Evening Classes

Week Seven

Telescopes

Presented by John Campbell

Astronomy Course Outline

Week 1: The Sky | Week 2: The Planets | **Week 3: The Stars** | Week 4: History of Astronomy | Week 5: Telescopes | Week 6: Deep Sky Objects | Week 7: Cosmology | Week 8: Alien Worlds

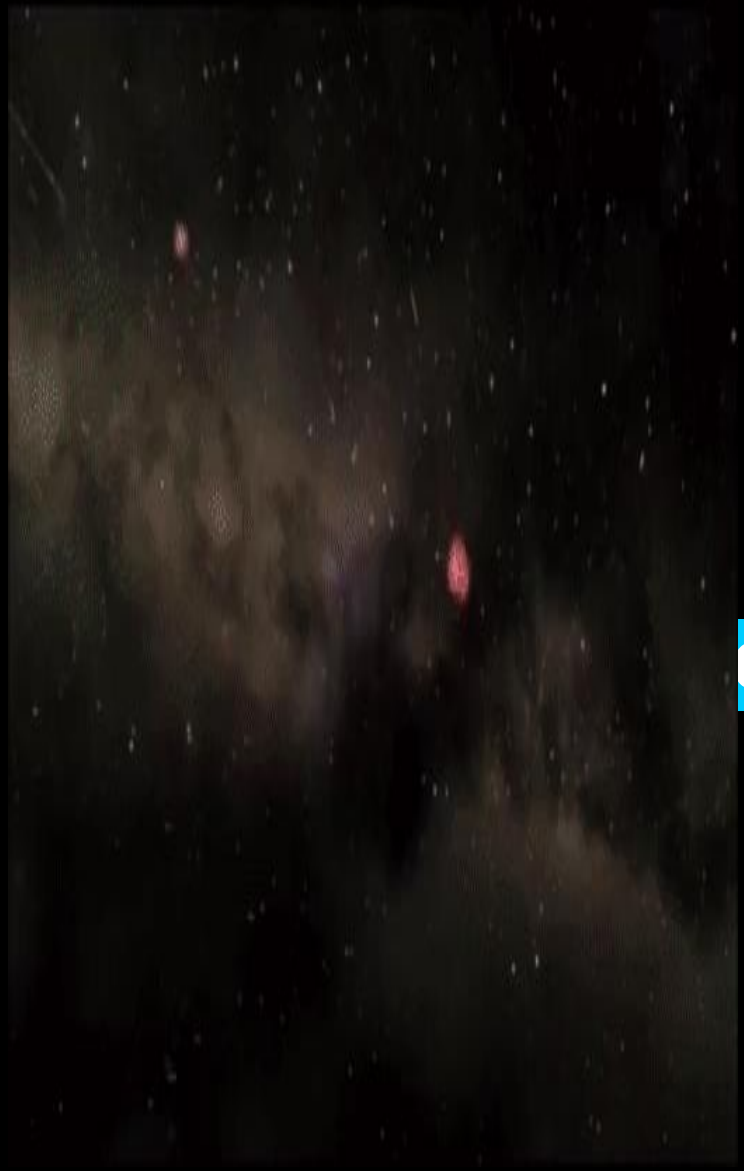
Night sky updates

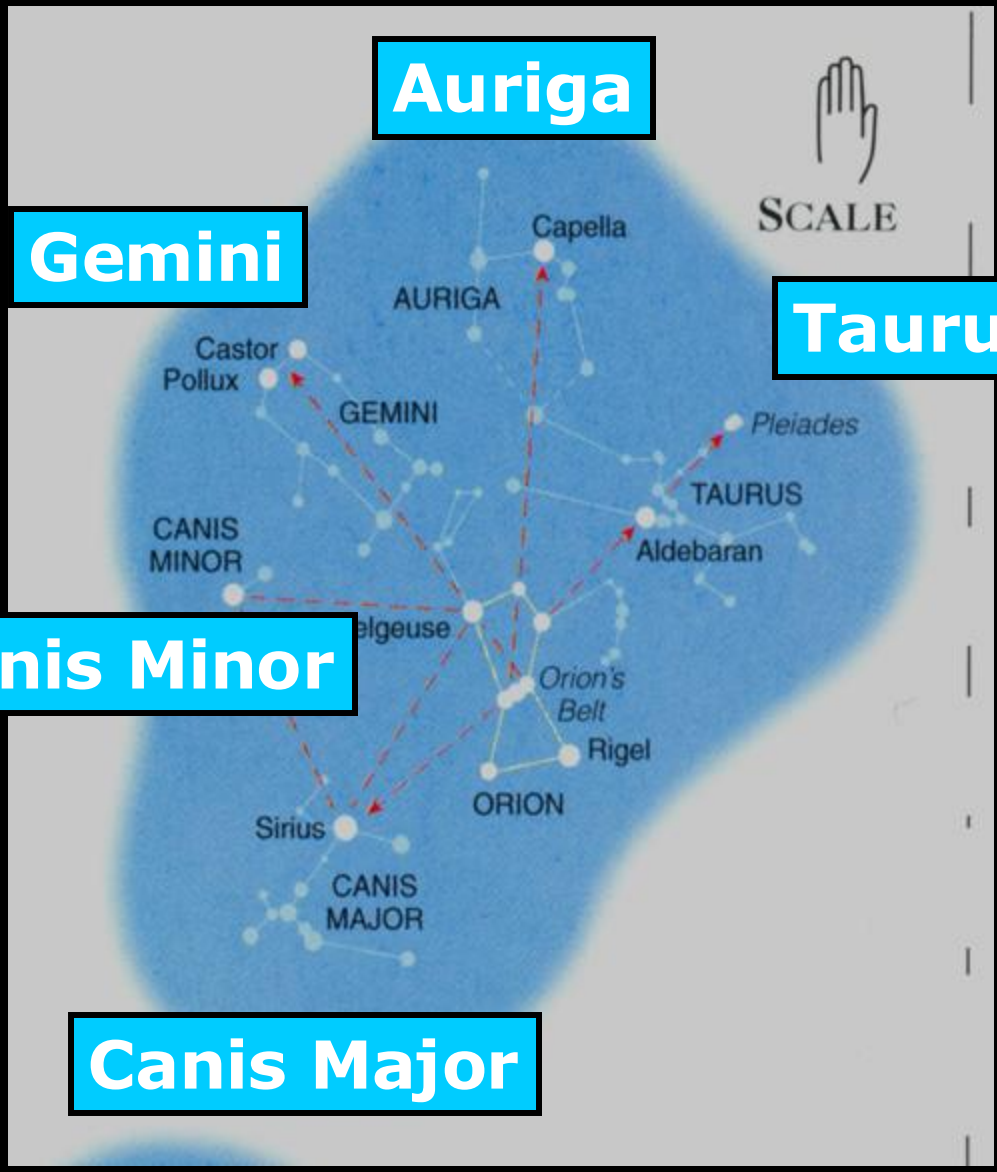
This was our Mars Watch on Jan 15 2023 during Mars Opposition – after clearing up a bit! - Should be like this for Sat 29th Nov for Saturn and Jupiter Watch

What can I see?

- **Stars & Constellations**
- The Moon and Planets (W2)
- Galaxies & Nebulae (W6)
- The Sun (CAREFUL!)

Orion as a perfect stellar signpost



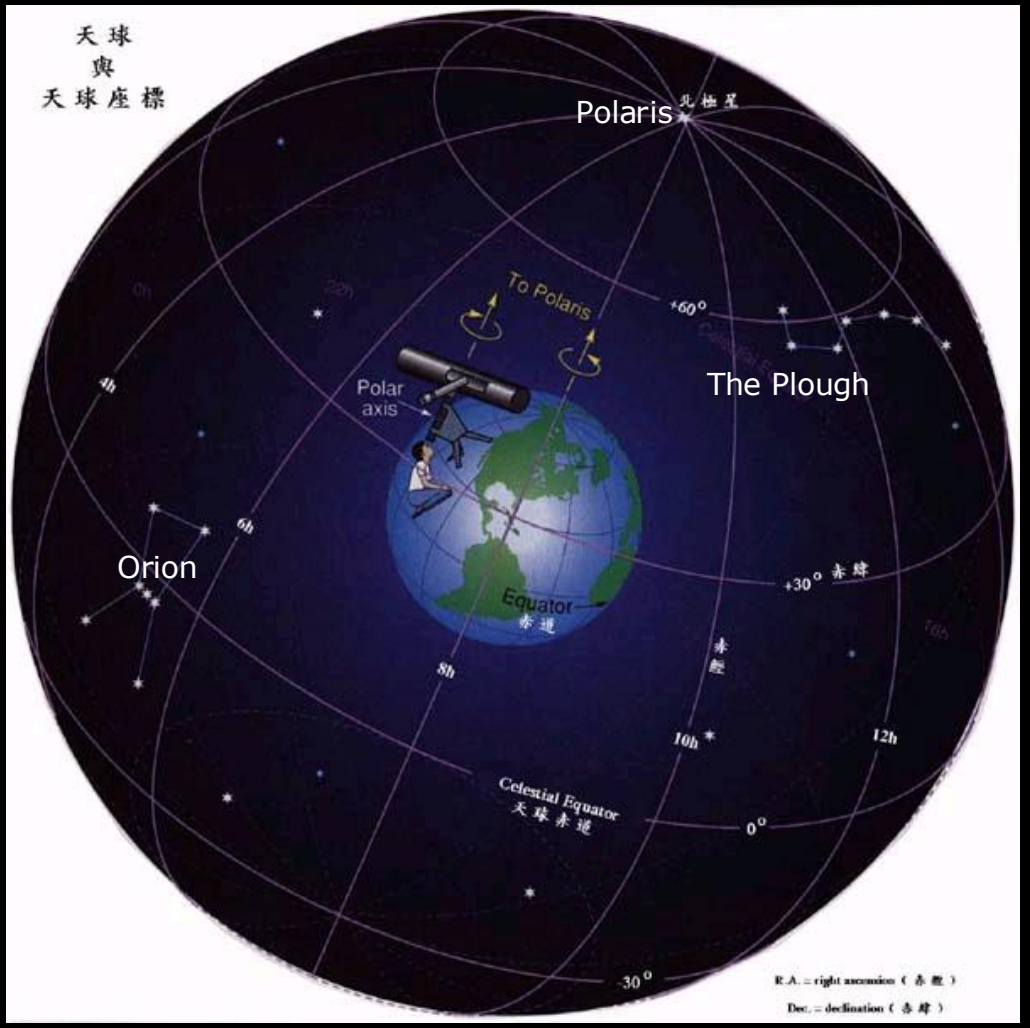


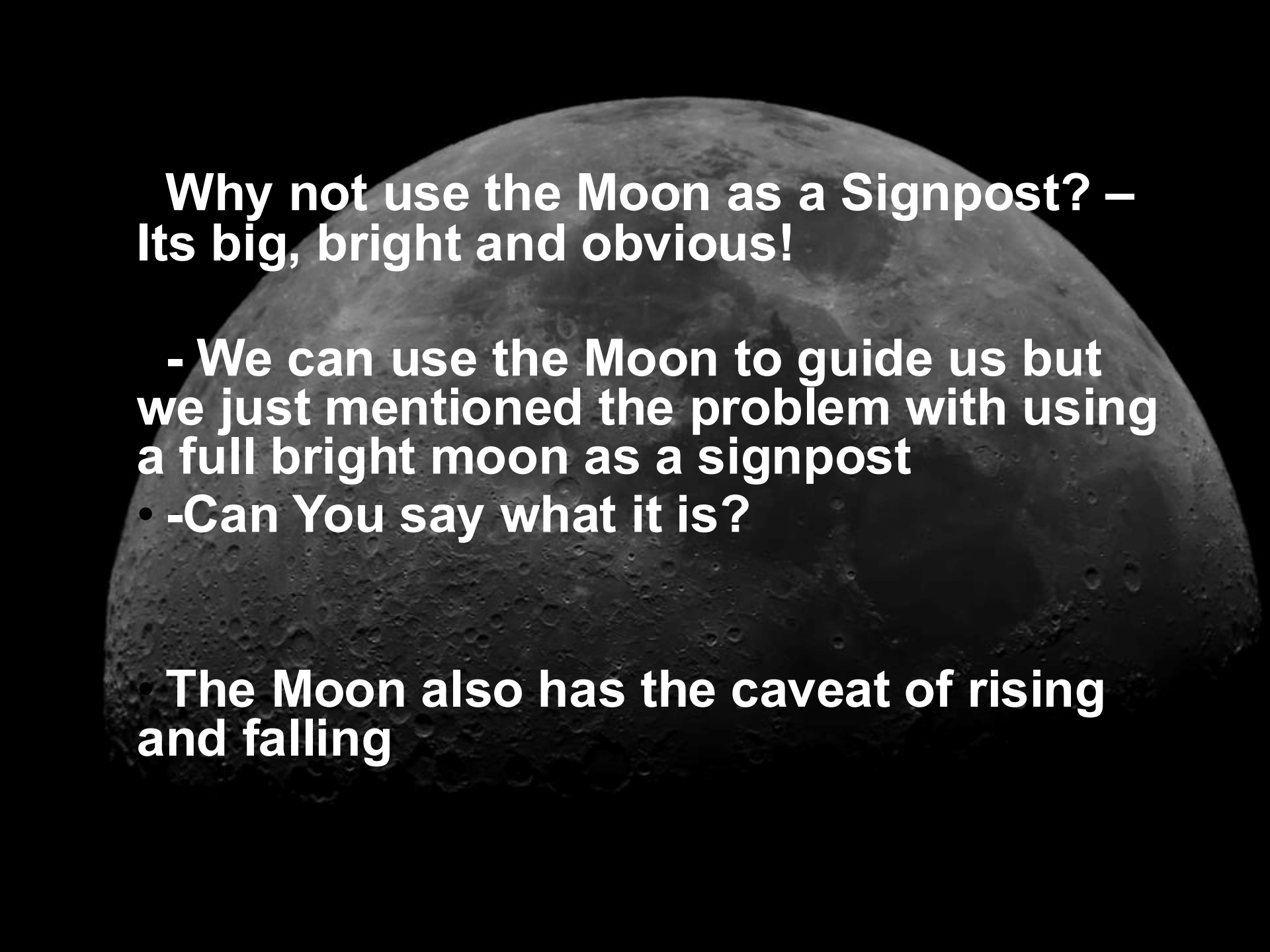
Stars appear fixed on the Celestial Sphere. But the caveat of using constellations as Signposts is that the celestial sphere moves

So the constellations also appear to rise and fall

You can note (over the course of a night) the positions of –

- **The Plough**
- **(Or Big Dipper)**
- **Polaris**
- **Orion**





Why not use the Moon as a Signpost? – Its big, bright and obvious!

