



Pete and Paul's Observing Challenges

2021

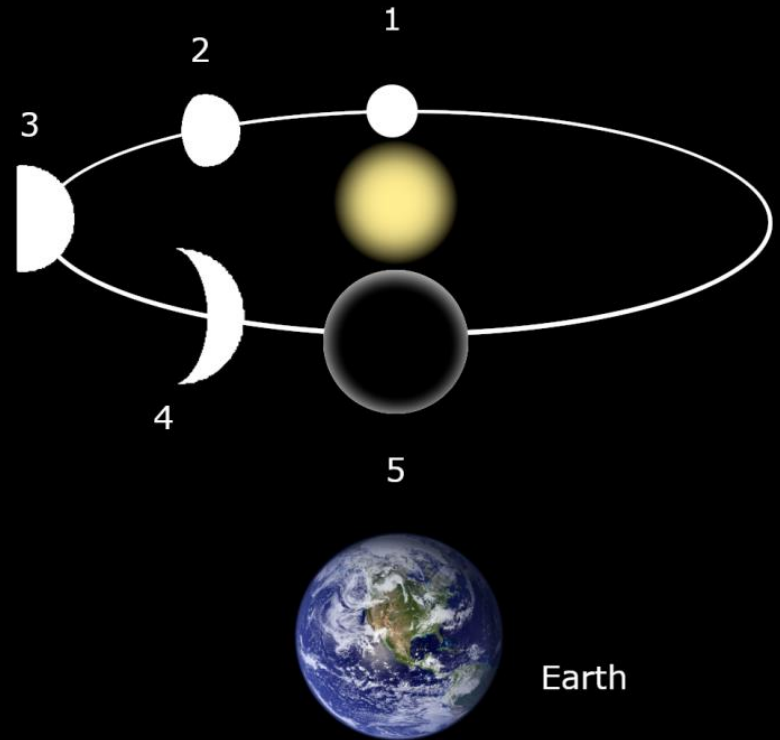




Challenge Number One
Venus at Dichotomy

Venus at Dichotomy

- On 26th March 2021, Venus passed Superior conjunction
- It has now moved into the evening sky
- On 28th October 2021, Venus will appear to be at 50% illumination-dichotomy



Venus at Dichotomy

- There is always a difference between the theoretical date and the observed date of dichotomy.
- In Eastern (evening elongations) observed dichotomy is later than predicted.
- To see Venus at 50% illumination you'll probably need a telescope as 49% or 51% looks the same in binoculars!
- There is an extra challenge in that Venus will be fairly low in the evening sky.

Venus Observation



Drawing 1(IL): 1851UT, x111, Seeing: AIII
CM1: 207.4" CM2: 295.5"

Drawing 2 (W15): 1858UT, x111, Seeing: AIV
CM1: 207.4" CM2: 295.9"

2020 March 22, Start: 1843UT, Finish: 1901UT. Sky: Twilight, Transparency: Good, Seeing: AIII-IV
203mm Newtonian Reflector, x111. Filter: W15 (yellow).
Phase(th)= 52.3%, Phase(IL)= 50%, Phase(W15)=50%, Disk Diameter= 23", Ls= 136°

Paul G. Abel, Leicester UK.

Venus at Dichotomy

- It will be best to try and do this in the day time.
- To find Venus in the day requires great care- if you're not confident then don't do it!
- Best method (if you have an equatorial mount set up):
 1. First look up the RA and Dec of the Sun and Venus
 2. Cap the telescope and move the telescope so that the finder scope is projecting the Sun. Then cap the finder scope.
 3. Turn the RA and Dec dials to that of the Sun.
 4. Move the telescope to the RA and Dec of Venus.
 5. Remove the caps and using a low power eyepiece, Venus should be in the field.



Venus at Dichotomy

- **Best time to start will be on the day of theoretical dichotomy: 28th October- Venus will appear slightly less than 50%.**
- **Continue to observe for a few days after the 28th October and find out when the planet seems exactly 50% illuminated (and the terminator is a straight line and not slightly concave).**
- **Note, if you observe with filters- the phase anomaly is even greater in a bluer filter than in IL, so use white light or a yellow filter for this observation.**
- **Finally: Send in your observations to the Mercury and Venus Section Director (me!)**

