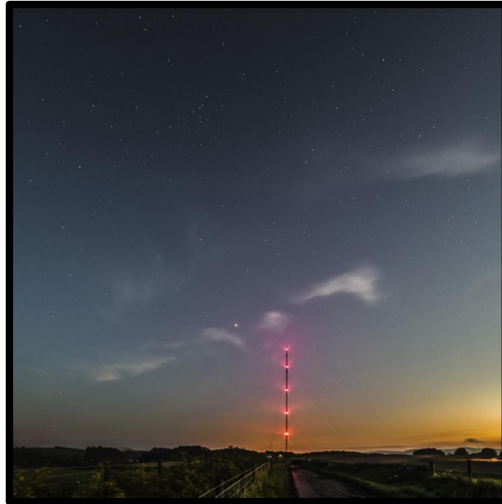


SHOOTING THE NIGHT SKY

Just a digital camera and a tripod, no
telescopes required



FORD RENTON (*Master Mariner Ret*)

WHAT CAN WE TAKE?

1. Wide sky shots incorporating a horizon such as a tree line or a mountain range.
2. Panoramas.
3. Star Trails.
4. Constellations.
5. The Planets.
6. The Moon.
7. Some Deep sky objects like clusters and galaxies. e.g. The Andromeda galaxy and the Great Orion nebula.
8. Time-lapse videography.

WHAT DO WE NEED?

1. Any digital camera with manual mode. (Full manual control of exposure and focus is vital)

Full frame is best but Crop sensor and Micro 4/3 can work very well. Even a point and shoot will work if you have full manual control. Nikon 800 series and DF, Sony A7 and Canon 6D all have a good rating for low noise. Nikon D5 and Canon 1DX II are of course top of the range but who can afford them?

2. A solid tripod. This is essential, bean bags on fence posts can work but not very practical.

3. A remote release. You could use the 2 sec timer delay and count the shots but it's easy to nudge the camera this way. If you are like me, I tend to lose count after 5 anyway. It is preferable to use a wired, or wireless, remote control. A timer release with "INTERVALOMETER" capability is ideal. Some cameras, Nikon in particular, have built in INTERVALOMETERS.

https://www.amazon.co.uk/Neewer-Display-Shutter-Release-Control/dp/B00UN04SFK/ref=sr_1_1?ie=UTF8&qid=1470483877&sr=8-1&keywords=neewer+880

OR: A wireless one https://www.amazon.co.uk/Wireless-Intervalometer-Control-Shutter-Release/dp/B01ER15Y9Y/ref=sr_1_fmkr0_2?ie=UTF8&qid=1470651147&sr=8-2-fkmr0&keywords=wireless+camera+remote+timer+EOS+M3

4. A computer with editing software.

I use LIGHTROOM AND Photoshop CC. To get best noise reduction results from stacking images you need CS6 or CC however, I believe "GIMP" is capable of achieving the required results, and it's free. In fact, NASA Mars Rover team use GIMP to process their images.

Most cameras come with the manufacturers own RAW image processing software. It's a good free alternative to Lightroom or Camera RAW.

Other free software includes STARSTAX for making star trails and DEEP SKY STACKER for processing your deep sky images of Galaxies and Nebulae. (see links below)

5. Lenses.

For wide sky shots the wider the lens the better and the larger the aperture the better. 14-24mm, f2.8 or less but you can still get good results at f4 on a 18-55mm kits lens. For Constellations a 50mm lens is perfect. The Moon and Jupiter require at least 300-400mm. For real deep sky objects like the Rosetta Nebula, the Orion Nebula or the Andromeda Galaxy, a 200mm lens and a tracking mount would be required but you may as well go for a telescope if you are interested in that field of Astro photography.

Also try making a panorama using a 50mm lens with 8 images in two rows. Results can be spectacular.

6. A torch with spare batteries. Head lamp gear is preferable as they allow hands free operation. Choose one with a red light or very dim white function to retain your night vision.

7. Warm clothing is vital.

You could be out for hours and even in the summer it gets bloomin' chilly in the wee small hours, particularly as there is a lot of standing around and waiting. If you have a weak bladder you'll be in trouble so find somewhere where there's a handy bush or wall. It is at this moment the police car will turn up to see what the flashing lights are in the field.