- We can use the Moon to guide us but we just mentioned the problem with using a full bright moon as a signpost

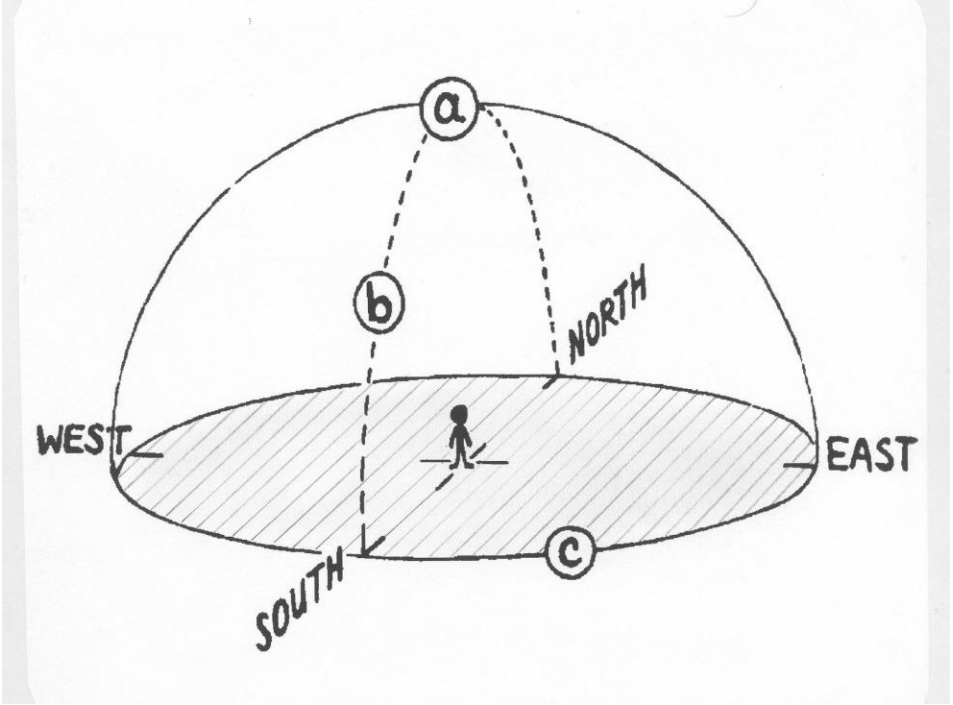
- -Can You say what it is?

- The Moon also has the caveat of rising and falling

remember the night sky is like an up-turned bowl above the astronomer's head.

- a: Zenith
- b: Meridian
- c: Horizon

- Meridian is important as it marks for us, at a given time when a constellation reaches this point in the sky.
- It is a coordination point in time.
- during a constellations exact instant of local time crossing the local meridian is formally called the *Sidereal Time*, which is exactly corresponds to the local meridian's Right Ascension
- You can look up these for constellations to get the best time to view them.



e.g. Andromeda in
summer vs winter

Why not use the Moon as a Signpost? – Its big, bright and obvious!

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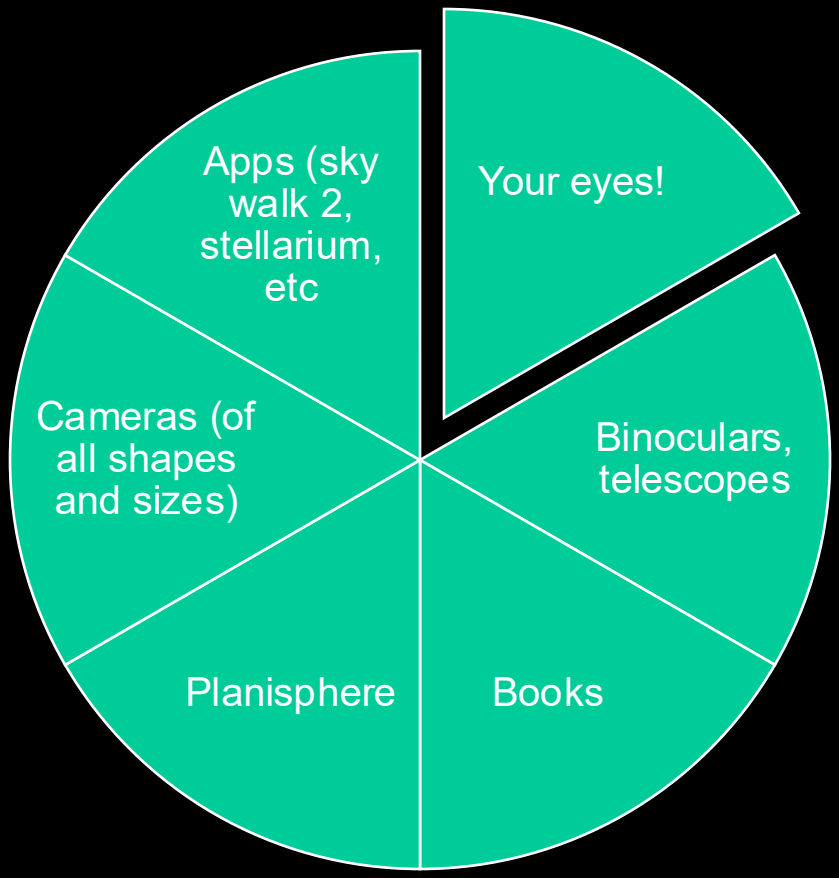
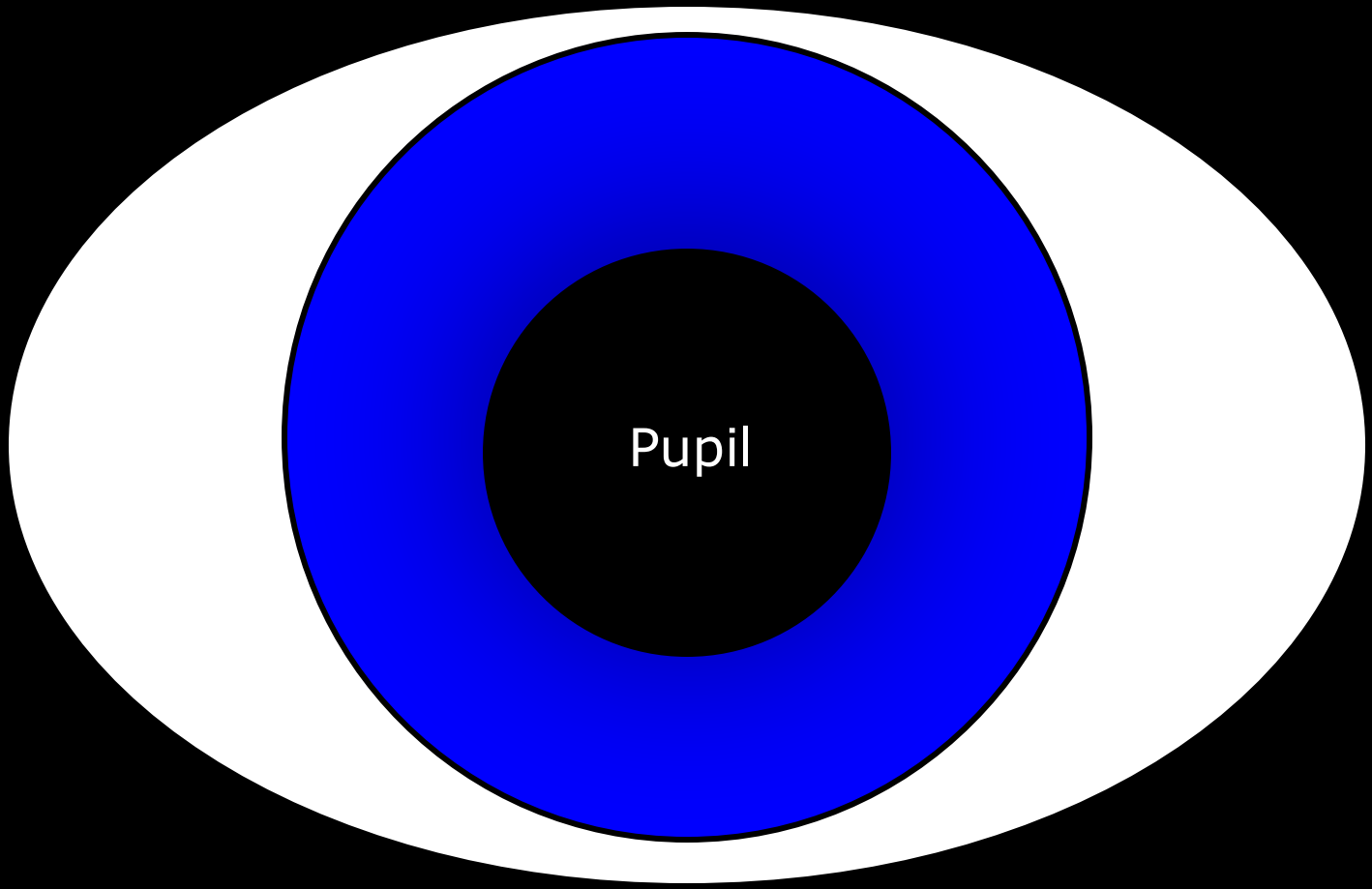
-Can You say what it is?

