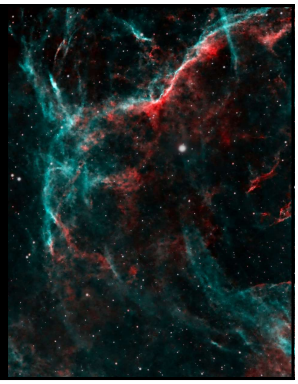
Beginners Astrophotography

Gary Liney

Week 6: Deep Sky Objects (DSO)



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DSO

- You DO NOT NEED huge telescope
- You DO NOT NEED to visit dark sky sight (for 90% targets)
- You WILL NEED to spend time to get good results
- You WILL NEED to do lots of post processing!!

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Don't forget Stars..

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DSO Targets: Star Clusters

- Very easy to image
- Do not require lots of integration time
- Basically groups of bright stars. Types:
  - Open Clusters
  - Globular Clusters

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Globular Clusters

- Omega Centauri
  - Most massive in MW
  - 10 million stars
  - 150 light years across
  - 17,000 ly away
  - 15 x 1 min at 360 mm

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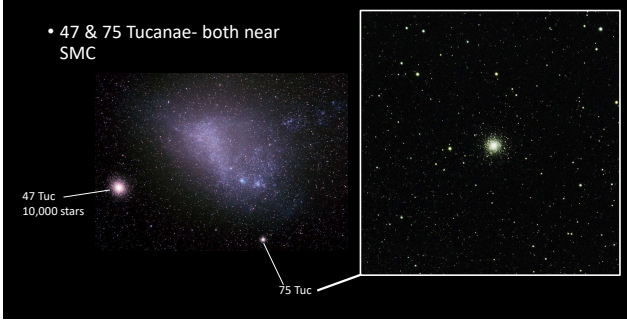
Globular Clusters

- 47 & 75 Tucanae- both near SMC



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Open Clusters

- Beehive Cluster
  - 610 ly away
  - Contains 1000 stars
  - Only 20 x 20 s
  - Added diffraction spikes

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Open Clusters

- Wishing Well Cluster
  - 1,321 ly away
  - 2 hours data
  - 120 x 30s
  - 15 x 4 min (L-extreme)

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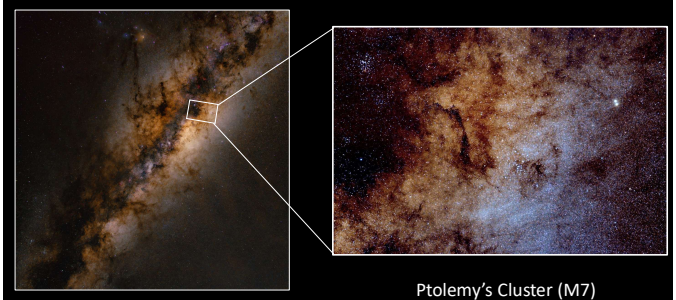

Approximate location in Scorpius constellation of MW

Ptolemy's Cluster (M7)

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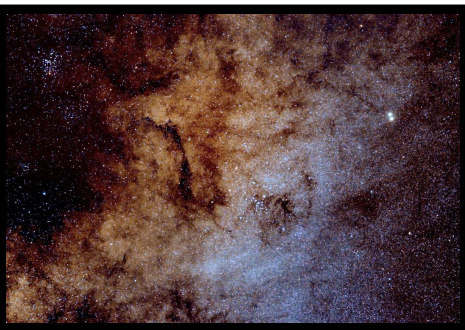

17 minutes data at edge of Milky Way at 135 mm

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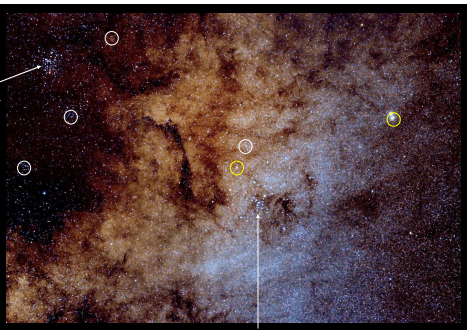

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Pleiades ('seven sisters'): Open Cluster with Reflection Nebula. Images taken in backyard (left) and dark sky (right)

40 min of 20 s subs

30 min of 60 s subs

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DSO Targets: Nebulae

Brilliant targets especially in southern hemisphere. Some may require long integration times.