WHEN?

Planning is the key. Decide what you want to shoot and use a combination of Star guides, Almanacs, Land maps and Weather forecasts to plan your shoot. Moonless nights are best, unless of course you intend shooting the moon itself, then moonless nights may prove difficult.

Useful software is **Stellarium**, a free application available for PC, Mac, Phones and Tablets.

For planning sunset /moonset times and twilight times try **The Photographers Ephemeris (TPE)**, also free. Obviously a clear night is ideal but some cloud isn't too much of a problem, except when stacking images.

Milky Way: The brightest part of the Milky Way, the galactic centre, is located near the constellation of Sagittarius, is only visible from our latitudes in the summer months. Unfortunately, in June and July there is no Astronomical twilight, in other words it doesn't get dark enough. In August however, it is still visible above the horizon late at night from 23:00 onwards until about 02:30.

Constellations: Orion has, for our purposes, the most going on. In Orion's belt and sword you can find the Great Orion Nebula, the Flame Nebula and the Horse Head Nebula, are all visible. Shoot using a 50mm lens at ISO 3200 and an exposure of 10 sec (Full frame cameras). If using a crop frame, up the ISO to 5000 and expose for 6 sec. To get the best results use Ian Norman's LRGB method (see links)

The bright red star top left in Orion is Betelgeuse or as it is commonly, and incorrectly, known "Beetle Juice". It is a Red Giant and widely thought to become the next Supernova. It could explode within the next 100 years but that could mean tomorrow. When it does go it'll be the brightest object in the night sky by far and even visible during the day. Watch this space.

Orion is highest in the night sky in December, January and February.

Galaxies and Nebulae: Our nearest galactic neighbour is the Andromeda galaxy. It can found in the summer months high in the evening sky about half way between Cassiopeia and the square of Pegasus. Although a relatively dim object it is still visible to the naked eye on a dark night but easily observed through binoculars. It is actually 8 times larger than a full moon so can be captured using a 200mm lens and stacking techniques. There are countless tutorials on YouTube. Ideally a motorised star tracker should be used but as it is such a large object manual tracking can be done by adjusting the camera position every 20 frames or so. Stacking in this case not only reduces noise but enhances dim light.

NB: (Stacking was technique originally discovered by a group of lady "computers" at Harvard University who noticed that piling glass negatives on top of one another brought up more detail. They were actually scanning for moving objects, possibly planets, by comparing one image with another)

The Andromeda Galaxy will eventually collide with our Milky Way, but not for another 4 billion years so there's to invest in that Canon 1DX MkII, you won't regret it.

Forrest Tanaka does an excellent tutorial on this on YouTube.
<https://www.youtube.com/watch?v=e0JSTF8SGi4>

Twilight:

Taken at sea level **Sunset** or **Sunrise** is defined as the point when the upper limb of the sun is precisely on the horizon.

Civil twilight is when the sun is between 0 and 6 deg. below the horizon. Lighting up time is based on this.

Nautical twilight is the period when the sun is between 6 and 12 deg. below the horizon. So called as we ruffy tufty sailor types can see both the horizon and the bright stars at the same time, and are therefore able to measure the altitude of a star above the horizon. From this information we can calculate our position.

Astronomical twilight is the period when the sun is between 12 and 18 deg. below the horizon. Full darkness is considered to occur after this period in the evening and before in the morning.

Astronomy stuff:

Distances to bodies within our solar system are measured in miles.

The distance from the earth's centre to the Sun's centre is an average of 93 million miles. This is known as an astronomical unit.

Distances to our nearest neighbours, the planets and stars within our galaxy, are measured in astronomical units (AU) or light years (LY). A light Year is just less than 6 Trillion miles. Our nearest star is Proxima Centauri, a dwarf star close to Alpha Centauri, is approximately 4.5 LY away. Betelgeuse, in Orion, is 495 LY away. Our Galaxy, The Milky Way, is 100,000 LY across and contains 600 billion stars.

Our nearest neighbouring galaxy is the Andromeda galaxy (M31) and is 2.55 million LY away. The light you see from it today left M31 when there were no humans on earth. Andromeda contains around 1 trillion stars.

