

Astronomy: Taking Pictures of the Night Sky

Thursday 1/21/2021 – 3/3/2021 6:15 – 7:00 pm

Zoom: <https://us02web.zoom.us/j/85949382384?pwd=R08xKzZuRXAxNkk3dXErSk1BSmpSQT09>

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What you will need:

1. iPhone
2. NightCap camera app. (<https://nightcapcamera.com/nightcap-camera/>)
 - a) Please familiarize yourself with the online tutorials
3. Tripod or equivalent camera mount: (e.g., <https://www.amazon.com/s?k=iphone+tripod>)
4. Shutter release
 - a) Some tripods come with remote shutter release.
 - b) You can also use the iPhone headphone volume up/down button.

Optional equipment:

1. Photo editing app (e.g., <https://apps.apple.com/us/app/snapseed/id439438619>)
2. Binoculars. Telescope or telephoto lens
3. iPhone adapter (e.g., <https://www.amazon.com/s?k=iphone+telescope+adapter>)
 - a. This is to mount the iPhone to the binoculars or telescope



Week 1: Photographing the Moon

- Dark location
- Atmosphere
- Phases and shadows
- Focus, ISO, Shutter speed

- Scenic vs Close- up

Apps to consider:

- Planets (<http://www.qcontinuum.org/planets>)
- Moon Phase and Lunar Calendar (<https://apps.apple.com/us/app/moon-phases-and-lunar-calendar/id1126370589>)
- Exif Metadata (<https://apps.apple.com/us/app/exif-metadata/id1455197364>)

Moon Data:

<https://nssdc.gsfc.nasa.gov/planetary/factsheet/moonfact.html>

https://community.dur.ac.uk/john.lucey/users/lunar_sid_syn.html

- Mass = 0.012 Earth
- Radius = .27 Earth
- Orbital Radius: 3.8×10^5 KM = 60 X Earth radius
- Orbital Period:
 - Sidereal 27.32 days (relative to stars)
 - Synodic 29.53 days (relative to Earth)
- Crater Theophilus:
 - 100Km diameter. 4000m deep, central mountain 1400m high
 - Grand Canyon 1800m deep

Theories of Moon Formation:

- Capture (But Earth and Moon are very similar in chemical composition)
- Fission (Spinning earth split. Hard to make happen)
- Co-formation (You might expect moon to have similar iron core as Earth)
- Giant Impact (explains why moon has small iron core)

Week 2: The Planets

- Visualizing the Solar System
 - Earth-centric vs Sidereal
 - <https://www.theplanetstoday.com/index.html>
 - <https://eyes.nasa.gov/apps/orrery/#/home>
 -



- Planet Comparison
 - https://ssd.jpl.nasa.gov/?planet_phys_par
 - https://callumprentice.github.io/apps/planet_compare/#
- Example Photos:
 - <https://www.erictheske.com/2012/04/iphone-astrophotography-of-venus.html>