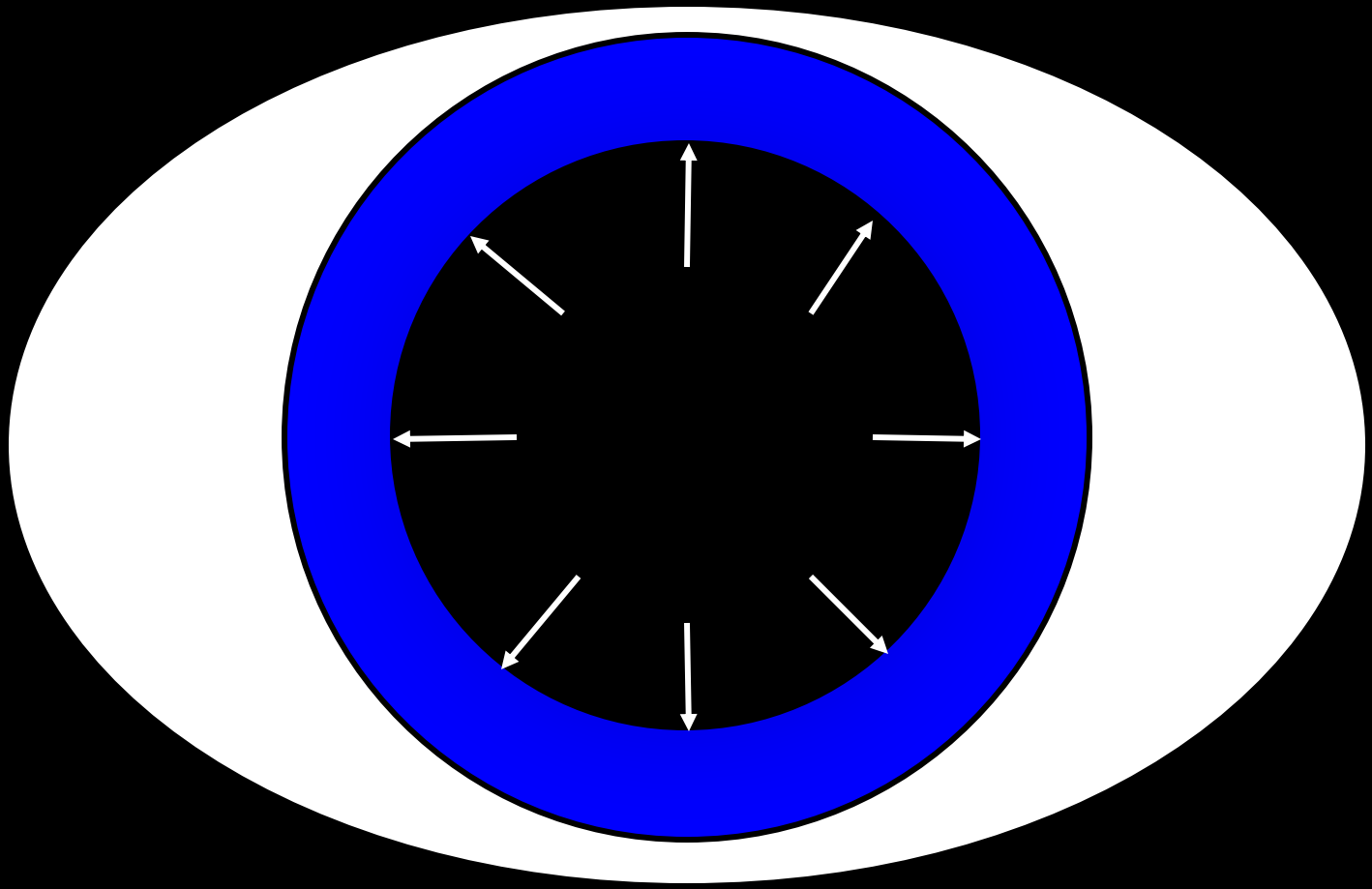
Equipment


Your eyes!
Binoculars, telescopes
Books
Planisphere
Cameras (of all shapes and sizes)
Apps (sky walk 2, stellarium, etc


The Miller
PLANISPHERE
Puts the stars within everyone's reach
NOON
JANUARY
DECEMBER

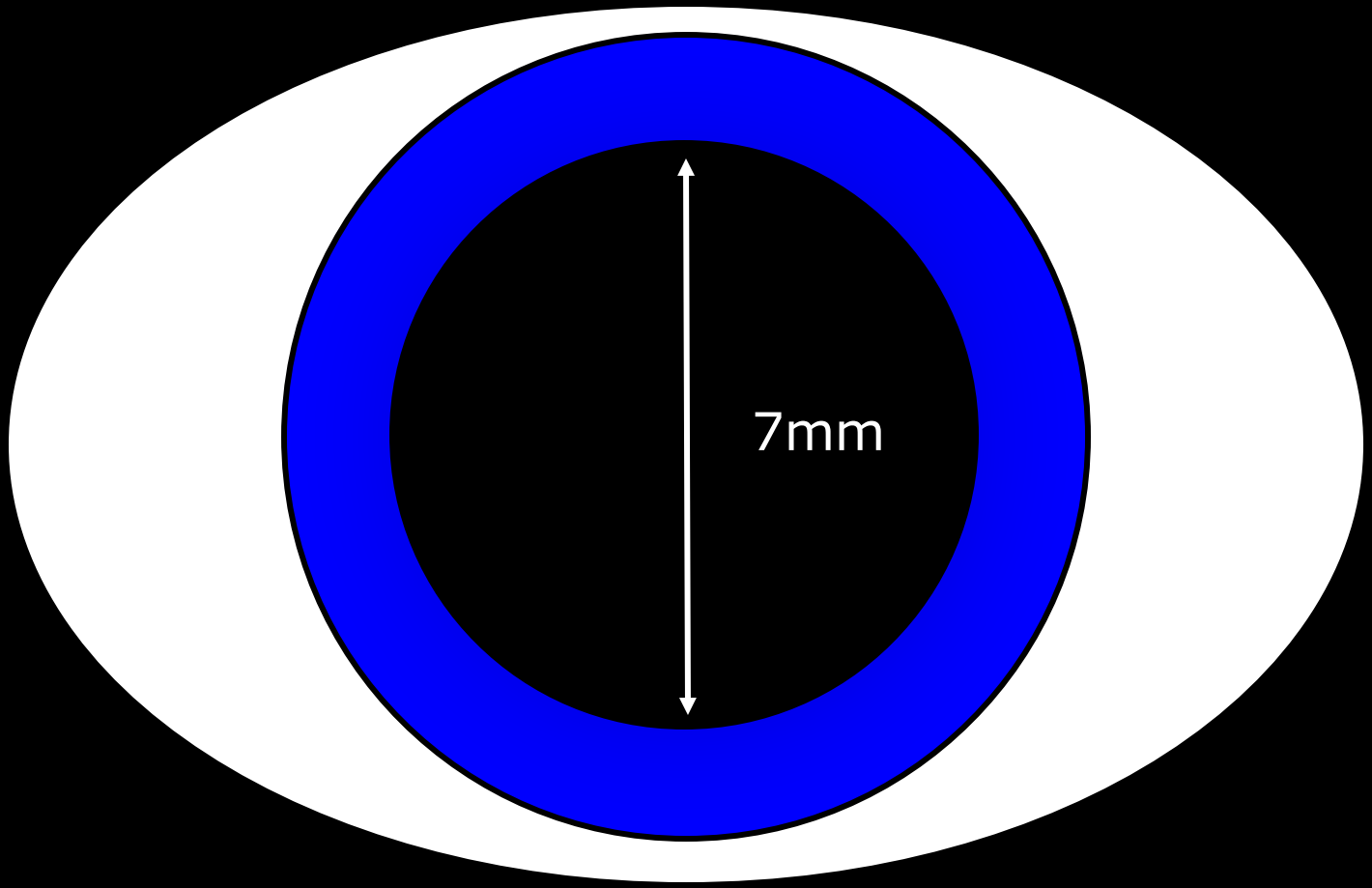

Pupil

The Eye at Night



The pupil widens to collect more light.

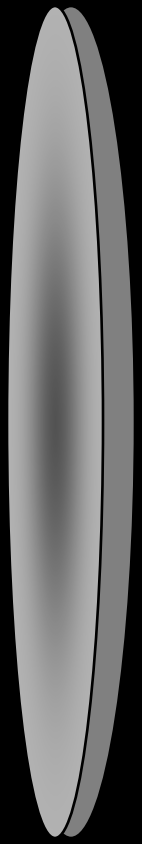
The Eye at Night




Space lies just above our heads!

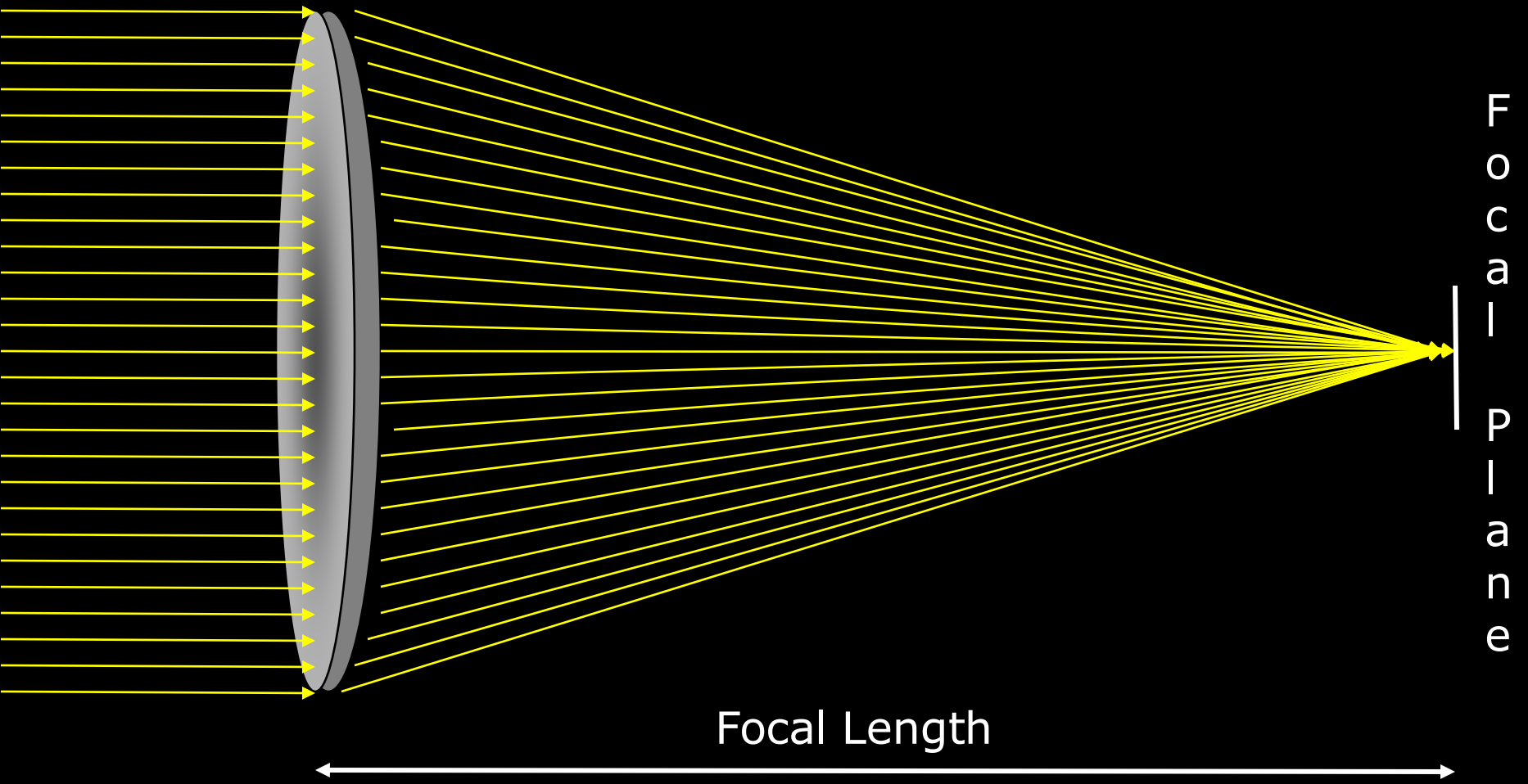
50mm x 50mm = 2,500mm^2

50mm binoculars collect 50 times as much light as the naked eye.

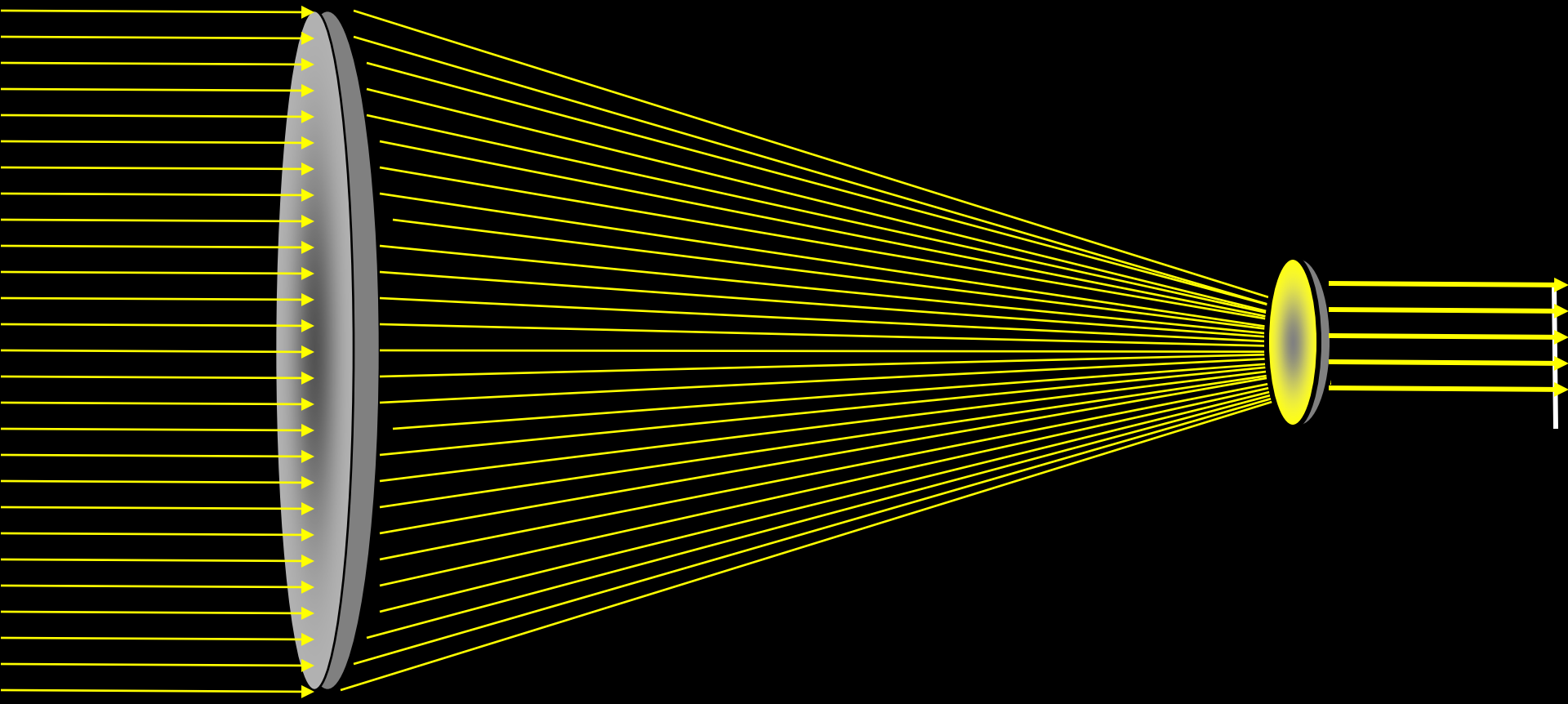


Aperture

Typical values are 5cm for modest binoculars to 30cm or more for large telescopes


Focal Plane
Focal Length

A second lens is used to re-diverge the rays.



