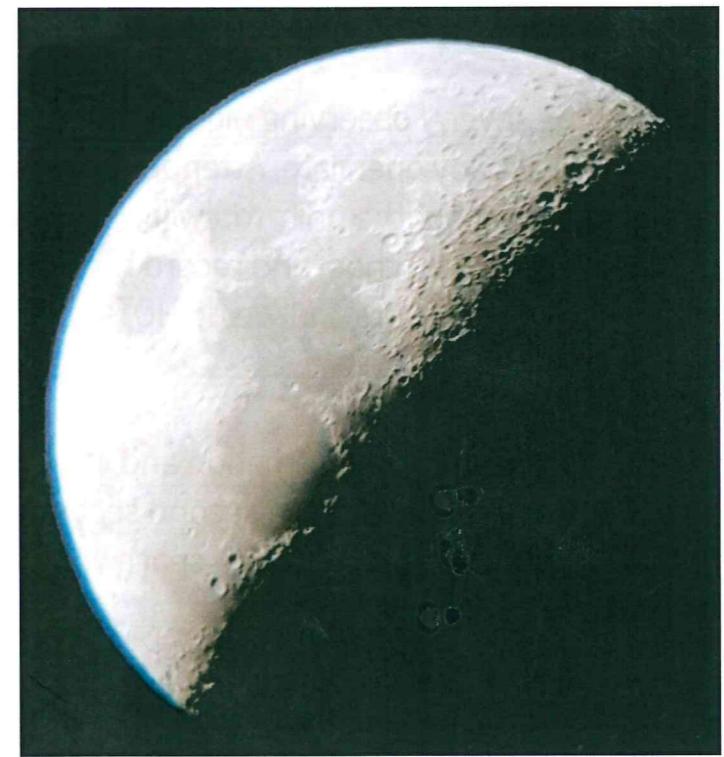


Observation Log



NAME

Master

SCHOOL

Introduction

During Unit 16B you will be making day and night time observations of astronomical objects such as the Sun, the Moon, the Planets, and various constellations and the stars in them.

You will keep all of your observations in this log so that they are safe and all in one place. If you take an image digitally, back it up online and also print out the picture to be stuck in this log.

You will be submitting three documents for 16B, a report on telescopes including an analysis of your observations, a zipped folder containing all your digital images (jpgs, FITS etc.), and this log.

As part of 16B there will be several observing nights scheduled. These will usually be when the school is already open late. Attendance is mandatory so that you pass the observation aspect of the unit. You will also have to be organised and make observations outside of school and record them here. Observations of the sun will be done in school hours and we do NOT recommend you observe the sun from home.

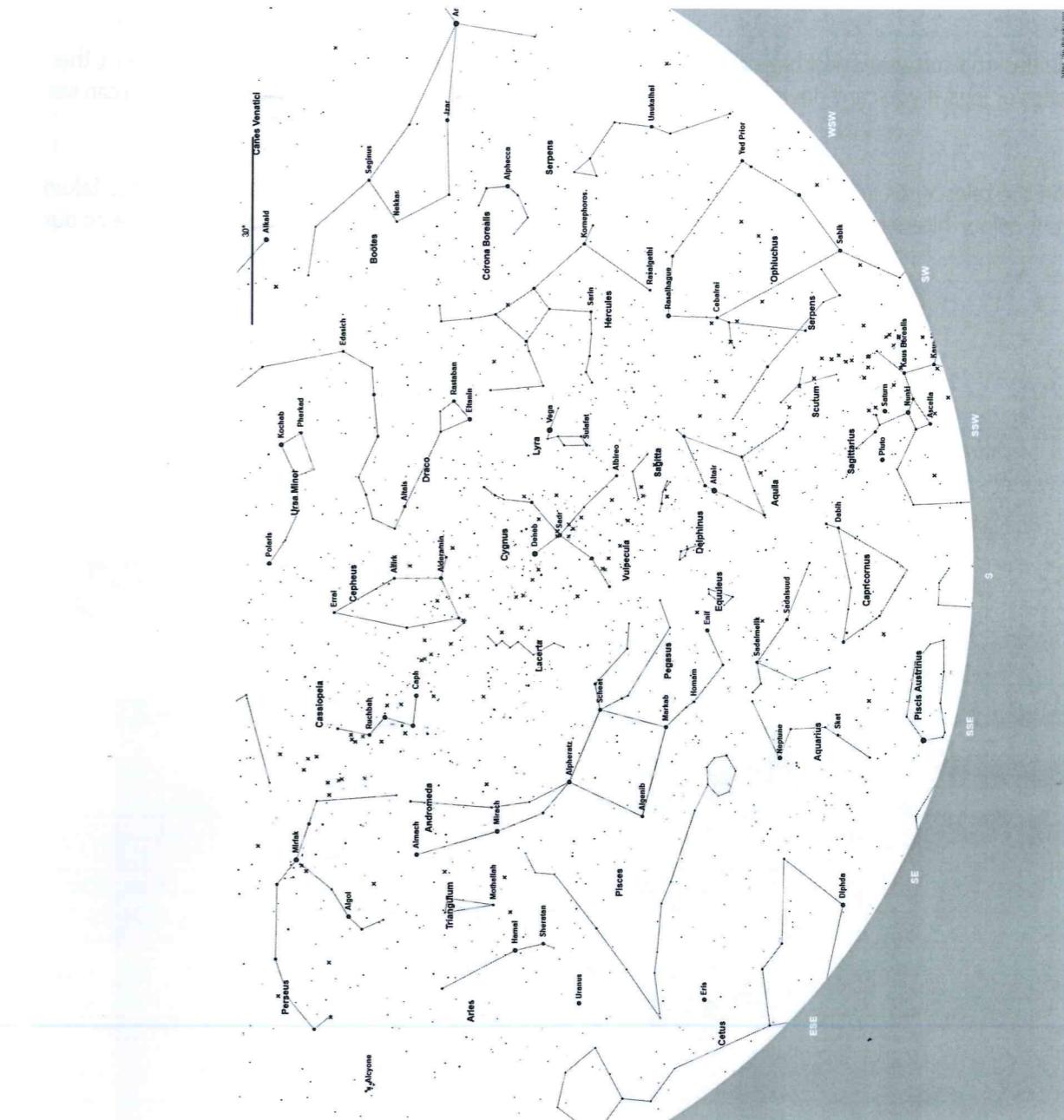
The first section of the log has useful information and instructions on how to construct an astrolabe and solar viewer. The second section has space for you to record your observations. If you require extra space you can attach more pages to the log with a treasury tag.

Useful Websites:

- Astronomy Picture of the Day - <https://apod.nasa.gov/apod/astropix.html>
- In-The-Sky.org Sky Maps - <https://in-the-sky.org//skymap.php?skin=1>
- Heavens Above Satellite Predictions - <https://www.heavens-above.com/>
- Las Cumbres Observatory - <https://lco.global/>
- National Schools' Observatory - <https://www.schoolsobservatory.org/>
- Daily SOHO Images - https://sohowww.nascom.nasa.gov/data/synoptic/sunspots_earth/
- NASA Photojournal - <https://photojournal.jpl.nasa.gov/>
- Stellarium Planetarium Software (online) - <https://stellarium-web.org/>
- JS9 The online version of SAOImageDS9 - <https://js9.si.edu/>

Starmaps

Nottingham 180° South
2019/11/21



You can make your own star maps like this one by visiting: In-The-Sky.org Sky Maps - <https://in-the-sky.org//skymap.php>. Make sure you choose the correct date and time. Slide the Field of View slider to 180 degrees then drag the image until the S (South) marker is at the bottom edge. Below the image in the 'Show' box select the Ecliptic, Galactic Plane, and Show Scalebar. Change the colour scheme to one of the printer friendly options. At least double the width and height of the image and export as PNG. If export as PNG fails export as SVG then open it with your web browser and print from there. Print your map A3 size so it's easier to plot your observations.

Repeat for the N (North) direction.

Creating RGB Images

You have each been given a student account on the National Schools Observatory which gives you access to a 2 m research grade telescope (the Liverpool Telescope) in Tenerife. There will also be opportunities to remotely control 2 m telescopes in Hawaii and Australia through the Las Cumbres Observatory network. The image files that you will get from these telescopes are called FITS files. FITS stands for flexible interchangeable transport system and is the standard file format for astronomical images.

You can use the desktop software SAOImageDS9 which is free to download to open your images, colour them, then save them as pngs or jpgs. If you can't download the software there is an online version called JS9 which you can see in the image below.

The cameras on the telescopes are black and white. To get a colour image you need three grayscale images taken through different colour filters (one red, one green, and one blue). To combine three FITS files into a single colour image you can follow the tutorial here for DS9:

<http://ds9.si.edu/doc/user/rgb/index.html>

or here for JS9:

<https://js9.si.edu/js9/demos/js9rgb.html>

JS9: astronomical image display everywhere

File Edit View Zoom Scale Color Regions WCS Analysis Help

Intro Plugins Analysis Demos Help Status Get Thanks

000 23:23:43.162 +58:50:56.70 0.000000 0.000000 (physical)

cool 100% log (0.51) ICRS casa.fits

Questions? Eric Mandel Source code @GitHub Follow @astrosoftware

About | Research | Education & Outreach | Events | News | Privacy

CENTER FOR ASTROPHYSICS | HARVARD AND SMITHSONIAN
60 GARDEN STREET, CAMBRIDGE, MA 02138

Astronomical Calendar

There are many astronomical calendars online but I find <http://www.seasky.org/astronomy/astronomy-calendar-2020.html> to be the best. Some Notable events for this academic year include:

September 11 - Neptune at Opposition.

October 1 - Mercury at Greatest Eastern Elongation.

October 13 - Mars at Opposition.

October 31 - Uranus at Opposition.

December 13-14 - Geminids Meteor Shower Peak.

2021

January 2-3 - Quadrantids Meteor Shower Peak.

March 20 - Venus at Greatest Western Elongation.

June 10 - Annular Solar Eclipse.

Be sure to check out seasky.org for the full list.

