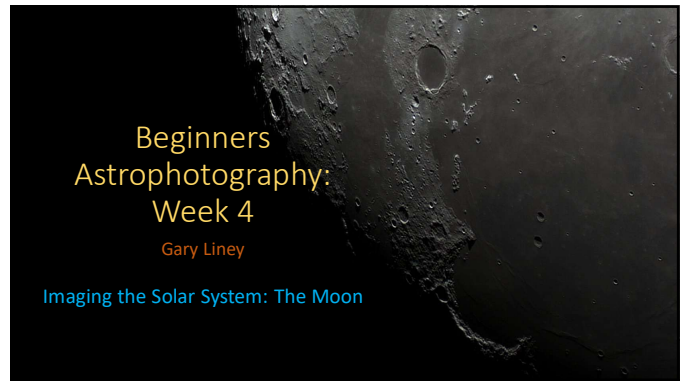


### Reminder for Me

- Get register
- Wk 4 pdf handouts
- Everyone to download gimp

1



## Beginners Astrophotography: Week 4

Gary Liney

Imaging the Solar System: The Moon

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### Introduction

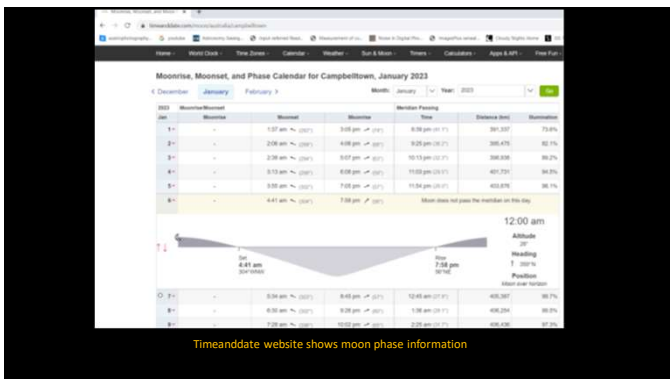
- The Moon is a very easy target for beginners
- Very bright and does not require much equipment
- You will however get better detail with better equipment
  - Craters best seen near edge of shadow
  - Ejection rays best seen at or near full moon
  - 'Mare' or seas are dark patches

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### Useful Tools

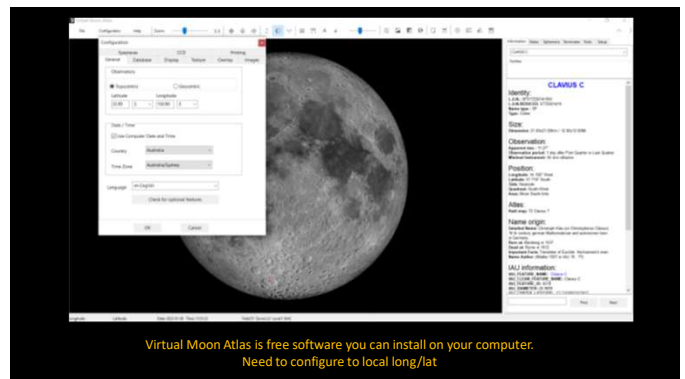
- Many moon resources on the internet, including:
  - Time and Date website
  - Virtual Moon Atlas
  - NASA moon images/Wikipedia

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Timeanddate website shows moon phase information

5

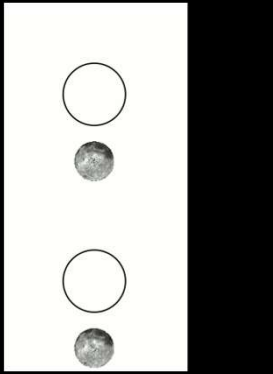


Virtual Moon Atlas is free software you can install on your computer. Need to configure to local long/lat

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## The Moon

- 384,000 km from Earth
- Approximately width of Australia
- Brightest object in the sky- can be a pain for DSO!
- 12 humans have visited, last over 50 years ago
- Rotation and orbit mean it is 'locked' to the earth
- We can never see 'dark' side



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## Phases & Terminator

- Four principal phases (new, 1<sup>st</sup> quarter, full, 3<sup>rd</sup> quarter)
- Intermediate phases are crescent or gibbous
- Additionally described as waxing or waning
- Also described by illumination ranging from 0-100%
- The light/shadow division is known as the lunar terminator
- Significant features appear along it

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## Libration

- In fact 59% of moon surface is observable
- This is due to the tilt and elliptical orbit
- Called Libration
- Can view this on Virtual Moon Atlas

