Photographing the Milky Way from the UK – Summary Notes

Basic equipment you need:

- Camera
- Tripod
- Remote shutter cable or intervalometer
- For long imaging sessions, pocket hand warmers & an old sock to create a lost cost dew heater. Relatively inexpensive battery powered dew bands are available from lots of places online

Get familiar with your camera. Read the manual. Then:

- Practice changing settings in the dark
- Practice removing & re-attaching the camera to the tripod
- Practice getting the focus right. Most SLR camera lenses go past infinity so you have to find the right focus spot manually. The way I do this is to set the camera to manual focus then chose a high ISO setting (I use ISO-3200 for focusing), then set the shutter speed to 30 seconds. Make sure the lens is zoomed out as far as you can go to get as much sky in the shot as possible. Then point at a bright star or planet, trying to get the bright star in the centre of the field of view. Switch to live view and use the x5 or x10 live view zoom in order to try and see the star on screen. If the focus is way off you won't see the star at all, so it may take a bit of practice to get it right. Once you do have the star in view, make sure you are on x5 or x10 on the live view screen then slowly adjust the focus until the star is as small as you can get it. Once you've done this you're ready to shoot the images

Settings:

- Lowest f number possible to let in the most light. Using a "fast lens", i.e., one that will go down to a very low f-number will really help to capture faint detail. The fixed 50mm lenses are excellent as they go down to f/1.8 and there are some brilliant wide angled lenses on the market which are very fast. However, be aware that using the lowest f-number may introduce more noise to your images, especially with entry level cameras, plus it is easy to over-expose the stars and lose the star colour, so experiment to find what works best for your camera/lens combinations. Be wary of using built-in noise reduction functions within your camera because it may remove some of the stars
- Use an ISO setting appropriate to your camera and sky conditions. Keep in mind that lower cost cameras will suffer with more noise at high ISO so run off a few test shots to check for noise levels. A high ISO can also contribute to the stars becoming over-exposed and it will pick up more light pollution. I generally shoot at ISO-800 or ISO-1600 with my Canon 1100D
- Turn off the flash!
- If using a static tripod, shutter speed depends on focal length

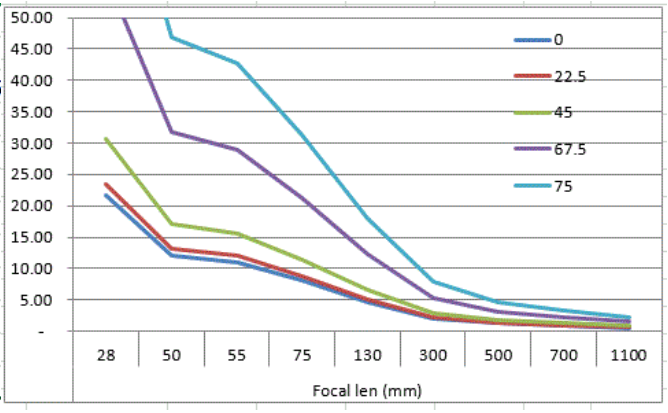
For a rough guide, use the "Rule of 600s":

600/focal length = length of time in seconds before trailing

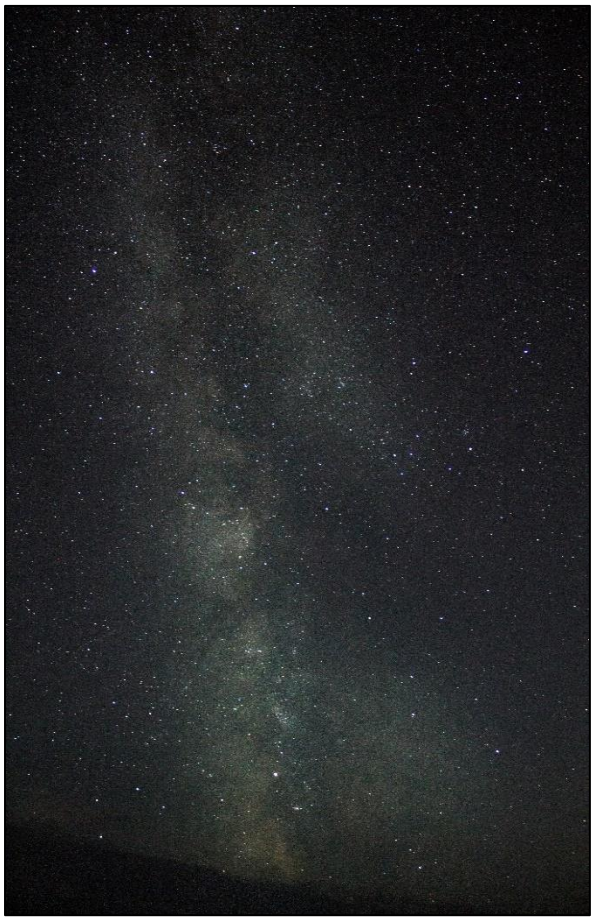
Eg 1: If you are using a length of 50mm:
600/50 = 12 seconds exposure
Eg 2: If you are using a 300mm lens:
600/300 = 2 seconds