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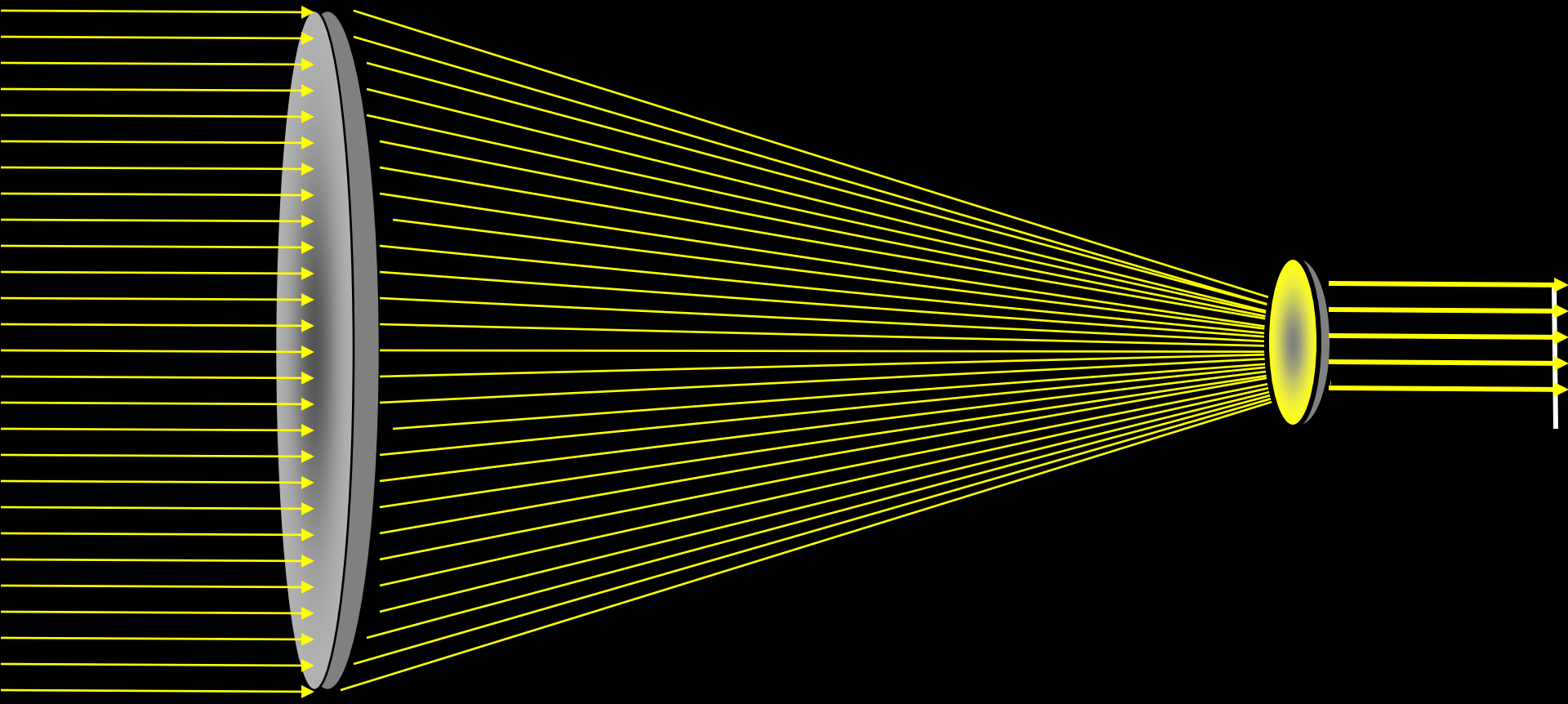


The eyepiece is placed at the focal plane

Binoculars

Point and look

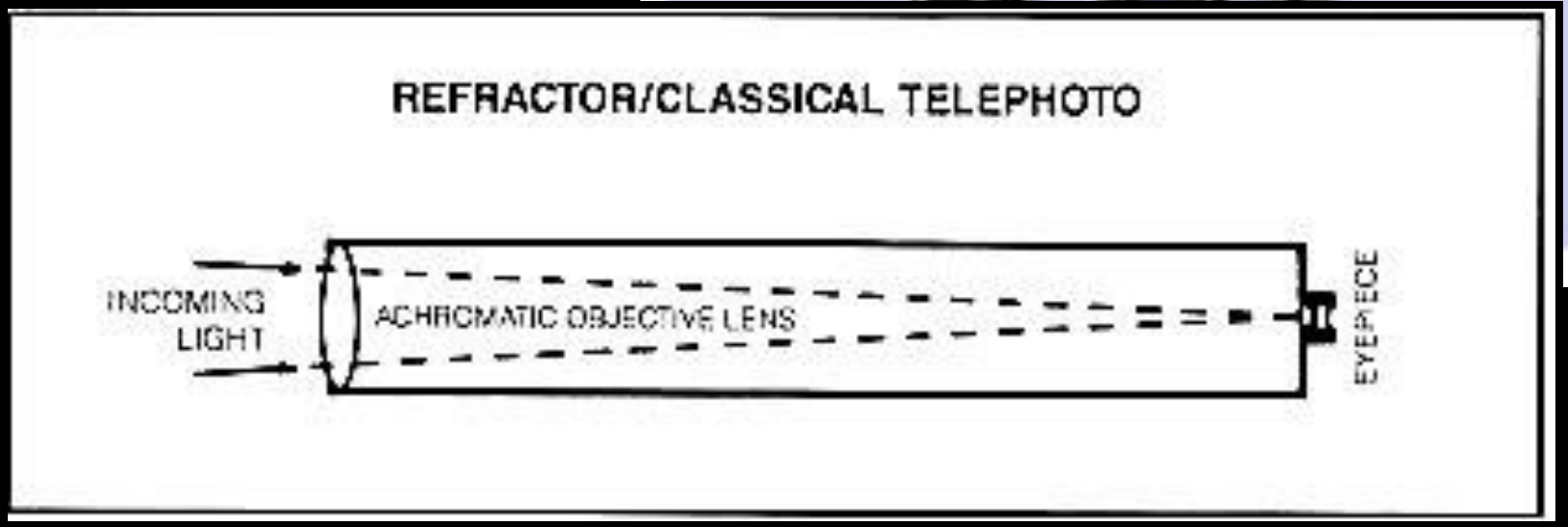
Adjust for each eye

Useful on land,
sea or sky!

Relatively inexpensive

Refractors


MEADE


REFRACTOR/CLASSICAL TELEPHOTO
INCOMING LIGHT
ACHROMATIC OBJECTIVE LENS
EYEPIECE

Refractors - Pros & Cons

- ADVANTAGES

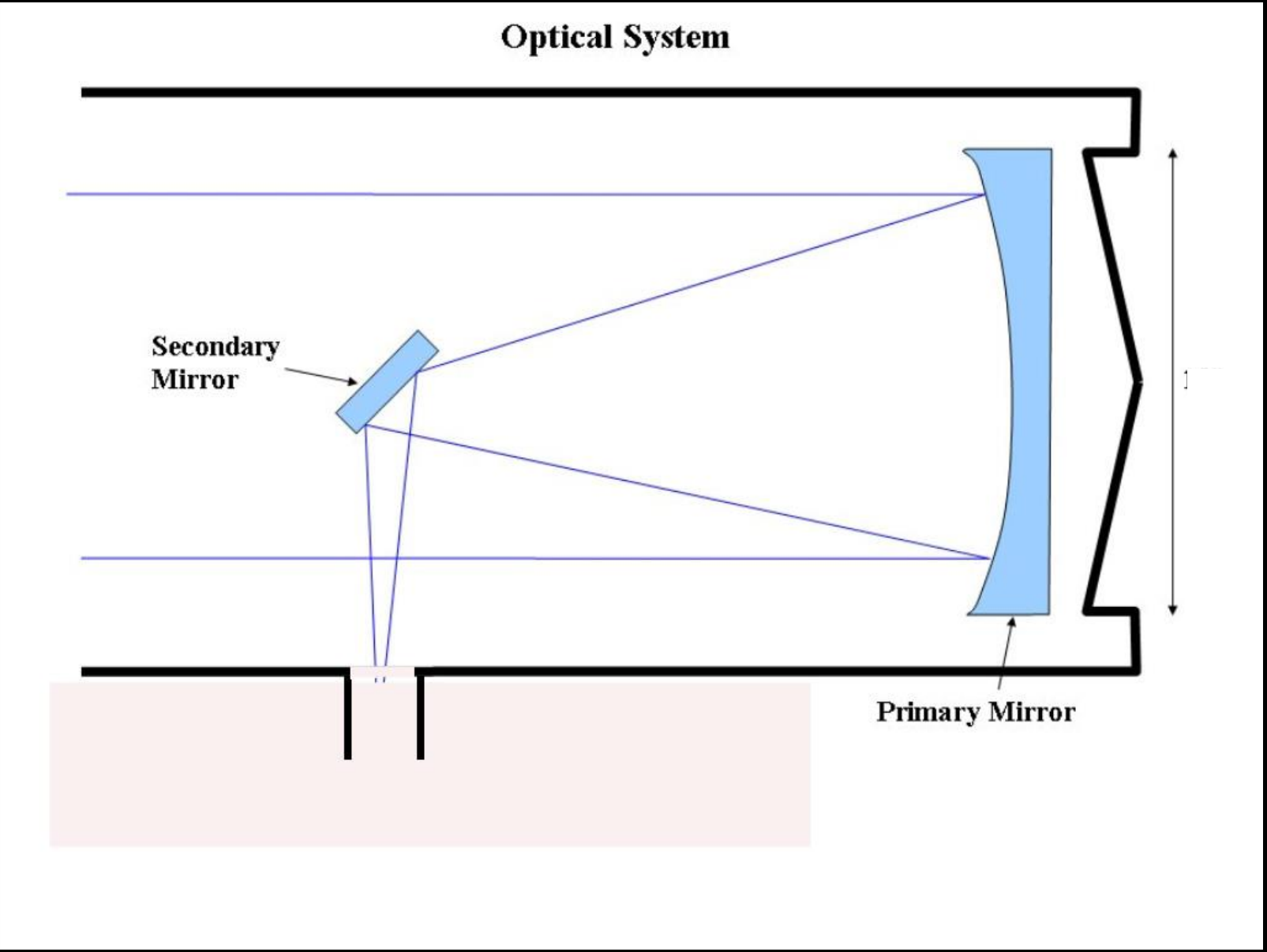
- Simplicity - no maintenance.
- Suitable for terrestrial viewing.
- No obstruction = high contrast.
- Sealed tube - no air currents.

- DISADVANTAGES

- Very expensive in large apertures.
- Long, heavy & uncomfortable.
- Residual chromatic aberration.
- Long f-ratios unsuitable for photography.

