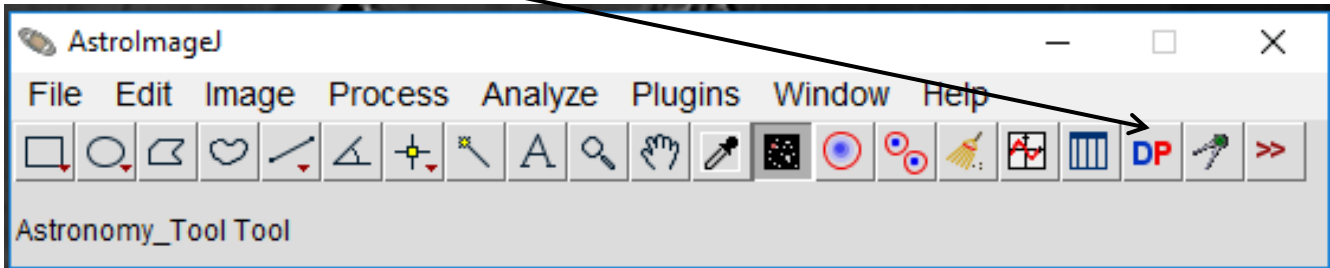
<http://astroimagej.1065399.n5.nabble.com/OS-X-10-12-and-10-13-Installation-Workaround-for-AIJ-td567.html>

CALIBRATING IMAGES

The first step in processing is to calibrate the images using bias, dark, and flat field frames. Skynet already creates master frames for these images which is a big-time saver. All you have to do is apply them to your image. This is an important step regardless of what telescope you are using.

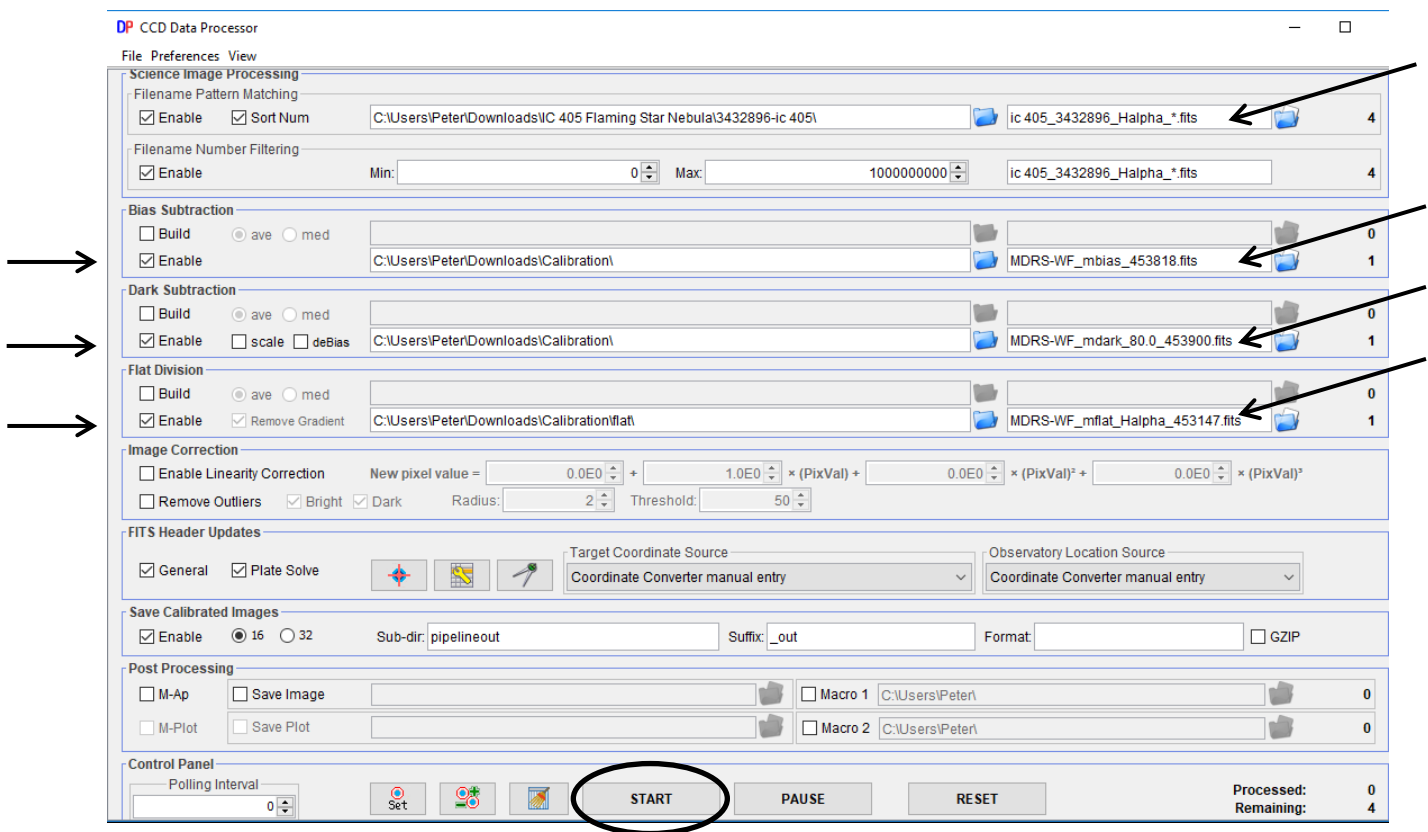
Download the Calibration Frames: You can download the master calibration frames as shown in the section under downloading images. Make certain you also download the fits files, and put them in a single folder on your computer, along with your images, in order that everything is together.