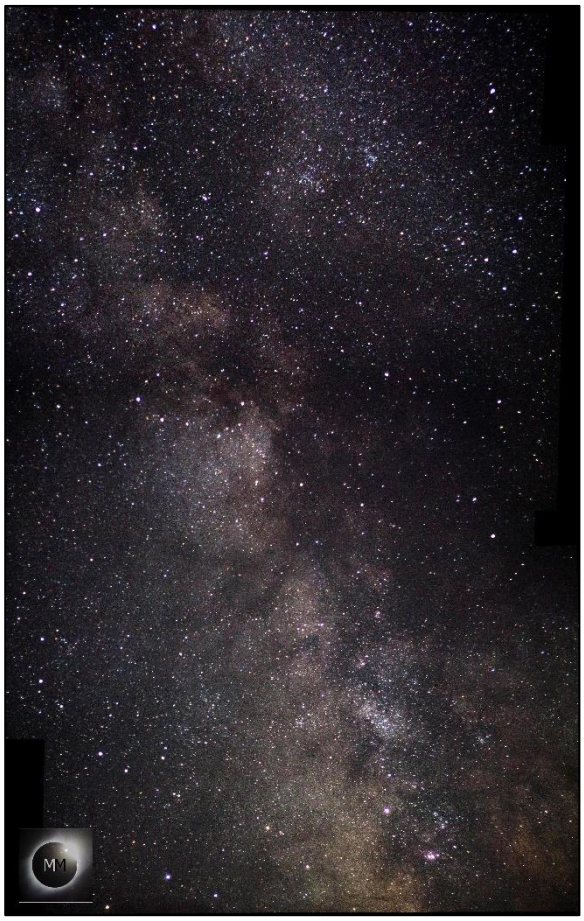
Because stars move further in our southern sky during a given time period than they do in the north, near to the celestial pole, the rule of 600s is only a quick guess at the starting point. The length of exposure will vary depending on where you point the camera. For a more accurate exposure guide, use this table & graph (produced by Mark McIntyre):

	Exposure times				
		dec (degs)			
		0	**22.5**	**45**	**67.5**
Focal len (mm)	**28**	21.70	23.49	30.69	56.71
	50	12.15	13.15	17.19	31.76
	55	11.05	11.96	15.62	28.87
	75	8.10	8.77	11.46	21.17
	130	4.67	5.06	6.61	12.21
	300	2.03	2.19	2.86	5.29
	500	1.22	1.32	1.72	3.18
	700	0.87	0.94	1.23	2.27
	1100	0.55	0.60	0.78	1.44



The two images below show the difference between using an 18mm kit lens at f/3.5 and a 50mm fixed lens at f/1.8. The image on the left was a 25 second shot, the one on the right was a 10 second shot (there are 2 stitched together to give a comparable field of view).





Shooting the Photos

- Set camera to RAW for long exposures. Jpegs are very compressed so you will get a much better result shooting in RAW. If your camera has no RAW option then chose highest quality jpeg
- Use remote shutter cable or intervalometer if possible
- If you can't use a shutter cable, then utilize the 10 second timer delay function to allow the camera to stop shaking before the shutter opens
- Take lots of test shots first and review to check for position & star trailing, etc
- If you're imaging for a long time, prevent dew from forming on the lens using the sock and hand warmers. Cut the end off the sock, wrap it around your lens then activate one or two of the hand warmers and tuck them inside the sock. Long term it's worth investing in a proper dew band, or alternatively there are blogs online which show you how to make them using nichrome wire and Duck Tape
- For best results you need a dark sky location with no moonlight to interfere
- Long exposures are better so a tracking device such as the Star Adventurer or iOptron are helpful. Bear in mind that if you have any light pollution in your location, a longer exposure will also increase the amount of unwanted light in your image as well as more Milky Way detail. As always, do a series of test shots of different exposure lengths to find what works best. A light pollution clip filter will help to filter out unwanted light from sodium street lights, but make sure your camera lens is compatible with clip filters. The kit lens that is supplied with the Canon 1100D protrudes a little bit at the back so the lens won't attach if you have a clip filter in place. But the Canon 10-18mm,

50mm fixed and 300mm zoom lenses can all be used with a clip filter. If you only have a static tripod, don't worry; you can still get some great results and they can be further improved by stacking multiple images using Deep Sky Stacker

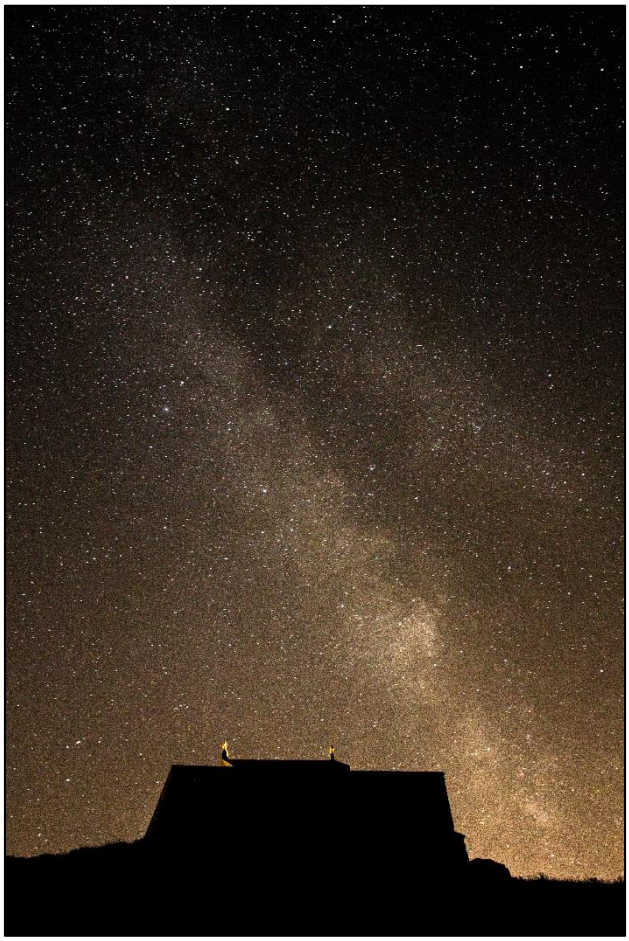
- Remember that a big part of the Milky Way is never visible from the UK, and the region towards the galactic core is only visible very low down in the southern sky during July/August. So make sure you have a realistic expectation of what you're going to capture
- Remember to add foreground interest to take your photos to the next level. Using an app such as Photo Pills or The Photographer's Ephemerides will help you to plan and frame shots taken with interesting landmarks

Image Processing

With Milky Way photography, image processing is just as important as image capture, especially if you are trying to combat background light pollution in your image. If you stretch the whole image you will also enhance the unwanted bits. I always use Lightroom for my Milky Way processing because the Adjustment Brush function will allow you to selectively enhance specific parts of your image.