Reflectors

Newtonian Reflector



Open-end of a reflector

Reflectors - Pros & Cons

ADVANTAGES

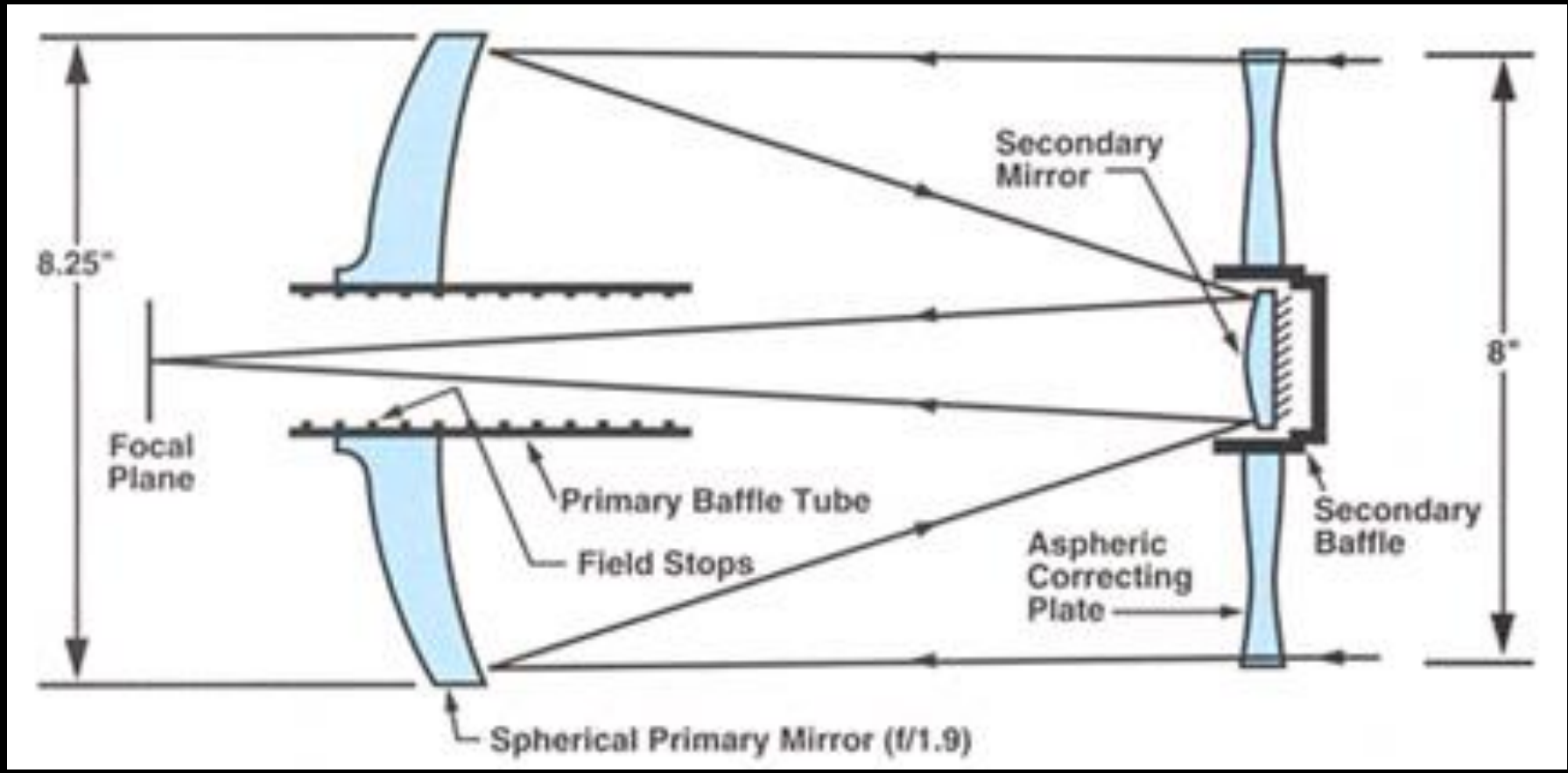
- Low cost for size
- No chromatic aberration.
- Compact & ergonomic.
- Short f-ratios possible.
- Optically simple.
- Can be built very large.

DISADVANTAGES

- Obstruction = loss of contrast.
- Only suitable for astronomy.
- Open tube = air currents.
- Mirrors tarnish & need re-coating.
- Need maintance, esp. collimation.
- Off axis coma.

Schmidt-Cassegrain Reflector

Light-path in a Schmitd-Cassegrain Reflector



Catadioptrics - Pros & Cons

- ADVANTAGES

- Best of both worlds
- Large mirrors available
- Suitable for terrestrial viewing.
- Extremely Compact
- Sealed tube - no air currents.

- DISADVANTAGES

- Can be expensive.
- Obstruction = loss of contrast.
- Long f-ratios unsuitable for photography.

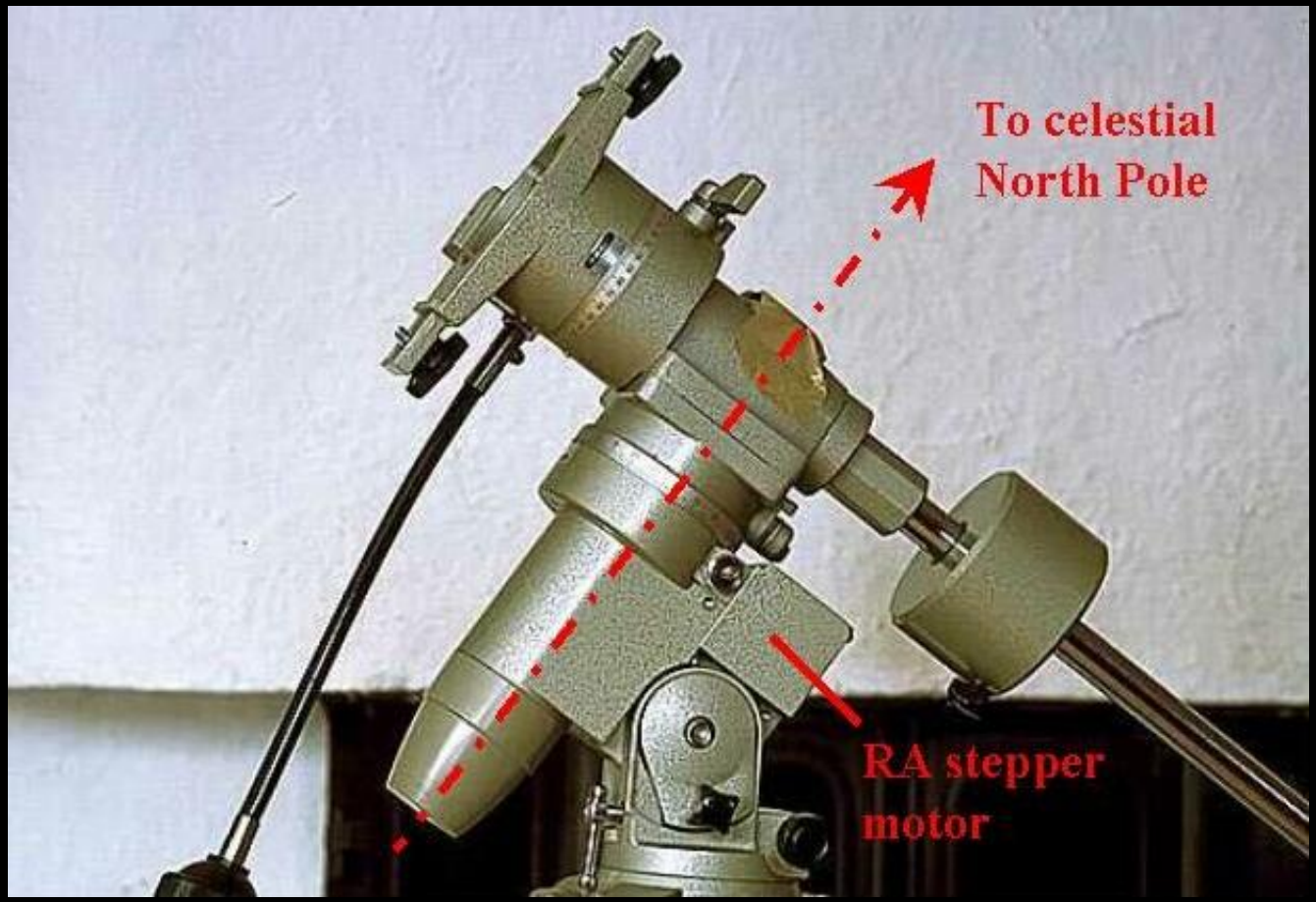
Alt-azimuth Mount

Dobsonian

Fork

Point and shoot

Equatorial Mount



Manual

Motorised

GoTo

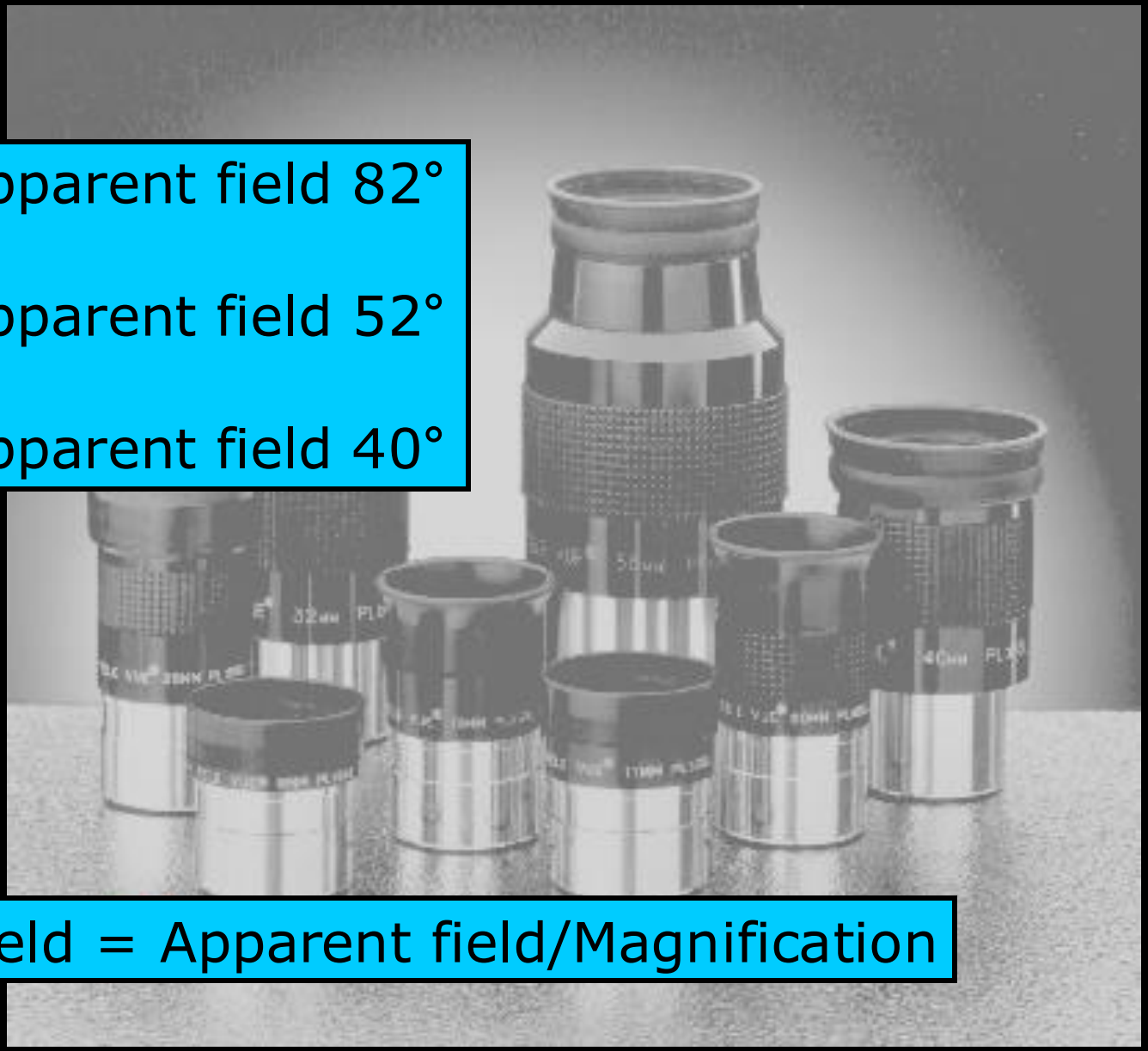
Photograph

Eyepieces

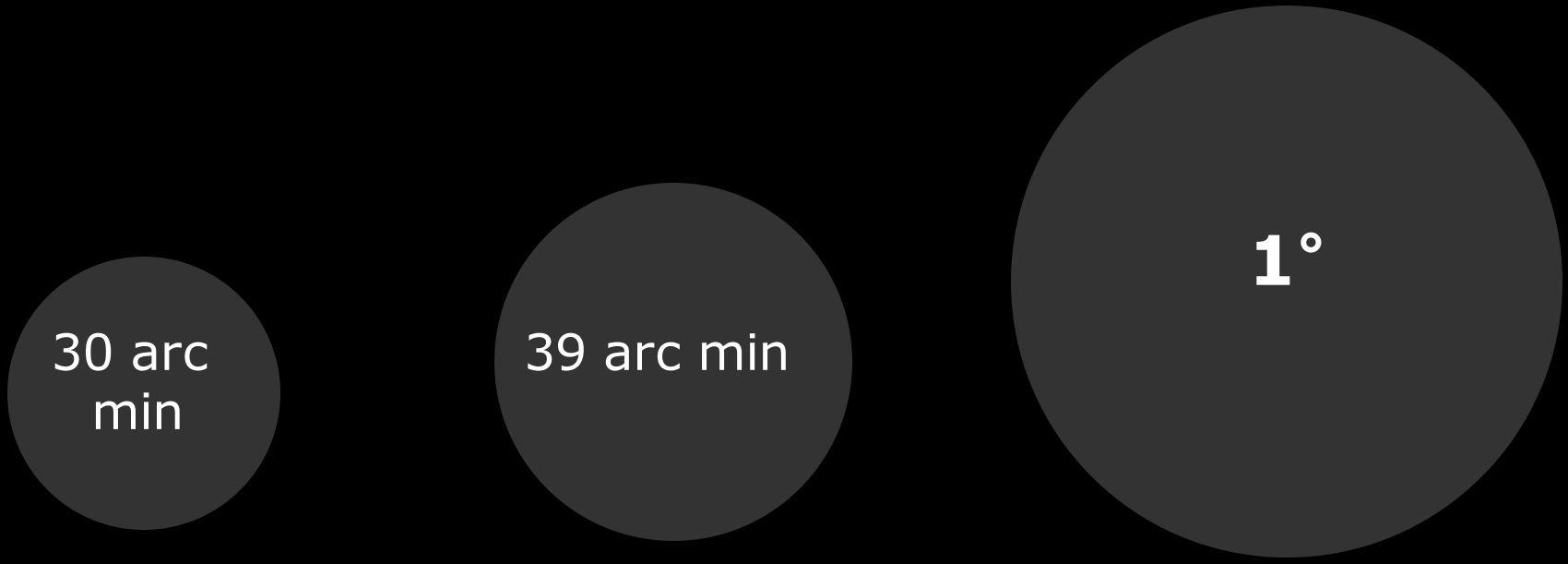

CELESTRON
E-lux 26mm
CELESTRON
E-lux 32mm
CELESTRON
E-lux 40mm
CELESTRON
E-lux 6mm PLOSSL
CELESTRON
E-lux 10mm PLOSSL
CELESTRON
E-lux 25mm PLOSSL
CELESTRON
E-lux 40mm PLOSSL