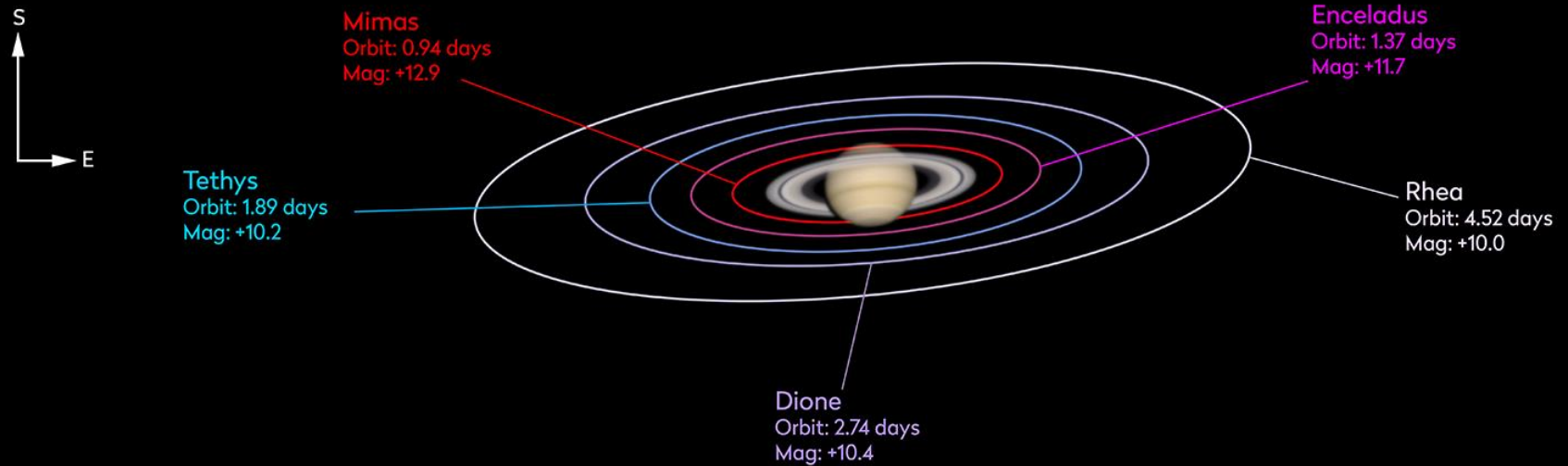


Challenge Number Two
The Saturn Moon Challenge

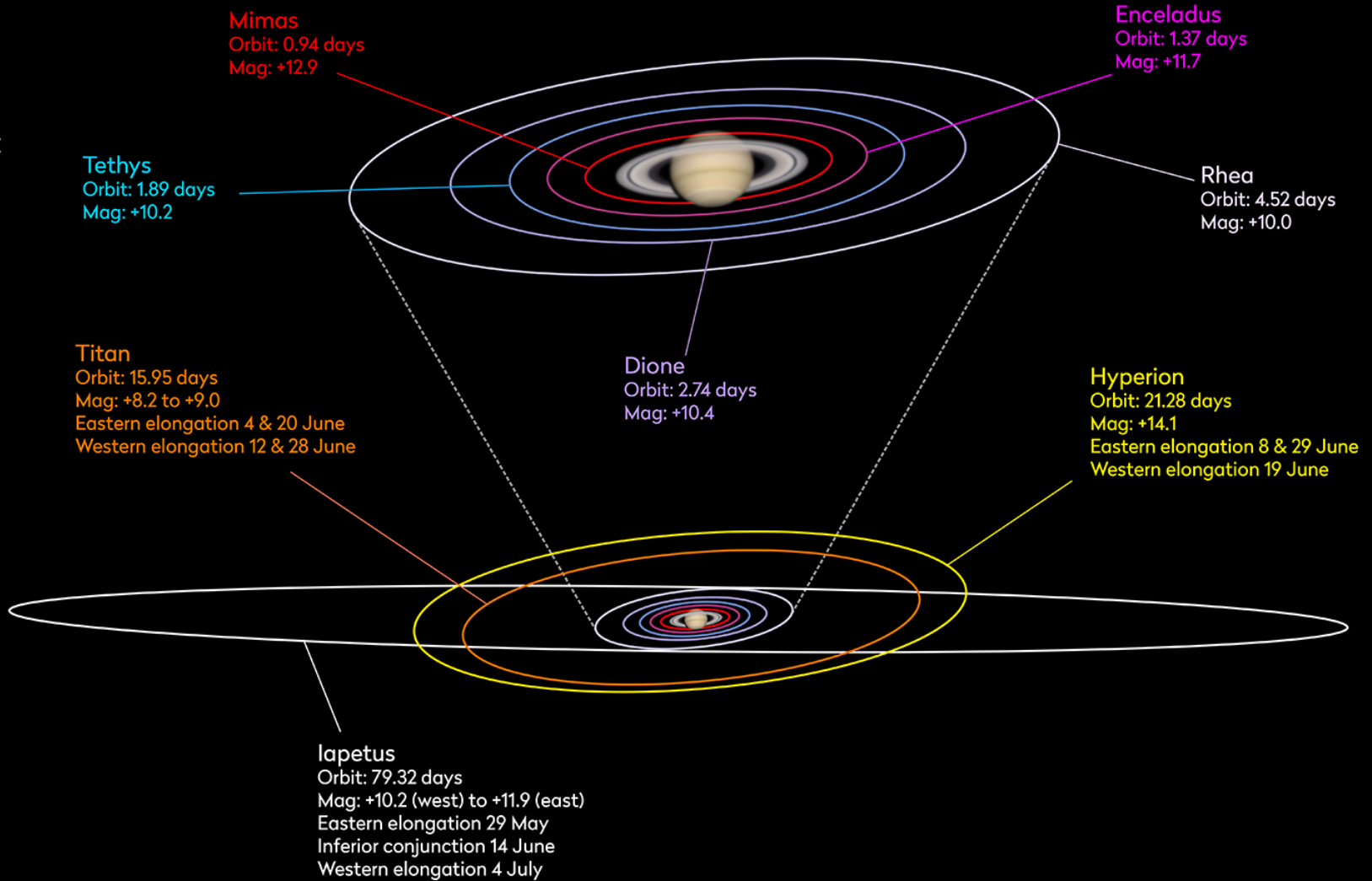
Saturn's Moons



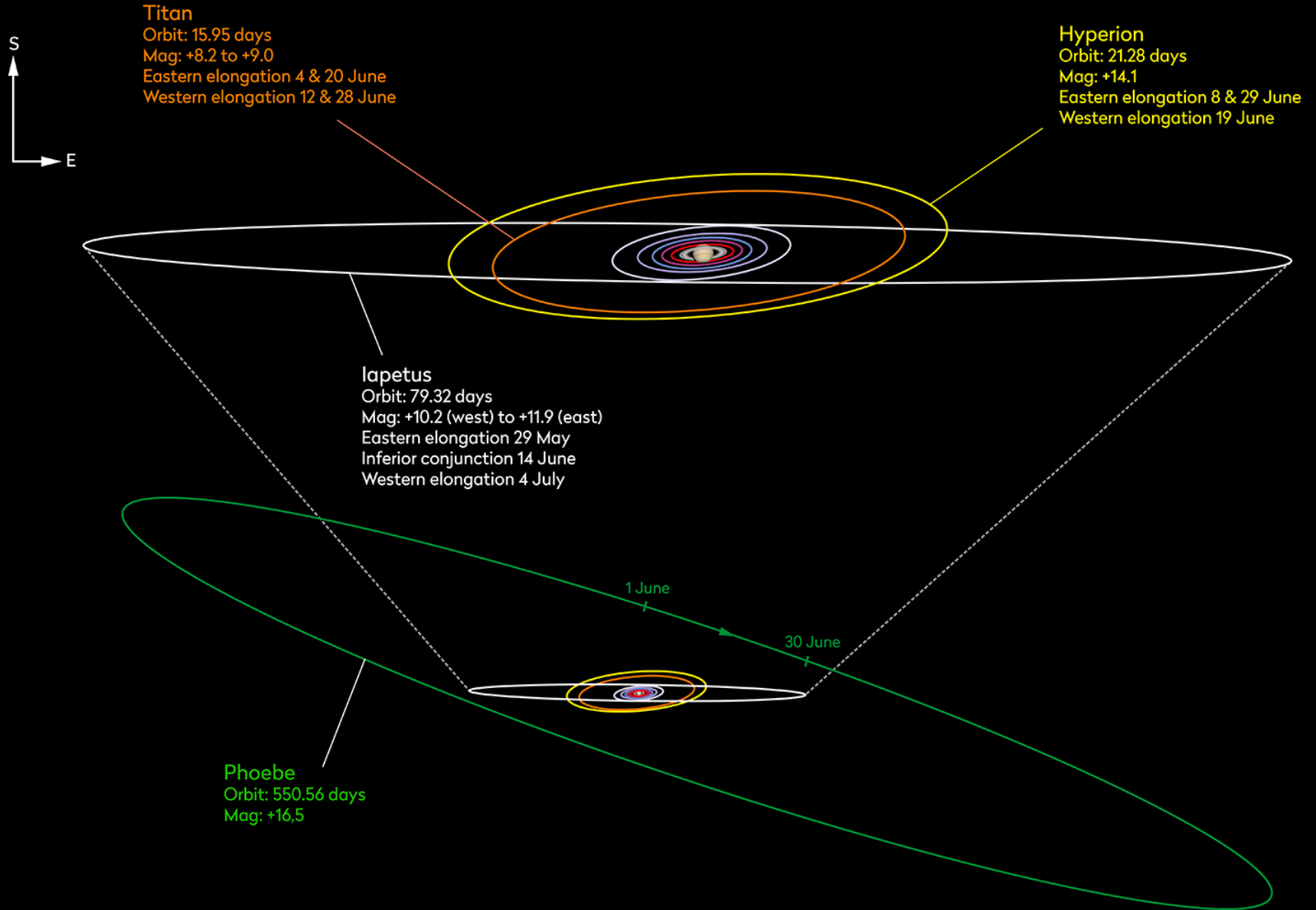
The 'Inner' Moons



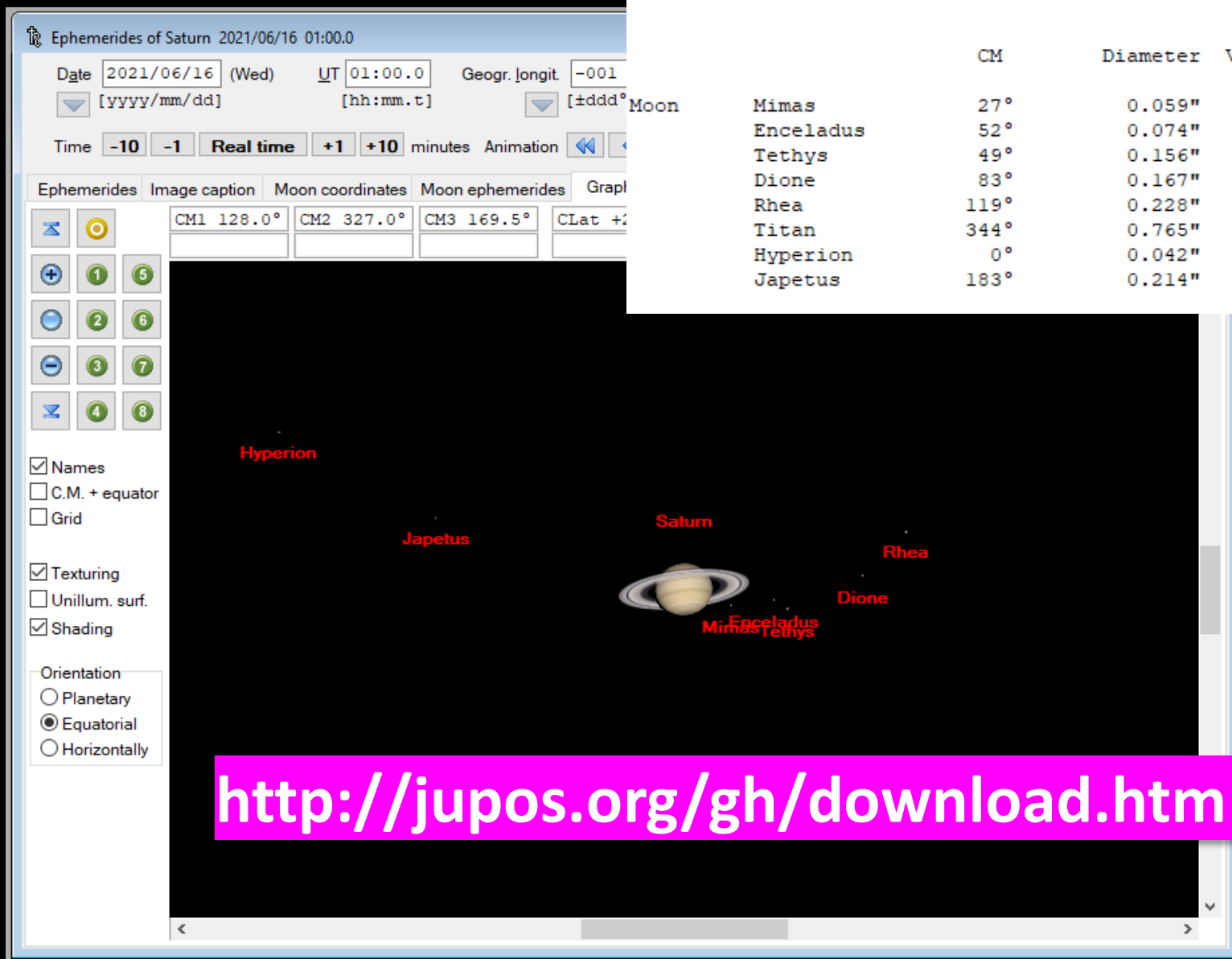
The 'Mid' Moons



The 'Outer' Moon - Phoebe



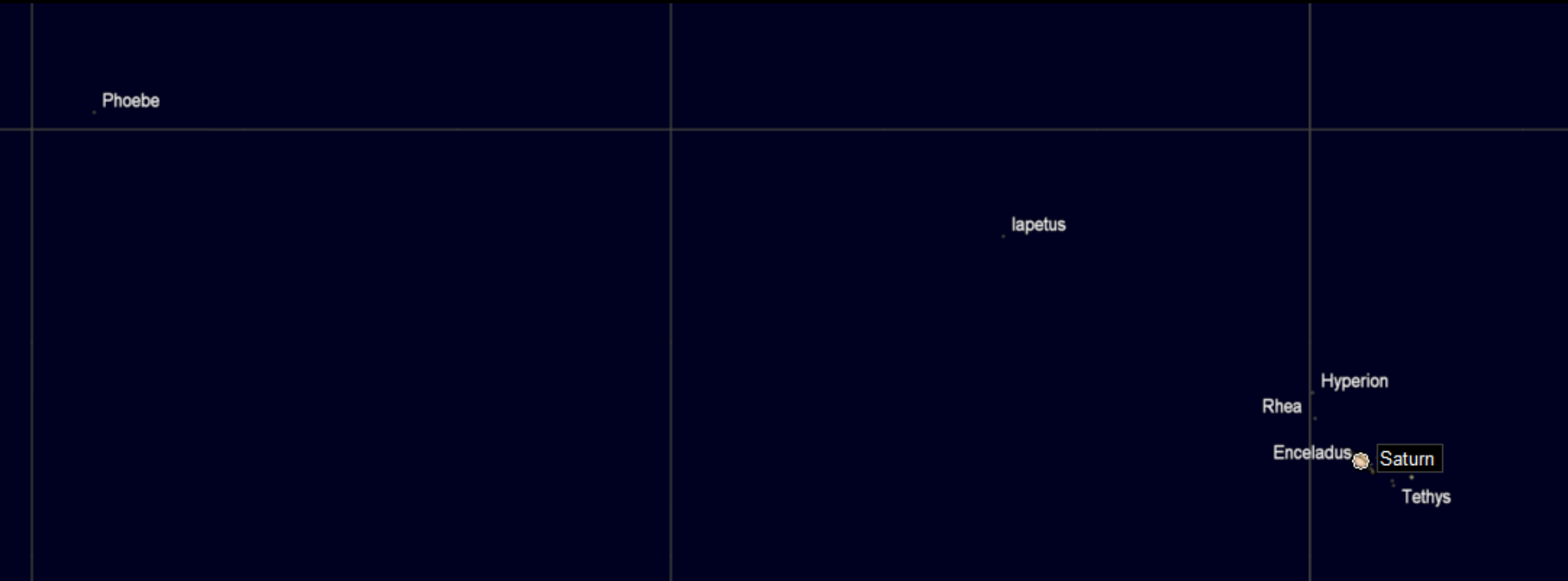
Moon Locators - WinJupos



The screenshot displays the WinJupos software interface. At the top, the title bar reads "Ephemerides of Saturn 2021/06/16 01:00.0". Below this, there are input fields for Date (2021/06/16), Day of the Week (Wed), UT (01:00.0), and Geogr. longit. (-001). There are also dropdown menus for date format [yyyy/mm/dd], time format [hh:mm.t], and longitude format [±ddd°]. A "Time" control shows -10, -1, Real time, +1, +10 minutes, and an "Animation" button. Below these are tabs for Ephemerides, Image caption, Moon coordinates, Moon ephemerides, and Graph. The "Moon coordinates" tab is active, showing CM1 128.0°, CM2 327.0°, CM3 169.5°, and CLat +. A control panel on the left includes zoom in (+) and zoom out (-) buttons, a central button with a yellow circle, and numbered buttons 1-8. Checkboxes for "Names", "C.M. + equator", "Grid", "Texturing", "Unillum. surf.", and "Shading" are present. Under "Orientation", "Equatorial" is selected. The main window shows a 3D visualization of Saturn and its moons, with labels for Hyperion, Japetus, Saturn, Rhea, Dione, Enceladus, Mimas, and Tethys. A pink banner at the bottom contains the URL <http://jupos.org/gh/download.htm>.

	CM	Diameter	Visual magnitude
Mimas	27°	0.059"	13.3 mag
Enceladus	52°	0.074"	12.1 mag
Tethys	49°	0.156"	10.6 mag
Dione	83°	0.167"	10.8 mag
Rhea	119°	0.228"	10.1 mag
Titan	344°	0.765"	8.7 mag
Hyperion	0°	0.042"	14.6 mag
Japetus	183°	0.214"	11.5 mag

Moon Locators – Cartes du Ciel



<https://www.ap-i.net/skychart/en/start>

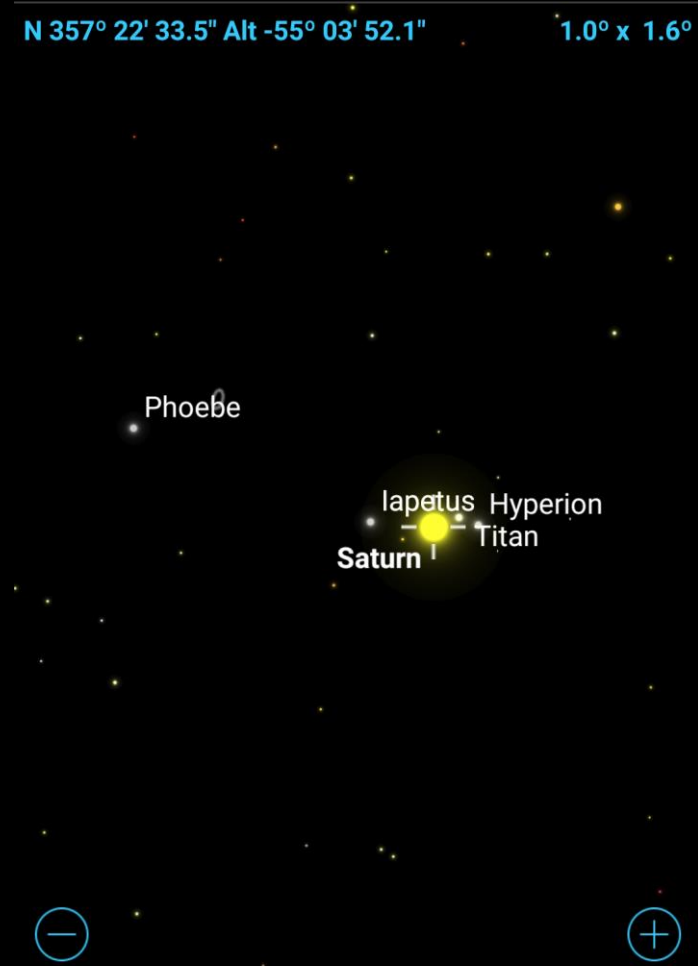
Moon Locators – Sky Safari Pro

Current Location

Sun Aug 01, 2021 13:09:48

N 357° 22' 33.5" Alt -55° 03' 52.1"