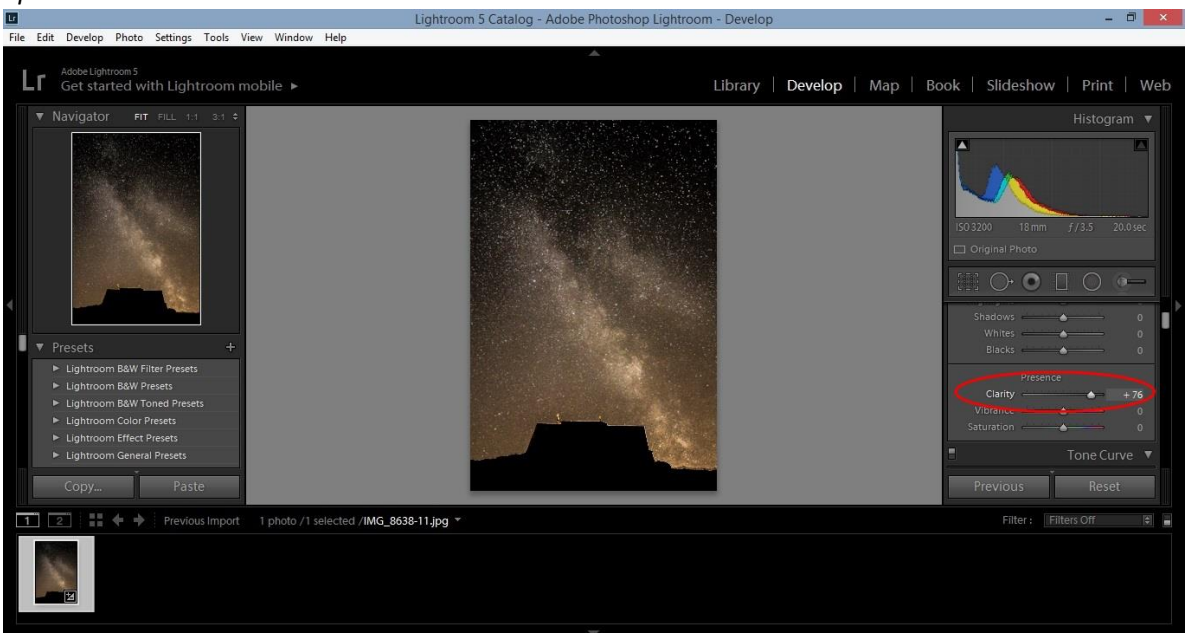
Here I have outlined the process I used on a Milky Way image taken in August 2015 from St. Ives. It was taken with a Canon 1100D and 18-55mm kit lens. The camera was set to ISO-3200 and it was a 20 second exposure, at f/3.5. Because of this being an entry level camera, the image is very grainy at this high an ISO, and these days I wouldn't usually shoot this high. But I wanted to show you what can be achieved with some simple steps in Lightroom.

Here is the starting image and the final result. Screenshots of each step are shown below.



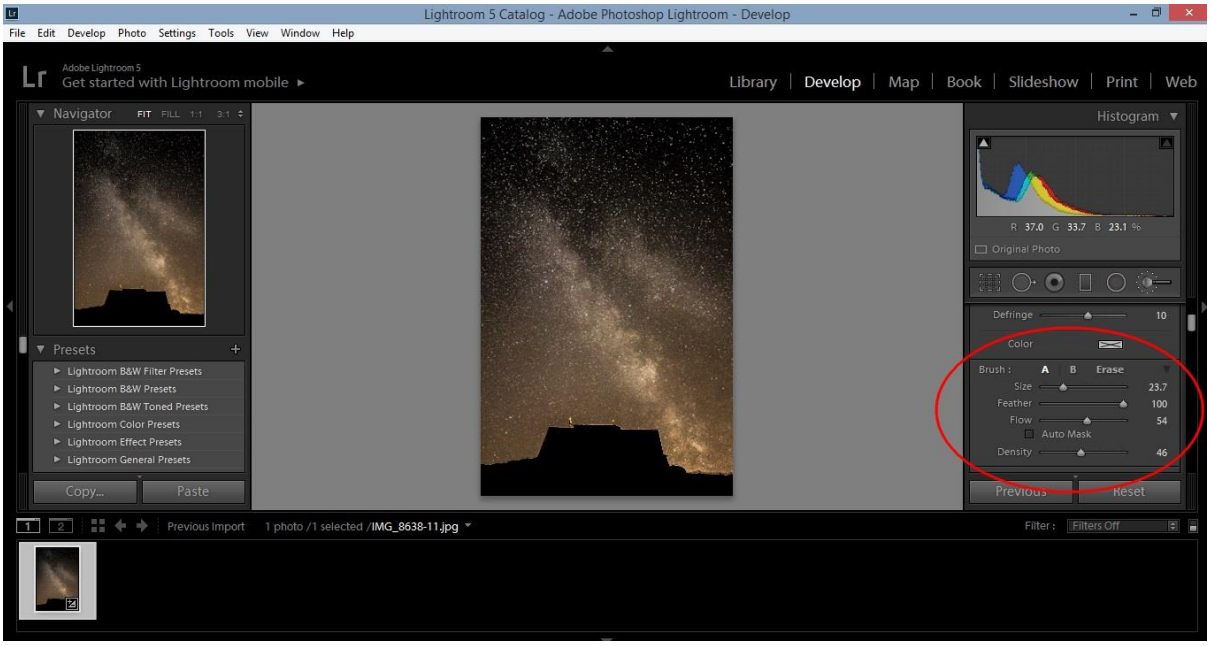
Step 1: Import the image into Lightroom and make sure you are in the “Develop” module. Move the “Clarity” slider up so that the detail of the Milky Way shows up more clearly. This will look very grainy at the moment but we will be moving the slider back down again later. Here I moved the slider up to +76.