Eyepieces

SWA	Apparent field 82°
Plossl	Apparent field 52°
Kellner	Apparent field 40°



Real field = Apparent field/Magnification



	Telescope FL	Eyepiece	Mag.	App.field	Real field
Kellner	2000mm	25mm	80x	40°	30 arc min
Plossl	2000mm	25mm	80x	52°	39 arc min
SWA	2000mm	25mm	80x	80°	1°

Barlow Lens

40mm -	20mm
32mm -	16mm
26mm -	13mm
20mm-	10mm
12mm -	6mm
9mm-	4.5mm

What can I see?- Pleiades stars

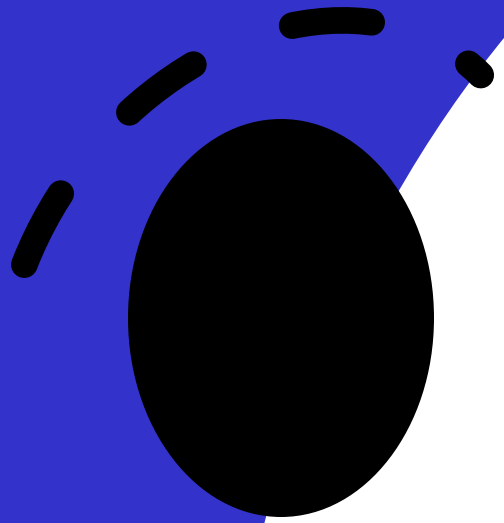
More like this

Evening Classes

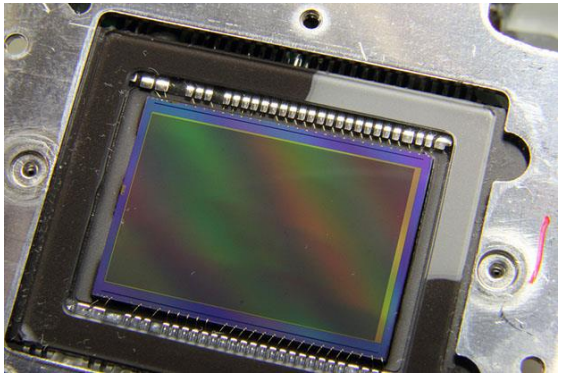
Week Five

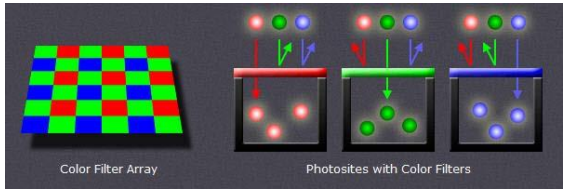
Telescopes

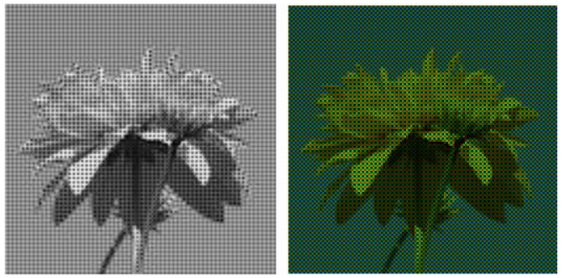
Demonstration (weather permitting)



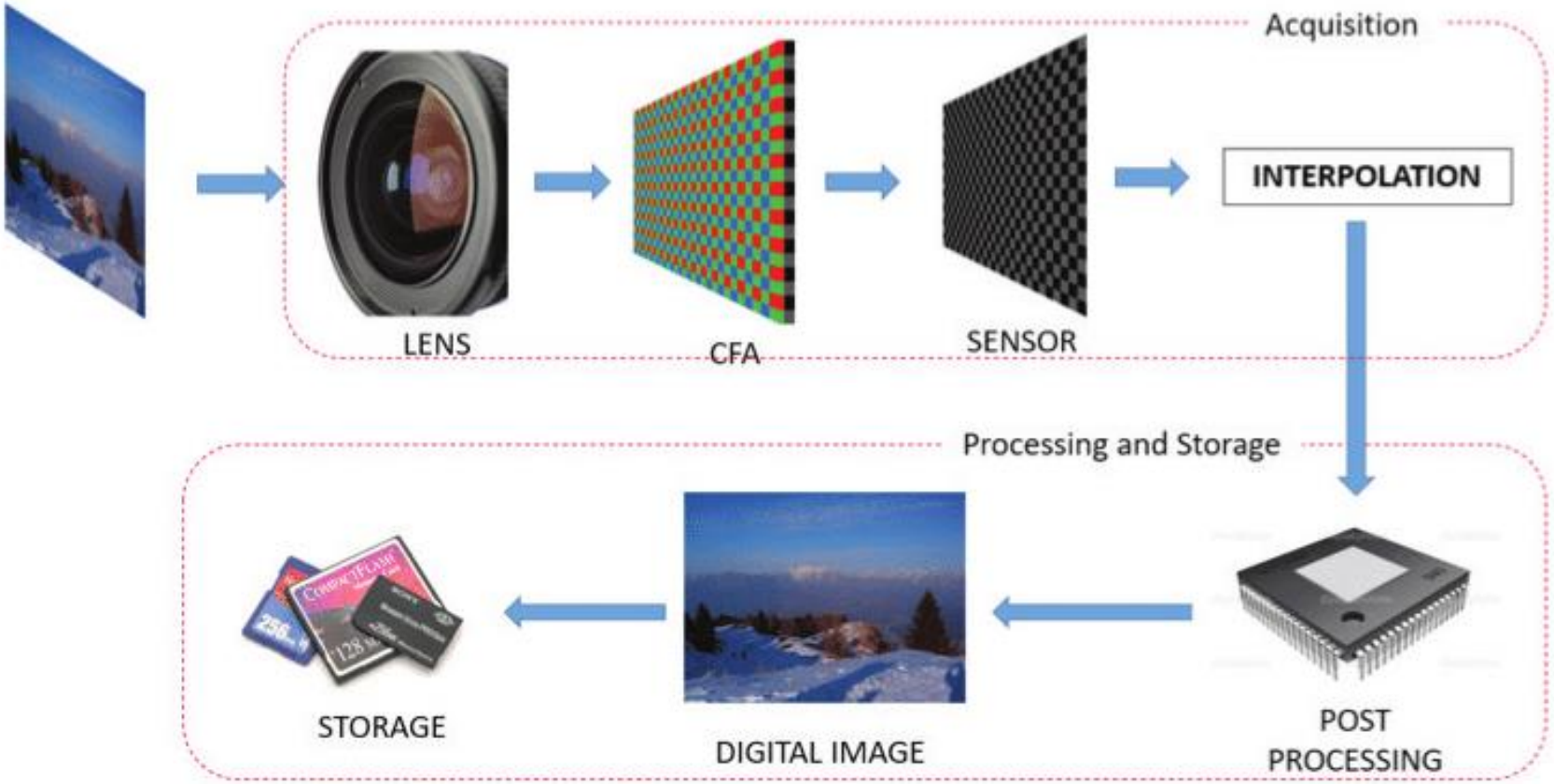
Cameras to the rescue

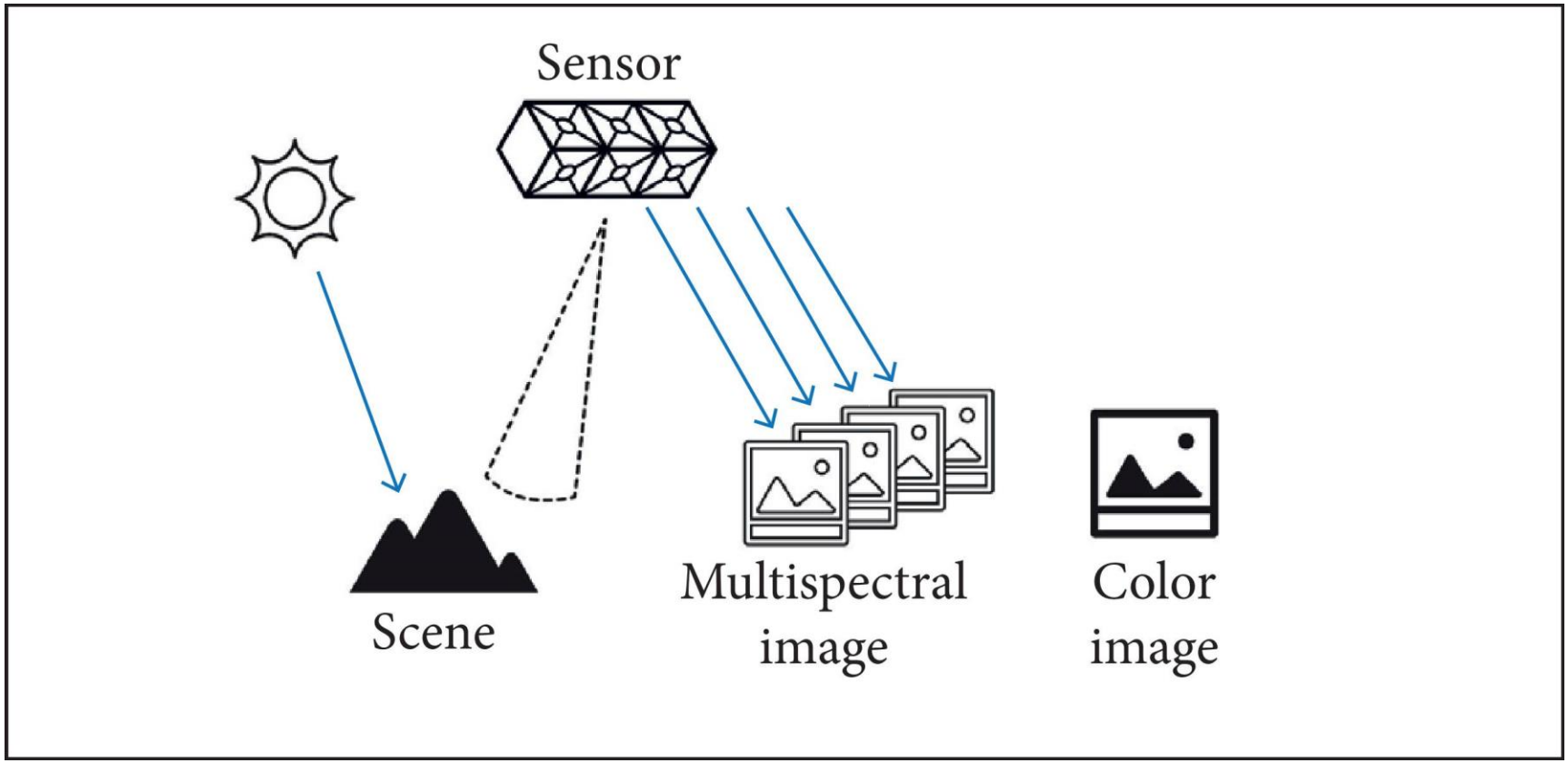






(a) (b)


Acquisition
LENS
CFA
SENSOR
INTERPOLATION
Processing and Storage
STORAGE
DIGITAL IMAGE
POST
PROCESSING