October 13 - Mars at Opposition. The red planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Mars. A medium-sized telescope will allow you to see some of the dark details on the planet's orange surface.

October 16 - New Moon. The Moon will be located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 19:32 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

October 21, 22 - Orionids Meteor Shower. The Orionids is an average shower producing up to 20 meteors per hour at its peak. It is produced by dust grains left behind by comet Halley, which has been known and observed since ancient times. The shower runs annually from October 2 to November 7. It peaks this year on the night of the 21st and the morning of the 22nd. The waxing crescent moon will set before midnight leaving dark skies for what should be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Orion, but can appear anywhere in the sky.

How to make a Solar Viewer

A solar viewer lets you project an image of the sun onto a piece of paper for safe viewing. The results will not be as good as using a dedicated solar telescope but it is the safest and easiest way to observe the surface of the sun.

WARNING: Never look directly at the sun without protection and proper filters.

To make a solar viewer take a piece of card and poke a small round and smooth hole in it using a compass or needle. You can then use your solar viewer as shown in the image below.

Your results will be better if you make a large hole in the card and stick aluminium foil over the hole. Then poke a small hole through the foil using a needle.



How to make an Astrolabe

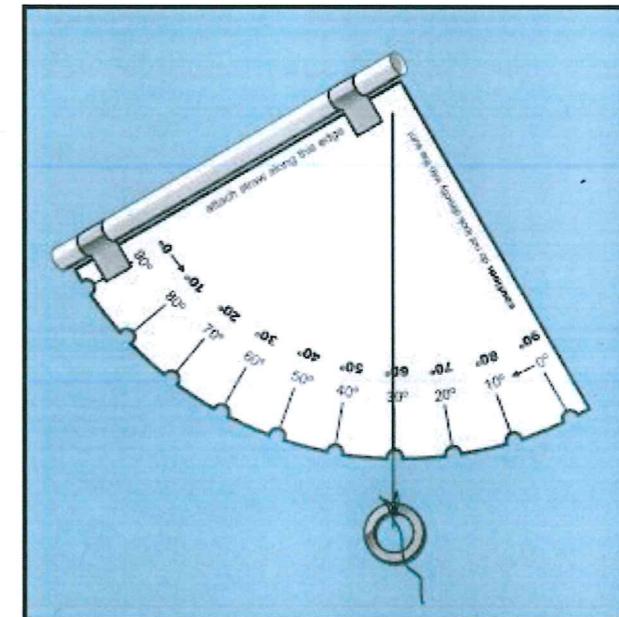
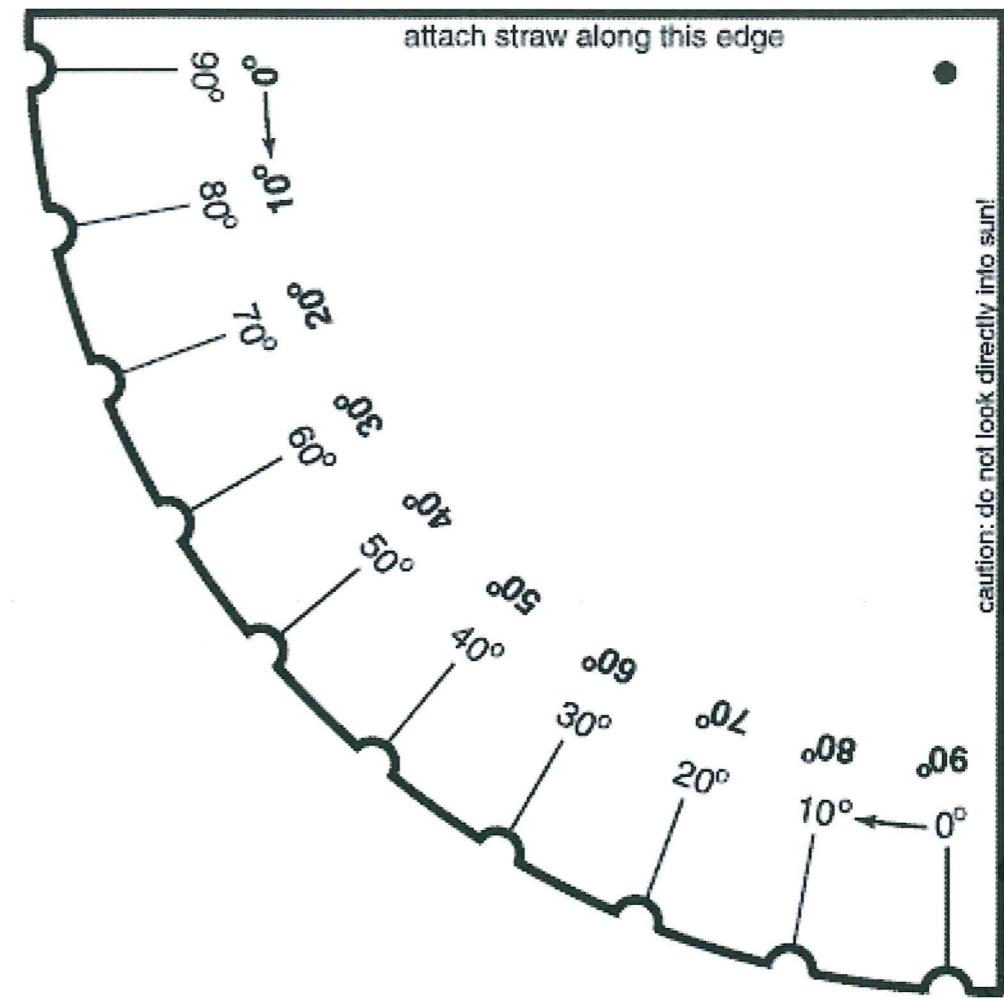
Using your astrolabe you can measure the inclination of astronomical objects. That is how high above the horizon in degrees the object is.

- 1) Cut out the next page and glue it onto a piece of thick card. Then cut around the template.
- 2) Take a straw and cellotape it to the top edge of the astrolabe.
- 3) Poke a hole where the black dot is. Put a piece of string through the hole. Tie a knot on one side and to the other side tie a small weight or a piece of plasticine to act as a weight.

To use your astrolabe look through the straw and locate an object. Hold the astrolabe steady and read off the angle that the string crosses on the scale as it hangs under gravity. It is easier if you work in pairs to get measurements.

Never use your astrolabe on the sun!!! You can try and measure the inclination of the sun by locating it with your hand. Place your hand at the end of the straw and move the astrolabe until a bright dot appears on your hand.

Your finished astrolabe should look like the image below from At Home Astronomy. The template is also from At Home Astronomy (cse.ssl.berkeley.edu/AtHomeAstronomy/activity_07.html).



Definitions

Find the definitions for the following words/astronomical terms and write them in the space below.

Right Ascension and Declination

Altitude and Azimuth

Prograde Motion

Retrograde Motion

Ecliptic Plane

Equatorial Plane

Solar Plane

Definitions

Find the definitions for the following words/astronomical terms and write them in the space below.

Apparent Magnitude

Absolute Magnitude

Resolution

Magnification

Aperture

Focal Length

Lens Power

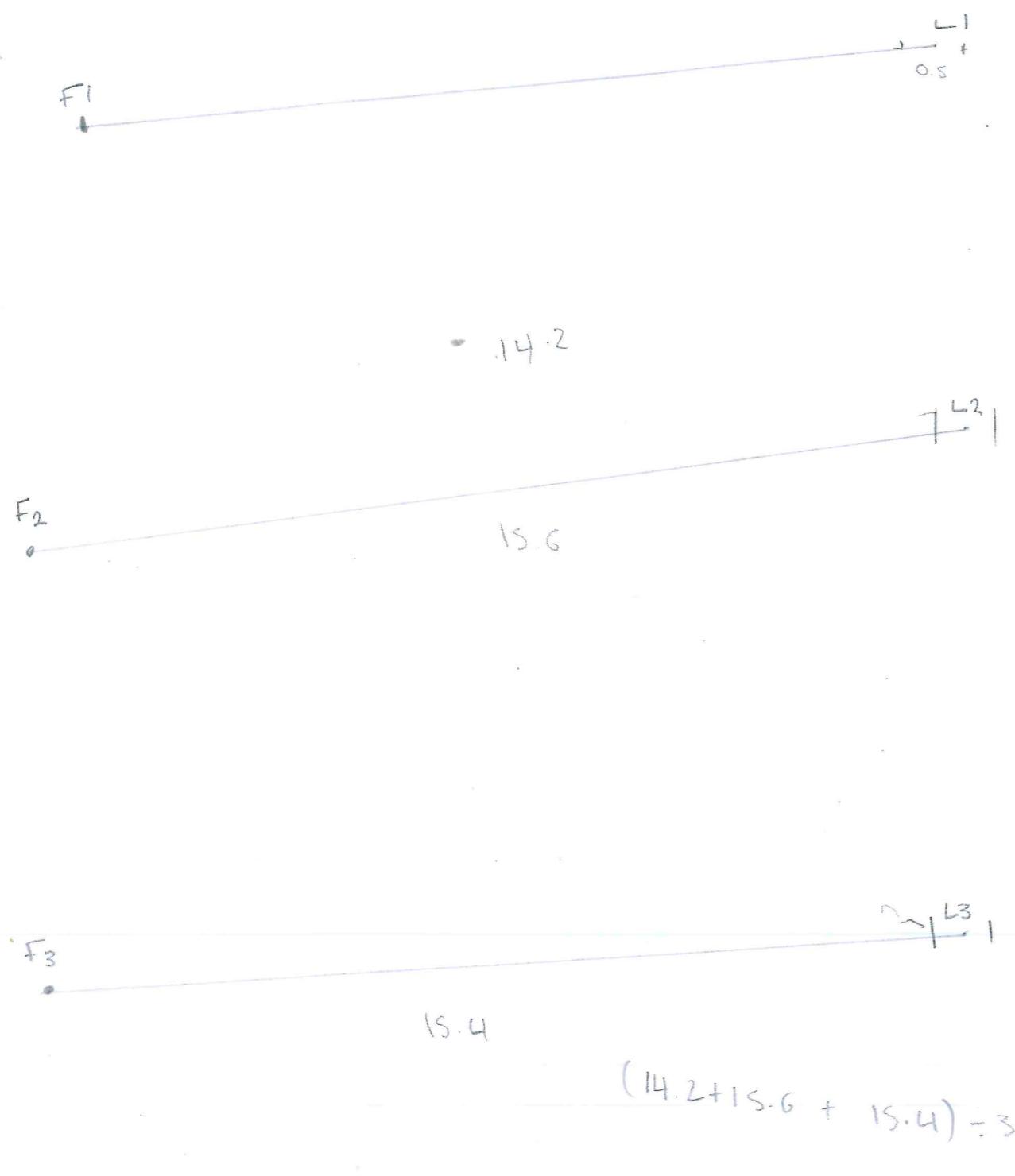
Ray Diagrams

You are going to draw some ray diagrams to measure the focal lengths of converging and diverging lenses, and concave and convex mirrors. These are vital components in all telescopes and a great deal of care goes into making flawless optics with very precise focal lengths.