Step 1 screenshot

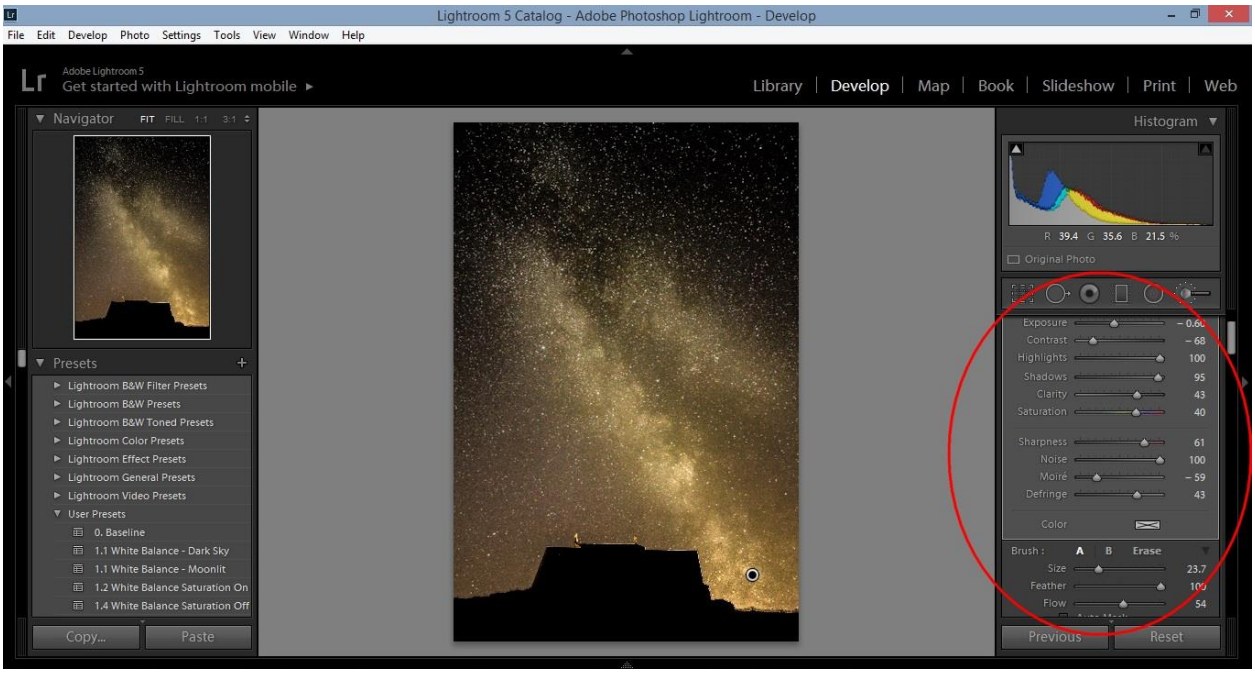


Step 2: Open the adjustment brush. You need to set the brush to a large size with a large feather to make sure there are no harsh edges to the adjustments you make. Here I made the “Brush Size” 23.7, set the “Feather” to 100, and “Flow” to 54. Now using the mouse, move the brush along the bright regions of the Milky Way and click over each bright part. Don’t just hold down the mouse and colour it all in otherwise it will look like you’ve taken a big crayon and coloured in a solid band! I just gently click once over each little bright patch, and if there are very bright patches I may click two or three times. I do this along the both sides of the visible Milky Way until I have selected all the bits I want to enhance. Now when you make adjustments in the brush module, they will only apply to the parts you have selected with the brush.

Step 2 screenshot



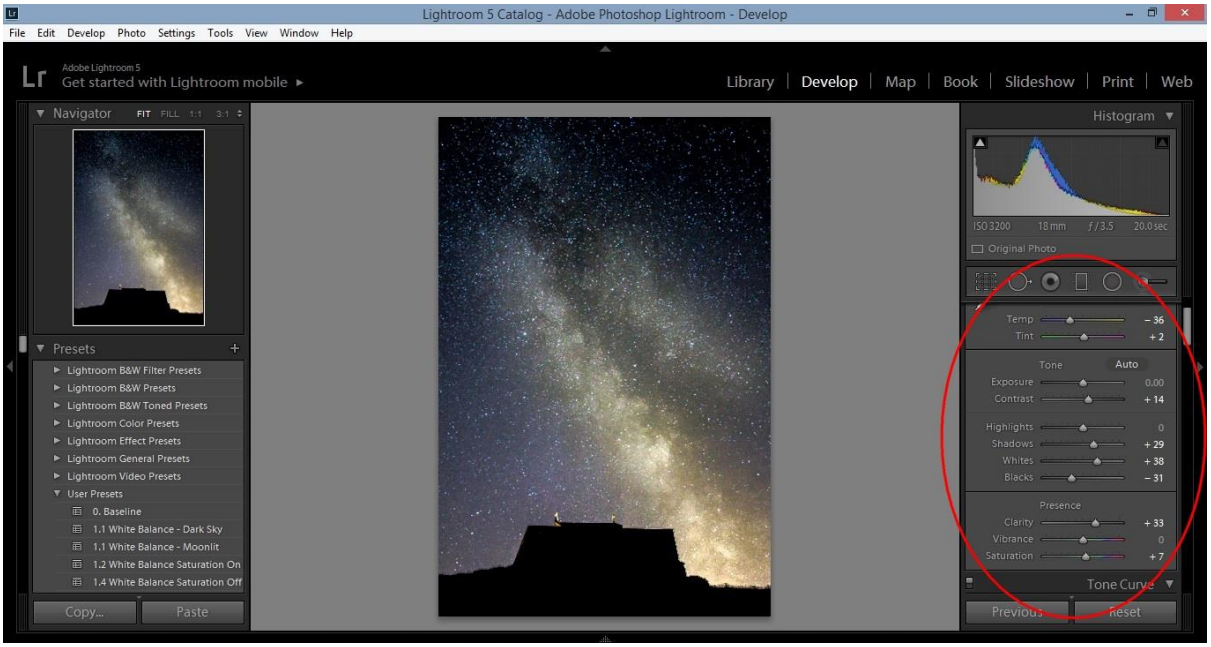
Step 3: Using the sliders within the brush tool, make changes to the regions you have selected. Here I moved the colour temperature slider across to the right, to make the Milky Way regions look warmer. They look very red now, but this will be corrected in the next step. *Step 3 screenshot*