Open AstromageJ and under the tab **PROCESS**, click on the **DATA REDUCTION FACILITY** or use the **DP** shortcut.

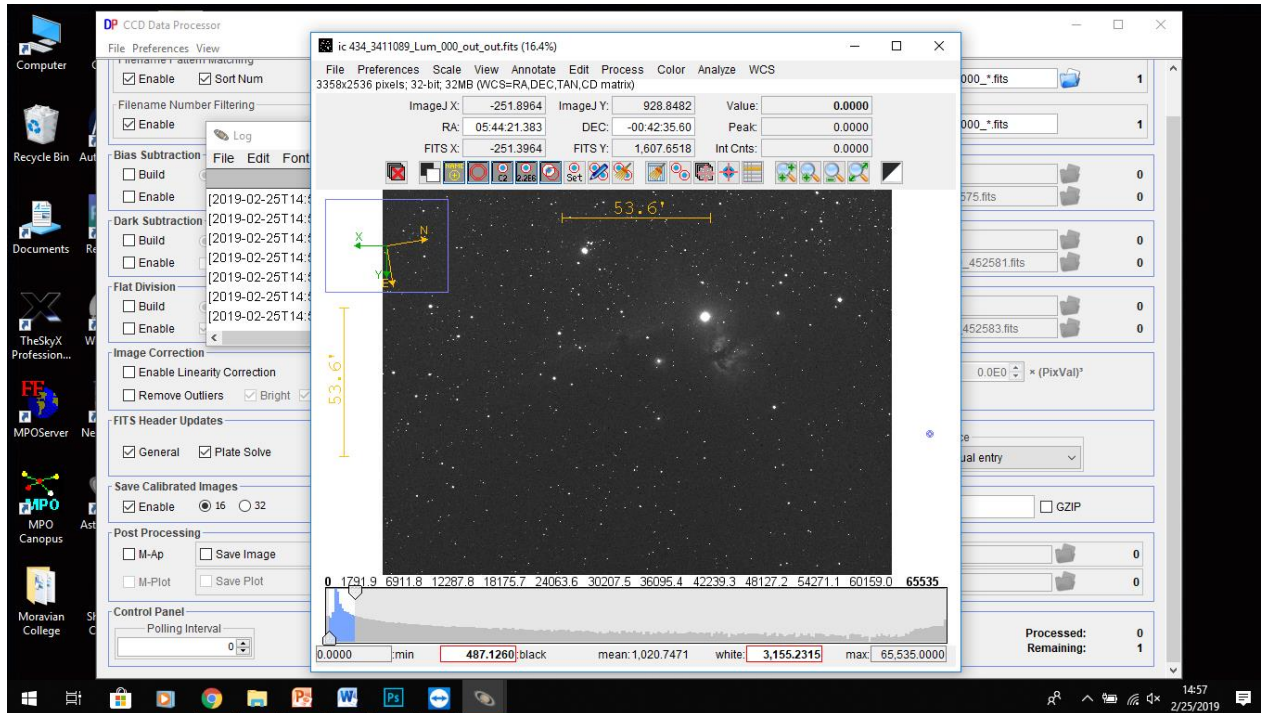


Two files will open with lots of numbers. We don't need the **DP Coordinate Converter** right now. You can close it out.

CCD Data Processor. This is what you'll be using to calibrate the images. Fields are provided to define the directory/folder locations and file names of data to be processed. Click on the folder icon, and go to the folder where your files are downloaded, and select the image(s). Detailed instructions can be found in "Chapter 6" of the *Astrolmage J User Guide*. Skynet has already created master calibration frames so you do not have to build them, just enable them. Press **START** when ready.



The final image(s) will come up. Notice the final name is already different and is designated in a folder labeled **PIPELINE OUT**. Your image is now calibrated.



SOFTWARE AND RESOURCES

Skynet

Website where you will be making and collecting observations with the robotic telescope.

Homepage: <https://skynet.unc.edu/>

AstroImage J

This is the freeware package I recommend in this manual.

Homepage: <https://www.astro.louisville.edu/software/astroimagej/>

User guide: http://www.astro.louisville.edu/software/astroimagej/guide/AstroImageJ_User_Guide.pdf

Image processing Resources for Astronomy Teaching

A great list of astronomy imaging software, both freeware and for purchase. Also has resources for remote telescopes and Citizen Science Projects.

<https://webhome.phy.duke.edu/~kolena/imagepro.html#ip>

American Association of Variable Star Observers

The AAVSO is an amazing source for finding observing projects and submitting data.

Homepage: <https://www.aavso.org/>

IAU Minor Planet Center

Professional site with data on asteroids and comets. Also, it is a good place to check on or submit new discoveries.

Homepage: <https://www.minorplanetcenter.net/iau/mpc.html>

July 18, 2020