The outer limits of the universe are 13.8 Billion LY away, unless you are a string theorist, then they could be anywhere. The Hubble had recently taken images of a galaxy 10 billion LY away however, the Chandra space telescope detected x-ray images 13 billion LY away. So Hubble was again tasked to observe the same galaxy 10 BLY away. The "shutter" was left open for 10 days, yes 10 days! The images revealed millions more galaxies further away than the original observation.

The next space telescope, the James Webb, is due for launch in 2018. It is hoped we will be able to detect objects near the edge of the universe, almost at the beginning of time.

Distances are sometimes measured in Parsecs. A Parsec is an abbreviation or Parallax Second. Distances to close stars and other objects are calculated by taking a parallax measurement. A bearing of the object is taken when we are at Perihelion with the sun, i.e. closest point and another, six months later, when at Aphelion, our furthest point. We know that half the distance between the two observations is 93 million miles, 1 astronomical unit. The angle between the suns centre and the mean sun distance is known as the angle of parallax. The length of one side of the triangle equating to 1 second of arc, with the opposite side being 1 astronomical unit, is called a Parsec. A Parsec is therefore calculated to be 3.2 LY and a measurement of distance.

So, in Star Wars episode 4, the first one, when Han Solo boasted that the Millennium Falcon completed the Kessel run in less than 12 parsecs he was talking rot as a parsec is not a measurement of time. Next time you watch the film you can shout at the screen and claim Han is talking mince. Everyone else will think you are mad but you can sit smugly in the knowledge that a parsec is not a unit of time, and Han Solo isn't all he's made out to be 😊

Keep an eye on Betelgeuse in Orion, it's thought to become the next nearby Super Nova. It will happen any time within the next 100 years, but it could be tomorrow. If it did show tomorrow then it would have happened in the year 1521, not long after Flodden. Other than the sun, it'll be the brightest object in the sky, day or night, and last for months. I hope I live long enough to see it.

EXPOSURE – for Starscapes

We need to gather as much light as possible, even if the photograph looks to be a bit over exposed. Try to shoot in Dark Sky Areas. Around here there's Smailholm, Greenlaw Moor, Hume, Threepwood, Lindean, and Midlem areas which I've found quite successful. Scott's view is also a good bet now due to reduction in light pollution.

If you're feeling adventurous there is always Dumfries and Galloway Dark Sky Park. <https://scottishdarkskyobservatory.co.uk/about-us/>

Kielder is closer but the lights of Newcastle do cause light pollution issues when looking south.

Since the council have embarked on a street light replacement program using low energy LED lighting the light pollution situation has improved considerably.

As the earth rotates at 15 deg per hour the stars appear to move relative to your location. A long exposure will cause the stars to "trail" across the sky in streaks.

For a maximum exposure time to prevent trailing use the **500 rule**. So what's that then? This is a simple formula to determine, approximately, how long you can leave the shutter open without the stars starting to form trails.

The formula is: **$500 \div \text{Focal Length} = \text{Max exposure in seconds}$** (for a full frame camera)

For crop frame and 4/3 cameras multiply the focal length of your lens by the crop factor first before applying the formula.

Examples:

A full frame camera with a 24mm lens gives $500 \div 24=20.8$ seconds maximum exposure

A crop frame (x1.6) with a 24mm lens gives $500 \div (24*1.6) =13.1$ seconds

A full frame with a 50mm lens gives $500 \div 50=10$ secs

A crop frame (x1.6) with a 50mm lens gives $500 \div 80=6.2$ secs

A 200mm lens on a full frame gives a max exposure of $500 \div 200=2.5$ secs

A good starting point for the Milky Way in relatively dark sky conditions would be ISO 3200 and 20 secs at f2.8 for a 24mm lens. With a crop frame you may need to up the ISO to 6400 to keep the shutter speed within the 500 rule. If you need to reduce exposure it is better to reduce ISO rather than stop down or decrease exposure time.

I mainly use a 14mm lens on a Canon 6D so that's ISO 3200, f2.8 and 30 sec as a starting point.

NB: If you still see some trailing then reduce exposure time by 5 seconds or so.