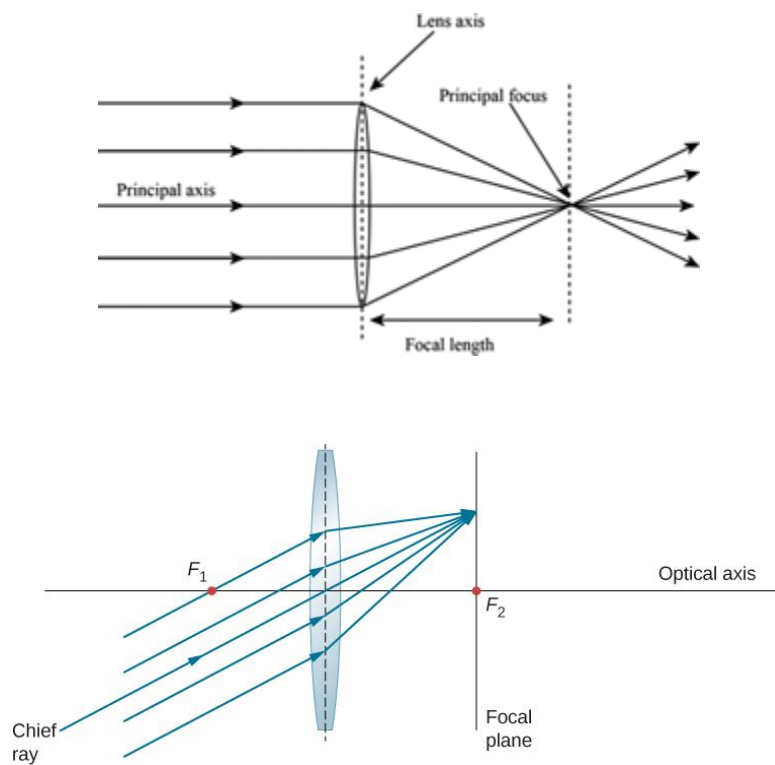


Week 3: Eyes, Optics, CCDs, Formation of the Solar System

Human eye dark adaptation:

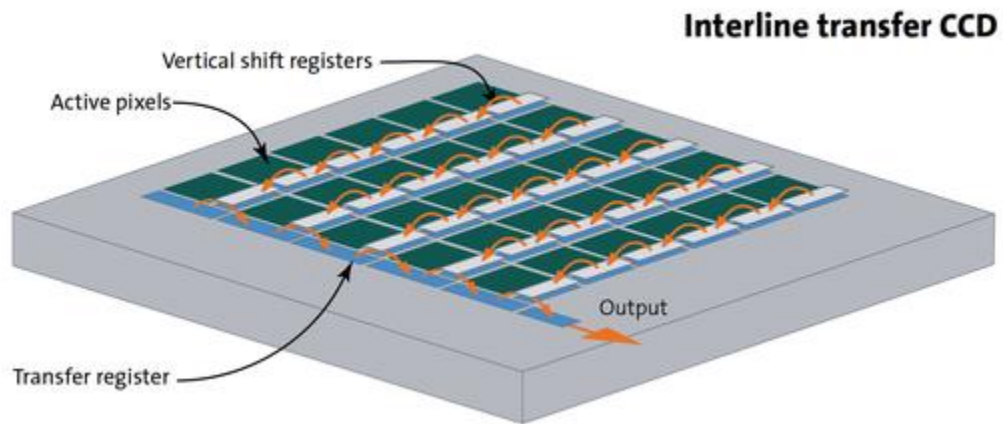
- Pupils open, change from cones to rods.
- 20 mins to adjust to darkness.
- Astronomers use dim red flashlight to not interfere with dark adaptation.
- Averted vision.

Optics lens and focal plane:

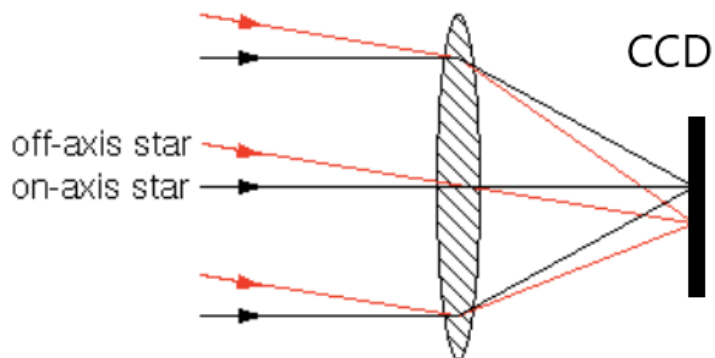


Light entering a lens is bent to the focal plane

CCD: “grid of buckets”



iPhone X: 4000 x 3000 grid = 12,000,000 pixels



Solar System Composition and Theories of Formation

Nebular Hypothesis (https://en.wikipedia.org/wiki/Nebular_hypothesis)

Stars form from gravitational collapse of Giant Molecular Cloud (mostly hydrogen)

Frost Line: water, ammonia, methane, carbon dioxide, carbon monoxide

Week 4:

7. The Messier Catalog

In 1758 Charles Messier, searching for comets.