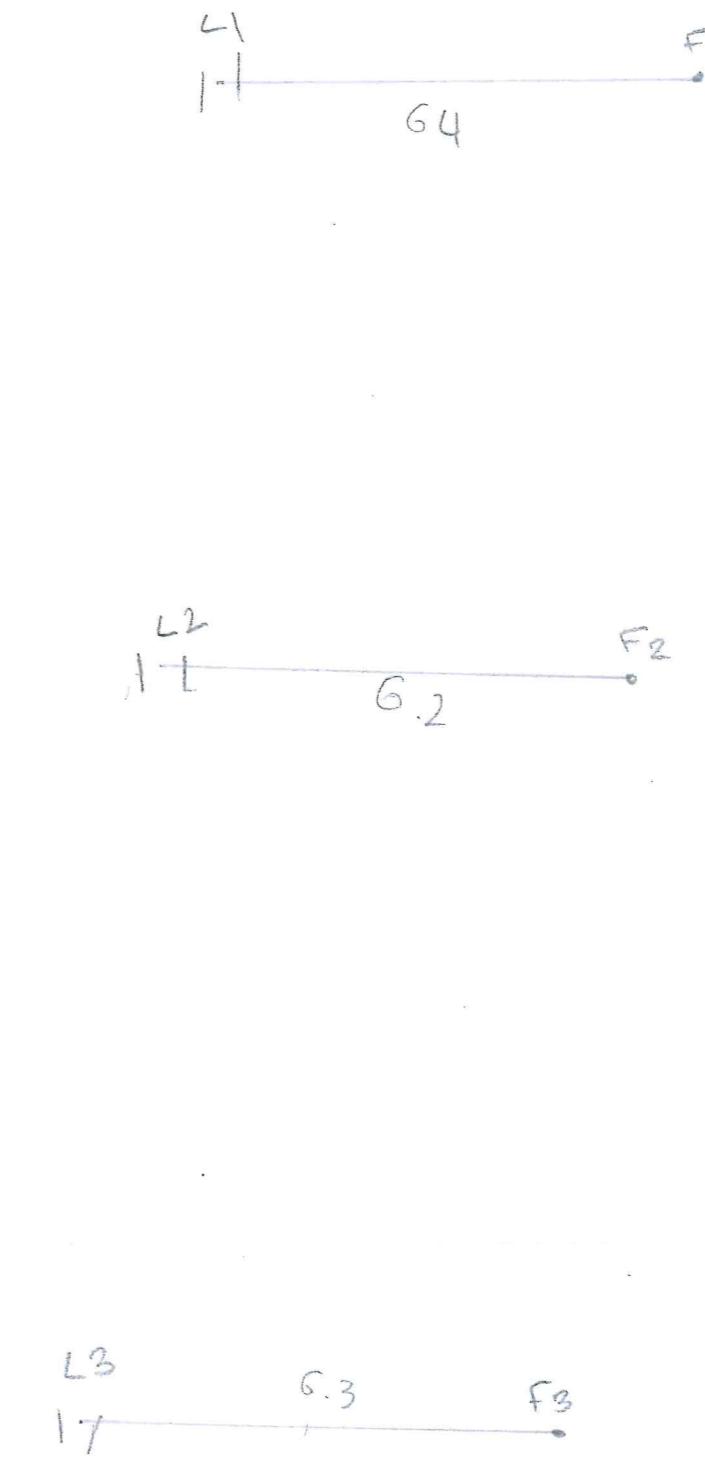
On this page write a general method (by hand or type and stick in) for measuring the focal lengths of the lenses and mirrors. Use the next four pages to draw your ray diagrams.

Method:

Ray Diagram - Converging Lens

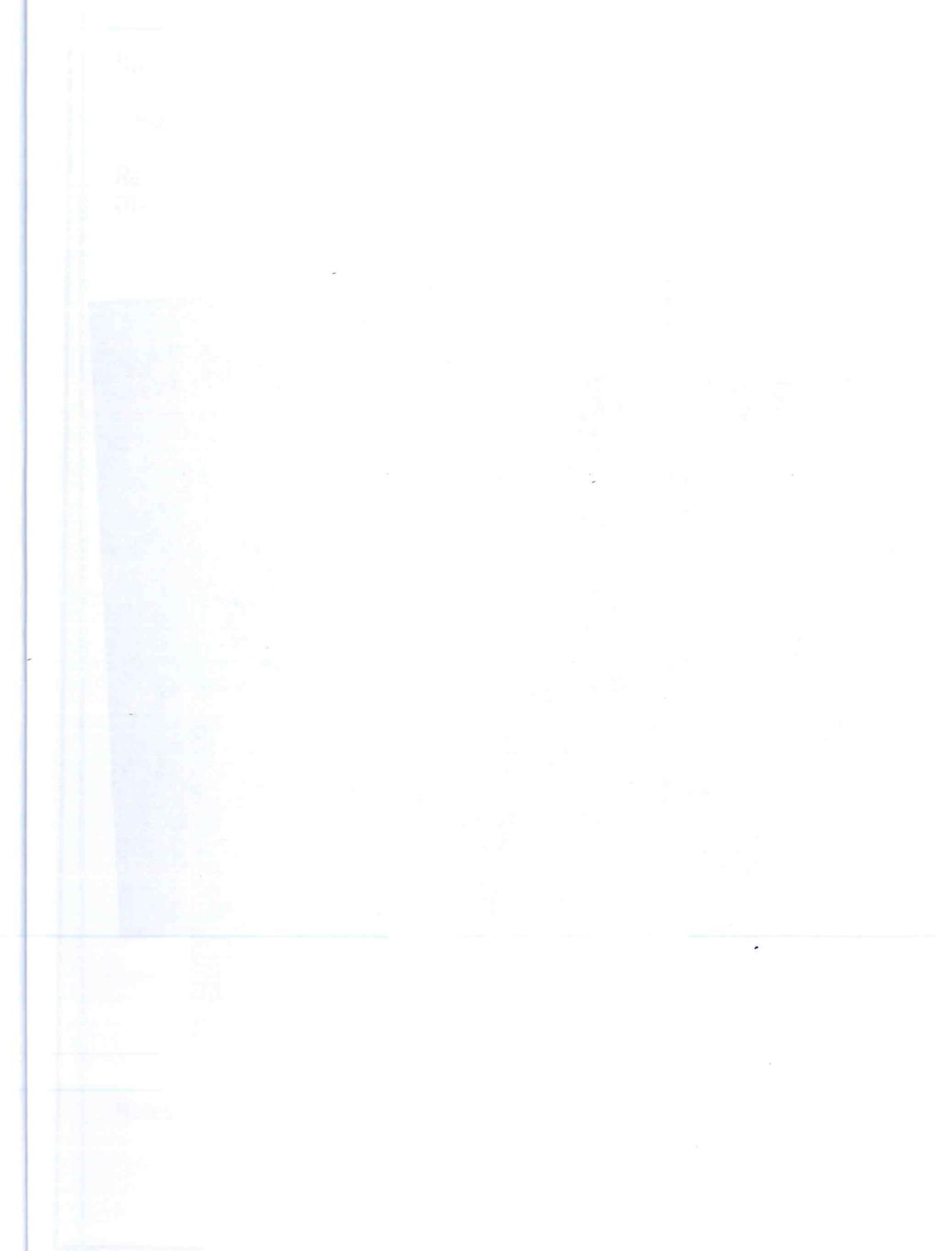


Ray Diagram - Diverging Lens



Ray Diagram - Convex Mirror

Ray Diagram - Concave Mirror



Observation Log

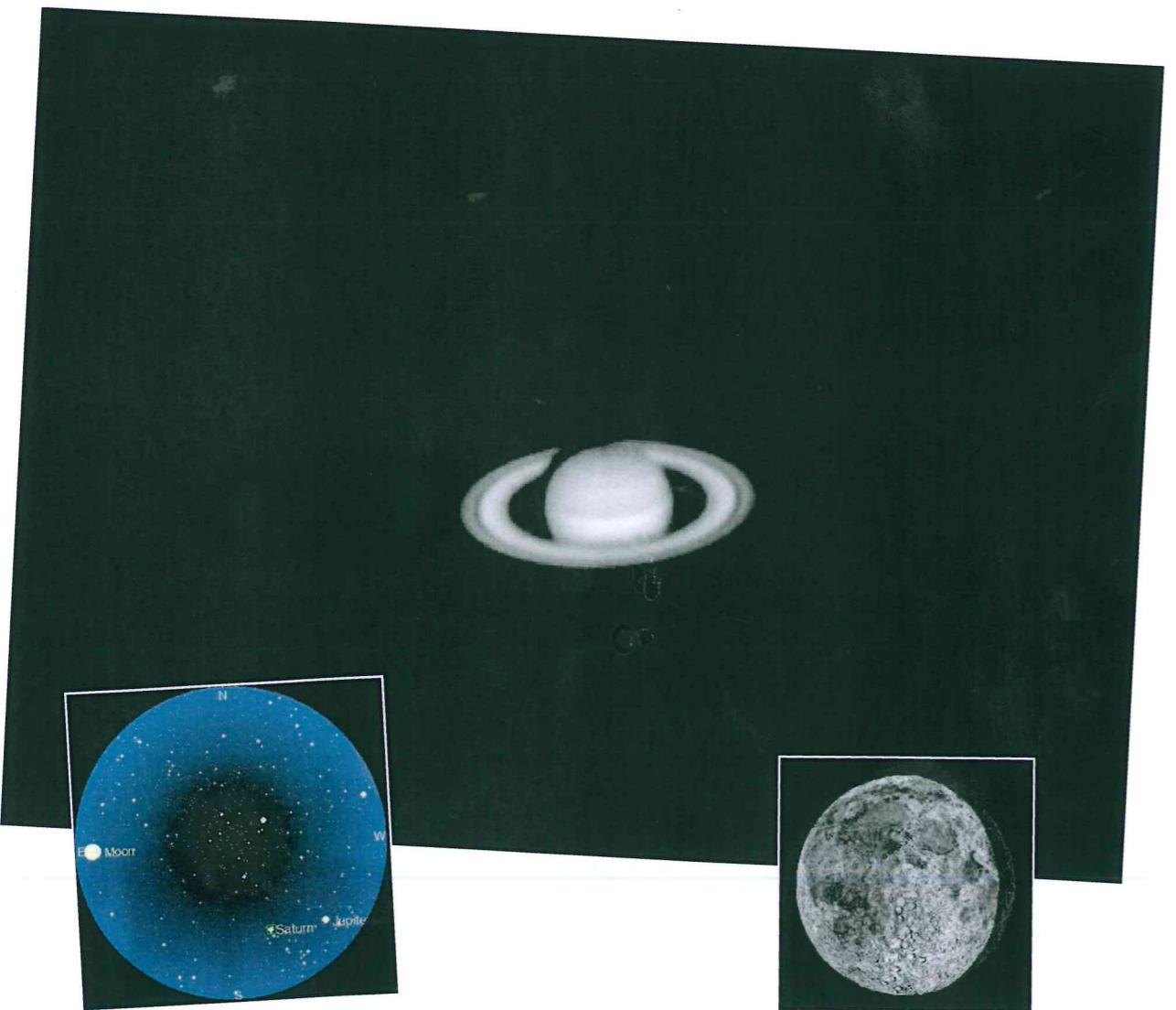
Use this page to log your observations!

Objects Observed:

Saturn!

Results:

(This could be a star map, a photo, a drawing, or something else!)



Notes:

The Liverpool Telescope is awesome and free for UK schools to use!
Visit - www.schoolobservatory.org

Date: 16/9/2019
Location: Tenerife (Liverpool Telescope)
Weather Conditions: Clear
Fellow Astronomers: Max
Moon Phase: Waning gibbous

Sky Mapping

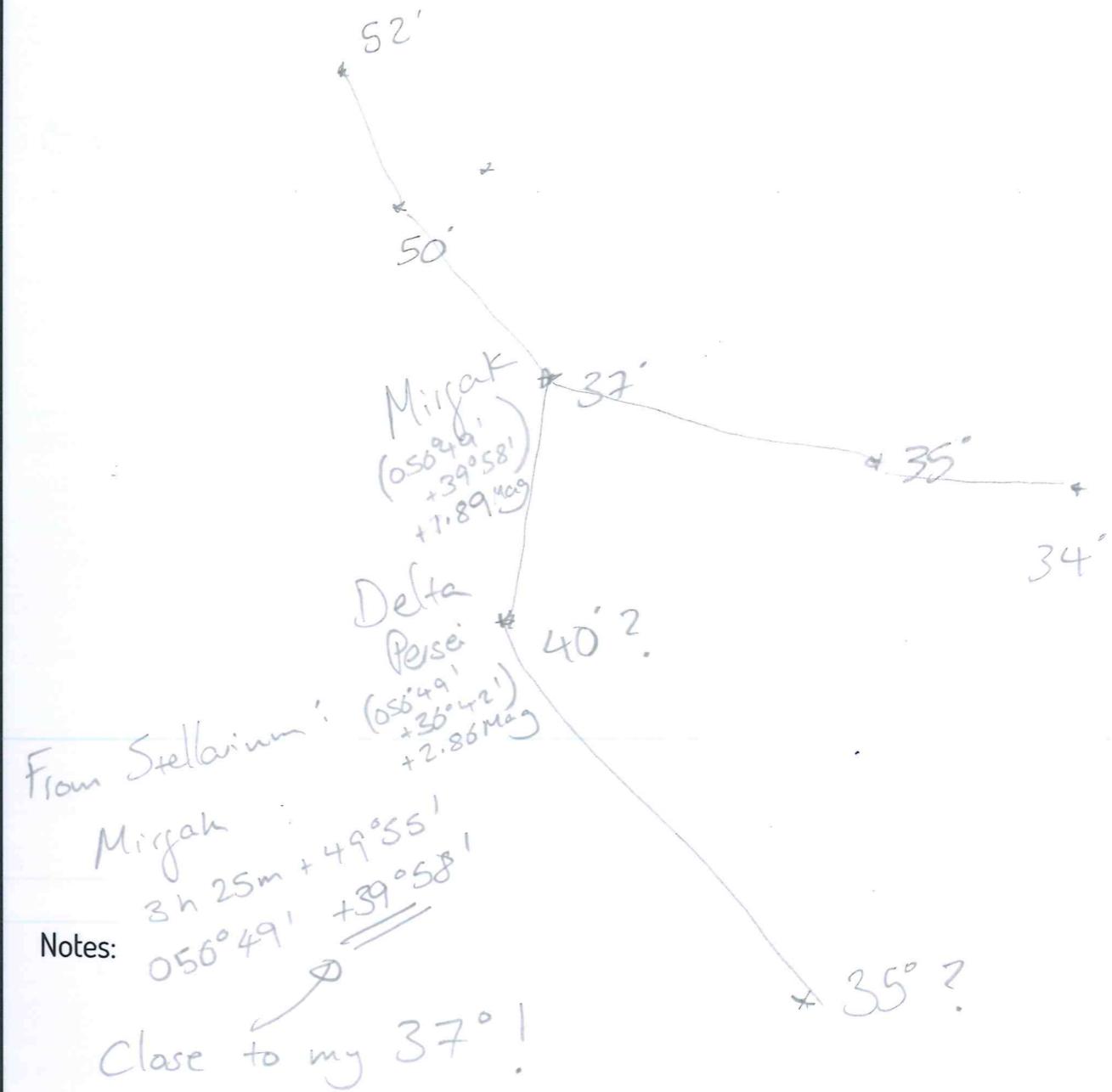
Use this page to log your observations!

Objects Observed:

Perseus constellation

Results:

(This could be a star map, a photo, a drawing, or something else!)



Date: 2019/11/11
Location: NUAST
Weather Conditions: Fair
Fellow Astronomers:
Moon Phase: Half

Constellation 1

Use this page to log your observations!

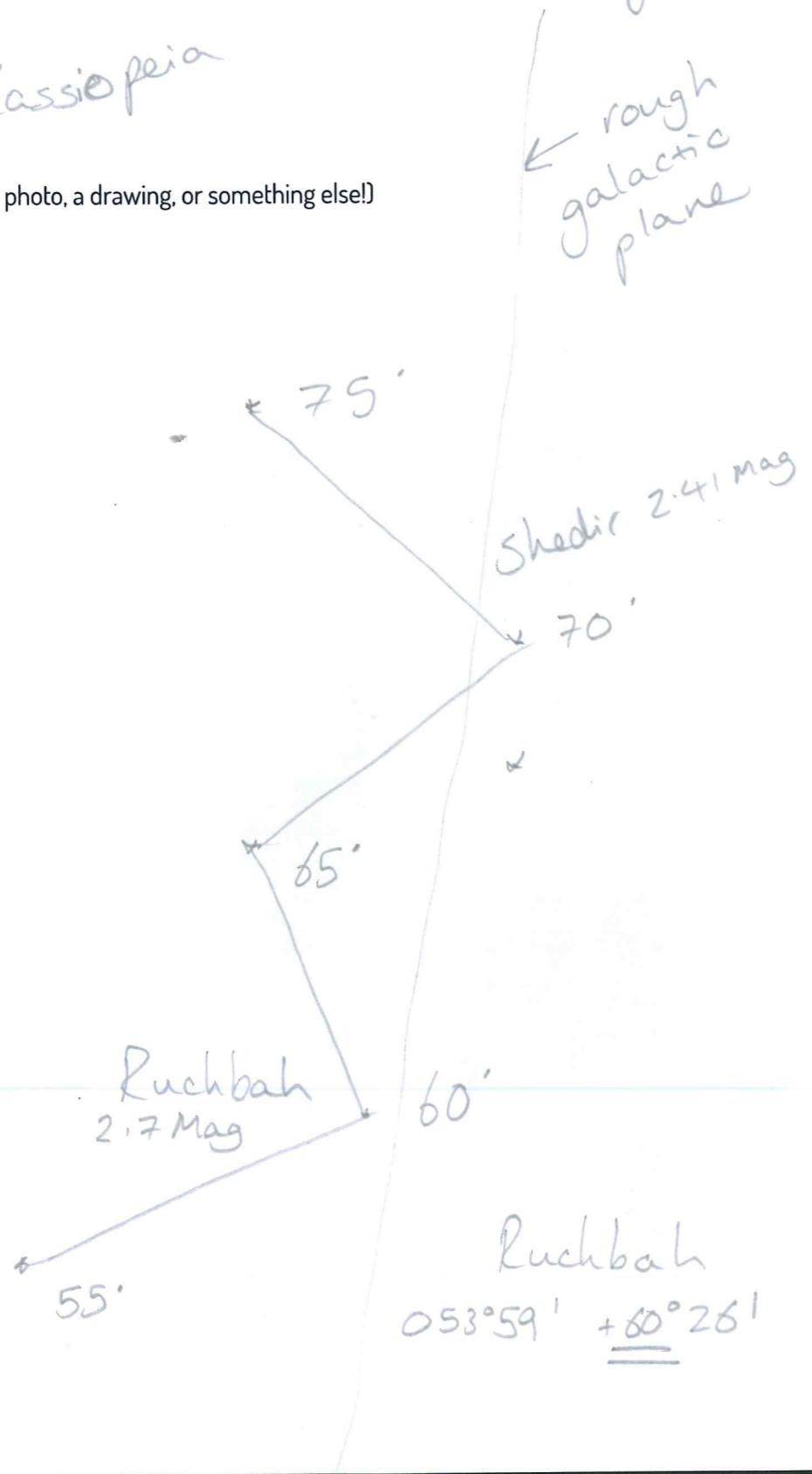
Date: 2019/11/11
Location: NOAST
Weather Conditions: Fair
Fellow Astronomers: /
Moon Phase: Half

Objects Observed:

Cassiopeia

Results:

(This could be a star map, a photo, a drawing, or something else!)