Types:

- Reflection Nebula
- Absorption (dark) Nebula
- Emission Nebula
- Planetary Nebula

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Reflection Nebulae

- These will be best from dark sky sites
- Light from star illuminates dust
  - Not enough to ionise gas
  - Causes blueish nebulae

(right) Witch Head: 58 x 1 min exposure in Bortle 3

Rigil on right is 120,000 brighter than sun!

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Absorption Nebulae

- Dark Nebula- dust thick enough to block star light
- Dark sky site will be best but I have only done backyard

Coalsack nebula
590 ly

Crux ('Southern Cross')
11 min of 30s ISO 400 at f/2.4

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- Dark Doodad nebula

Aka Sandqvist 149 discovered in 1977

Approx 30 min of 20s at 135 mm

Also can see variable star and globular cluster

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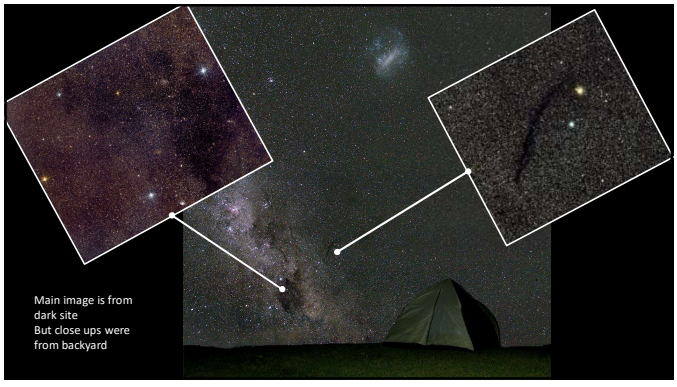

Main image is from dark site
But close ups were from backyard

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Horsehead

- Most famous dark nebula
- 1,375 ly away
- 25 x 4 min using L-Enhance filter
- Also shown is flame nebula

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Emission Nebulae

8,500 ly; one of the brightest and largest in the sky- easy target

- Carina Nebula

100 mm kit lens

135 mm f/2.4
8 x 30 s

With H-alpha filter
Starless image & false colour
8 x 30 s

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- Orion Nebula (M42)
  - Magnitude 4.0
  - 1,340 ly away, 24 ly across
  - 1 degree in sky
  - 30 min of 20 s subs
  - Also see Running man nebula

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- Eagle Nebula
- 5,700 ly
- Contains the 'Pillars of creation'
- Approx 1 hour

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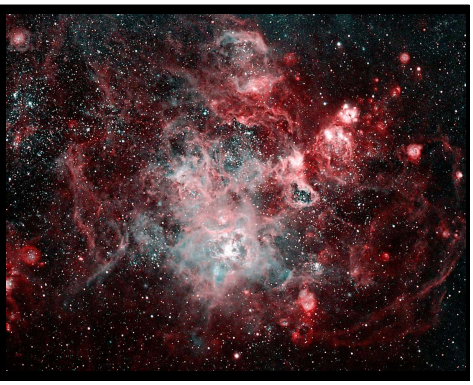
- Tarantula Nebula

Largest emission nebula
Magnitude 8
931 ly radius
160,000 ly distance
40' x 25'
2 hrs of data



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Lagoon Nebula

4,100 ly

54 x 1 min

Trifid Nebula

4,100 ly

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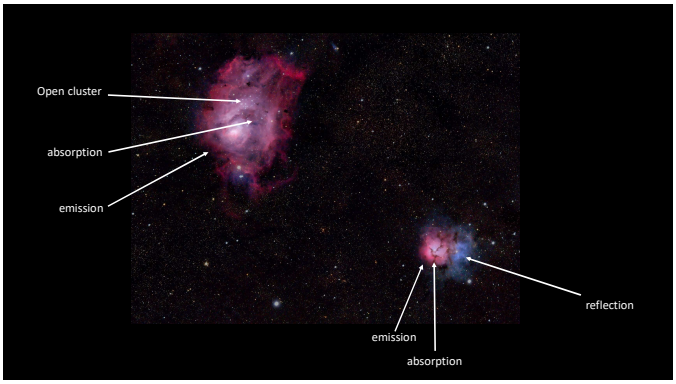