A note on INTERVALOMETERS:-

I've found the best way to use these for night sky photograph is to set camera to bulb and let **INTERVALOMETER** control the shutter speed. On occasions I've miscalculated the interval/shutter speed combination and ended up having the camera buffer lock everything up therefore not taking the number of shots I wanted.

If using a shutter speed of 20 sec you would set the interval to 23 seconds thus allowing 3 secs between shots. Beware though as some intervalometers work differently. Consult the manufacturer's instructions.

However, if you use BULB mode you would set the intervalometer to 20 seconds length and interval to 3 seconds.

COMPOSITION:

It is easier to use live view with exposure sym turned on to compose your shots. It's not easy to see much through the viewfinder.

STAR TRAILS:

In the Northern hemisphere the sky appears to rotate around Polaris (The Pole star) therefore the stars 90 deg from Polaris are moving faster than those near to Polaris. This is how those circular star trails are achieved.

Use an exposure of about 30 seconds to 1 minute, depending on your focal length, adjust aperture to suit and take an hour's worth of shots. Take a test shot for ISO setting. Adjust so only the brightest stars show otherwise you'll just end up with a mess. Process all your shots with the same settings then export to a separate folder as jpegs or TIFFs as STARSTAX won't handle RAW files. Now use STARSTAX to create your star trail. A very nifty piece of software and easy to use.

Creating a star trail image in Photoshop is easy. Open all your shots as layers. Select all except the bottom one and change the blend mode to "lighten". Job done, more or less. You could make a composite with the foreground processed separately.

Here's a tutorial https://www.youtube.com/watch?v=ncX04_oZw-M

THE MOON:

The Moon is a very bright object in the night sky. You can use a much lower ISO, perhaps as low as 100 in some cases. I took my moon shot using a Powershot SX50 at 50x zoom (1200mm), hand held, but resting the camera against a drain pipe, and ISO 100 with a shutter speed of 1/250. Use spot metering. You'd be surprised at just how quick the moon is moving when using a very long lens so keep adjusting the camera position to keep the image central. Stacking techniques also work with the moon but not really necessary. Shooting the moon is best done around then end of Nautical Twilight so you can still get a little colour in the sky and the bright edges don't get blown out against a black sky. I took 20 shots of the moon and only got 2 sharp shots. Experiment and practice.

PROBLEMS:

1. Noise:

Probably the biggest issue but can be greatly reduced using noise reduction software and/or stacking techniques in Photoshop.

NB: Median stacking is, to my knowledge, only available in Photoshop CS6 / CC. I think GIMP may be able to do it but not sure.

2. Light pollution:

Also a big issue but can be reduced by choosing a good dark sky location. Enhancer filters are available which filter out the colour frequency produced by sodium lamps. Unfortunately they won't work for other types of street lighting and they are relatively expensive.

3. Dew:

As the night goes on, and the temperature begins to drop, the amount of relative moisture in a given body of air increases. The moisture will condense out onto anything colder than the air temperature. The glass of a camera lens loses heat quicker than the surround land so it's the first to get a covering of dew. Combat this by using firstly a lens hood then lens heaters. The simplest of these are just chemical hand warmers wrapped around the lens and held in place with an elastic band. They cost a mere 50p each and keep your lens glass above the dew point for 4-8 hours. If the air temperature drops below its dew point you'll get fog so all bets are off anyway.

Powered heaters or fans can be used but they require a 12v power source and who wants to carry 12v batteries around with them?

4. Lens distortion:

This is most prevalent near the edges of the image and called Coma. It is particularly noticeable in zoom lenses so use prime lenses as your first choice. Shoot a much wider field than you need and crop in to get rid of the edge distortion. You can make a Coma brush in PS but this is a very time consuming process and not really worth it unless you have that killer shot. Ian Norman's website <http://www.lonelyspeck.com/> has a tutorial on this.

5. Stray light:

Passing car headlights can ruin a shot so stay away from the roads.

Don't forget to **turn off your torch**.