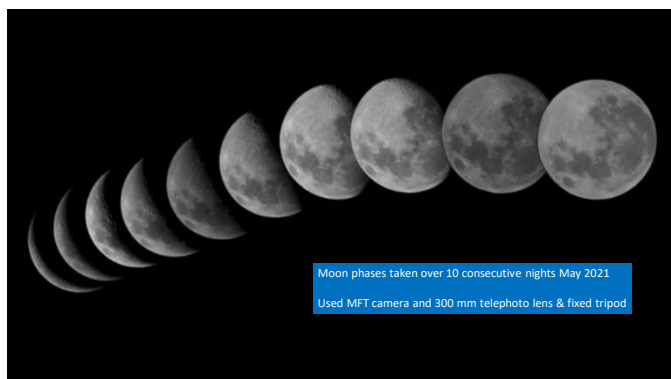


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## Photographing the Moon (Basic)

- Fixed tripod
- Your longest telephoto lens
  - Not as demanding as DSO so kit lens is fine
- Short exposures (e.g. 1/250 s) to prevent blurring
- Possible to use autofocus but I would still use manual
- Best results when moon higher up

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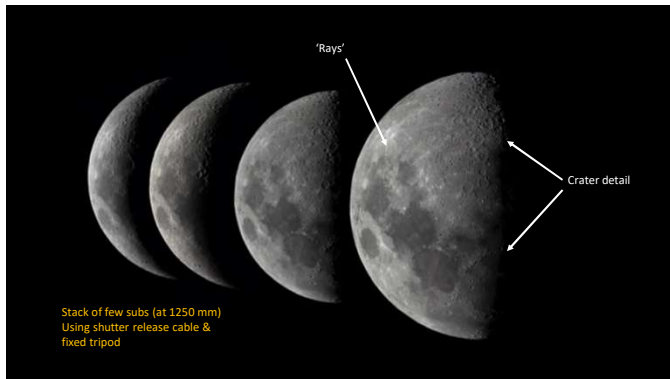


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## Photographing the Moon (Intermediate)

- Very long FL Telescope
- Camera adaptor
- Multiple short exposures
  - Can be stacked in PS Lightroom or Autostakkert

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## Photographing the Moon (Advanced)

- Use video mode or planetary camera on telescope
- Can still use tripod but star tracker will be easier
- Acquire fast frame rate as possible for 'lucky imaging'
- Stack (100s) of images in AutoStakkert

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- Video of Moon moving on fixed tripod

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- More detailed using video capture
- Different phases will have different appearances
- Shadows vary along the terminator



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## Typical workflow (Star Tracker)

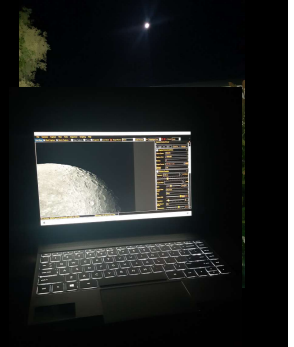
- Rough PA only
- No need to star align
- Can find bright moon in finderscope and start tracking at lunar speed
- Manual focus on crater detail
- Whole process from set up to capture can take just a few mins



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## Typical workflow

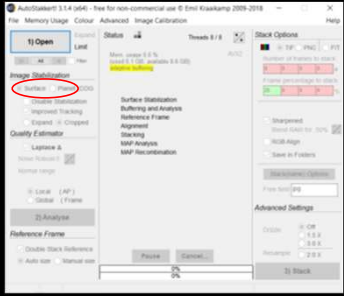
- Video capture at 60-120 fps using SharpCap
- Stack best data in AutoStakkert
- Optionally apply sharpening in PS or use wavelets in Registax



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## AutoStakkert

- Special stacking for planets and moon surface
- Free and easy to use
- Don't have to change default settings



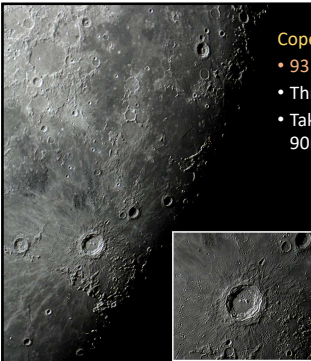
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## Demonstration



Video frame (59 fps)      Stacked best 25%

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**Copernicus (Left & bottom image)**

- 93 km wide crater, 3.8 km deep
- Three 1.2 km mountains in centre
- Taken from Sydney backyard using 90mm scope

**Photo from LRO (Bottom right image)**

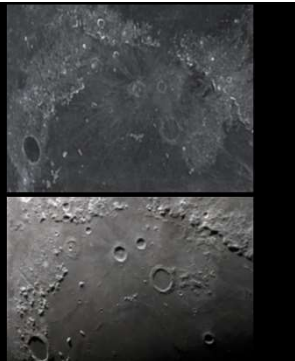
- Orbit 50 km above moon, mapped 98% surface down to 50cm/pixel resolution
- Cost : USD\$583M