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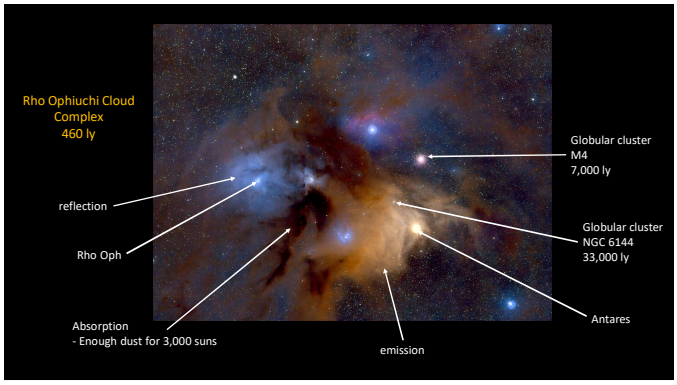

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Planetary Nebulae

- Layer of ionized gas shed at end of stars life
- Helix nebula
  - Aka 'eye of God'
  - Closest example
  - 650 ly
  - 2.5 hours data

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DSO Targets: Galaxies

Not the primary targets in the southern hemisphere due to the direction of the milky way. Types:

- Diffuse
- Spiral
- Barred
- Eliptical

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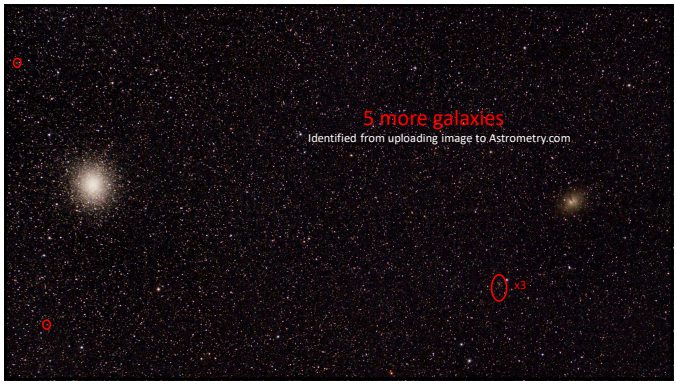

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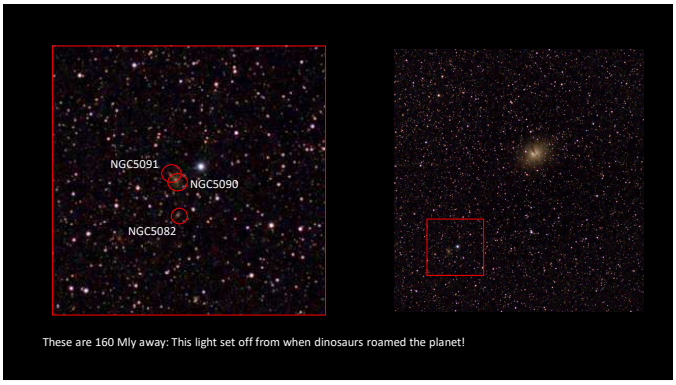

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Narrowband Filters

- Have small bandpass to match specific bandwidth of *nebula emission*
- These are OIII (Oxygen) 496 nm, HII (H alpha) 656 nm, SIII (Sulphur) 672 nm
- Typical BW of 3,5 or 7 nm
- Some filters are not compatible with fast optics (e.g. <f/4)
- Better at stopping light pollution

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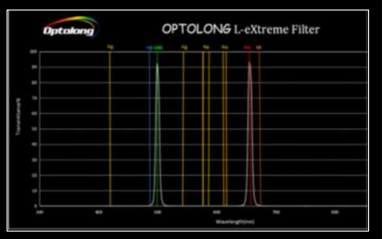
Narrowband Filters

- Duoband can be used in OSC
- Can combine data from RGB cameras
- Very good for planetary nebula that have O & H



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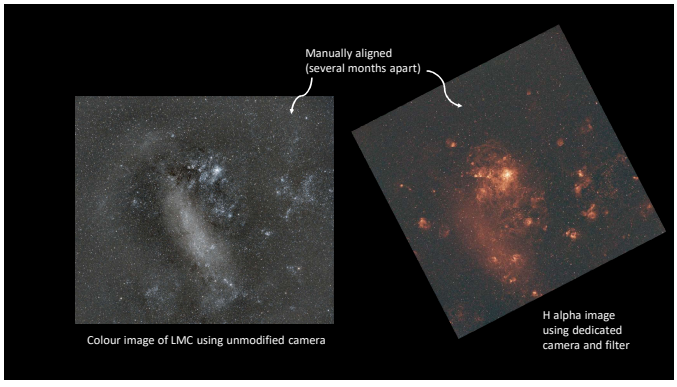

