

It's that time of year when the Milky Way's Galactic Core is become visible. Milky Way images can be difficult to shoot keeping everything sharp. Processing is time consuming and is learned through trial and error even after watching videos on "how to". Most of the best Milky Way images are focus stacked, blended, composites and/or panoramas.

Location is important. You need dark skies, the darker the better. Dark Sky maps and apps are available that show the darker locations in your area or the areas you are planning on visiting. Milky Way calendars are available online for when and where to find them. There are also apps to help you find the Milky Way at any given time and date. Some are free while others you pay for. You can effectively shoot the Milky Way through most of the moon's cycle, shooting before the moon rises or after it sets. However, there are times that lights from a distance city or the moon can enhance a Milky Way photo. You need to practice to see what you like.

When the Galactic Core and the Milky Way arch is visible it travels from the East to the West. The Core first shows up in mid-March early in the morning to the East. By mid-May, the Core and arch comes up in the Southeast heading West and is up for most of the night. By mid-October it is in the Southwest and by mid to late November it goes over the West horizon, not to be seen again until mid-March. Time of night is also important when shooting the Core and arch as they travel towards the West as night progresses.

Most people only shoot the Galactic Core with a foreground element or by itself. It can be shot in one frame/image and does not require shooting a panorama. Shooting the entire Milky Way arch requires blending multiple photos for the foreground and a different set for the arch. Also keep in mind that Astrophotography almost always requires some type of post processing, often extensive.

Basic Milky Way photography setup and settings:

Recommended camera settings for a full frame camera:

1. Use a full frame camera body, capable of shooting higher ISO's. A cropped sensor camera body (APS-C) is not recommended; however, if it's all you have, remember to add the additional crop factor to your focal length formula in #4 to keep from trailing stars.
Examples:
 - a. Canon ASP-C is 60% larger, a 24 mm lens = 38mm lens
 - b. Nikon adds 50% and a 24 mm lens = 36mm
2. A low aperture wide angle lens, F2.8 or lower lens is preferred. Turn off the lens' image stabilization. However you can shoot it with a lens up to F4.0, but it does not take in as much light.
3. Use a shutter release, intervalometer, wireless or in camera timer/delay. Shoot in mechanical shutter and single shot. I would recommend a 2 - 10 second delay to minimize camera shake when the shutter is depressed.
4. Shutter speed depends on lens size in mm, typically 8-20 seconds to keep stars from trailing. Most photographers use what we call the 500 rule to calculate times which is $500/\text{Focal length} \times 1.5$. Example: $500/24\text{mm} \times 1.5 = 13.9$ or 14 seconds. I recommend the following, but your mileage may vary:
 - a. 14mm 15-20 seconds,
 - b. 20mm 12-15 seconds,
 - c. 24 mm 10-13 seconds,
 - d. 35mm 8-10 seconds
5. ISO depends on F-stop of lens between 1600-6000. You will need to try different ISO's until you see one you like. I recommend: ISO 1600- 2400 with a F1.8 lens, ISO 2000 to 3200 with a F2.8 and ISO 3200 to 6000 for a F4.0 lens. ISO will also vary depending on the amount of available light.
6. Set white balance to Kelvin settings between 3200(cool/blue) and 5200(warm/yellow), I like 4200K, but shoot various white balance setting until you find what you like.
7. Setup your tripod. It needs to be sturdy. Any movement and your shots will be out of focus.

For beginners I recommend shooting while a partial moon is up to get a foreground and the Milky Way. Another option is the use of an external light source to light up the foreground called light painting. It takes a while to become proficient at light painting and result may vary. Please be aware that several Western National Parks and some state parks do not allow light painting so check before you go. Light painting has so many different applications. Only your imagination limits what can be done.

Getting ready for your Milky Way Shots:

1. Find a foreground that you like setup your tripod and camera and leave it there for the duration.
2. Know how far you need to be from your foreground, also known as hyperfocal distance* for setup for everything to be in focus. Here are a few examples for minimum hyperfocal distances for the two most common lenses:
 - a. F 2.8 lens 14mm 9 feet, 24mm 20 feet
 - b. F 4.0 lens 14mm 5 feet, 24mm 15 feet*Note: hyperfocal length is in focus but not necessarily clear/sharp
3. Shoot at a higher ISO's 6000-8000 to allow more light to illuminate your foreground, or you can use a light source such as a flashlight, light stick, headlamps, vehicle lights, etc. which is referred to as light painting.
4. It is possible to use an external light source to illuminate or light paint the foreground. You will have to experiment with how much light you need and where you need or want it. Stronger lights require less time but can be harsh.
5. Check your images to see if they are in focus and if there is too much noise. Re-focus if necessary and if there is not much noise, drop the ISO to the next setting. Milky Way photos are inherently noisy and some noise is desired.

More advanced photographer settings:

1. Find a foreground or foregrounds that you like. Setup your tripod and camera and shoot several shots at various times (golden, blue hour or later), at various ISO and speeds. Select your favorite shot or shots for focus stack, blend, composite or panorama.
2. You can use the hyperfocal distance recommended above or several focal points for a focus stack, which is recommended.
3. For blended photos shoot the Milky Way at infinity for the sharpest images and focus stack your foreground elements.
4. Check your images to see if they are in focus or if there is too much noise. If so, re-focus and/or drop the ISO to the next setting. Milky Way photos are inherently noisy, some noise is desired. It is especially important to check focus if it is windy or the camera or tripod have been moved or run into.

NOTE: Blending and stacking images give the sharpest Astro images, and can be an extensive discussion and/or article, so let us address this in a separate article.

IMPORTANT: How to manually focus to infinity in the dark:

1. Make sure lens is in manual focus and leave it there
2. Put the ISO as high as you can, and/or adjust the shutter speed of necessary, this allows enough light for you to manually focus.
Examples: ISO 6000 and shutter of 30 seconds, or ISO 25,600 and 8 seconds....
3. If your camera is capable, use Live View and Zoom to focus.
 - a. One of the easiest ways to focus to infinity is to find a bright light source in the far distance, like the moon, building or other lights. Turn the ISO way up then manually turn the focus ring until it is clear with no halo.

- b. If your camera is capable, use Live View and Zoom to focus. Another method to focus is to focus on the brightest planet or star you can find (it doesn't have to be in your shot). Turn the speed way down and turn the ISO way up then manually turn the focus ring until it is clear with no halo.
4. Make sure to re-adjust your settings from # 2 and #3 to your preferred Milky Way settings after you get focused, and do not touch your focus ring.
5. Point your camera to the area you want to shoot and make sure it is stable on the tripod. Take a shot and review it to see if you have what you want in the frame. Shooting the arch take some practice, so be patient.
6. It is a good idea to check focus on occasions during the shoot, especially if it's windy or the tripod or camera have moved.

Recommendations for lens settings:

1. Shot at the lowest aperture/F-stop possible
2. Shoot in Manual focus
3. Turn off lens stabilization. Leave it on for camera body

Required equipment:

1. Tripod
2. Camera
3. Lens F 1.8 to 4.0 wide angle lens preferably 12-35mm
4. Headlight or flashlight with a red light setting

Nice to have equipment:

1. Chair
2. Shutter release/intervalometer
3. Star-tracker for more advanced shooters
4. Blanket
5. Snacks/drinks