110 objects in the Northern hemisphere sky. M1 – M110

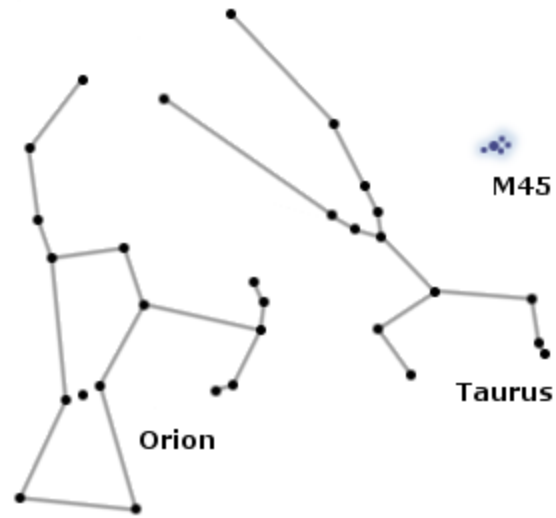
<https://www.nasa.gov/content/goddard/hubble-s-messier-catalog>



M31 Andromeda Galaxy

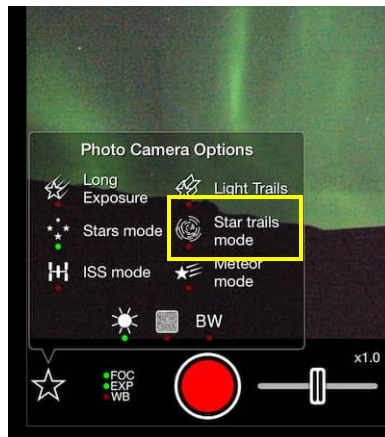


M45 The Pleiades Star Cluster



Week 5:

1. Star Trails



Nightcap Star Trails Mode



- Find North direction.
- Choose a nice foreground. (No bright lights!)
- Set up camera on tripod.
- Wait for dark sky.
- Nightcap: select star trails mode (tap to dismiss info screen.)
- Press shutter button to start. (it is nice to use a remote shutter release)
- Wait about 10-30 minutes
- Press shutter button again to stop

2. Astronomy Distances

Speed of light: 670,616,629 mph

186,282 miles per second

299,792 kilometers per second

It takes 8 minutes 19 seconds for light to travel from Sun to Earth.

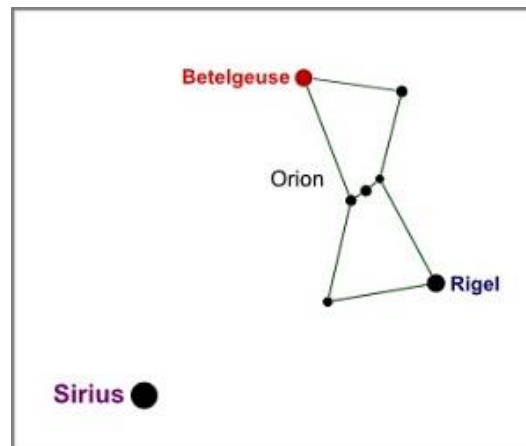
Light Year: How far does light travel in 1 Year?

300,000 kilometers/sec x **60** sec/min x **60** min/hour x **24** hour/day x **365** day/year

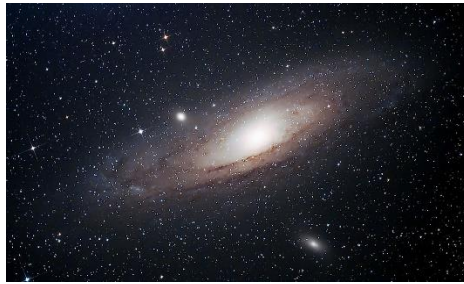
= 9,400,000,000,000 kilometers

Nearest stars to Earth (not including Sun):

	Star system	Distance in light-years
1	 Alpha Centauri	4.24-4.37
2	 Barnard's Star	5.96
3	 Wolf 359	7.78
4	 Lalande 21185	8.29
5	 Sirius	8.58
6	 Luyten 726-8	8.73
7	 Ross 154	9.68
8	 Ross 248	10.32
9	 Epsilon Eridani	10.52
10	 Lacaille 9352	10.74
11	 Ross 128	10.92