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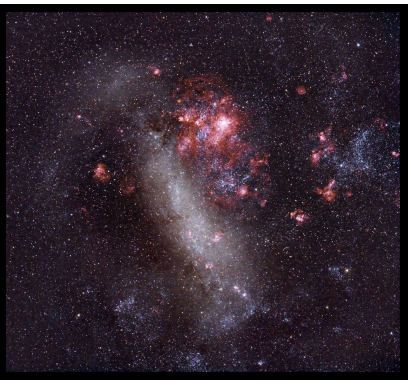
Final Image

In this case the nebulosity (Tarantula nebula) is distinct from the galaxy
Easy to add and colourise the H-alpha layer



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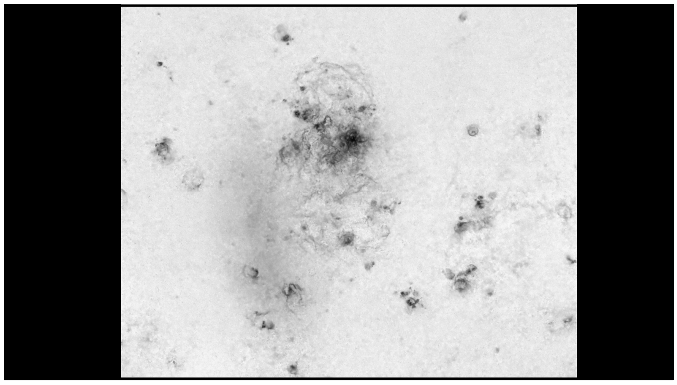

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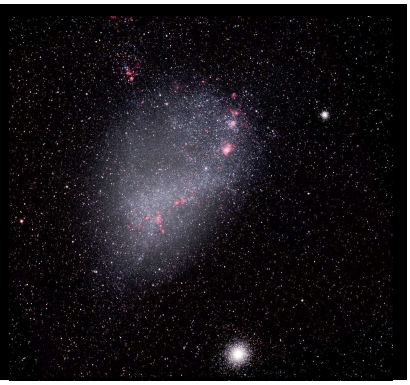
SMC

- Colour & HII for SMC



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Star Reduction

- Some Nebula are in dense starfield
- Carina Nebula good example
- Star reduction & star removal techniques to enhance the nebula

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- Rosette Nebula

5,200 ly

30 mins in dark sky

But still very faint nebulosity

Lots of distracting stars

Could stop here or try to enhance

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1) Original stacked data

2) Starless version

Use StarnetV2 (free) to remove stars

3) Star Field

Subtract 1 and 2
Further reduce stars if want

4) Final

Add 2 & 3 as layers
Adjust each one to taste

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Original

New Version

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Using RGB Channels

- Hydrogen emission is in red channel
- Oxygen emission is in blue and green
- With narrowband filters it is possible to isolate these and remap the colours- 'Hubble Palette'
- Also can be done with duoband filters to get false colour versions

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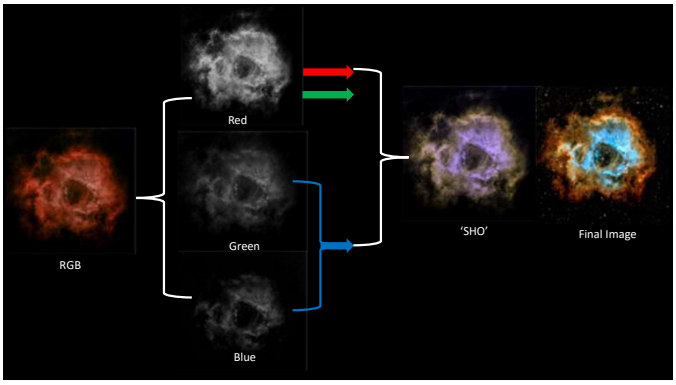

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More on Mosaics

- Mosaics useful in DSO when FOV is not right for target
- Enables better resolution over larger area
- Tricky to accurately plan them
- I have recently found 'telescopius' can do this (free online website)
  - Need to set up sensor and telescope details
  - The get co-ordinates of each panel…