Notes:

Constellation 2

Use this page to log your observations!

Date: _____
Location: _____
Weather Conditions: _____
Fellow Astronomers: _____
Moon Phase: _____

Objects Observed:

Results:

(This could be a star map, a photo, a drawing, or something else!)

Notes:

Constellation 3

Use this page to log your observations!

Objects Observed:

Results:

(This could be a star map, a photo, a drawing, or something else!)

Notes:

Date: _____
Location: _____
Weather Conditions: _____
Fellow Astronomers: _____
Moon Phase: _____

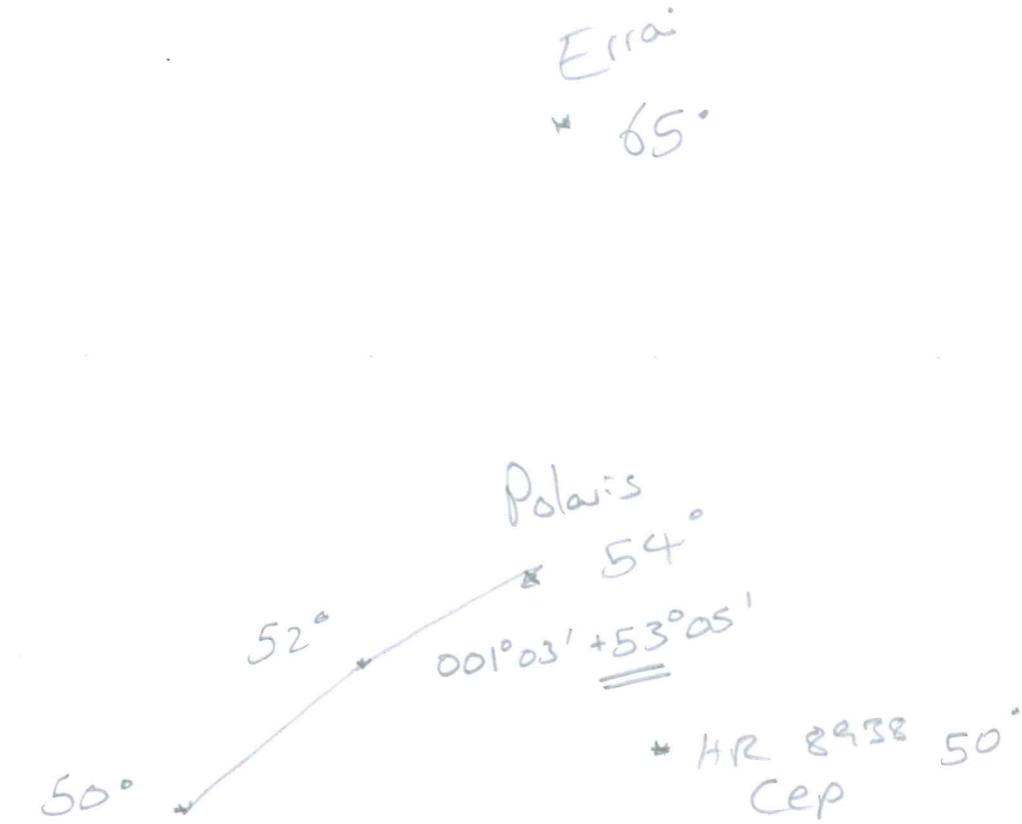
Polaris

Use this page to log your observations!

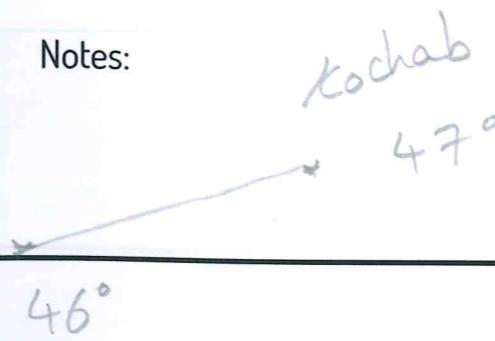
Objects Observed:

Results:

(This could be a star map, a photo, a drawing, or something else!)



Notes:



Date: 2019/11/1
Location: NUAST
Weather Conditions: Fair
Fellow Astronomers: /
Moon Phase: Half

Moon

Use this page to log your observations!

Objects Observed:



Distance to the Moon

To calculate the distance to the moon you need to work out the resolution of the image [note this won't work if the full disk of the moon isn't visible in your image].

$$\text{resolution [arcsec / pixel]} = \text{pixel size [micrometre]} / \text{focal length [mm]} * 206.25$$

You'll need to look up the pixel size for your camera and the focal length of the telescope. If you used a smartphone then you should also times your result by the focal length of your smartphone's camera.

The distance to the moon in parsecs is then just:

$$d = D / \tan(\theta) \quad \text{where} \quad \theta = \text{resolution} * \text{diameter of the moon in pixels}$$

D is the diameter of the moon which is approximately 3474.2 km.

My image resolution: 0.7641"/pixel

Working:

$$\text{res} = 1.3 / 700 * 206.25 * 4.1 \quad (4.1 \text{ from smartphone})$$

Pixel co-ords on photo (1356, 2489) & (1140, 406)

My calculated distance: 452,000 km (3sf)

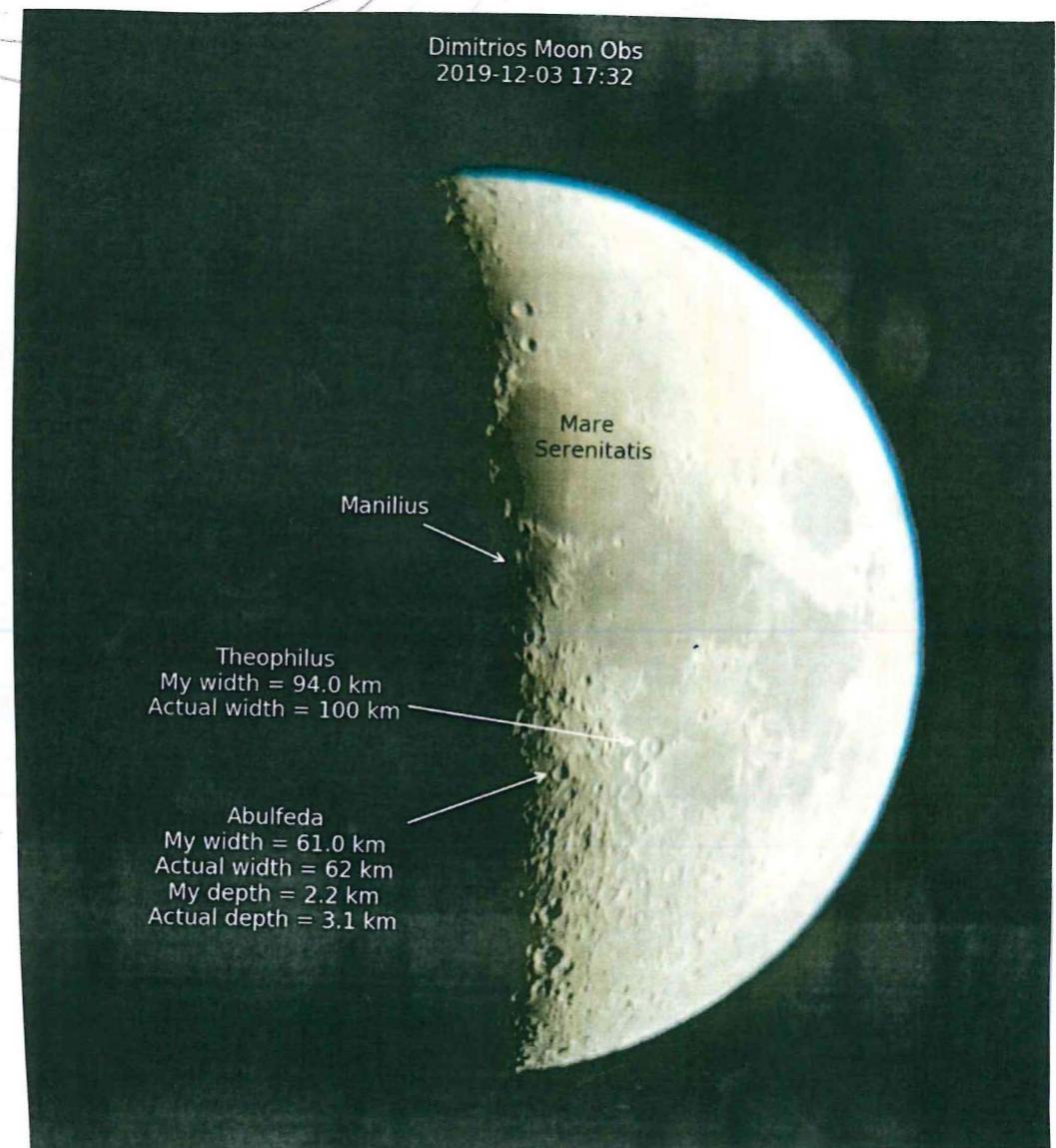
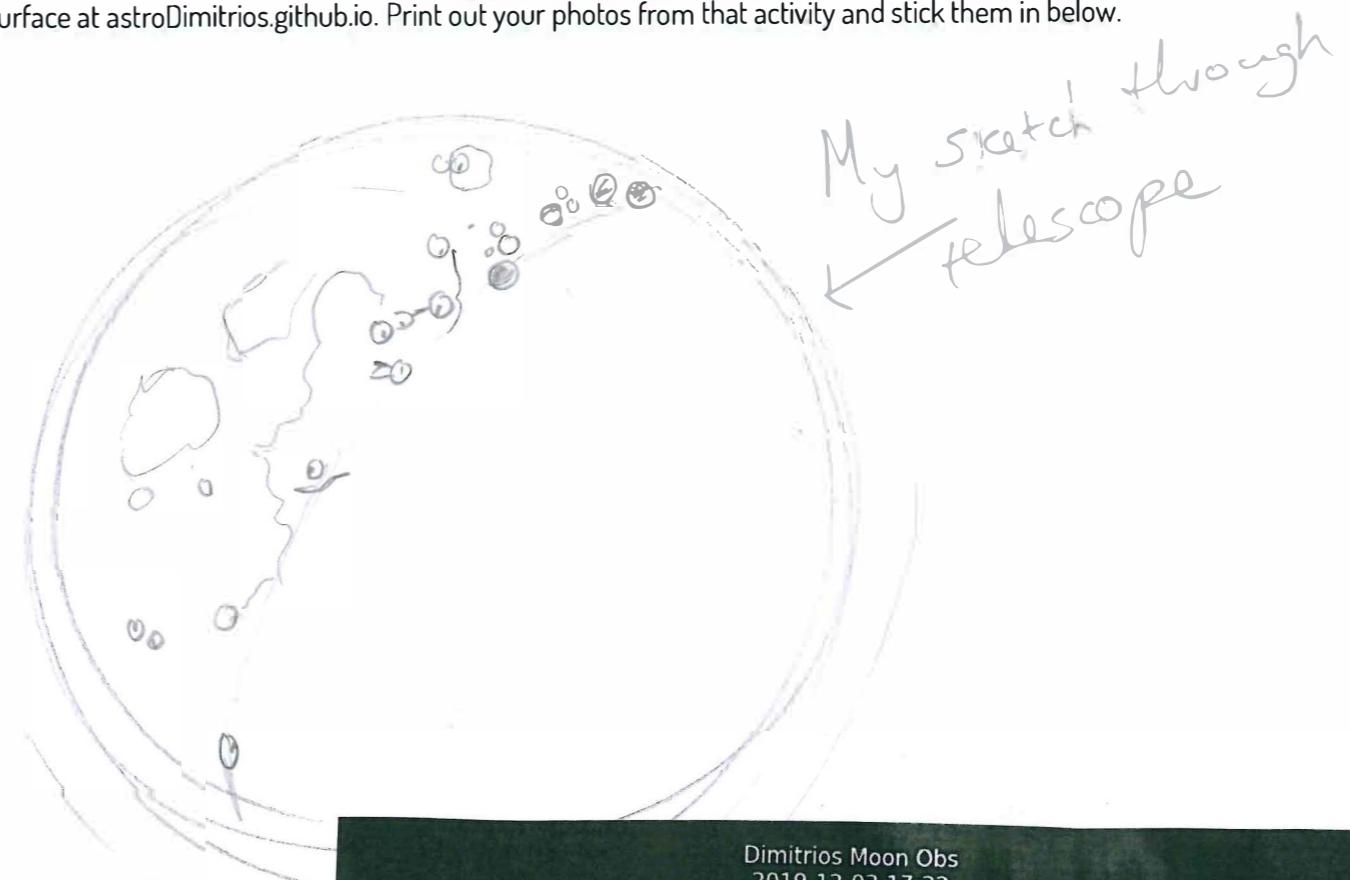
$$\begin{aligned} \text{change in } x &= 1356 - 1140 = 216 \\ \text{change in } y &= 2489 - 406 = 2083 \\ \text{diameter in pixels} &= \sqrt{2083^2 + 216^2} = 2094 \end{aligned}$$