1.0° x 1.6°



Sun Aug 01, 2021 13:09:48

1 Month ◀ ◀◀ Now ▶▶ ▶



Saturn's Visibility in 2021

Opposition: 2 August 2021



Saturn

2020

Saturn

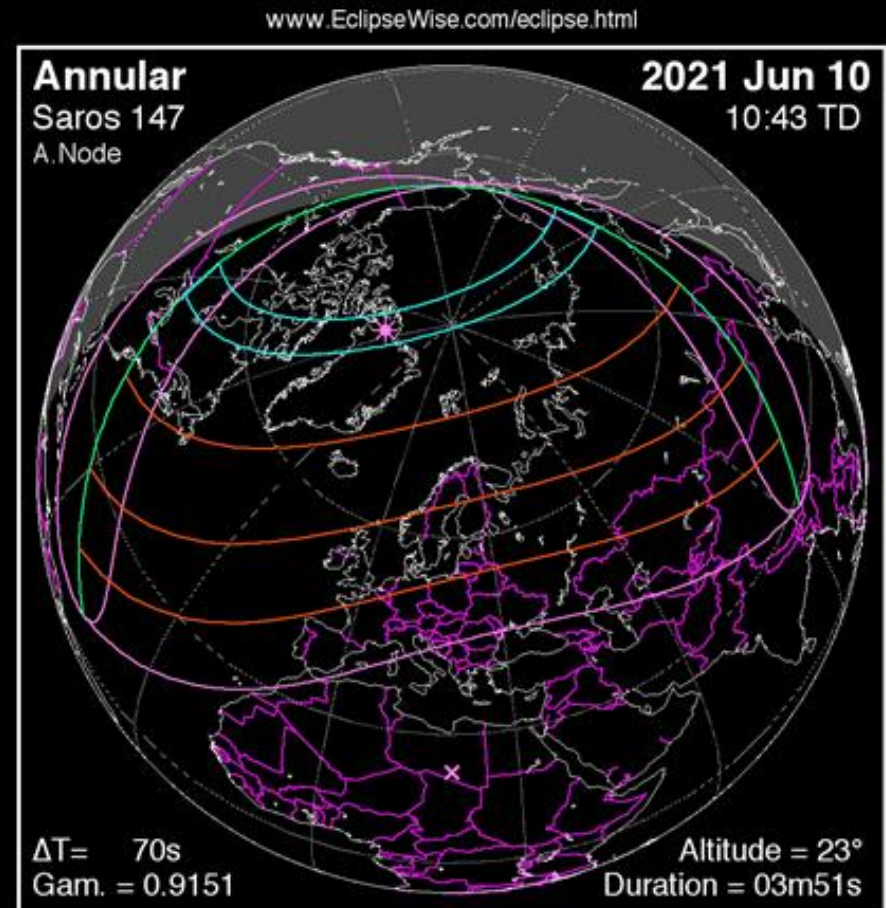
2021



Challenge Number Three
An Early Partial Solar Eclipse

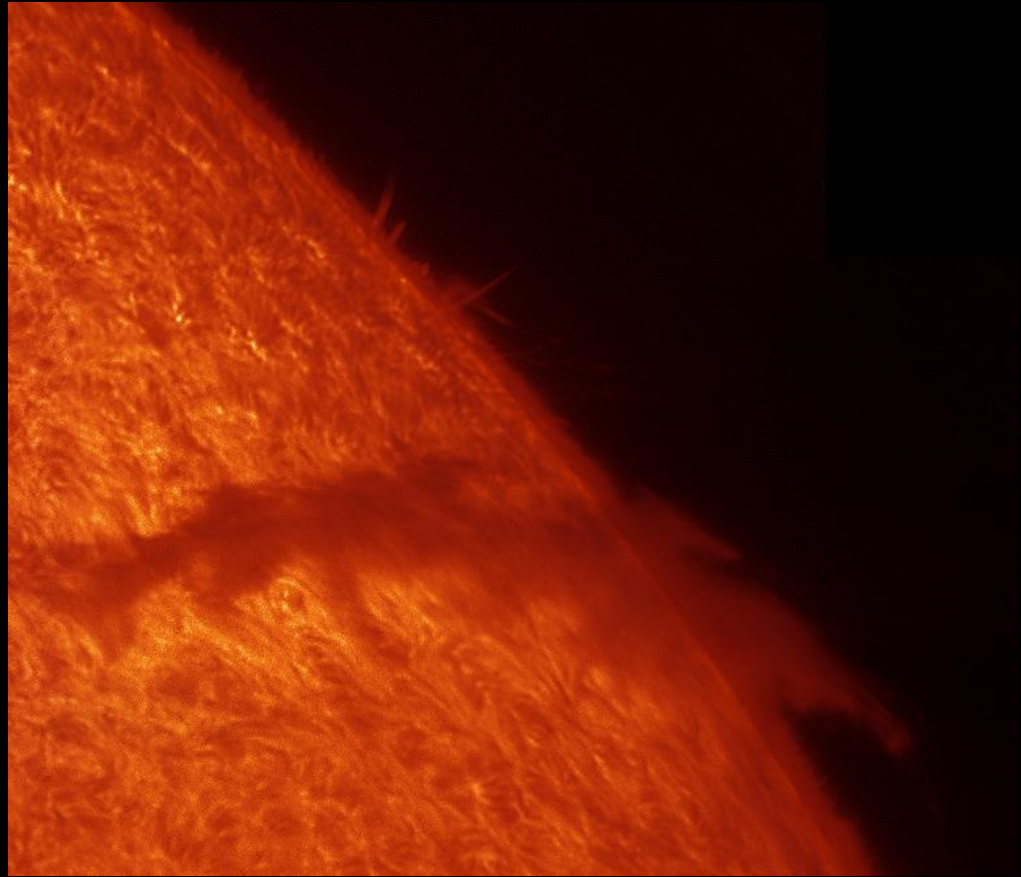
Partial Solar Eclipse- the Moon against the Spicule Layer

- There will be a annular solar eclipse on 10th June 2021.
- The path of totality crosses Canada and the far north.
- From the UK, it will appear as a partial eclipse and the further north you are, the more of the eclipse you will see.
- The start and end times of the eclipse vary depending on your location (see BAA Handbook)
- For London, first contact occurs at 09:08:40 UT, max obsc. = 20%
- For Aberdeen, 09:10:42, 32.8% Sun is covered.



Partial Solar Eclipse- the Moon against the Spicule Layer

- This is an excellent opportunity to observe the Moon against the spicule layer of the sun.
- The spicule layer is part of the Sun's chromosphere.
- The chromosphere is a layer of hot hydrogen gas above the photosphere of the Sun.
- Normal white light observations show the photosphere, a H-alpha telescope (or H-alpha filter) is required to see the Chromosphere.



Partial Solar Eclipse- the Moon against the Spicule Layer.

- For this challenge, you'll need access to a H-alpha telescope or a suitable H-alpha filter which can be fitted to the telescope.
- The first thing to do is to make sure you know the orientation of the sun in your telescope (do this before the day!)
- You'll need to know which way is north and the directions of east and west.
- In a mirror inverting telescope (with no star diagonal), the Moon will pass over the Sun's disk from the 7 o'clock position.



<https://www.atoptics.co.uk/tiltsun.htm>

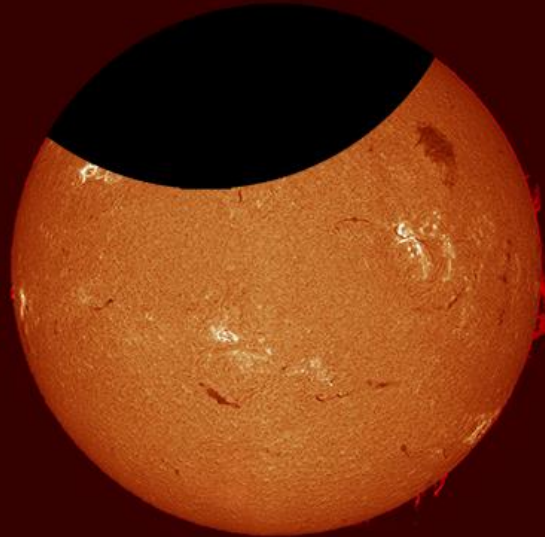
Partial Solar Eclipse- the Moon against the Spicule Layer

- You'll need to work out what time first contact is due to occur from your location.
- Once you have the time, start observing the sun in H-alpha about 15 minutes beforehand.

10 June 2021



First contact
10:07 BST



Maximum eclipse
11:14 BST



Last contact
12:26 BST

*Correct for central UK and will vary slightly both in eclipse coverage and timing, depending on location
First and last contact overlaps exaggerated for clarity*

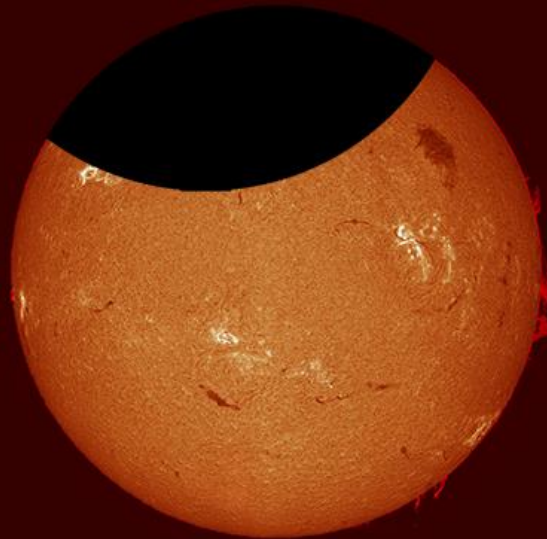
Partial Solar Eclipse- the Moon against the Spicule Layer

- Keep a careful watch out for the back disk of the Moon eating against the spicule layer of the Sun!
- Try to make a drawing or grab an image of the event as it's fairly rare to capture the event from the UK!

10 June 2021



First contact
10:07 BST



Maximum eclipse
11:14 BST



Last contact
12:26 BST

*Correct for central UK and will vary slightly both in eclipse coverage and timing, depending on location
First and last contact overlaps exaggerated for clarity*