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- Two images taken on consecutive nights
- Shows how the sunlight moves and causes different shadows

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- Mare Imbrium ('sea of rains')
- Massive impact crater 1145 km wide
- Difference between full (top) and 1<sup>st</sup> quarter (bottom)

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## Other things to see

<p><b>Frequent</b></p> <ul style="list-style-type: none"> <li>• Specific craters</li> <li>• Apollo landing sites</li> <li>• 'Earth shine'</li> <li>• 'Claire Obscure' effects</li> </ul>	<p><b>Less often</b></p> <ul style="list-style-type: none"> <li>• Lunar eclipse</li> <li>• ISS transit</li> </ul>
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### Crater spotting

- My images (left) compared to NASA LRO (right)

Arzachel  
Albategnius  
Walther  
Purbach

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### Lunar Landings

- My image of location of Apollo 11 (first man on the moon) & Apollo 16

Interactive map on all 21 landings (6 manned) at:  
<https://www.smithsonianmag.com/science-nature/interactive-map-shows-all-21-successful-moon-landings-180972687/>

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### Earth Shine

- Sunlight reflected back off the earth's surface
  - Best time to capture is around crescent phase
  - Brightness is lowest
- Often combined with moon phase image
- Can be done on fixed tripod or star tracker

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### Earth Shine

1) Long 2s exposure, sunlit part over exposed  
Use high ISO to capture earthshine part  
2) Short 250 ms exposure to capture detail of moon phase  
3) Final combined image

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### Lunar 'X'

- Occurs around Purbach crater
- Appears for 1 hr each month at colongitude = 358°
- Use virtual moon atlas to plan imaging

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### Lunar Eclipse

8<sup>th</sup> November 2022 lunar eclipse, three single images (1250 mm) due to cloud.  
(l to r): 11 deg mag 0.2, 28 deg mag 1.3, 32 deg mag 0.99  
Next eclipse is Sept 2025!

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### ISS Transit

- Plan using *transit-finder.com*
- I have still never managed this after many attempts due to last minute clouds!
- I do have a solar transit to show next week



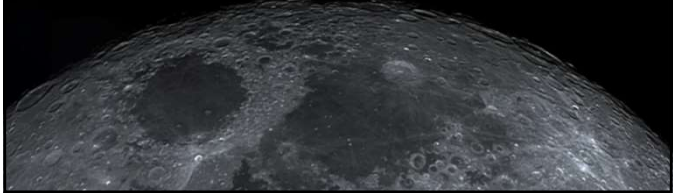
Wed 2023-02-22, 17:09:39.80 • Sun transit  
 ISS angular size: 35.13" • distance: 786.59 km  
 Angular separation: 10.9°; azimuth: 278.4°; altitude: 33.4°  
 Center line distance: 5.23 km; visibility path width: 9.64 km  
 Transit duration: 1.01 s; transit chord length: 23.8"

Fri 2023-02-24, 15:35:09.36 • Moon close pass  
 ISS angular size: 42.26" • distance: 653.89 km  
 Angular separation: 4° 57'; azimuth: 19.8°; altitude: 39.1°  
 Center line distance: 75.45 km; visibility path width: 7.55 km

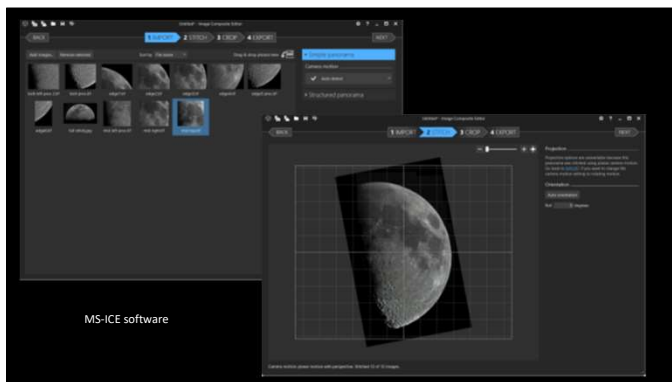
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### Mosaics

- Cover moon in multiple (20+) video captures
- Process each as normal
- Combine using MS-ICE or PS
- High resolution result



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MS-ICE software

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Bintel astrophotographer of the year 2022 Silver Award  
 Gary Liney  
 BINTEL  
 SAMYANG, BENRO

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- Show images in pan/zoom

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Questions?



Austrophotography

www.austrophotography.com

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