Actual distance: 385,754.7 km from Stellarium

$$\theta = 0.7641 * 2094 * 0.000277778$$

Date: 2019/11/11
 Location: NuAST
 Weather Conditions: Fair
 Fellow Astronomers:
 Moon Phase: Half

You need to make an annotated version of your moon image. You can do this with the coding activity AstPy-7 Lunar Surface at astroDimitrios.github.io. Print out your photos from that activity and stick them in below.



Solar Projection

Use this page to log your observations!

Date: 2019/10/22
Location: NUAST
Weather Conditions: Clear
Fellow Astronomers: /
Moon Phase: /

Objects Observed:

Results:

(This could be a star map, a photo, a drawing, or something else!)



No sunspots visible!

Notes:

Sun with Telescope

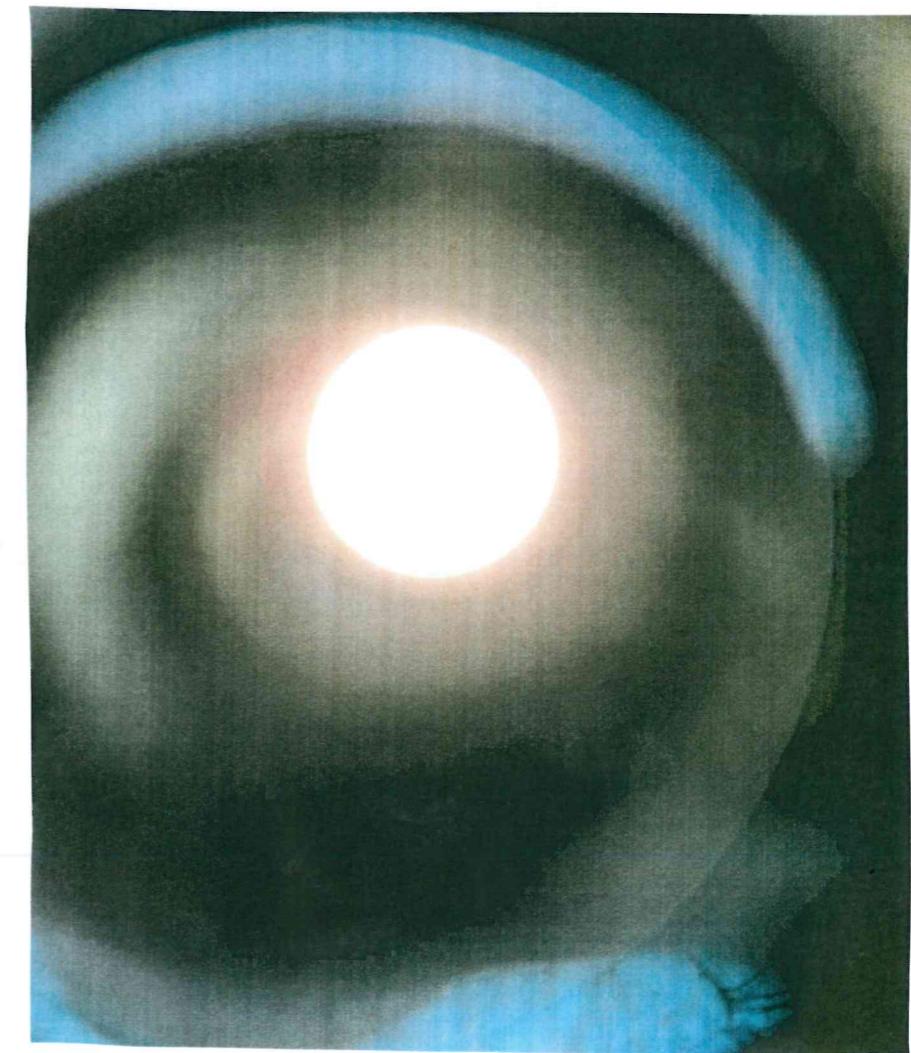
Use this page to log your observations!

Date: 2019/10/22
Location: NUAST
Weather Conditions: Clear
Fellow Astronomers: /
Moon Phase: /

Objects Observed:

Results:

(This could be a star map, a photo, a drawing, or something else!)



Notes: No sunspots

Photo shows reflections from eyepiece

Extra

Use this page to log your observations!