I moved “Exposure” and “Contrast” sliders down slightly, moved the “Highlights”, “Shadows”, “Clarity”, “Saturation”, “Sharpness” and “Noise” sliders up. I do this by eye because every image I work will need different adjustments so just play with different combinations to see what works for your image.

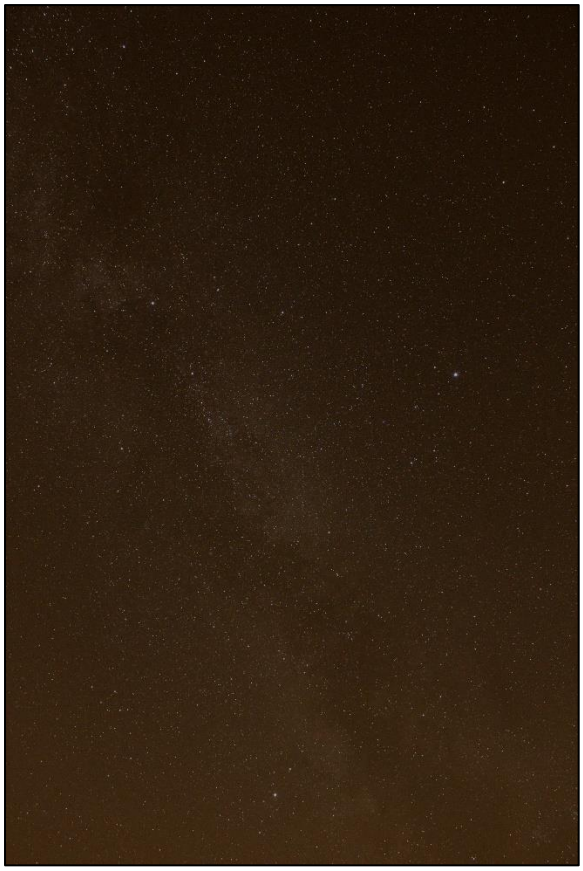
Step 4: Close the brush adjustment module. Now we are working on the entire picture again. To begin, I moved the colour temperature over towards the blue end, -36 on this occasion. This will make the background a more pleasant colour and less affected by background light pollution, but because we have warmed up the Milky Way with the brush tool, it remains a warmer colour than the background therefore making it stand out more. I then worked with the rest of the sliders. I always do this by eye and experiment moving each one up and down until I achieve a look I’m happy with. I also moved the “Clarity” slider down from the initial adjustment of +76 to +33. This keeps the Milky Way bright but helps to make the image less grainy. I increased the colour saturation a little bit, but on this occasion not much was needed. I wanted to keep the image looking quite natural. I also increased the “Noise Reduction” slider a bit (it can be found lower down in this module) but I find that the Lightroom noise reduction tool can lose a lot of detail in the image so I exported the image at this stage and made some final tweaks to the noise levels using Fast Stone Image Viewer. You can continue to play with the exported image in any of your preferred image processing programmes until you are happy with the results.

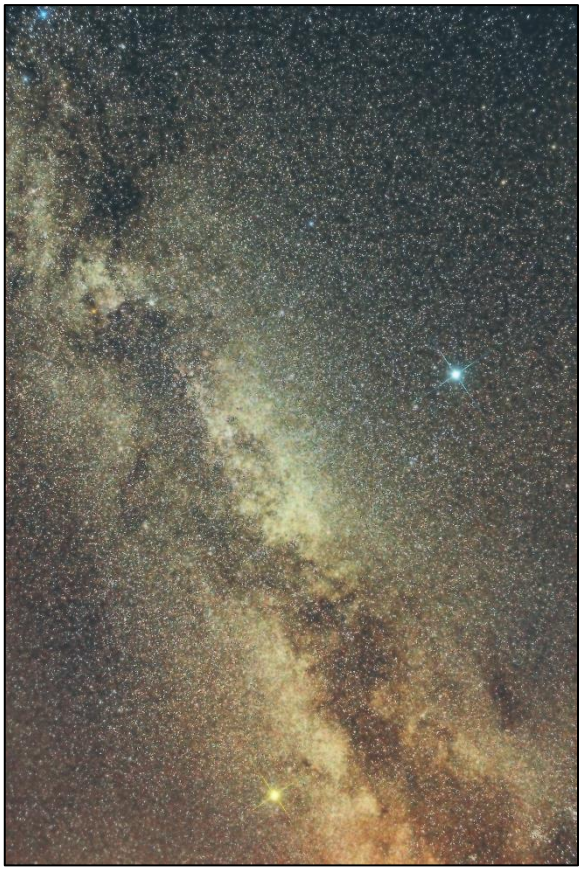
Step 4 screenshot



The above processing was done on a single shot, but you can apply the same technique to a stacked image. I used the same steps in Lightroom and Fast Stone Image Viewer on the image below. It was taken from Oxfordshire in August 2014 using a Canon 1100D with 18-55mm kit lens, piggy-backed onto my tracking telescope mount. The starting image was 7 x 3 minutes, stacked with darks and flats, and the starting point was straight from Deep Sky Stacker. The difference between the starting image and final result are very striking. Diffraction spikes were added to Vega & Altair just for fun!