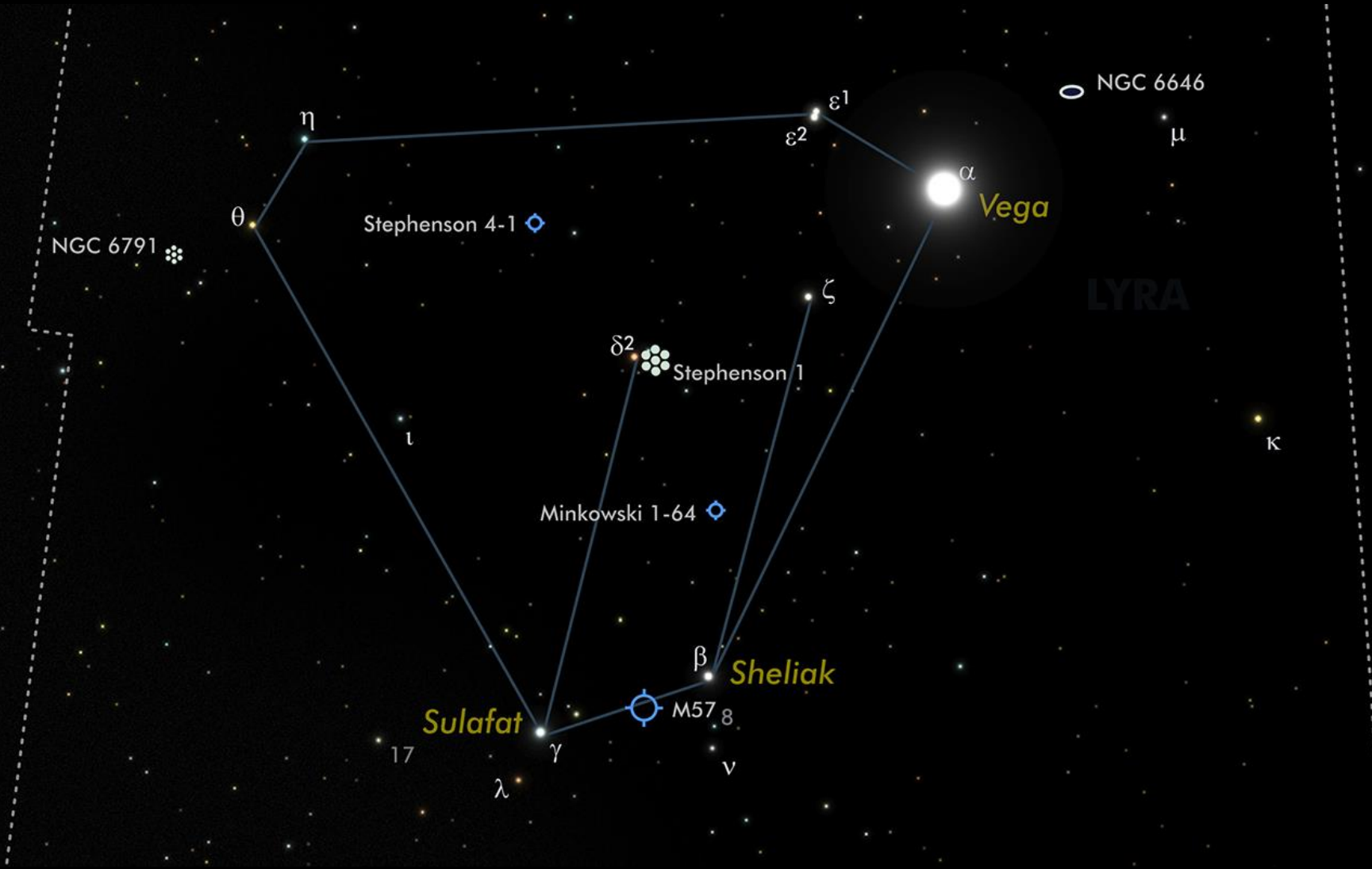


Challenge Number Four
A New Twist on
M57's Central Star

Lyra



Lyra



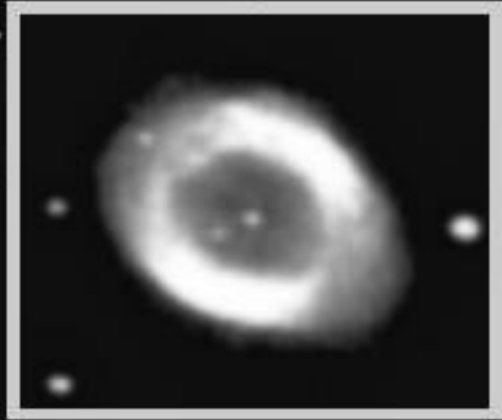
Messier 57



Messier 57



Messier 57



Messier 57



Afocal Imaging with a Smartphone



Smartphone to Eyepiece Adapter



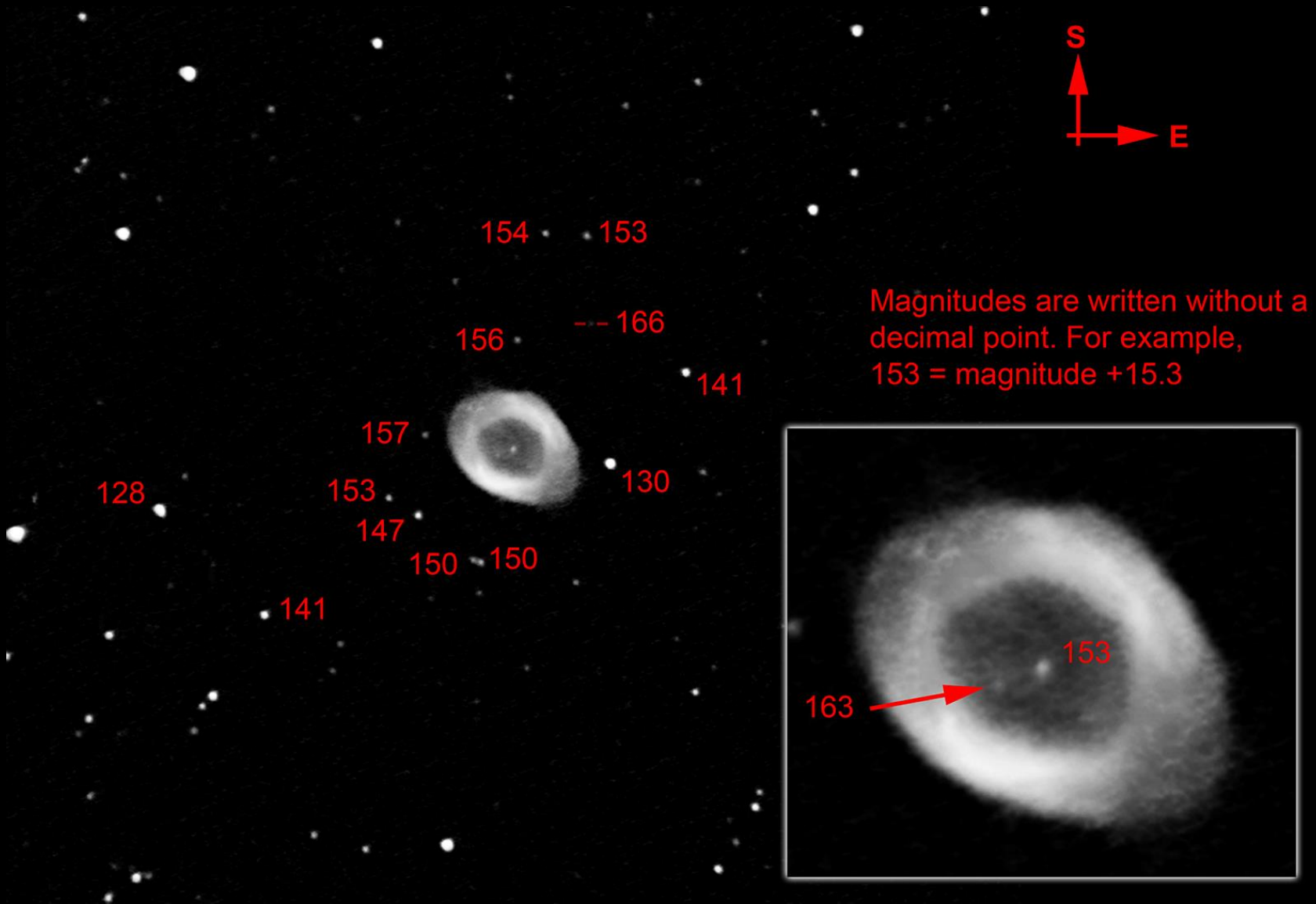
Smartphone to Eyepiece Adapter



The Challenge...



The Challenge...



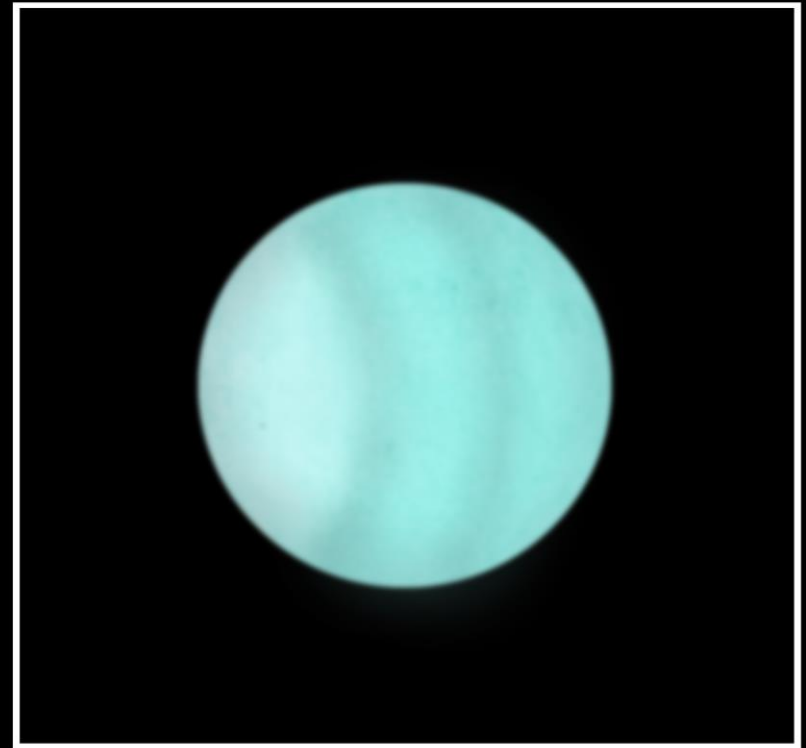


Challenge Number Five
The Moons of Uranus

The moons of Uranus

- Uranus is the 7th planet from the Sun and orbits way beyond Saturn.
- Uranus comes to opposition on 4th November in the constellation of Aries.
- It will be magnitude +5.7 and have an apparent diameter of 3.8''
- Although the planet is technically below the threshold of naked eye visibility, you will need binoculars to see it.
- For this challenge, you will need at least an 8 inch (203mm) telescope to see the brightest of the satellites.

Uranus Observation

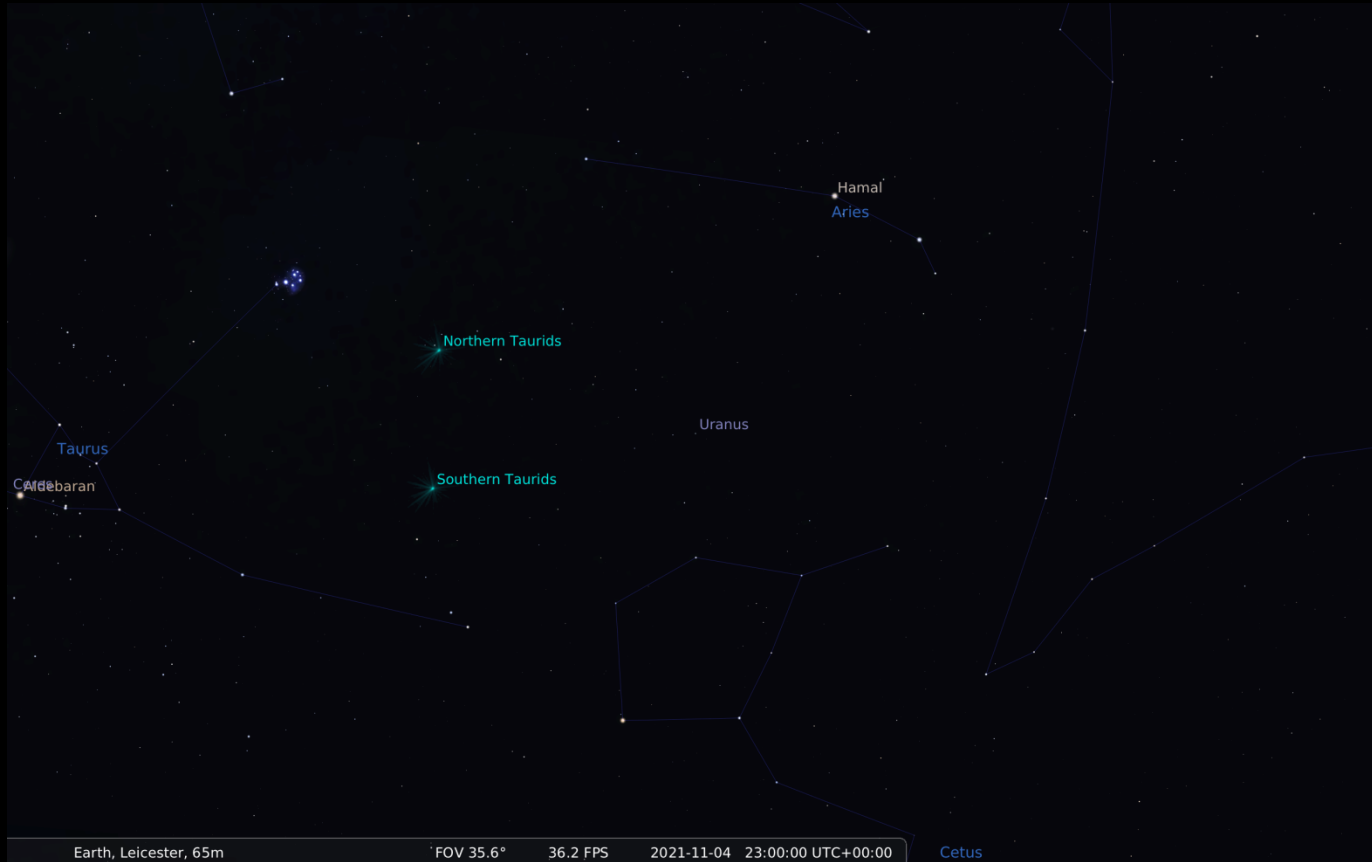


Disk Drawing: 2241UT, x540, CM: 153.2°, Seeing: All

2018 September 23rd, Start: 2231UT Finish: 2249UT, Seeing: All, Transparency: Good
508mm Planewave Dall-Kirkham, University of Leicester Observatory, x540.
B= 43.4°, Ds= 41.9°, CLat= 44.7°, Disk Diameter= 3.7", Ls= 30°

Paul G. Abel, Leicester UK.