Sensor
Scene
Multispectral image
Color image

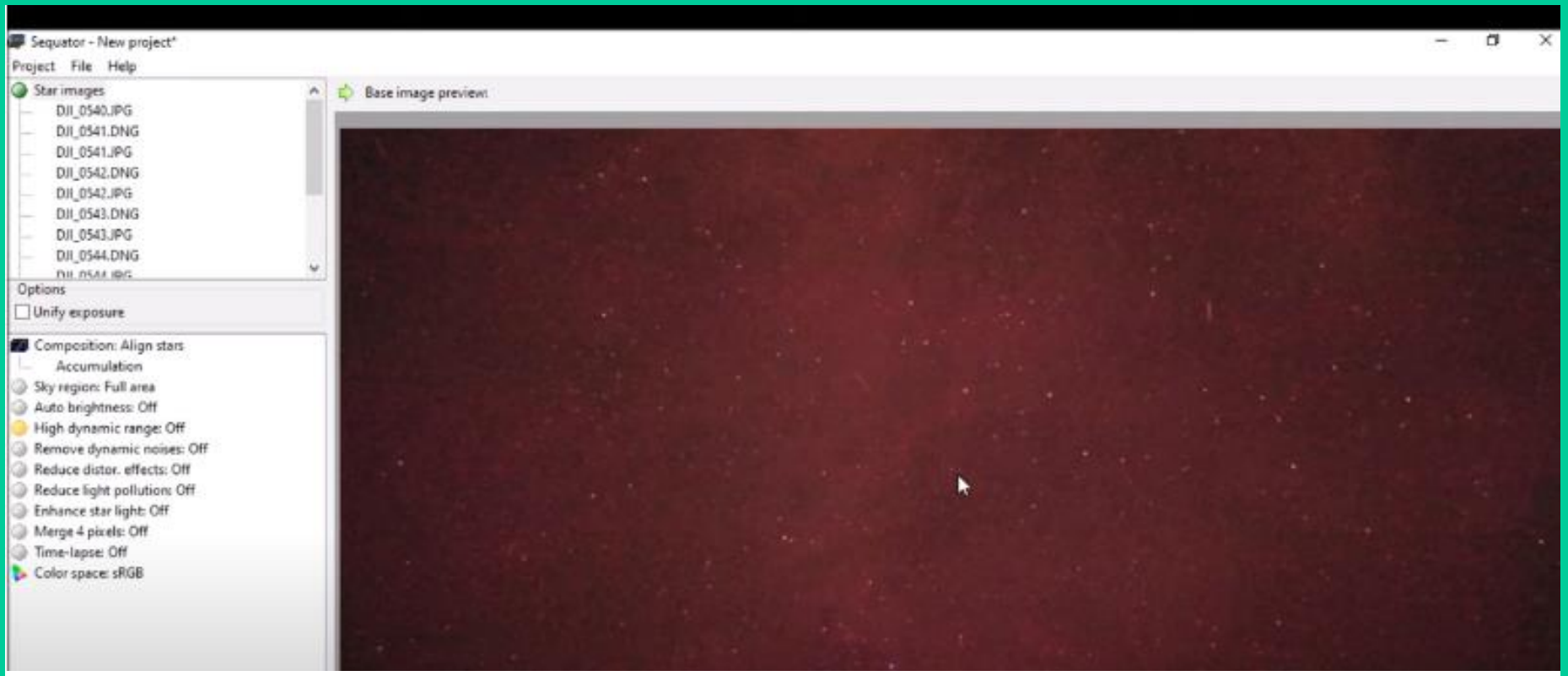
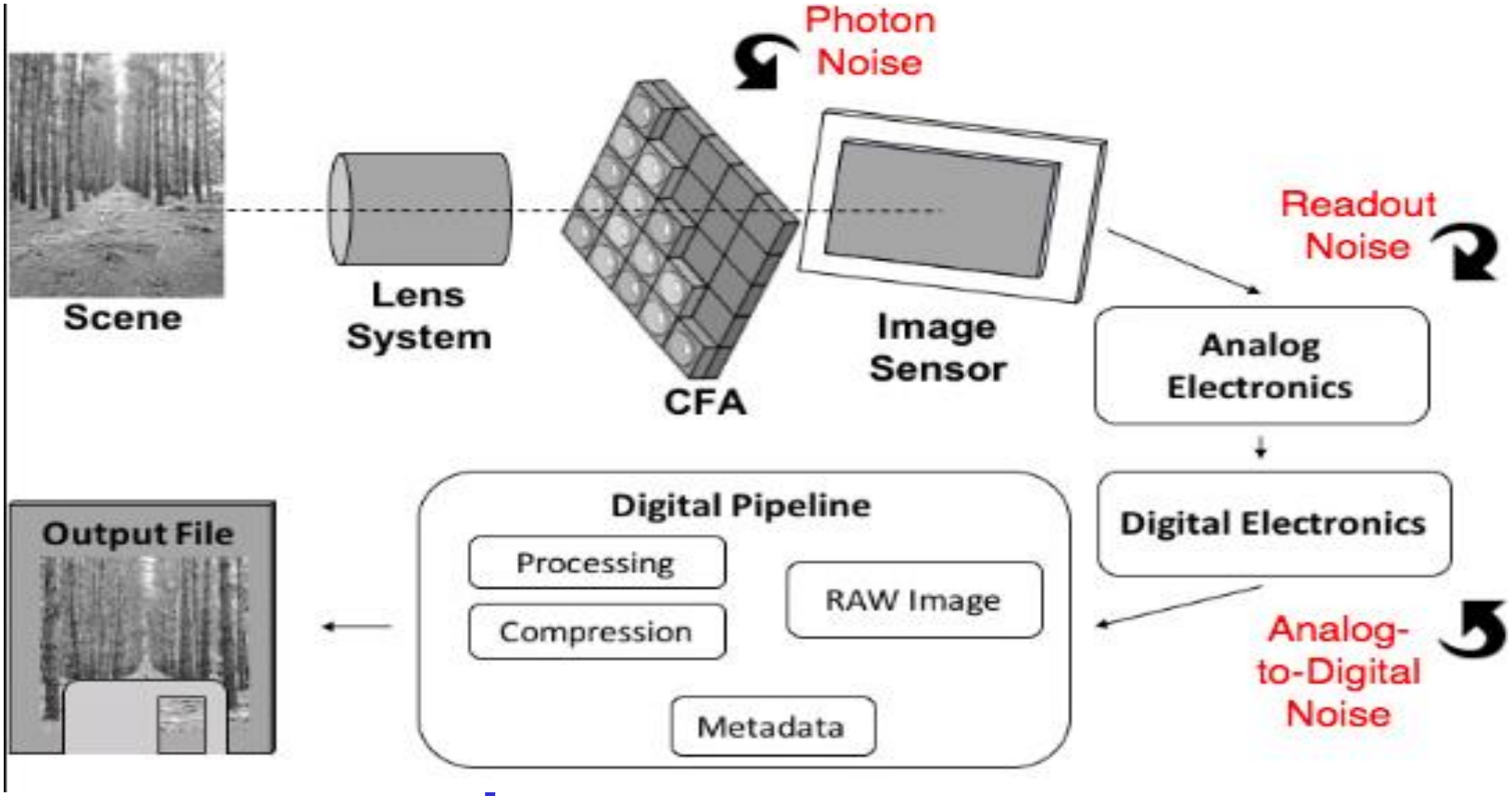
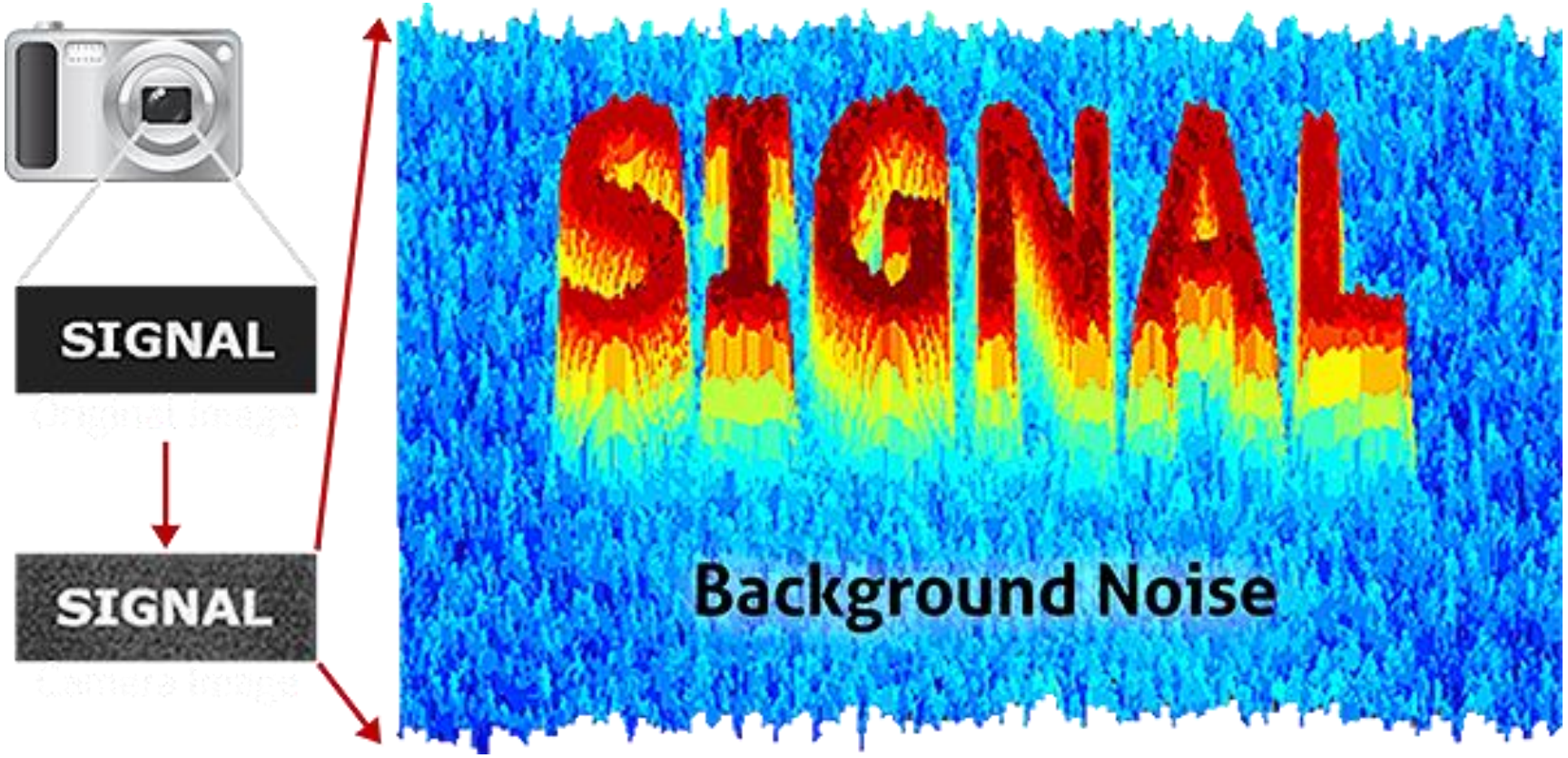
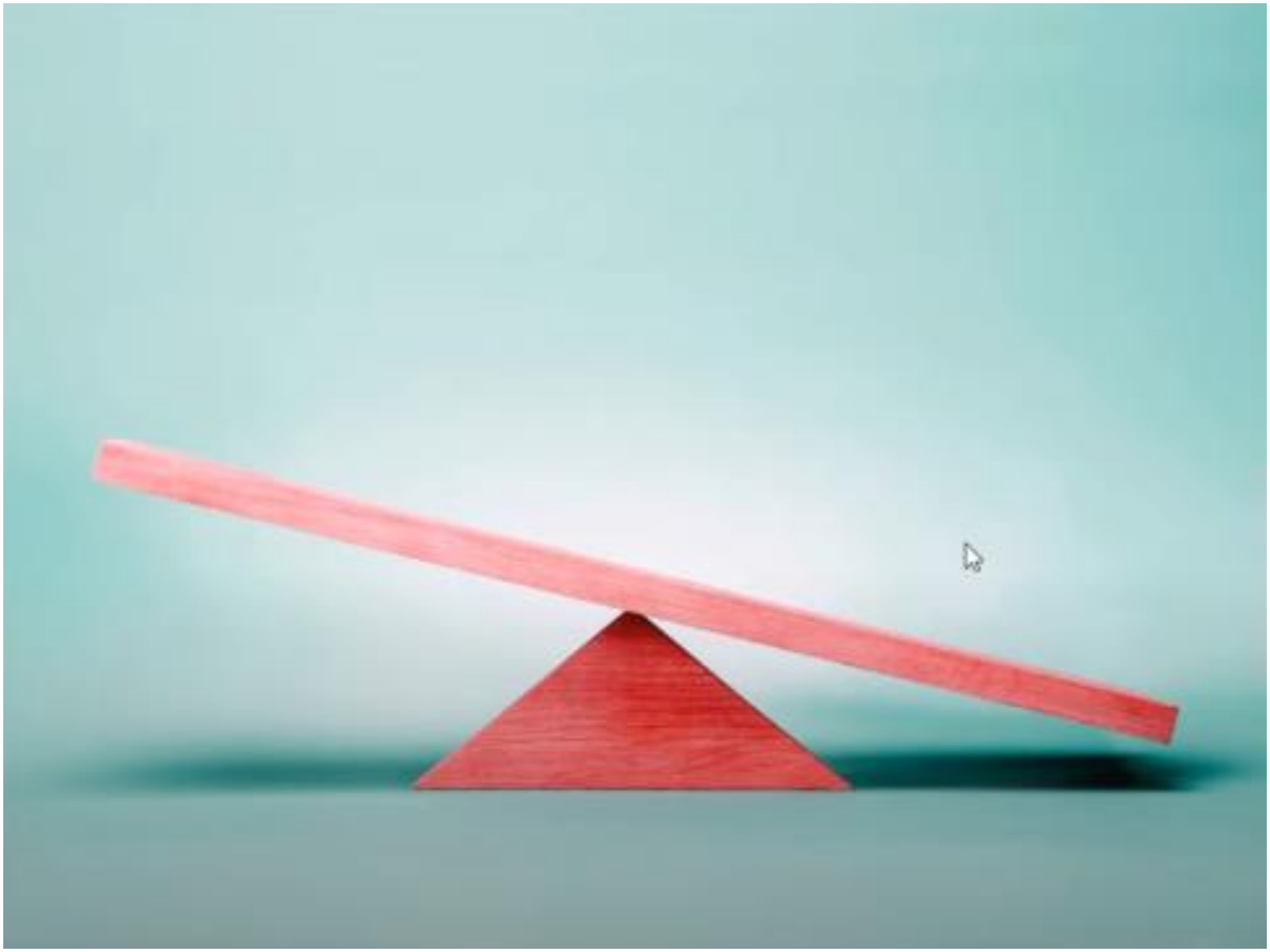