BASIC LIGHTROOM STARSCAPE WORK FLOW: (works in Camera RAW too)

- 1. Import your images into LIGHTROOM (unless using camera RAW)**
- 2. Select the first image and go to Develop module ("D" on the keyboard)**
- 3. Correct white balance by sliding Vibrance and Saturation up to max.**
- 4. Adjust colour temp until you have an even mix of blue and orange in the sky**
- 5. Reset Vibrance and Saturation to zero**
- 6. Adjust Tint slightly to remove green or magenta cast, just until you think it looks right. The sky should be a greyish blue.**
- 7. Adjust for vignetting by setting contrast to max and selecting a high contrast curve. Adjust vignetting as necessary using the profile correction section in manual**
- 8. Reset contrast and flatten curve**
- 9. Now adjust Contrast, Highlights, Shadows, Black and white levels for best effect.**
- 10. You can now use an adjustment brush to pick out the detail on the Milky Way. (Don't do this if you are going to stack images)**
- 11. Try a bit of Clarity but try not to exceed 50% or you may get halos around high contrast areas**
- 12. Don't use lens correction profile or it may stretch the edge pixels and blur the stars. Experiment as some corrections are more severe than others.**
- 13. Apply noise reduction as necessary but be a bit sparing on colour noise correction or you may blot out some of the faint colour in constellations.**

For best results in noise reduction take 16 shots in succession and follow tutorial below:

To reduce noise by stacking:

1. Now you have done the basic correction you can select all the images (CTRL/CMD A) you wish to stack and sync all settings.
2. Select all again and select EDIT IN and Photoshop as layers. Follow this tutorial:

<https://www.youtube.com/watch?v=Rydg7JGTAbw>

Manually aligning a stack.

This is time consuming but worth the effort to save a shot which won't align automatically due to cloud or excessive light pollution

<https://www.youtube.com/watch?v=zzVSm64zq44>

Medium format effect, Panoramas:

<https://www.youtube.com/watch?v=RDvXZyHUFvw>

Constellations: something for the colds winter nights

<https://www.youtube.com/watch?v=Rltg47Q64W0>

Other Links:

www.lonelyspeck.com contains all the tutorials you'll ever need for night sky photography and all explained in an easy to follow step by step way. Not to mention some cracking shots. Rather than listening to me prattle on or even reading these notes, go to this site, it'll tell you far more than I can.

<https://www.youtube.com/user/inorman88/videos> Ian's YouTube videos tutorials

http://www.stellarium.org/en_GB/ A very useful Sky Guide (Free)

<http://photoephemeris.com/> Useful almanac for sunrise/set times (Free)

<http://www.markus-enzweiler.de/software/software.html> Use for star trails (Free)

<http://deepskystack.com/english/index.html> Deep Sky Stacker for your Galaxy shots (Free)

<http://www.astronomie.be/registax/> As above (Free)

<https://www.gimp.org/> Free open source image processing (Free)

NB: Use the link above. If google "Gimp" you may find more than you bargained for.

<http://www.samyang-lens.co.uk/> for very good manual lenses

<http://www.ioptron.com/product-p/3302b.htm> Sky tracker

<https://www.vixenoptics.co.uk/Pages/polarie.html> another Sky tracker

<https://www.youtube.com/watch?v=e0JSTF8SGi4> Deep sky stacker tutorial

<http://www.photozone.de/> Get a good lens review before purchasing.

CHECK LIST FOR AN EVENING UNDER THE STARS

1		CAMERA
2	!	SPARE BATTERIES
3		WIDE ANGLE LENS
4		MEDIUM FOCAL LENGTH LENS e.g. 50MM
5		SPARE MEMORY CARDS
6		TRIPOD
7		CABLE RELEASE / INTERVALOMETER
8		SPARE BATTERIES FOR INTERVALOMETER
9	!	HEAD TORCH
10	!	SPARE BATTERIES
11		MOBILE PHONE WITH STAR APPS.
12		COMPASS IF YOU DON'T HAVE ONE ON YOUR PHONE
13		HAND WARMER SACHETS AND ELASTIC BANDS FOR YOUR LENS
14		ROLL OF TAPE TO SECURE YOUR LENS FOCUSING RING
15		HAT, GLOVES, WARM COAT
16		NOTEBOOK AND PEN
17	!	HAVE I TOLD SOMEONE WHERE I'M GOING?
18		STAR TRACKER IF YOU HAVE ONE
19		BALL HEAD FOR THE TRACKER
20		SPARE BATTERIES FOR THE TRACKER
21		MULTI TOOL SUCH AS A LEATHERMAN