The moons of Uranus



- The moons of Uranus are quite faint, and the best time to see them is when Uranus is at opposition.
- Finding Uranus is fairly easy - it's located in Aries, near Taurus.

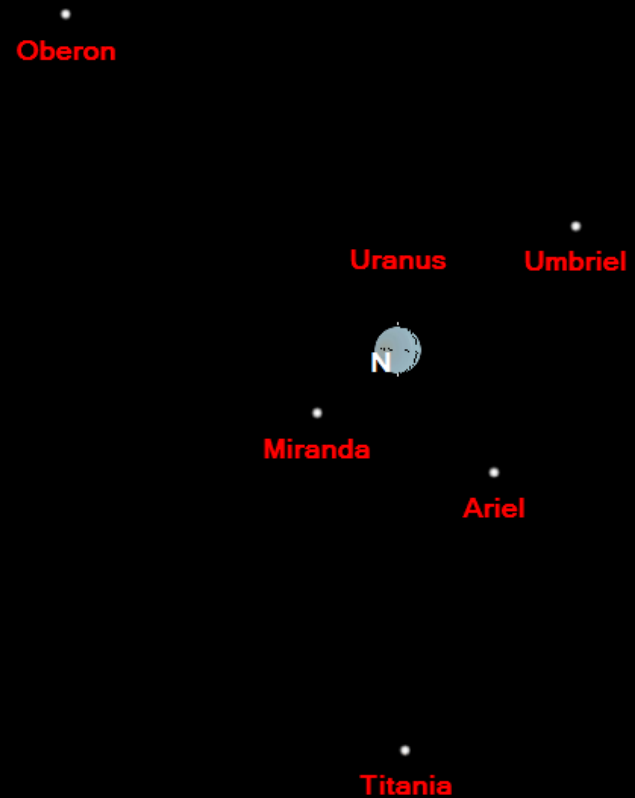
The moons of Uranus



- Locate the star Sigma Arietis, then star hop to Omicron Arietis and you should see Uranus nearby (or alternatively you can use setting circles)
- Even low power eyepiece, Uranus should be obvious as a small greenish disk.

The moons of Uranus

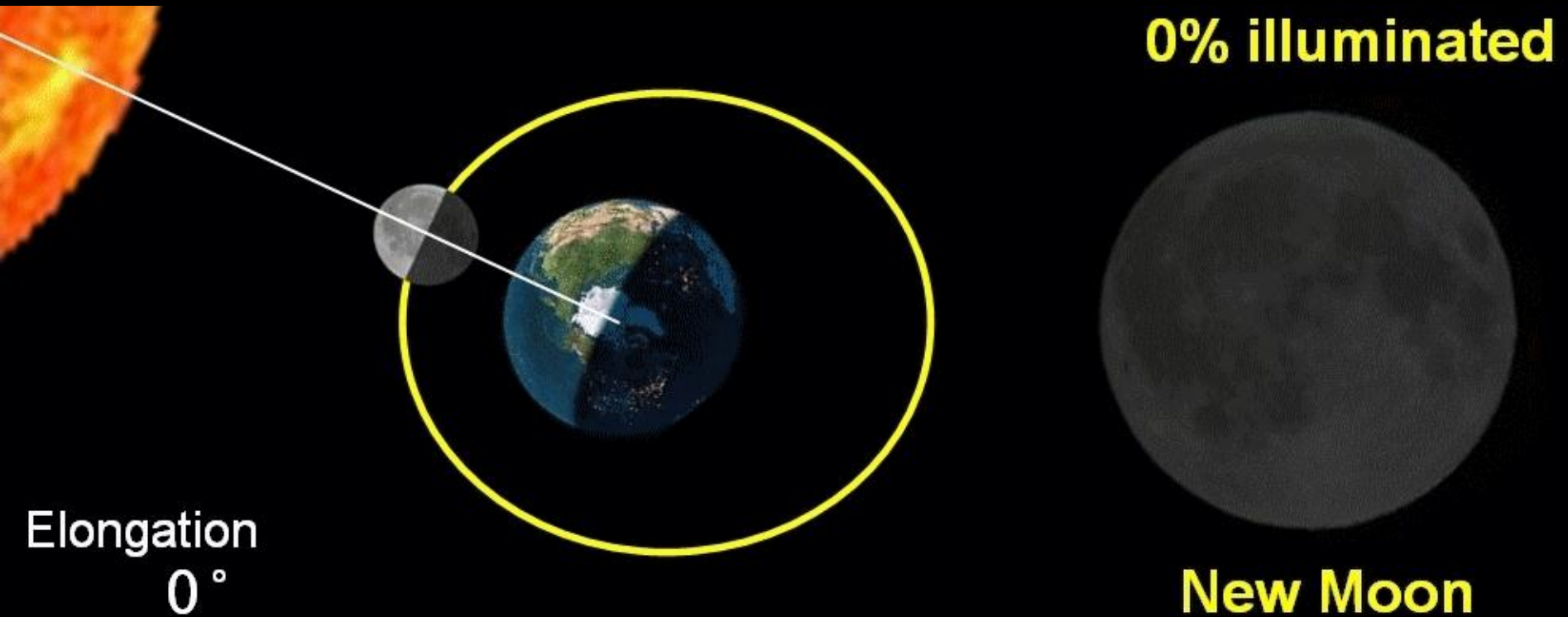
- Graphic shows the positions of the 5 brightest moons on 4th November at 2300UT.
- Their magnitudes are:
 - Titania, $M_v = +13.9$
 - Oberon, $M_v = +14.1$
 - Ariel, $M_v = +14.3$
 - Umbriel, $M_v = +14.9$
 - Miranda, $M_v = +16.4$
- I have seen Titania with my 8" Newtonian and the others should be visible in my 12" Newtonian (except Miranda!)
- How many can you see?





