

SUN CITY SHADOW HILLS

Camera Club – Night Sky Photography

Scouting and Planning

Scouting is all about dreaming big and finding new locations which will be exciting to explore, and beautiful to photograph.

To photograph the night sky, you will have to plan in advance. Sunrise, sunset. What is in the sky? The moon is at what stage full, partial, new? Is the milky way visible? What time do they rise and set? Where to go to avoid light pollution. What is the weather forecast, cloud cover etc.? When is Civil, Nautical and Astronomical Twilight? The following are all excellent tools to aid in this process – Search the web using your favorite browser and search engine.

- Google Earth
- PhotoPills for iPhone
- Google Maps – My Places
- The Photographer's Ephemeris
- Star Walk – Night Sky & Milky Way Planner
- N.O.A.A. – Weather and Cloud Cover
- GOES Weather Satellite
- Clear Dark Sky Website
- Blue Marble Navigator Light Pollution Map
- Stellarium – Night Sky Planning Program

Focusing Your Lens at Night

Prior to focusing your lens correctly, it is impossible to effectively perform any type of night photography. Autofocus will not work in the dark. Since you are going to be taking photos of the night sky you will want to focus at infinity to ensure sharp photos of the stars. Unfortunately, this does not mean setting your focus to the infinity mark as most lenses will focus beyond infinity, but it is a great place to start. I have listed several methods below which work well for night photography.

Important: Set your camera to use Manual Focus

Method 1: Preset Your Focus Point During the Day

- 1) Set up your camera during the day with the lens you will be using
- 2) Adjust your lens to focus at infinity or a distant horizon.
- 3) You may, depending on your camera be able to use Live View to fine tune
- 4) Take a practice shot with an aperture of f/8 – f/11 and make sure the entire photo is in focus
- 5) Using a permanent marker or tape, mark both the focus ring and the barrel of the lens

Method 2: Live View Focusing at Night

- 1) With your camera on a tripod (and lens set to focal length you will be using if you are not using a prime lens) point camera at a medium bright star. Some cameras have a center point for focus /

exposure that will blink as you depress your shutter half way. If so, then with both eyes open you can center your lens on a star. This can be tricky and some practice may be required.

- 2) Once you have centered on a star then turn on live view and zoom in with live view to max (not lens). Now slightly turn the focus ring on your lens clockwise, then counterclockwise. You will see the star you have zoomed in on gets bigger, then smaller, then bigger again.
- 3) Turn your focus ring until the star is the smallest it can be, prior to growing larger again. The star is now in focus and you are focused at infinity. Note: The star you have zoomed in on may look blurry in Live View, this is okay. You should only be worried about finding the focus point where the star is smallest.
- 4) Turn off live view, take a practice shot, and make sure all of the stars are in focus.
- 5) In the case that the stars are still not in focus, repeat Step 1 – 3 until they are.

Method 3: High Contrast Focusing

At times there is a very high contrast between subjects on the landscape's horizon and the sky. Effective use of this method depends on the time of night and the amount of light pollution present where you are shooting.

- 1) Turn on your camera's Live View shooting mode and adjust your lens focus to the infinity marker. Next use the "+" (zoom button) on your live view to zoom in on the high contrast distant (30+ feet away) horizon or object. You should be able to see the high contrast line where horizon transitions to sky.
- 2) Once you've zoomed in all the way on the horizon, slightly turn the focus ring on your lens clockwise, then counterclockwise. You will notice this high contrast line becomes blurry (less contrasted), then gets sharper again (more contrasted). You want to find the lens focal setting where the line is most contrasted and sharp.
- 3) Turn off your Live View and take a practice shot. Make sure all the stars are now in focus.
- 4) In the case that the stars are not in focus, repeat steps 1 – 3 until they are.

Method 4: Trial and Error (when all else fails)

Last and least favorite method. Set focus on infinity marker and take a practice shot. Check if photo is in focus, if not slightly turn focus ring and try again. This could take 8-10 (or more) practice shots.

Method 5: Focusing at Night with Artificial Light

Focusing with artificial light can be used in addition to any of the other 4 methods, given you are close enough to shine a light on the subject you want to focus on. Note this cannot be used for the stars but can be used for your foreground and then use focus stacking techniques to blend foreground and background.

TIP: Once you have set focus I recommend you tape your focus ring to prevent accidental movement.
Recommended tape is gaffer tape as it will not leave any residue on your lens and camera.

Composition and Framing

Once you have decided where to go, try and get there during daylight so you can explore and plan your composition.

The standard ‘rules’ of composition still apply at night. Pointing your camera straight up to only get the stars will not make a picture that will keep the viewers interest for very long.