Nearest Galaxies:



Andromeda Galaxy: 2.5 million LY

3. Hubble Telescope Archive

<https://hubblesite.org/resource-gallery/images>



Week 6:

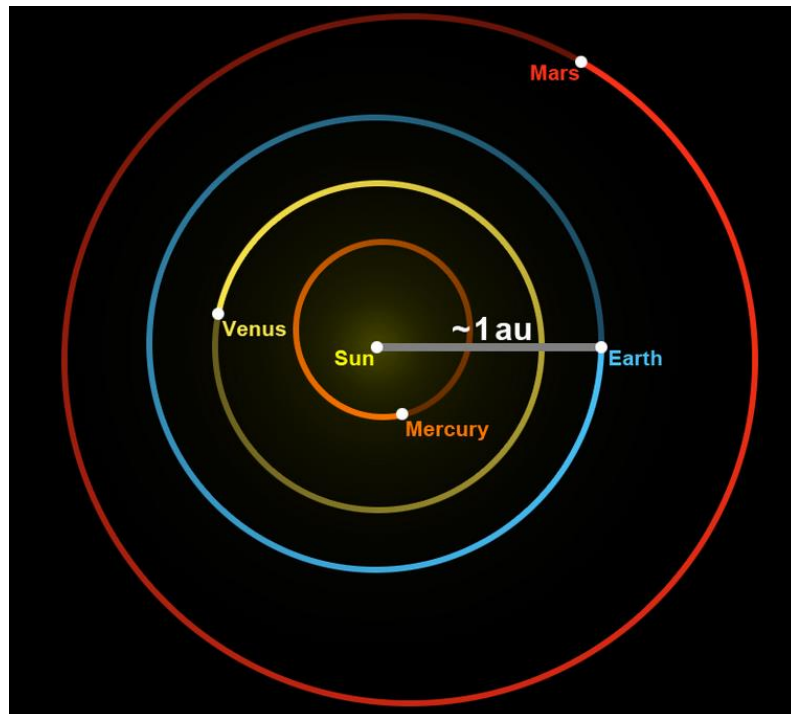
1. Your Photos?



2. The Cosmic Distance Ladder

How do we know how far away objects are?

1. Orbital Dynamics (planets)
 - a) Astronomical Unit: (1AU = 150,000,000 km)

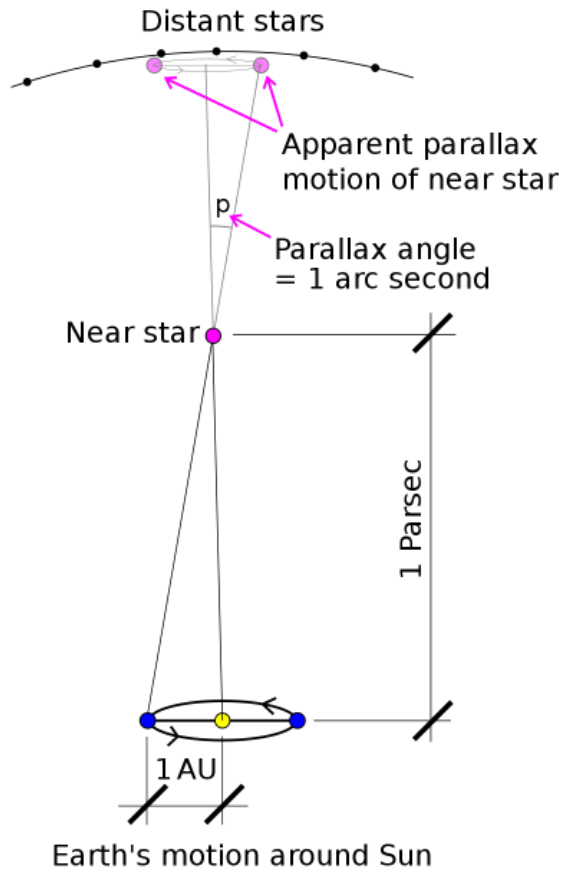


Planet	Period (years)	Radius (AU)
Mercury	0.24	0.39
Venus	0.6	0.72
Earth	1.00	1
Mars	1.88	1.52
Jupiter	11.86	5.20
Saturn	29.46	9.54
Uranus	84.01	19.19
Neptune	164.82	30.06