Another great piece of free processing software is Fast Stone Image Viewer. It has some of the features that Photoshop has but it is much more intuitive and in my opinion it has the best noise reduction function of all processing software I use. If you have access to Photoshop, there are many useful plugins that are helpful for astrophotography processing, such as RC Astro Tools, Astroflat Pro and StarSpikes Pro.



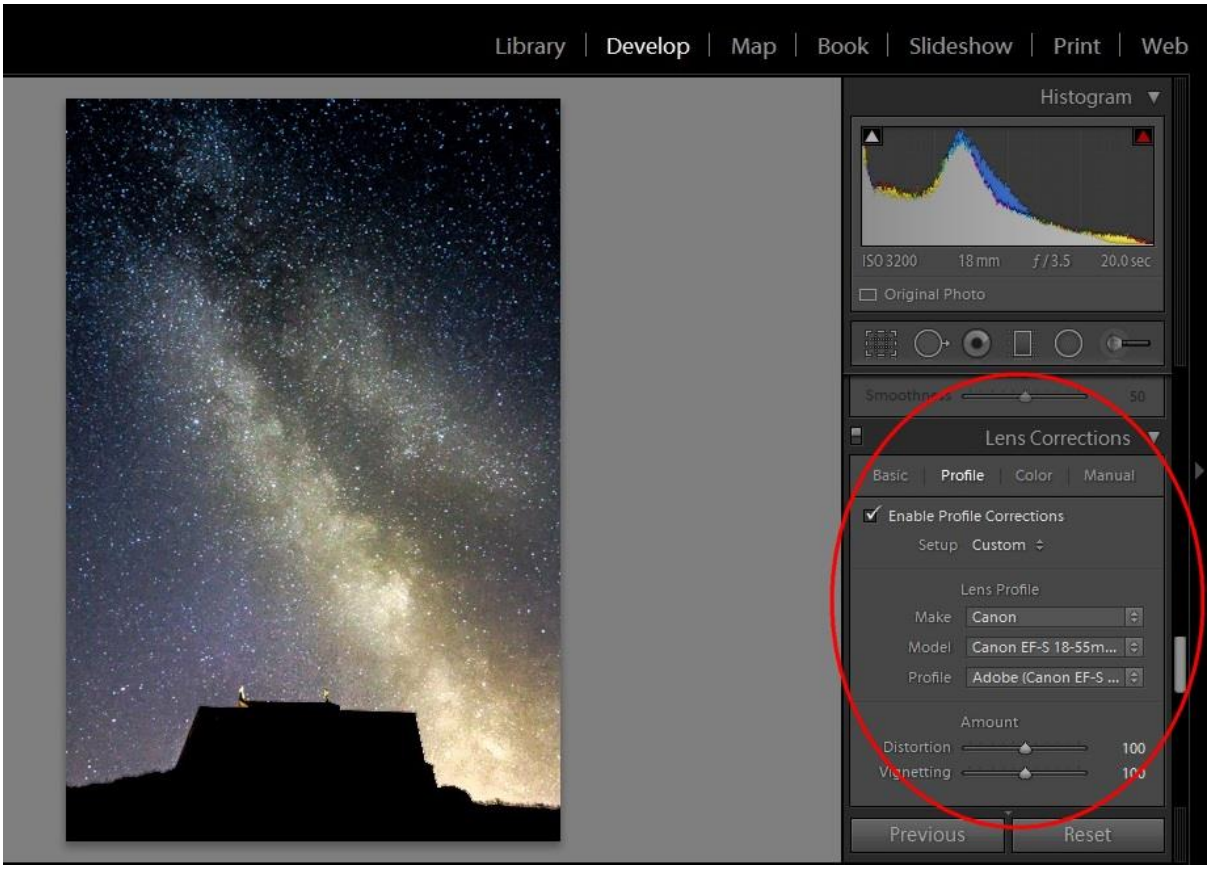


Creating Panoramic or Mosaic Stitches

As the Milky Way spans the entire sky, even a very wide angled lens can't capture it all in one shot. If you are using a fixed 50mm lens, you can capture much more detail but you also have a much smaller field of view. This is where stitching images together can be really helpful.

In order to do this, you shoot your images in exactly the same way, but as you move your camera just make sure that you overlap each region by around a third. This will give the stitching software a good portion of sky to work with and it will help it to align images correctly. If you are doing a straightforward panoramic stitch you would just move your camera across the sky in a straight line. If you are building up a mosaic, you can do this by working across in sections.

Most camera lenses introduce an element of distortion to the centre of the image. Lightroom has a really useful tool which can correct for this. In the "Develop" module, scroll down to "Lens Corrections", select "Profile" then from the dropdown menus chose your camera make. Lightroom is pretty good at figuring out which camera lens you used from the exif data, but you can chose a different one from the list if it gets it wrong. The difference this correction makes is subtle, but makes a big difference to how successful your stitching will be.



Apply this correction to all of the images you want to stitch together. I prefer to stitch together all of my images before processing, so I import all of my raw files into Lightroom, apply this lens correction to them and export them unprocessed as TIFF files. I then use Microsoft ICE (free software) to stitch my images together. You can stitch together single shots or you can create stacked images of each region, then stitch them together.