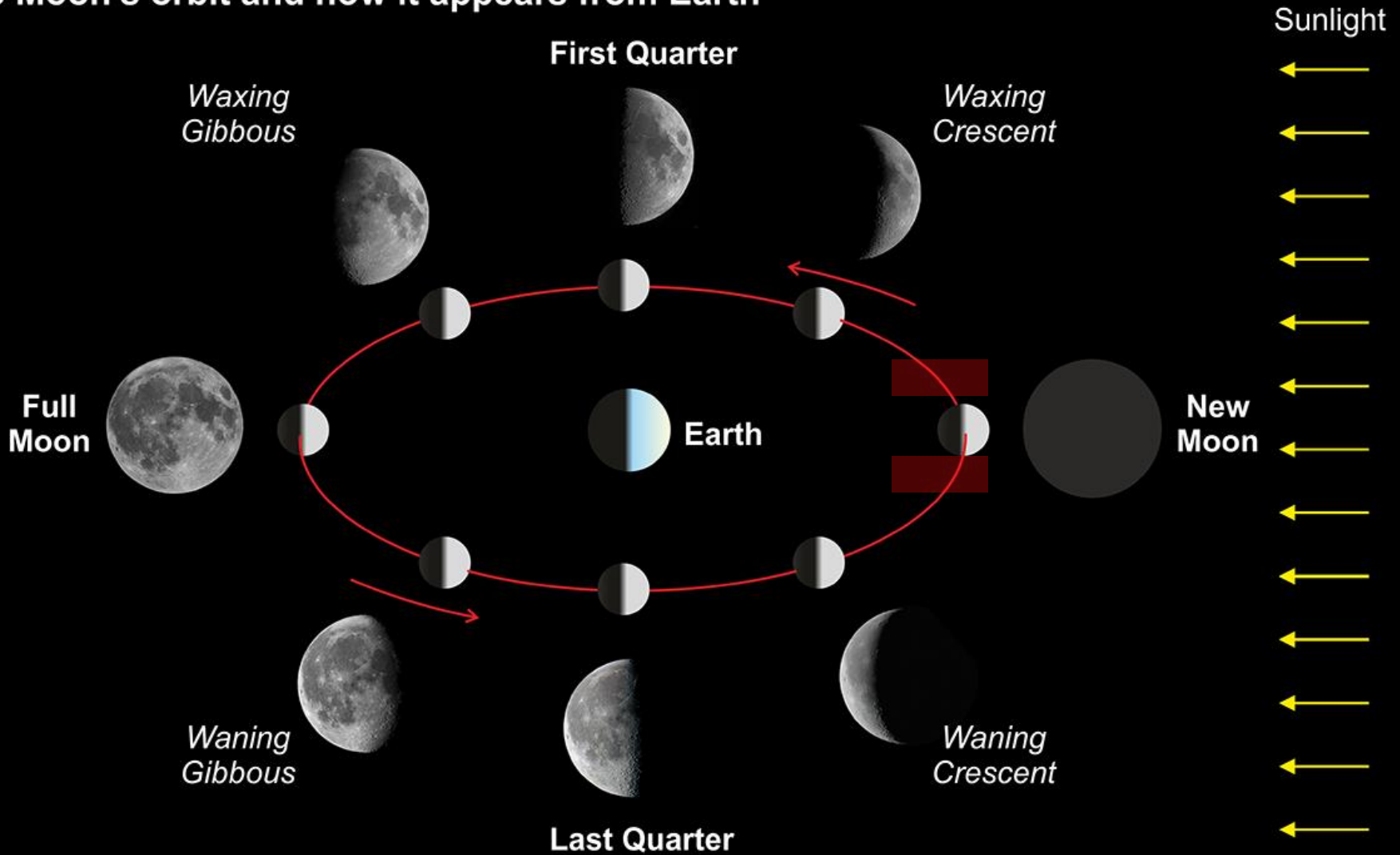
Challenge Number Six
Thin Moon Hunting

Lunar Phases

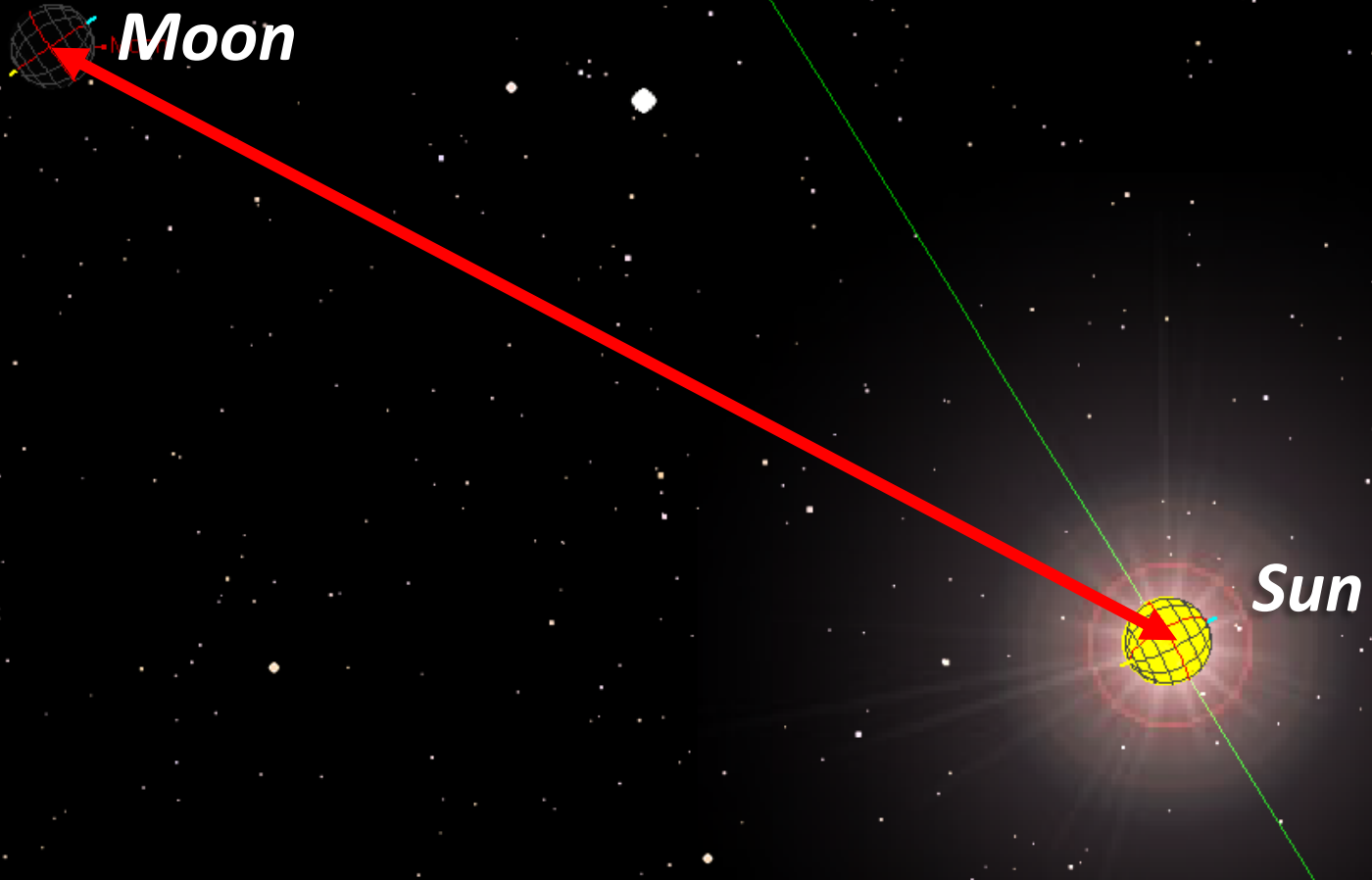


Lunar Phases

The Moon's orbit and how it appears from Earth



The Danjon Limit



~7 degrees separation

Crescent Appearance



Crescent Appearance



Crescent Appearance



Crescent Appearance



Crescent Appearance



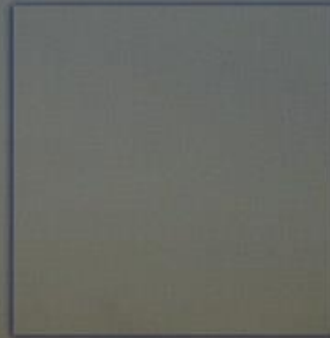
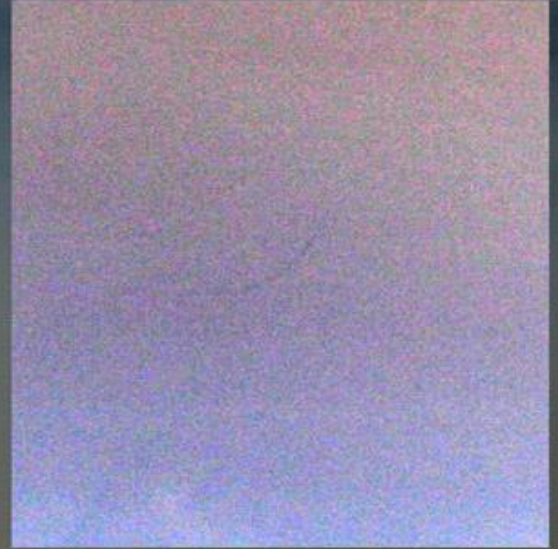
Crescent Appearance

A faint, light-colored crescent moon is visible against a solid red background. A yellow arrow points from the bottom right towards the crescent moon.

Age: 19h 14m

Crescent Appearance

Thin Moon (Age 22h49m)
2005-06-07 20h44m UT



Crescent Appearance



Moon aged 15h 13m

2008-04-06 19h08m UT, Canon 40DH 1/20s @ ISO 100, f/5.6 zoom lens at 226mm

Pete Lawrence

Upcoming Thin Moon Dates...

April: 12th, 0.7d, 0.4% waxing, 7.9° sep.

May: 12th, 1.0d, 0.9% waxing, 10.6° sep.

June: 9th, 28.3d, 1.6% waning, 13.8° sep.

11th, 1.3d, 1.5% waxing, 15.1° sep

July: 9th, 28.7d, 0.8% waning, 9.6° sep.

10th, 0.7d, 0.5% waxing, 9.3° sep.

August: 8th, 29.1d, 0.2% waning, 5.5° sep.

8th, 0.2d, 0.1% waxing, 4.7° sep.

September: 6th, 28.6d, 0.9% waning, 10.5° sep.

7th, 0.7d, 0.6% waxing, 10.2° sep.



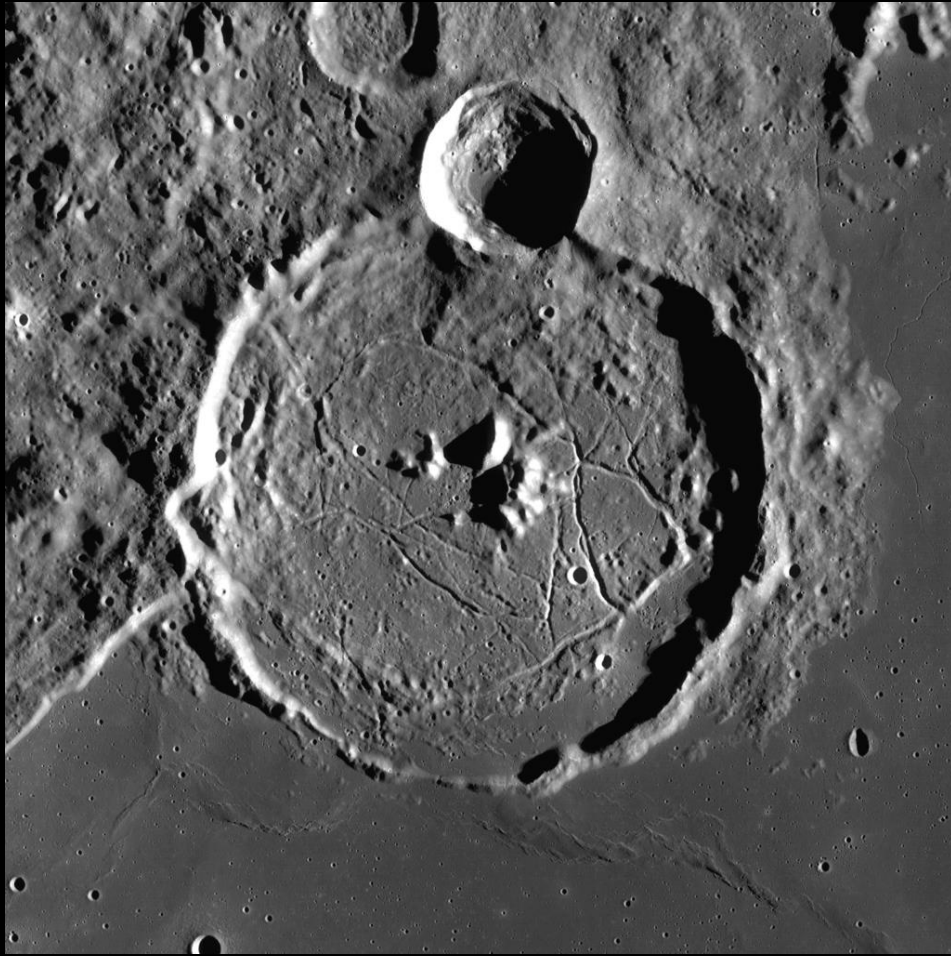
Challenge Number Seven
The Rilles of Gassendi

The Rilles of Gassendi

- Gassendi crater is a large impact crater located on the northern edge of the Mare Humorum.
- Gassendi is some 110km in diameter and has a depth of 1.9km.
- It is quite distinctive with the smaller impact crater, Gassendi A overlapping its northern wall.
- The feature is best seen in the evening sky when the Moon is a few days from full (phase of 81%)



The Rilles of Gassendi



The Rilles of Gassendi

- The rilles of Gassendi are a splendid sight telescopically!
- You will need a telescope to be able to see them, and they are best observed when they are filled with shadow.
- This typically occurs when the terminator is nearby- say about 80% illumination.
- To spot them, you will need to get the timing right!
- Each month, work out when the Moon is at the correct phase- the free software 'dial a moon 2021' is excellent.

Gassendi Crater



2021 March 24, Start: 2149UT Finish: 2214UT. Seeing: All, Tr; Average 305mm Newtonian Reflector, x300 & x600.

Moon's age: 11.5d, Illumination= 81%. Colong: 46° to: 46.2°

The Rilles of Gassendi

- Google 'dial a moon 2021' – it is a NASA website.
- When you're at the site, you can input the date and time and the website will give a very high resolution image of the Moon for that date.
- You can work out each month when its best to try- remember you can try again in the morning sky!
- You will need fairly stable seeing to be able to see the smaller rilles- the better seeing occurs when the Moon is higher in the sky.

Gassendi Crater



2021 March 24, Start: 2149UT Finish: 2214UT. Seeing: All, Tr; Average 305mm Newtonian Reflector, x300 & x600.

Moon's age: 11.5d, Illumination= 81%. Colong: 46° to: 46.2°



Challenge Number Eight
Smartphone NLC's

What are NLC's?



What are NLC's?



Natural vs Artificial Light



Natural vs Artificial Light



Smartphone NLC's



21 June 2019

Smartphone NLC's



Smartphone NLC's



Smartphone NLC's



Hints and Tips

- High(ish) ISO
- Multi-second exposure
- Stable platform
- Remote shutter release