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More on Mosaics

- Can align stacks manually but the edges are obvious
- Use MS-ICE (like for Moon) and ensure overlap is >20%
- Also have photomerge option in PS
- Here is a works in progress for the Orion cloud complex…

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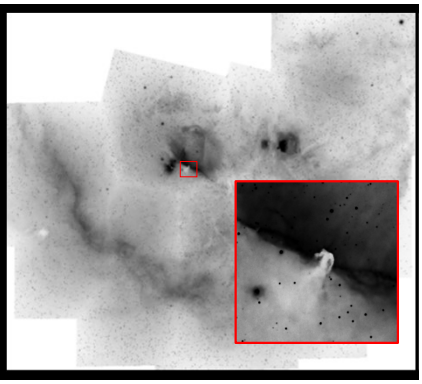
- Barnard's Loop & Orion
- 11 panels each 35 min
- Used H alpha filter to eliminate signal variation
- 4 nights data
- 6 arc sec/pixel
- Shown inverted grayscale



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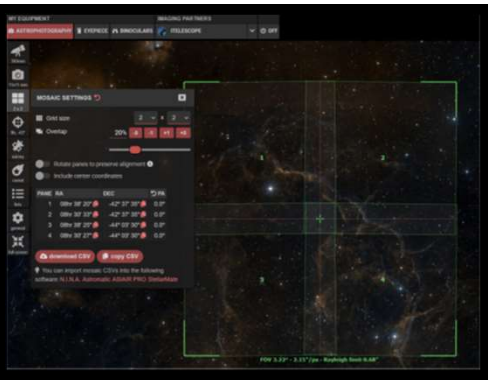
Now started to use Telescopius (website) to plan exact coordinates of each panel



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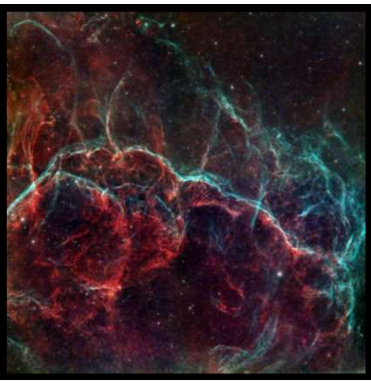
Vela SNR



4 x 40 min panels
Repeated over two nights
5 hrs 20 min total

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Summary

- Many good DSO targets are in your reach no matter what equipment you use
- Some example times and results have been shown- from tens of minutes to a few hours
- Narrowband filters are very useful for emission nebula
- A minimum exposure length can be calculated but ultimately its about trying things out!

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Questions?

www.austrophtography.com

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Appendix

- Extra Information about calculating your *minimum* exposure time
- If you use SharpCap software there is a sensor analysis tool that does this for you from your image
- Remember you can use your live view camera histogram to make a good estimate if you don't want to do this…

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Sky Noise Calculation

- Can quantify optimum minimum sub exposure length (t_{min})
- Based on:
  - light pollution (P)
  - camera read noise (R)
  - factor related to level of additional noise* (C)
  - any filters being used

*assume 5% acceptable noise which equates to C=10

$$t_{min} = C \times R^2/P$$

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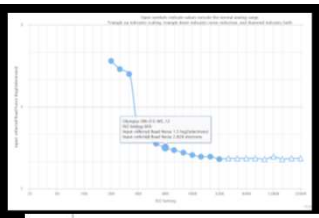
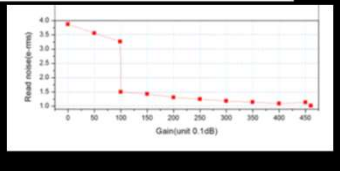
Camera Read Noise (R)



Read noise of my Olympus MFT

Find your camera at 'photons to photos' wesbite



Read noise of my ZWO ASI533MC

Find camera specs on Astro/ZWO websites

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Light Pollution (P)

- Type details in to obtain sky electron rate
- Find this at 'Sharpcap tools' website
- In this case, I estimate Bortle 6
- I use f/6 for my refractor here

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Sub Exposure Time

- Sky electron rate = 1.97
- From previous equation this means exposures of:

(MFT at ISO 800)	40 s
(ASI533MC Pro at 100 gain)	11 s

Much shorter than you might expect
Remember this changes for filters or different sky

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