Microsoft ICE is really easy to use. Once you've opened the images the software should auto-detect the structure of your mosaic/panorama and will attempt to stitch them together. Once stitched, it will take you to the projections step. There are many different projections listed on the right had side. You can use the mouse to centre your image, then you can manipulate the image to create the effect you're looking for. There are endless combinations here! If you are trying to achieve the full Milky Way arch effect, it's better to photograph it when it ls lower in the sky. I have successfully done this in April, May and early June. In July and August the Milky Way is much higher in the sky so a straight panoramic stitch works better.

The projections that I have found work quite well for the Milky Way are fish-eye, mercator and spherical, and examples of each are shown below on images I took on 30th May 2020, but just experiment with all of them to see what you get. Once you've manipulated an image and exported it, you can go back and change the projection and create different versions until you find one you like best.

The panoramic images below were both taken by me from North Oxfordshire, where there is a lot of light pollution near to the horizon.

“Fish Eye” projection

“Mercator” projection

“Spherical” projection

The panorama below was taken when the Milky Way was much higher in the sky and passing directly overhead. It was taken with the 50mm fixed lens at f/1.8 and it has captured much more detail.

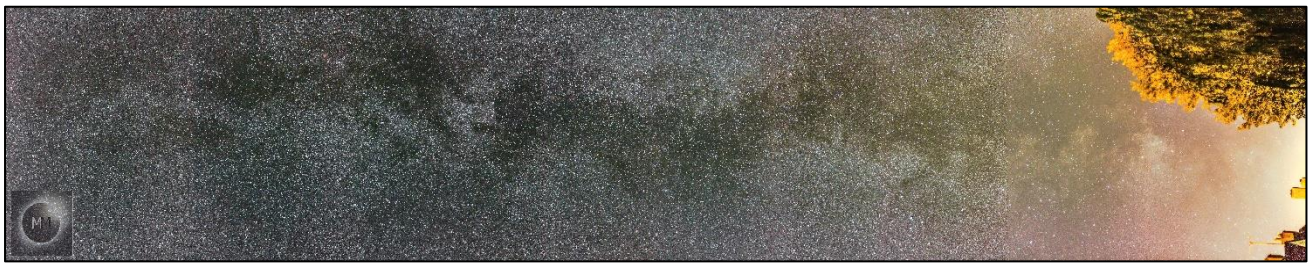
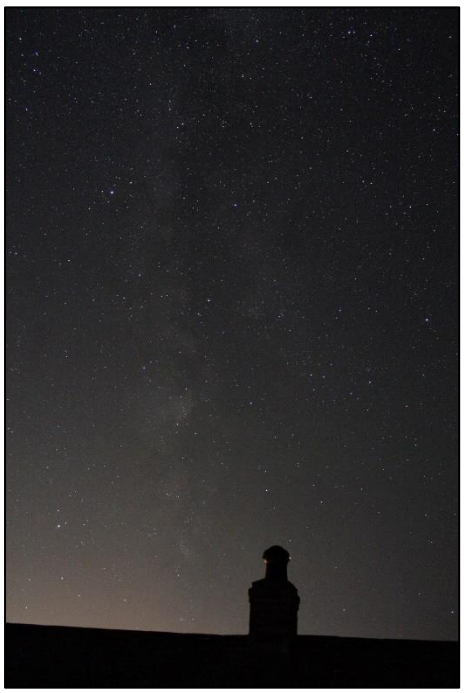
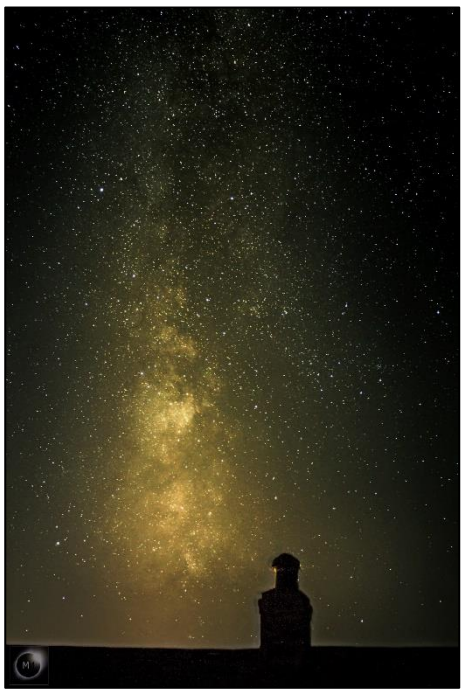


Image Stacking:

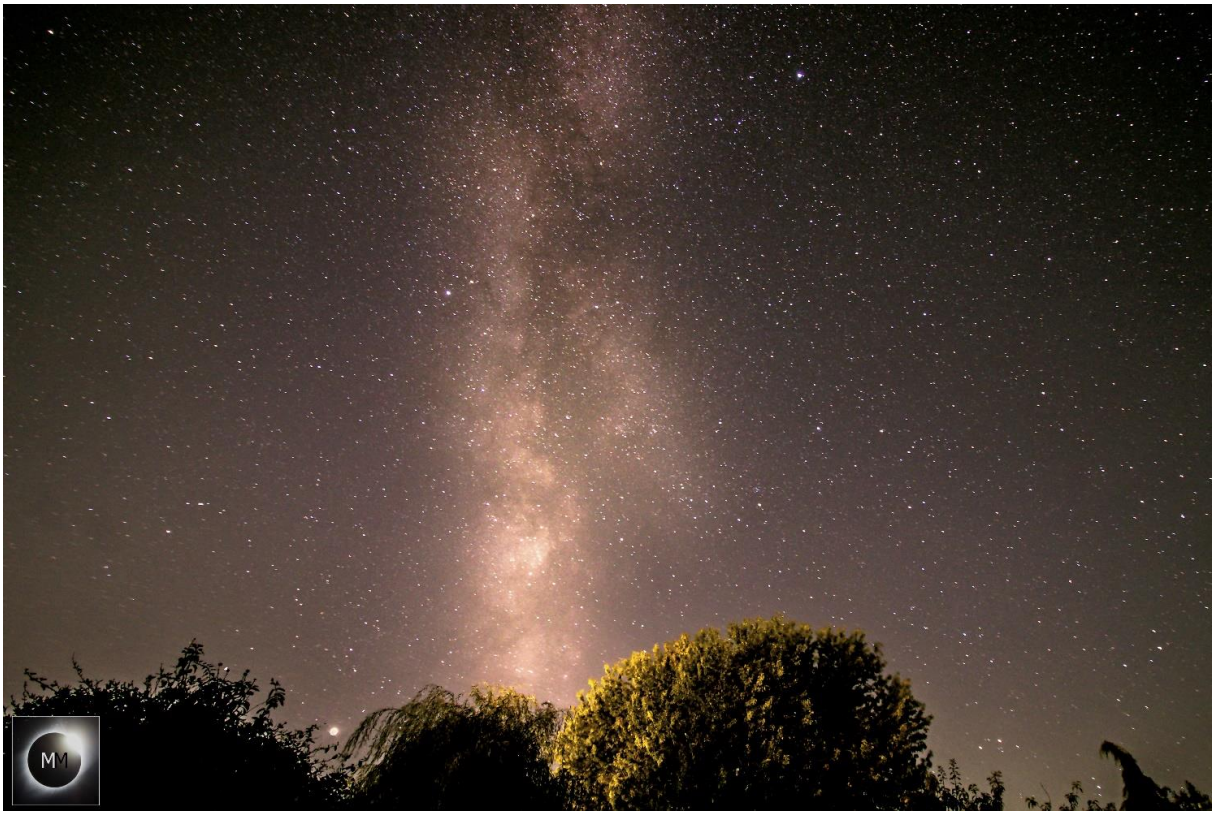
If you want to build up a much longer exposure time but you don't have a tracking mount, you can take lots of identical images with a static tripod and use software to stack them together and create a more detailed image. Traditionally I've always used Deep Sky Stacker to do this. Even though the Milky Way will have moved between shots, Deep Sky Stacker will align the stars when it does the stacking. If you are stacking and have any foreground in shot, the foreground will become blurred so you will need to blend the foreground of one of your single shots into the stacked image using a layer mask in Photoshop. More recently I've been using another free piece of software called Sequator which allows you to mask off the foreground before stacking your shots, so it gets around the foreground blurring issue. Most locations from the UK will give you some kind of issue with light pollution so stacking will allow you to build up a longer exposure time using settings that are appropriate for your sky conditions. Even stacking a small number of images will make a huge difference to how much detail you can capture in the Milky Way. Stacking multiple images helps to increase the signal to noise ratio so that means you get more Milky Way and less noise.



Single 20 second shot



7 x 20 seconds stacked



10 x 30 second shots taken with a Canon 10mm lens, stacked using Sequator with the foreground masked

If you have an entry level camera like mine which suffers from more noise, especially in warm temperatures, you can shoot some dark calibration frames to help reduce that. Dark frames (called noise frames in Sequator) help to remove the dark signal noise from your camera. The way you do this is the put the lens cap on your camera, then keeping all of the other settings exactly the same, you shoot about 15 frames. The frames will just look black when you review them, but Deep Sky Stacker and Sequator will pull them all together and create a master dark frame which is subtracted from your images before stacking. This process also helps to remove hot and cold pixels.

Because noise is affected by temperature, it's important to shoot darks at the same time as you shoot your Milky Way shots. If you are planning to create a panorama you can take multiple shots of each pane of the mosaic and stack it. If you do this, it's better to stack and stitch the images before processing.

Shaun Reynolds created this amazing 9-pane panoramic image of the Milky Way from Suffolk. It was taken with a Canon 6D with Sigma 50mm lens at ISO-3200 f/2 on a Star Adventurer mount. Each pane was 10 x 60 seconds.

To see more of Shaun's work, follow him on Twitter: @shaunreylec
or visit: www.shaunreynoldsastro.com

The photo below was taken by Stephen Cheatley from Lizard Point. If you want to photograph the whole arch of the Milky Way, it's better to attempt it when the Milky Way is a bit lower in the sky. When it is running directly overhead, the distortion towards the zenith is difficult for the stitching software to deal with.

This next photo is another taken by Stephen Cheatley. It was taken at Durdle Door and shows how much impact some foreground interest can add to a Milky Way shot.

To see more of Stephen's work, follow him on:
Twitter: @Stephencheatley
Instagram: Starman_1969
You Tube: Starman

If you are completely new to Milky Way photography, don't worry about trying to create mosaics or stack images because it may all become a bit overwhelming! Keep it simple and just get used to how best to use your camera for specific parts of the Milky Way and how to process the images. Once you're comfortable with that, you can start to stitch together single shots. Then think about stacking images of one particular region before attempting to produce a complicated stacked and stitched panorama.

I hope you found these notes helpful and that they complimented my presentation well for you. If you have any questions or comments please contact me. This is an area of astrophotography where I still feel I am learning myself so if you have any useful tips please do pass them on! Also, if you have been inspired to have a go at imaging the Milky Way after seeing this presentation and/or reading these notes, please send me a photo of your results. I love seeing what images other people are capturing!

Mary McIntyre

My Milky Way album on Flickr: https://flic.kr/s/aHsmqFHHsX
To download Microsoft ICE: http://bit.ly/2WdQwTr
To download Fast Stone: http://bit.ly/2GcCs6L
To download Deep Sky Stacker: https://bit.ly/3cDXbOv
To download Sequator: http://bit.ly/3sNafdt

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