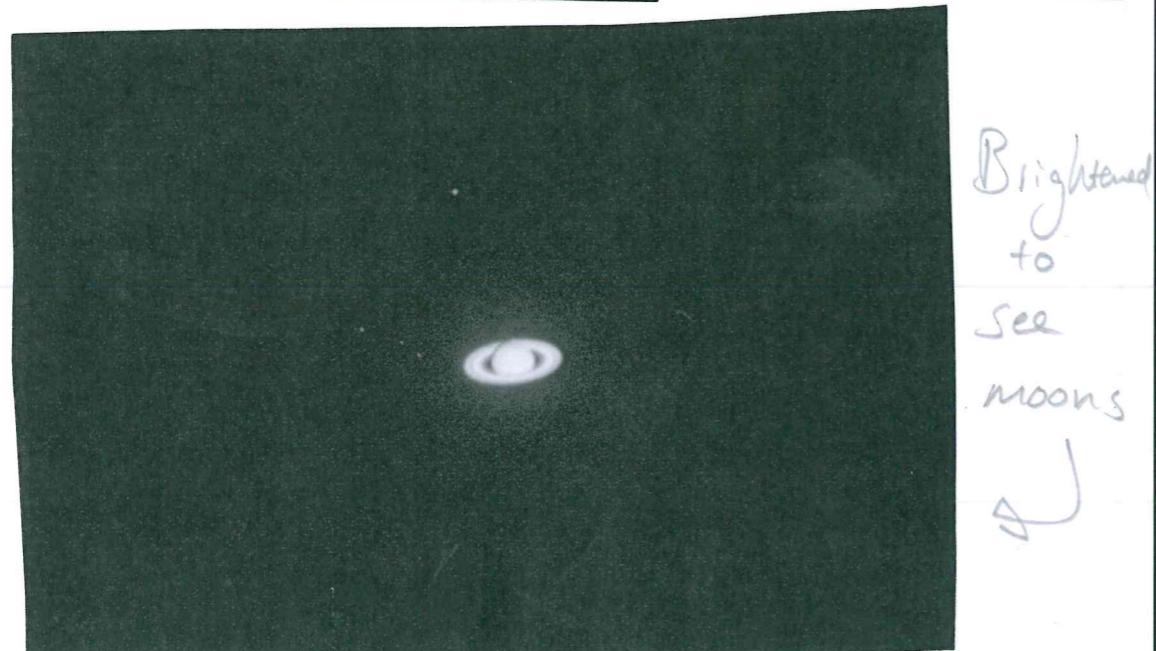
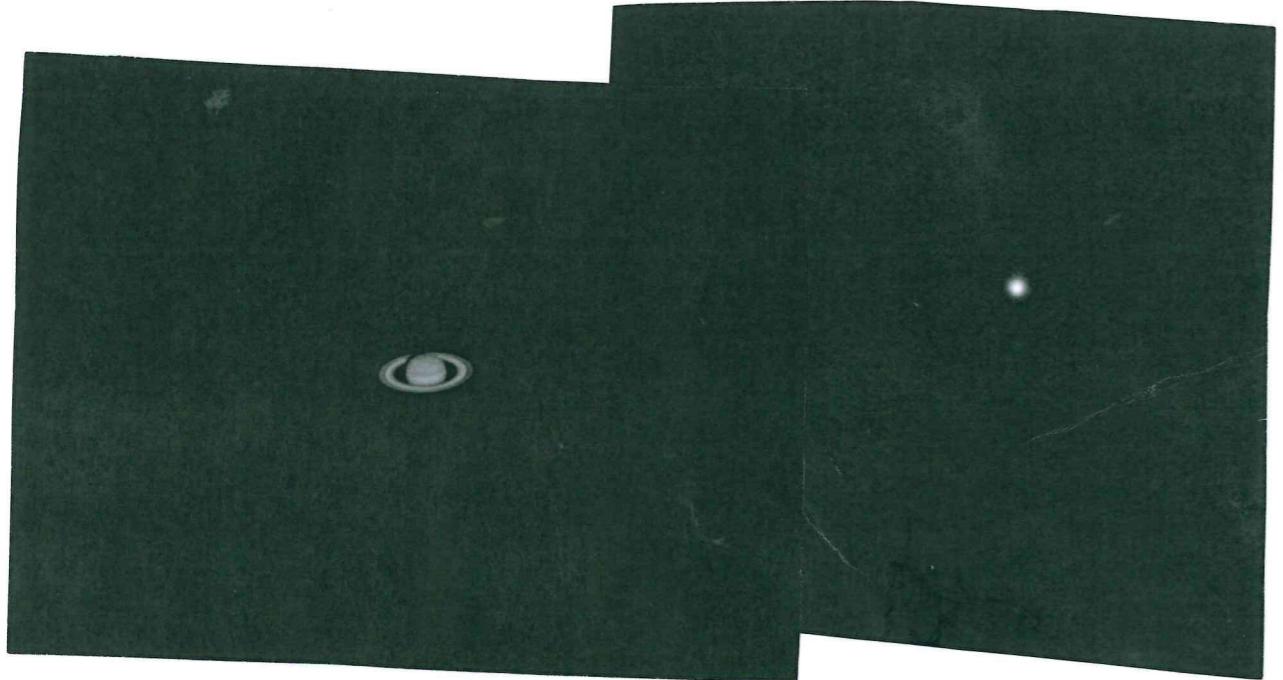
Date: 2019 / 10 / 11
Location: NSO / NUAST
Weather Conditions: /
Fellow Astronomers: /
Moon Phase: /

Objects Observed:

Saturn & Uranus NSO

Results:

(This could be a star map, a photo, a drawing, or something else!)



Notes:

Extra

Use this page to log your observations!

Date: 2019 / 10 / 30
Location: NSO / NUAST
Weather Conditions: /
Fellow Astronomers: /
Moon Phase: /

Objects Observed:

Pinwheel Galaxy NSO

Results:

(This could be a star map, a photo, a drawing, or something else!)



Extra

Use this page to log your observations!

Objects Observed:

M1 Crab Nebula



Results:

(This could be a star map, a photo, a drawing, or something else!)

Date: 2019/10/30
Location: NSO/NUAST
Weather Conditions: /
Fellow Astronomers: /
Moon Phase: /

Extra

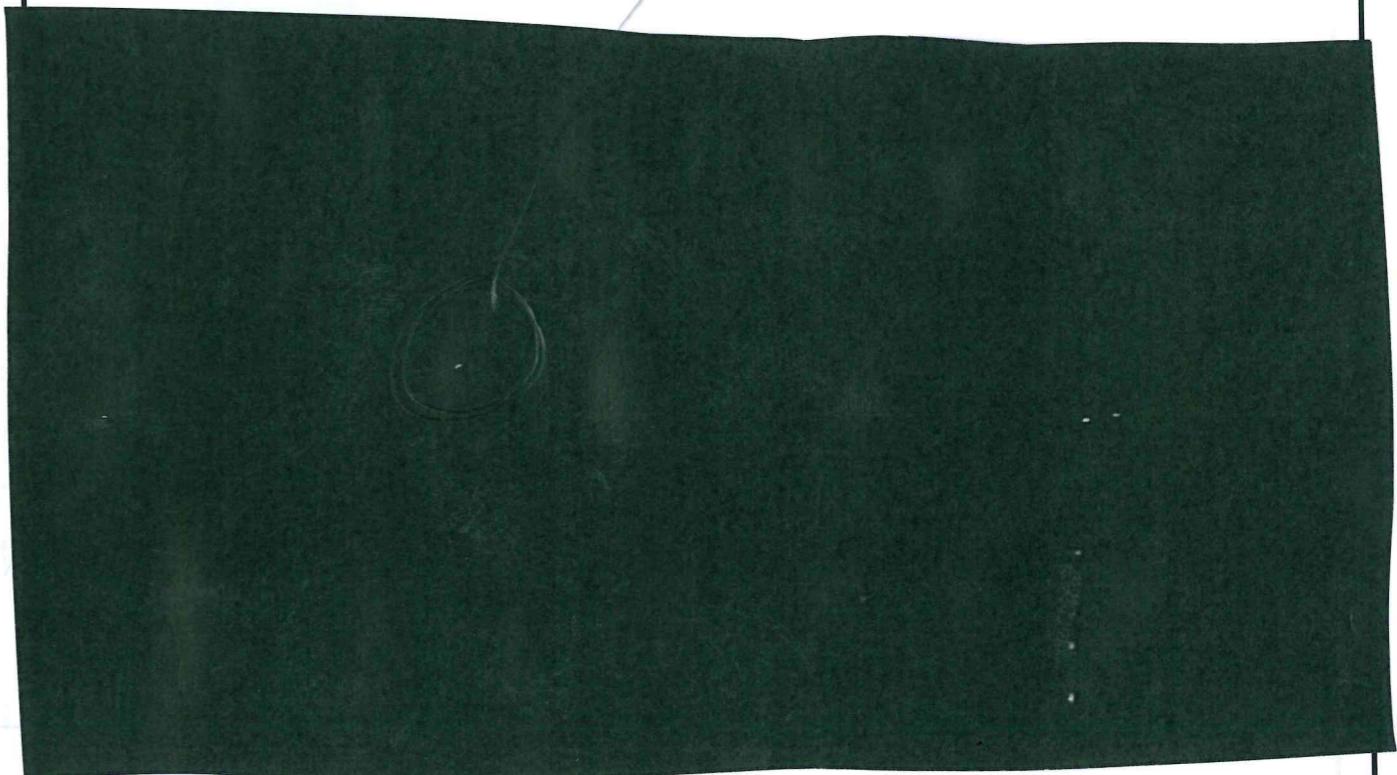
Use this page to log your observations!

Objects Observed:

ISS

Results:

(This could be a star map, a photo, a drawing, or something else!)



Notes:
2 min 31 s pass
peak mag -3.4

Hard to
observe with
a phone!

Date: 2019/11/13
Location: NUAST
Weather Conditions: /
Fellow Astronomers: /
Moon Phase: Half ~54%