Image stacking increases the number of effective seconds we expose our cameras to light and/or combines different wavelengths to give richer more detailed images (containing more information)



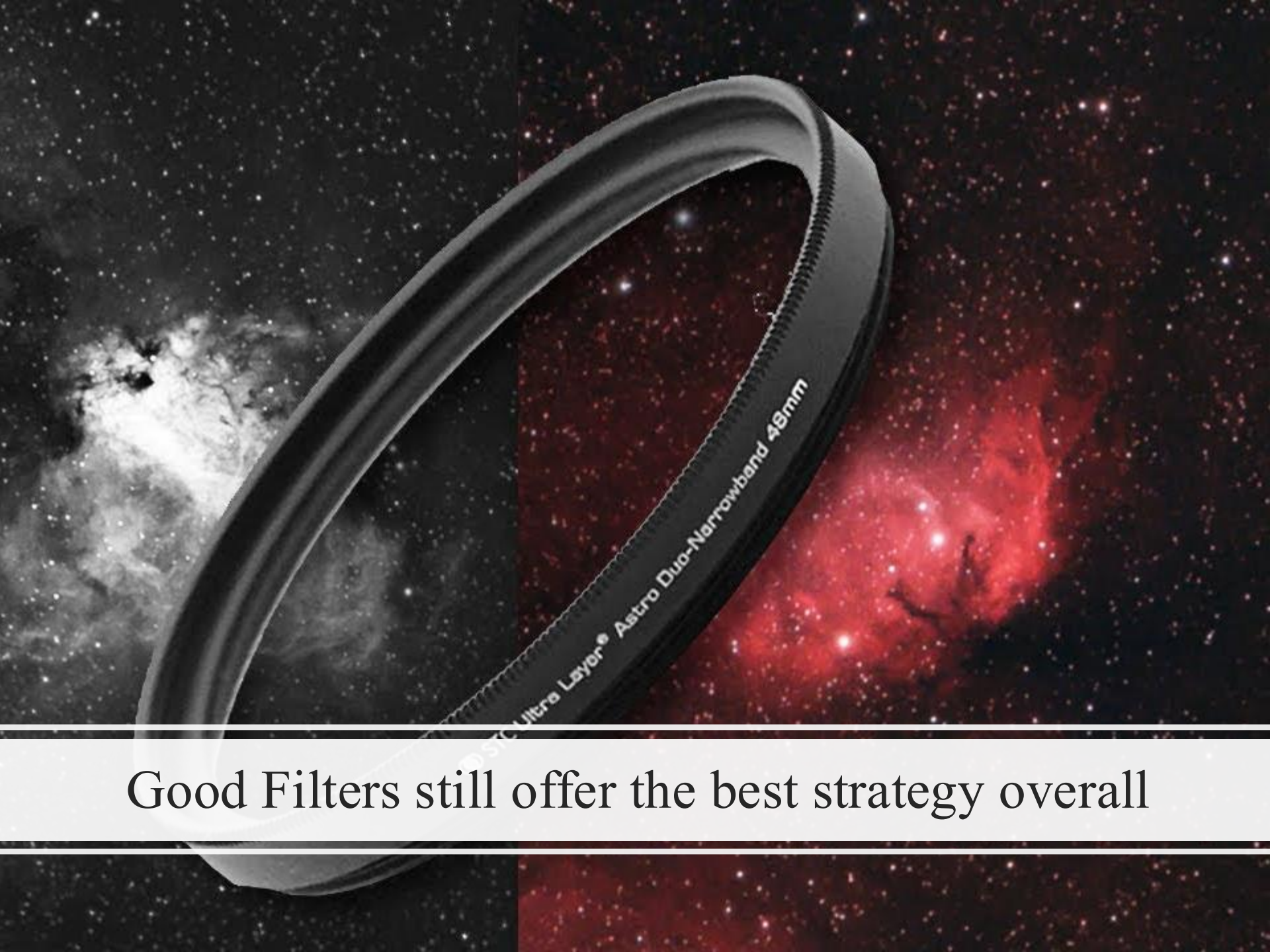
- Image processing can get complicated but can be made simpler if we think about **noise**


SIGNAL
SIGNAL
SIGNAL
Background Noise




more images
taken but
each image
has a low
exposure
less images taken
but each image
has a high
exposure
Worse Detail
but Best SNR
Best Detail
but Worse SNR
So Our High Exposure Images
Benefit More from Noise Reduction

Coding can also help but often is not necessary if light conditions are chosen well beforehand

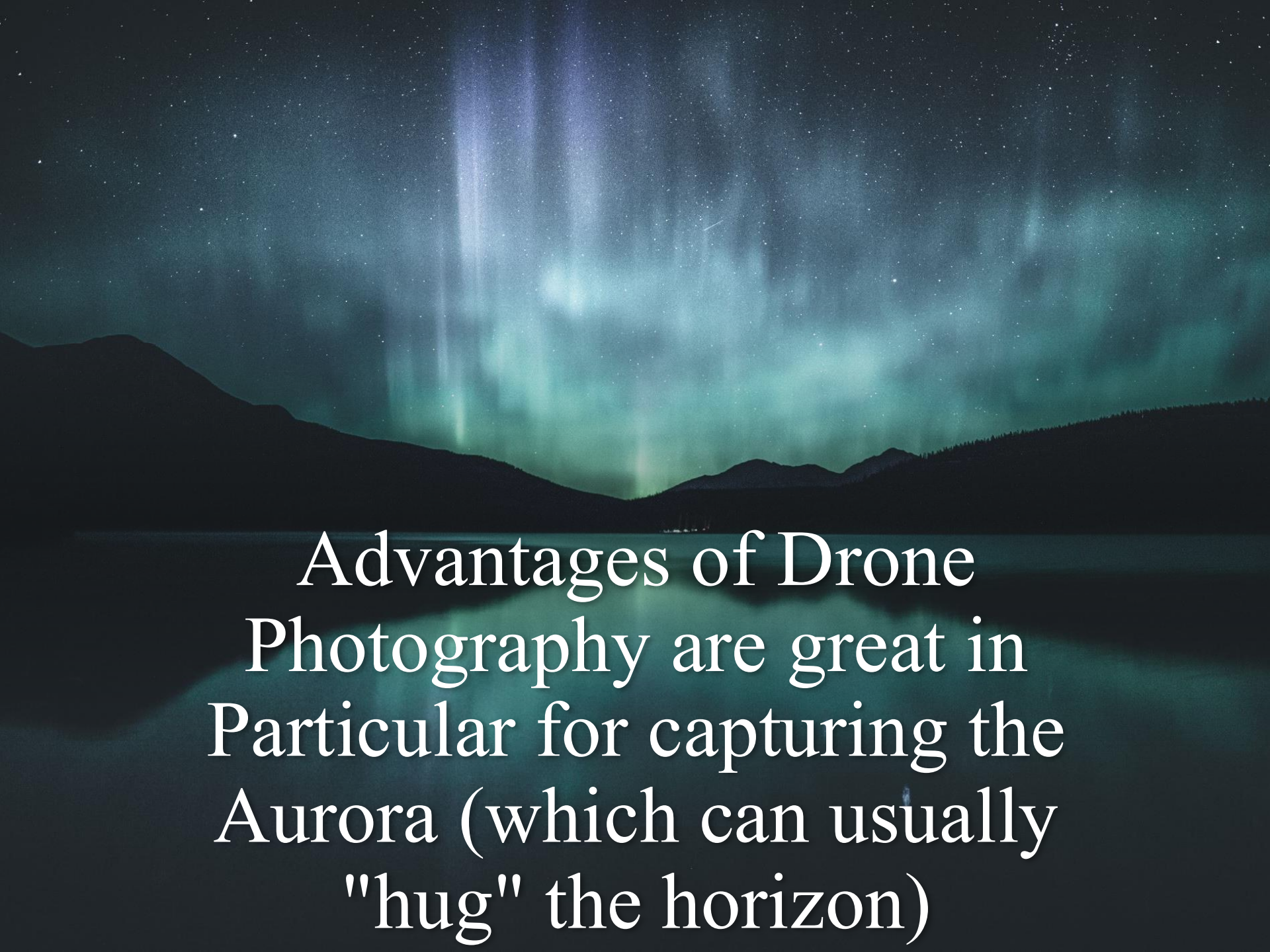


Good Filters still offer the best strategy overall

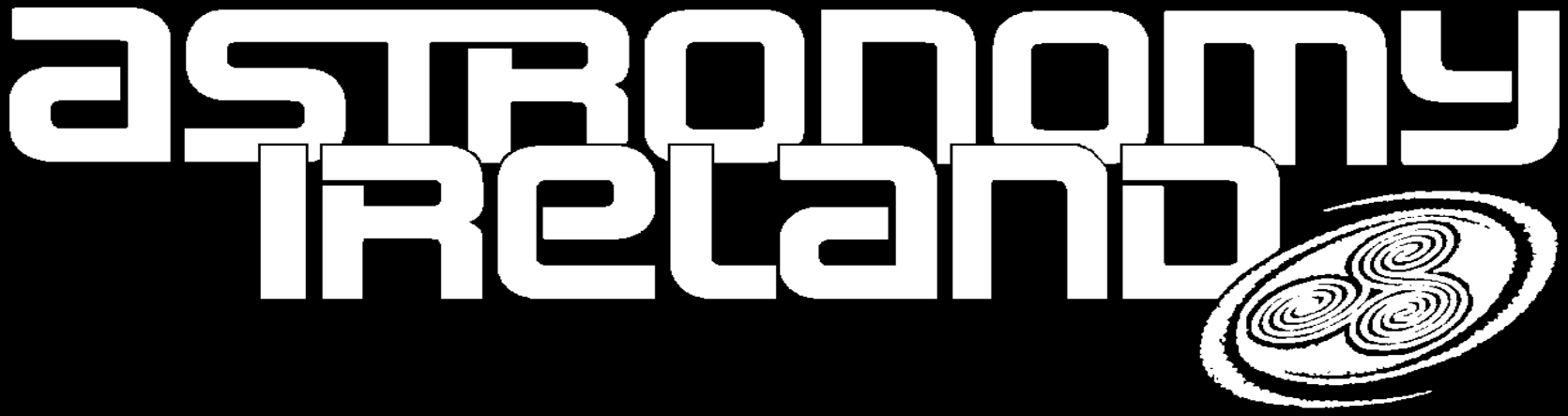
- Why Use a Drone for Astrophotography?

- one of the main reasons is to reduce the impact of the horizon and the objects within, on astrophotography – objects on the ground are interesting but sometimes get in the way! (unless we are on a height already)
- The other reason is that drone cameras are really very good!

- Flying at night can be challenging but key is to fly in an area that's familiar to you and away from air traffic, wildlife etc.
- Practice in a location during the day so that you can fly there at night with confidence that you will not cause a disturbance
- Legal maximum flight height for a drone is 120 meters
- Do not fly over people, cars, houses and away from aircraft
- Check your local authorities for permission to fly at night
- Critically be cautious, keep your drone in sight when flying at night.
- This is still a very new practice and local law has not been up to date outside of recent incidents at airports etc.


Advantages of Drone Photography are great in Particular for capturing the Aurora (which can usually "hug" the horizon)

Great Also for imaging the Milky Way, Deep Sky Objects



Useful websites

www.astronomy.ie/handouts

www.stellarium.org

Thank You