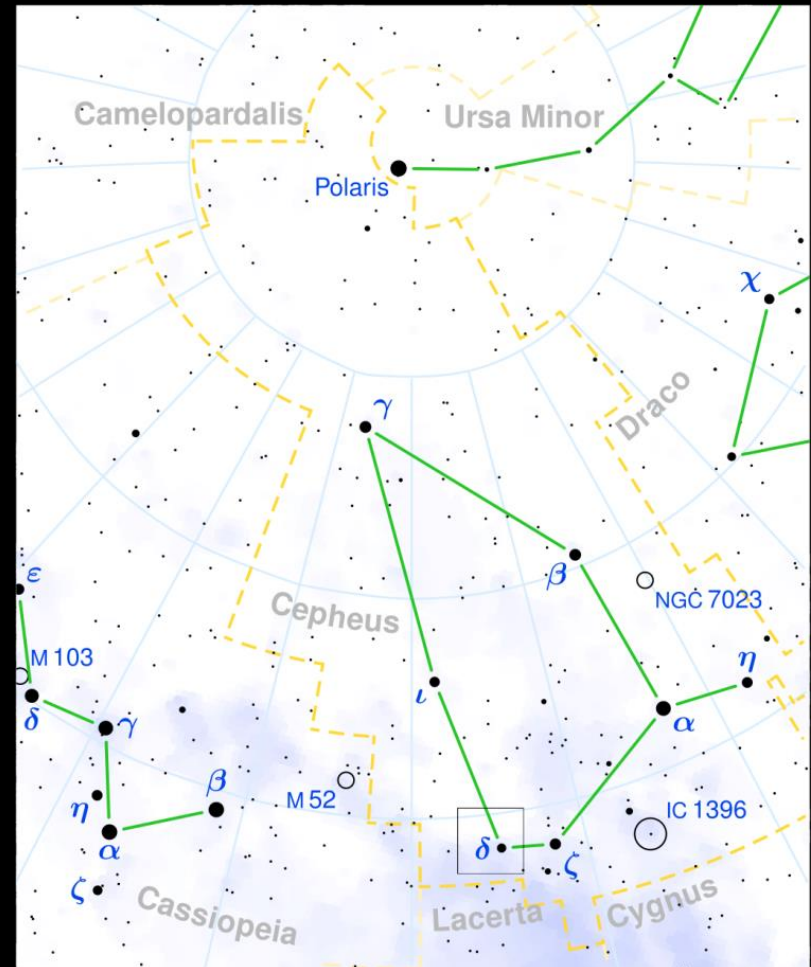




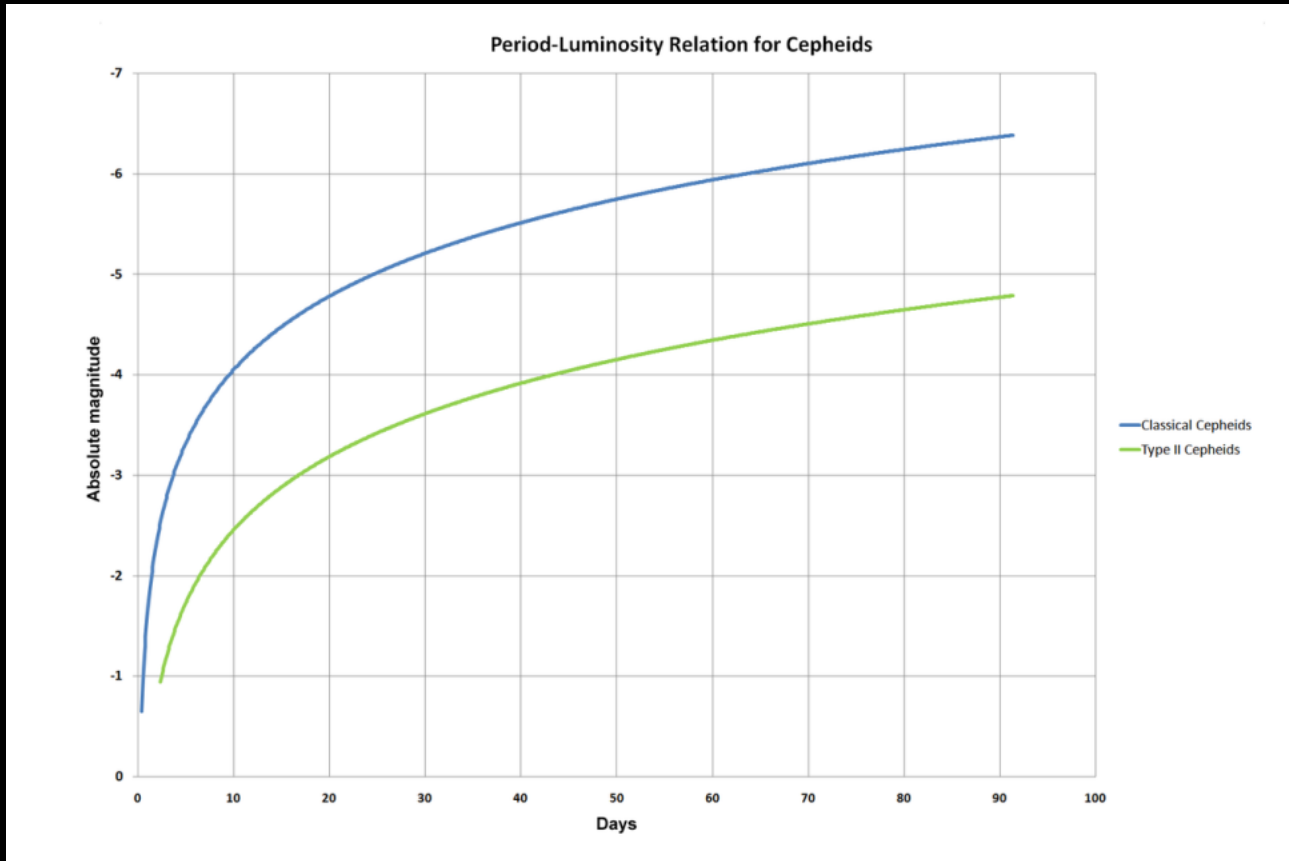
Challenge Number Nine
Distance of Delta Cephei

Measuring the Distance to Delta Cephei

- Delta Cephei is a bright variable star in the constellation of Cepheus.
- In general, the star varies from magnitude 3.5 to 4.4 over approximately five days.
- The star can be seen easily with binoculars or a small telescope.
- Circumpolar- visible all year from UK.
- Cepheid variables are special types of variable star- they have a well established relationship between their intrinsic brightness (absolute magnitude) and their distance.



Measuring the Distance to Delta Cephei



- Once you measure the period of variation of the Cepheid variable, we can look up its absolute magnitude on the graph. (The top curve!)

Measuring the Distance to Delta Cephei

- When we have the absolute magnitude, M we can look up the average apparent magnitude m (this is how bright the star appears in the sky)
- There is a very useful relationship between magnitude and distance:

$$m - M + 5 = 5 \log(d)$$

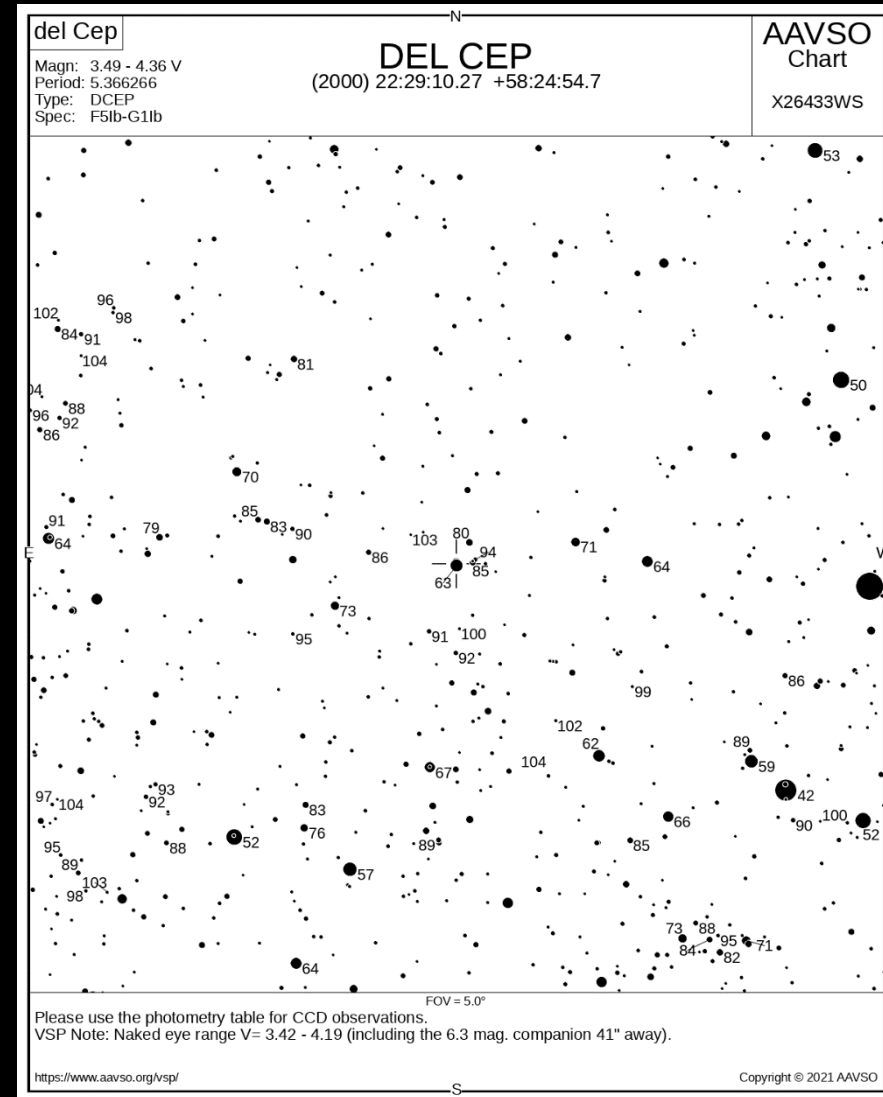
- Where d is the distance in Parsecs. Since we want to calculate the distance, we re-arrange this formula for d :

$$d = 10^{(m-M+5)/5}$$

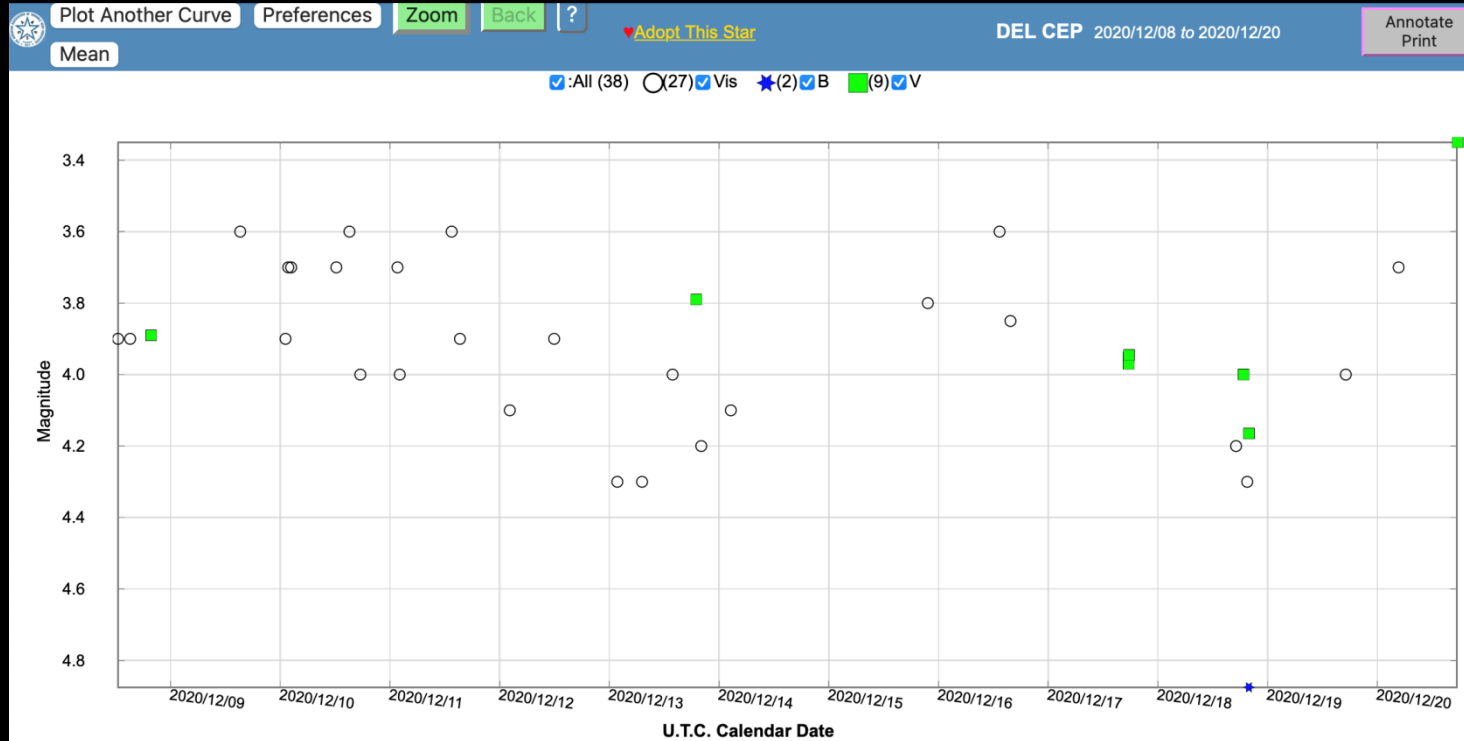
- When we have this value, we need to multiply it by 3.26 to convert Parsecs into light years.

Measuring the Distance to Delta Cephei

- The first thing to do is to make estimates of the apparent magnitude of Delta Cephei.
- Here is a comparison chart for Delta Cephei- it contains lots of stars of different brightness.
- Each night, compare the brightness of Delta Cephei with a suitable comparison star to deduce its apparent magnitude.
- See the BAA Variable Star Section website if you need help to estimate the magnitude of variable stars.



Measuring the Distance to Delta Cephei



- If you plot the magnitude over 5/6 consecutive nights, you'll get a light curve.
- From this you can get the period, and from the previous graph, the absolute magnitude. Then substitute the values into the formula!

Worked Example!

Suppose we have a variable star which we make magnitude estimates for two weeks. We find it has a period of 10 days and we look up its average apparent magnitude $m = +3.5$.

First we use the graph to find the absolute magnitude $M = -4.1$.