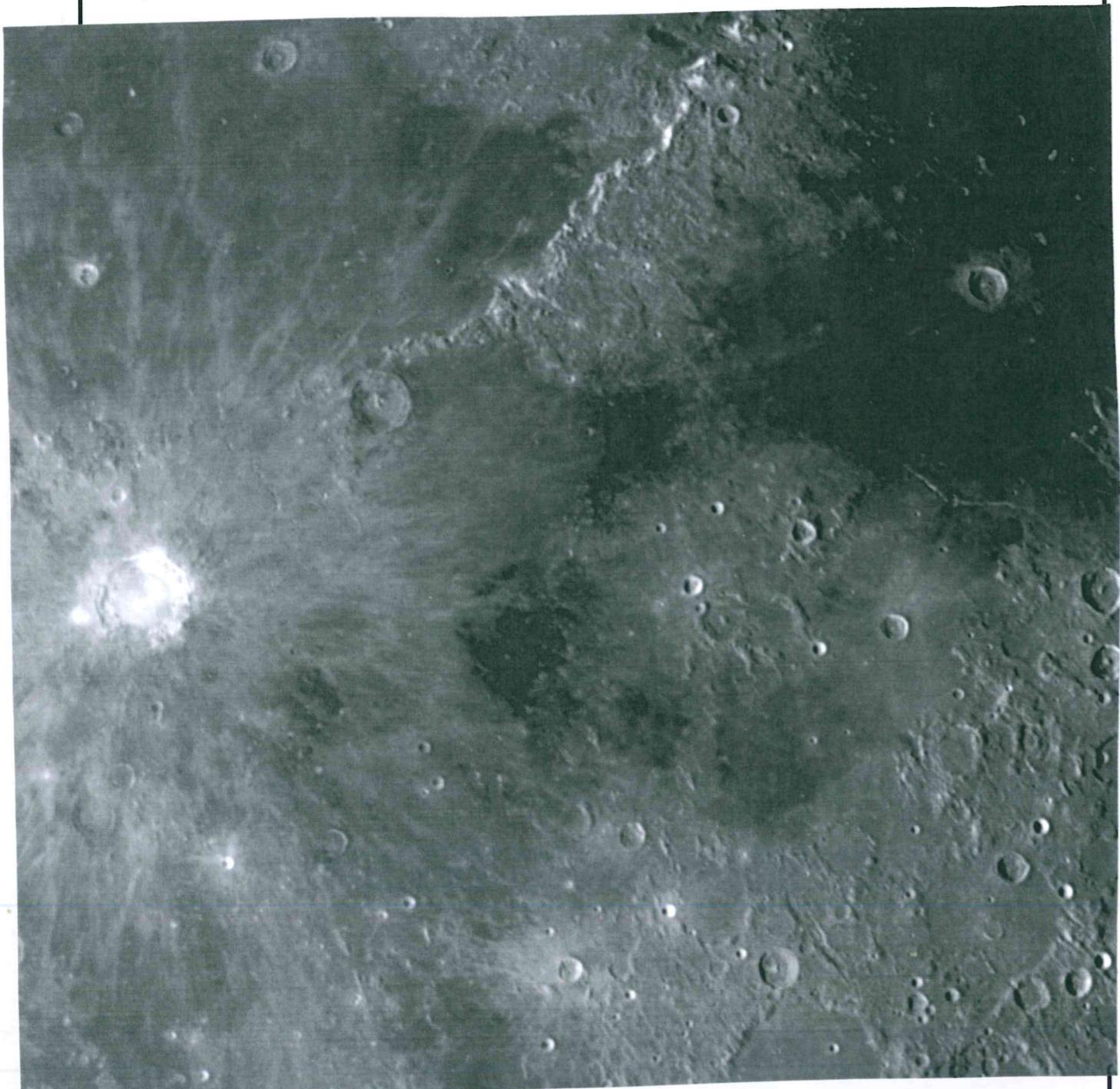
Extra

Use this page to log your observations!

Objects Observed:

Moon

Date: 2019 / 11 / 6
Location: NSO / NUAST
Weather Conditions: /
Fellow Astronomers: /
Moon Phase: /



Notes:

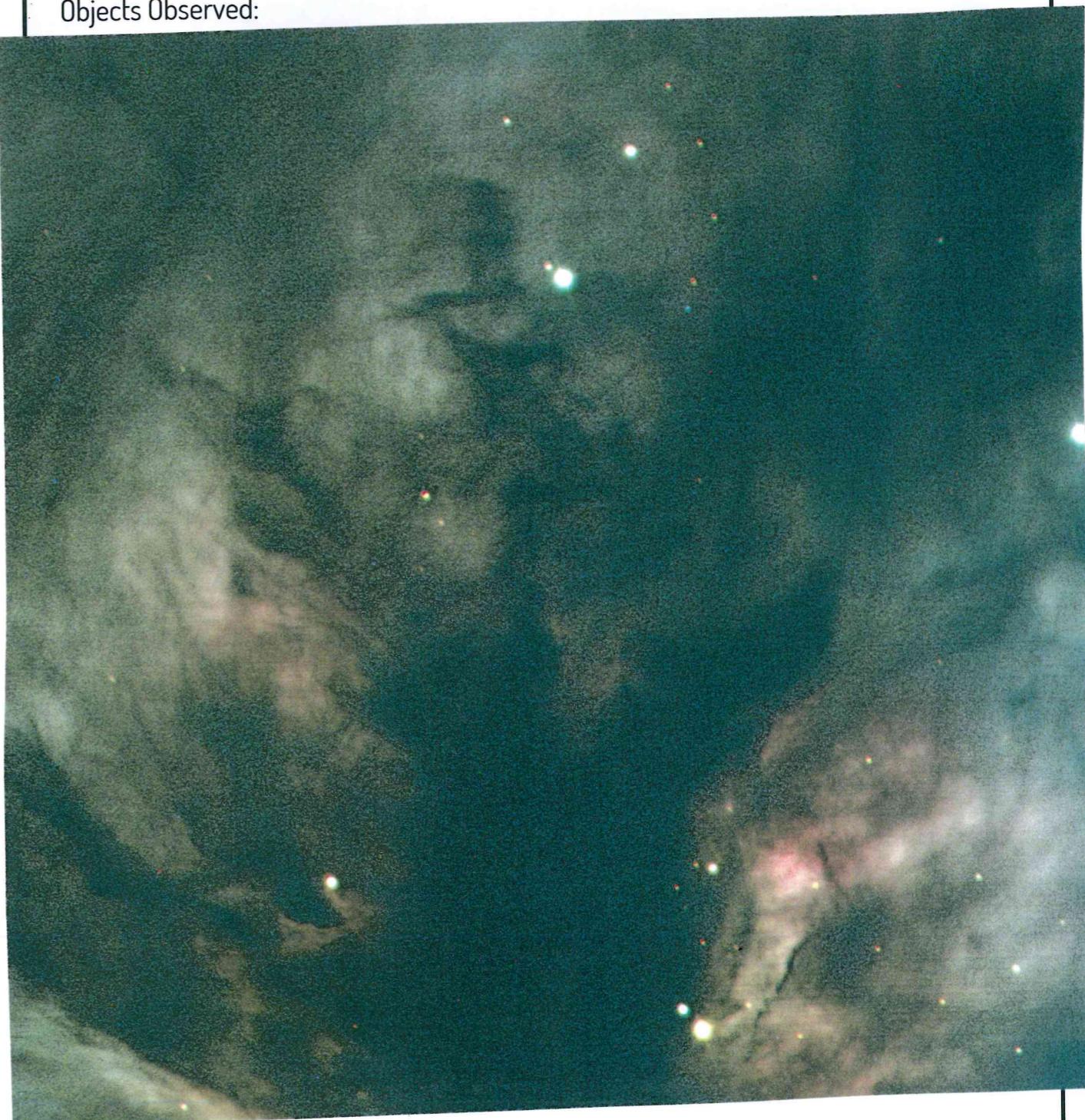
Show Large Copernicus crater on
left! d ~ 93 km

9.62°N 20.08°W

Extra

Use this page to log your observations!

Objects Observed:

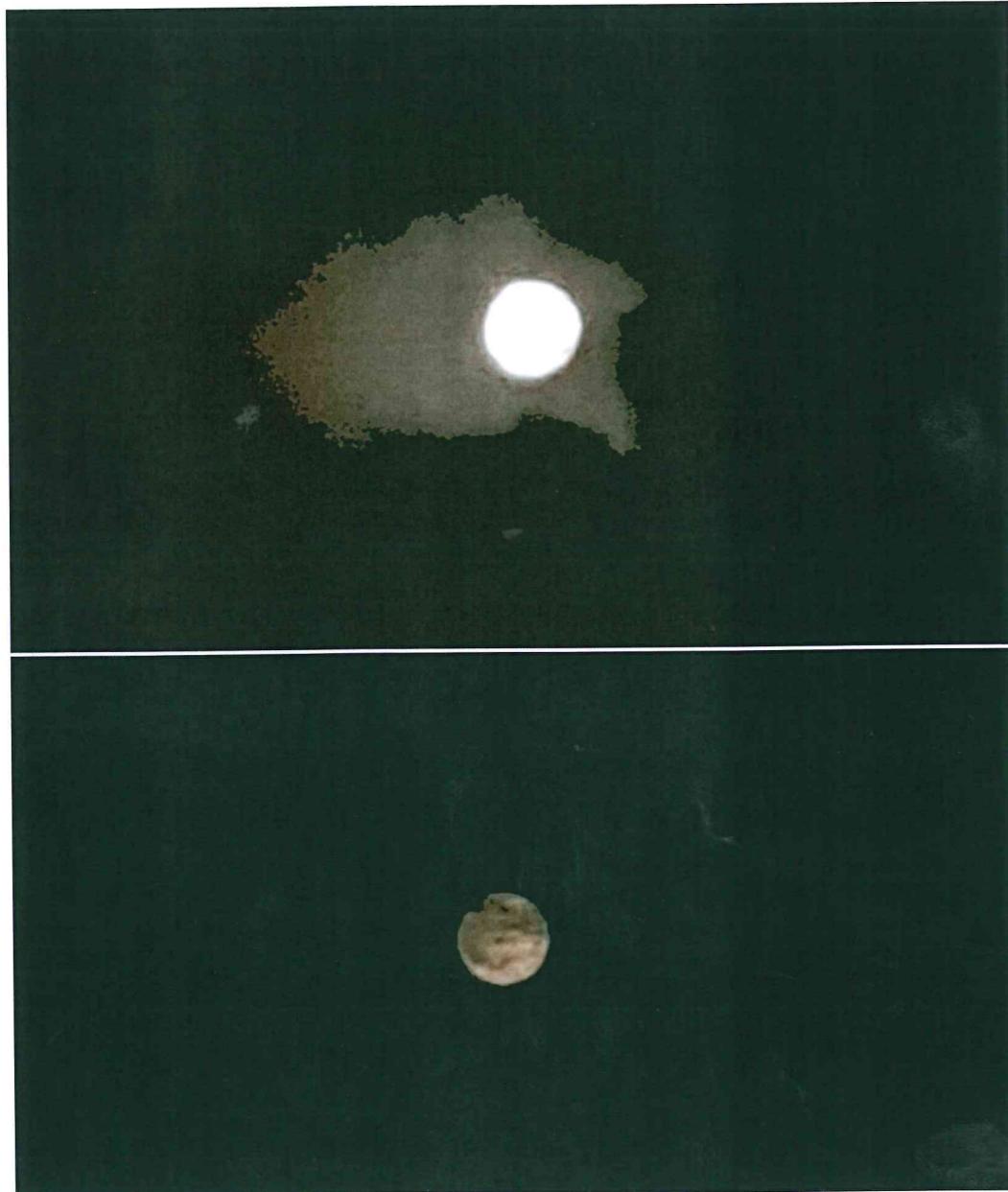


Notes:

Flame Nebula 45s R, G, B

MASTER

L2 - 12/11/2019 6:10pm



MASTER

Moon Observations

L1 - 4/11/2019 5:41pm