$$G M / (4 \pi^2) P^2 = R^3$$

2. Parallax (stars up to a few thousand light years)

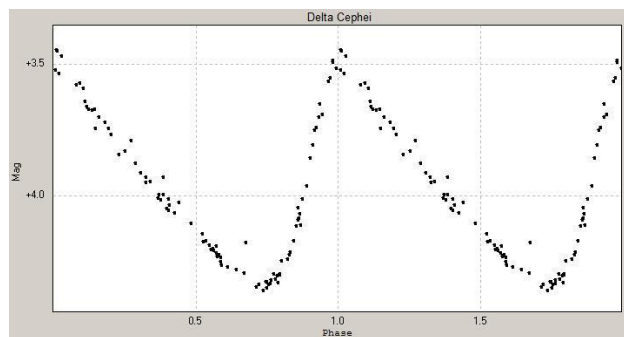
a) Parsec: (= 3.26 LY)

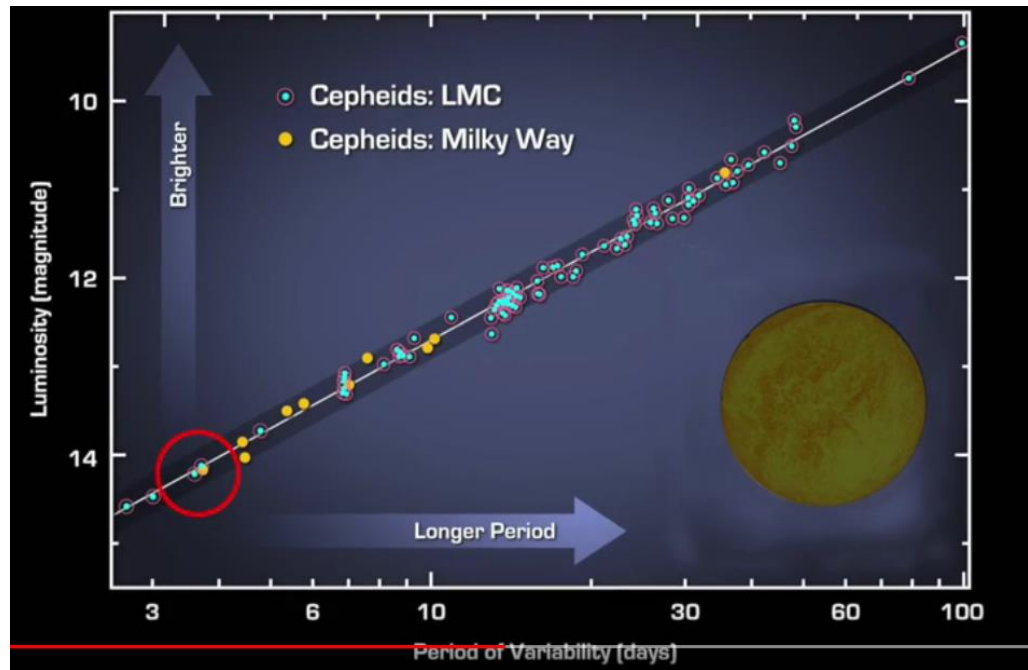


3) Standard Candles

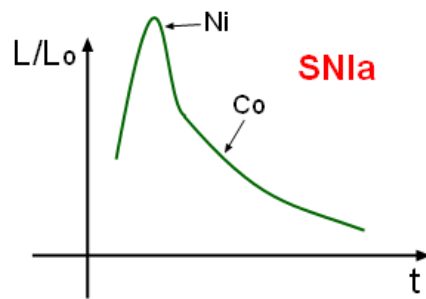
a) Cepheid Variables (Nearby Galaxies - 50 million LY)

<https://astronomy.com/news/2018/01/mapping-the-cosmos-with-cepheid-stars>





b) Type 1a Supernovae (up to ~10 billion LY)



4) Redshift (13 billion LY – age of universe)