Substitute this into the formula:

$$d = 10^{(m-M+5)/5}$$

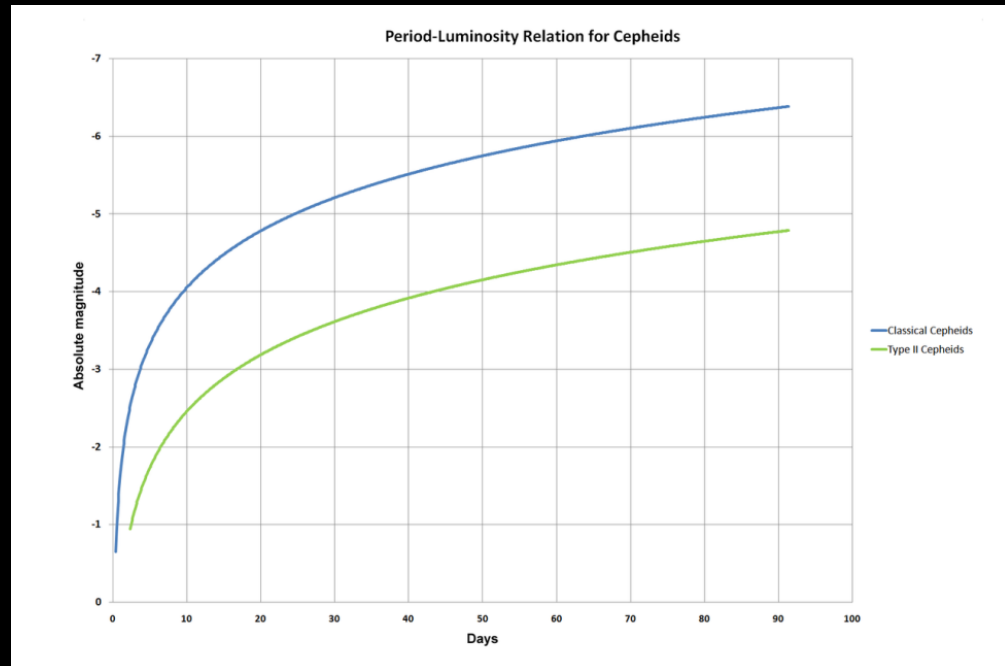
Gives:

$$d = 10^{(3.5 - (-4.1) + 5)/5} = 331.13$$

We multiply this by 3.26:

$$d = 331.13 \times 3.26 = 1079.5$$

So the Cepheid in this example is 1079.5 light years away!



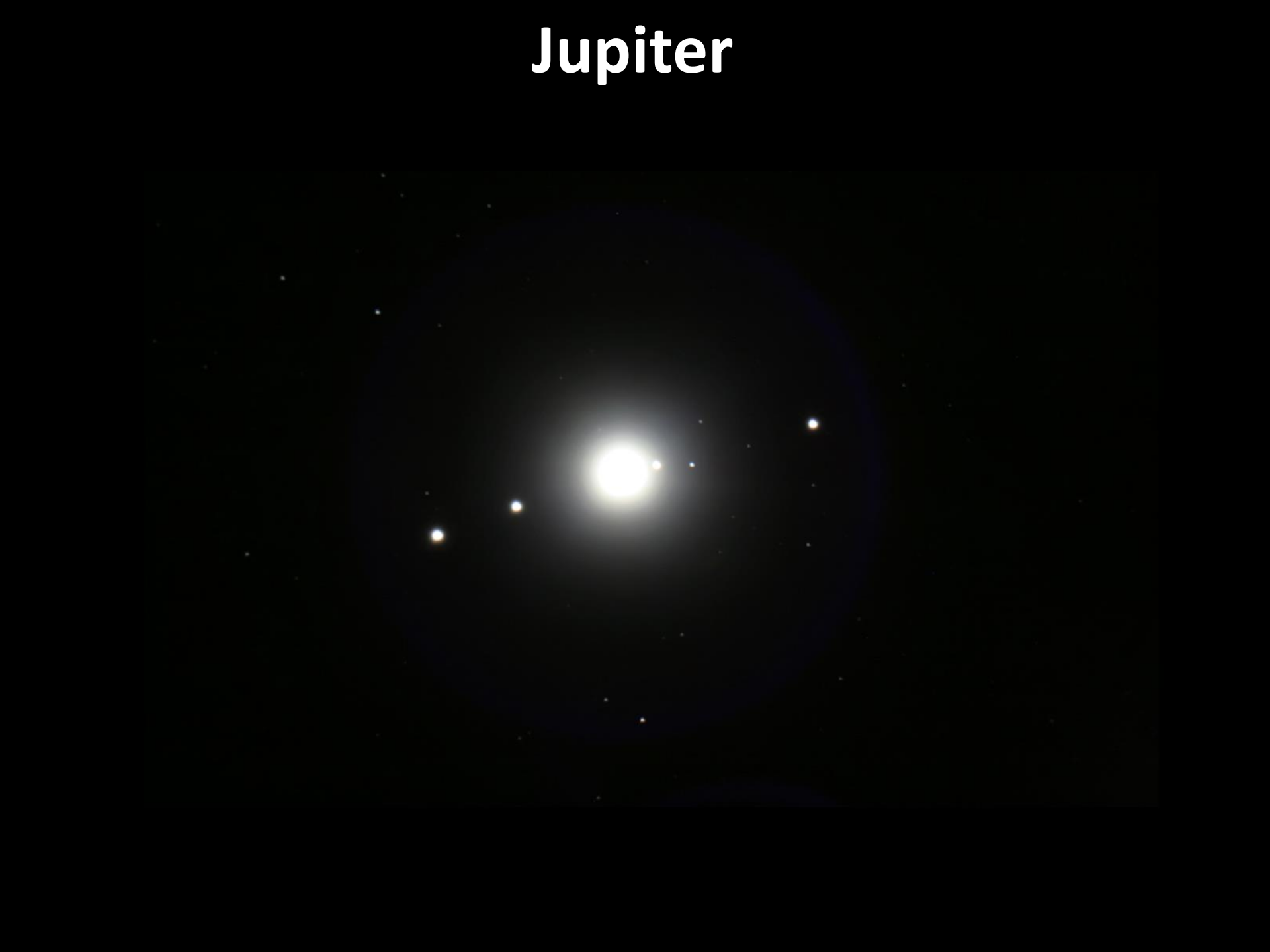
Other Cepheids...

- You might want to do this measurement a couple of times- repeat the magnitude estimates to check the period.
- If you get this working to Delta Cephei, there are some other stars you can try using exactly the same method:
 - RU Cam
 - R Scuti
 - RV Tauri
 - AL Virginis
 - W Virginis



Challenge Number Ten
Imaging a Galilean Satellite Eclipse

Jupiter



The Galilean Moons

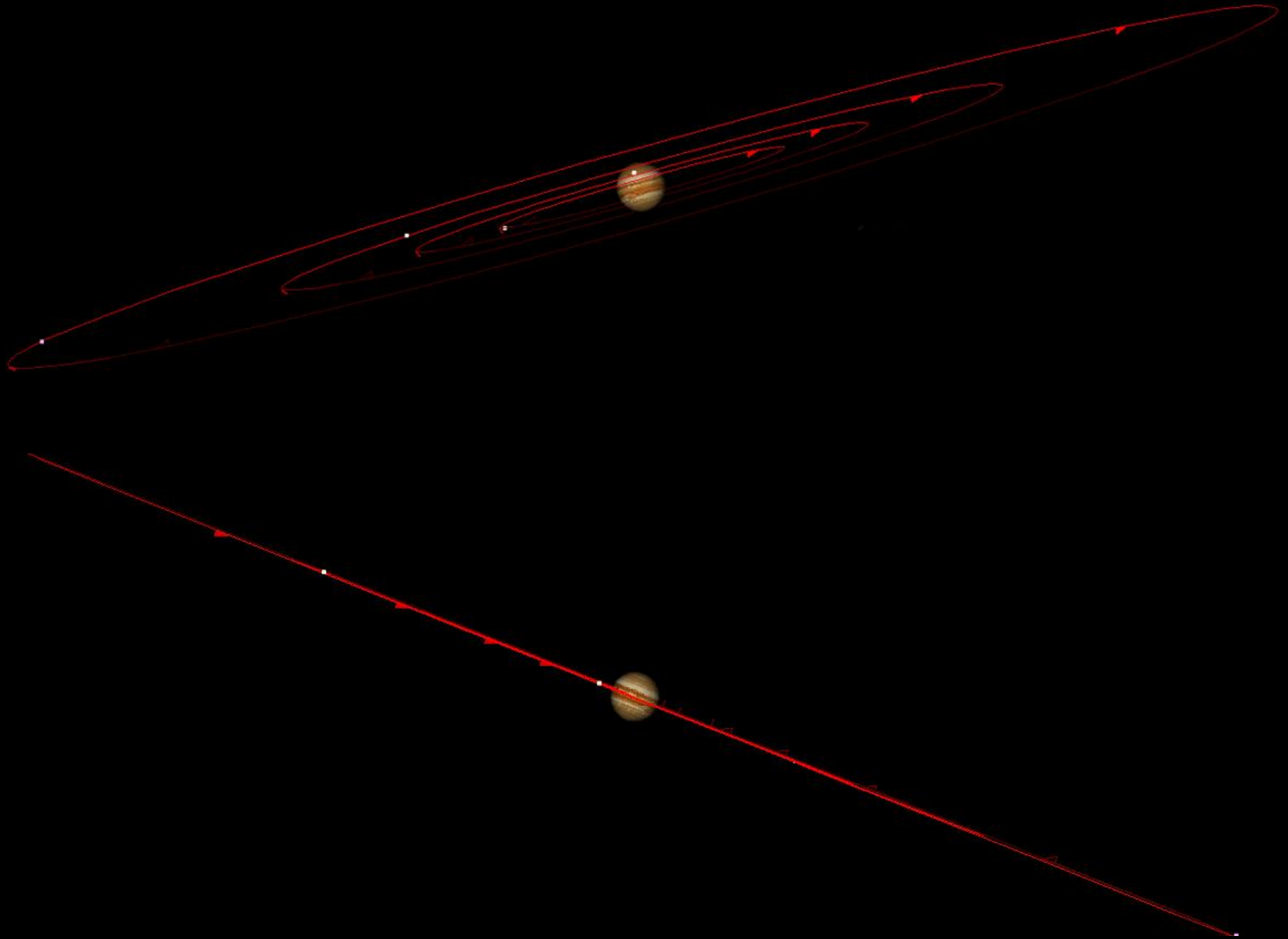


Moon Events



15 September 2011 03:22 UT

Jupiter at Equinox



Mutual Events

IMCCE

l'Observatoire
de Paris | PSL

INSTITUTE

RESEARCH

SERVICES

TEACHING

PUBLICATIONS

Research

Observation campaigns

Presentation •

PHEMU21 campaign of
observations Equinox on
Jupiter in 2021 •

The observer's guidebook •

Observational campaign of the mutual phenomena of Jupiter's satellites

Presentation

Mutual events occur when the Earth and the Sun are crossing the common plane in which the satellites orbit. In the case of Jupiter's satellites, this configuration happens every 6 years.

<https://www.imcce.fr/recherche/campagnes-observations/phemus/phemu>

Imaging the Galilean Moons

Ganymede

2010-08-24 01h00m UT

Diameter: 1.8"

Altitude: 37°



WinJupos simulation



RGB

Mutual Event Example

Io
Ganymede



Main image: Jupiter, Io and Ganymede
2015-02-12 21:33:19 UTC



Right: Sequence showing Io's shadow transiting onto Ganymede's disc - presented at 200% actual capture size



Upcoming Mutual Events

6 May - Io's shadow eclipses Europa

04:26-04:32 BST (03:26-03:32 UT)



04:26:00 BST
(03:26:00 UT)



04:29:30 BST
(03:29:30 UT)



04:32:00 BST
(03:32:00 UT)

29 May - Ganymede's shadow eclipses Io

03:27-04:17 BST (02:27-03:17 UT)



03:31:00 BST
(02:31:00 UT)



03:49:30 BST
(02:49:30 UT)



04:15:00 BST
(03:15:00 UT)

Upcoming Mutual Events



Jupiter

Io



View through a telescope (south up) at 04:48 BST on 14 May



Pete and Paul's Observing Challenges

2021

Email observations to
paul.abel@yahoo.co.uk