The stars should be your focal point but you will also need other details such as a foreground element to create interest. Mountains, lakes, reflections, unusual rock formations can work well. Look for transitions in contrast or detail to bring in the viewer eyes.

Composition, as in any photograph is extremely important. This is beyond the scope of this workshop, but only mentioned so that it is not forgotten.

Framing Picture in the Dark

- If Live View is good, use it with Exposure Simulation to frame. Depth of field (DOF) may require a smaller aperture (larger number)
- If Live View is not good, frame using lens wide open and very high ISO (12800, 25600...) 2-4 second exposure and review picture (ignore noise). Repeat until good composition.
- Use an artificial light source (flash light) to illuminate the foreground to assist in framing your composition

Gear & Equipment

Minimum

- 1) Tripod, the sturdier the better
- 2) Camera with manual mode functionality. Manual Mode means you can independently and manually adjust the ISO, Aperture, and Exposure time by hand.

Important but not essential

- 1) A timer / intervalometer. This is key for taking exposures longer than 30 seconds. Most DSLR cameras will take up to a 30 second exposure without a timer. You can also set your camera on ‘B’ or Bulb Mode and hold down the shutter button manually for longer than 30 seconds.
- 2) A wide angle lens with a very fast aperture. This will allow your camera’s sensor to pick up as much light as possible in the shortest amount of time. For full frame cameras, wide angle lenses between 14mm and 20mm are recommended. For crop sensor cameras, wide angle lenses between 10mm and 17mm are recommended. Apertures of f/2.8 – f/4 are required.
Recommend an f/2.8 or better.
- 3) A full frame camera with high ISO shooting capabilities. A full frame sensor provides a larger surface area to capture the light of the stars. Using a full frame camera will help to reduce the amount of noise in high ISO images in turn providing higher quality RAW files.
- 4) Spare batteries for everything, extra memory cards
- 5) Camera Lens cleaning gear
- 6) Headlamp – preferably with red light so you do not lose your night vision
- 7) Flash Light for light painting
- 8) Tape – preferably Gaffer Tape as it will not leave residue on your camera
- 9) Small Glow sticks – to attach to tripod so that they are visible in the dark
- 10) Elastics – to attach glow sticks or other straps

11) Basic comfort item – Hand Warmers, appropriate clothes, water/ snacks, first aid, pliers

Camera Settings

What are the right exposure settings? This cannot be answered. The ‘right exposure’ will depend on many factors including but not limited to:

- Camera body high ISO noise abilities
- Lens Speed
- How long after sunset
- How long before sunrise
- How much moon
- How long before moon rise
- How long after moon set
- How much light pollution
- How close, large and dark is the foreground

There are no rules, nothing is right or wrong – they will just influence what look you will get in different conditions.

The 500 Rule

Since the stars are always moving with respect to us here on Earth, technically the stars in your photos will always produce a trail, no matter how short the exposure time. The 500 Rule ensures these trails are small and unnoticeable when printing, viewing online or any other format. To obtain the maximum exposure time, take the number 500 and divide it by the effective focal length you will be shooting at. You can also reference the 500 Rule Chart below.

If you are not shooting with a full frame camera, you will need to know your cameras crop factor. This you should be able to get from your camera's manual or 'Google' your camera's make and model for more information.

If using full frame camera, then your crop factor will be 1.

Next, using the crop factor calculated above and the focal length you will be shooting with, calculate the maximum exposure time your camera can capture, prior to exhibiting star trails

$$\text{Maximum Exposure Time (Seconds)} = 500 / (\text{Focal Length (mm)} \times \text{Crop Factor})$$

500 Rule Chart

Focal Length (MM)	Sensor Size Full Frame	Max. Exposure Length (Seconds)	Crop Sensor 1.5x (mm)	Max Exposure Length (Seconds)
12	12	42	18	28
16	16	31	24	21
20	20	25	30	17
24	24	21	36	14
28	28	18	42	12
35	35	14	53	10

Exception to the Rule

As with most ‘Rules’ in photography, they are simply a guide line. You will need to determine for yourself how much of a star trail you are willing to tolerate. Some photographers will use a ‘600 Rule’ (more trailing) or a ‘400 Rule’ (less trailing) for themselves. 600 Rule could work for you if you are only taking photos to post on the web. If you plan on printing to large format, then you may want to use the ‘400 Rule. Simply change 500 in the formula above with either 600 or 400.

Bottom line you will have to experiment with different exposure times to determine what works best for you.

[Milky Way \(Star Points\)](#)

- **Camera Mode:** Manual
- **File Format:** RAW (preferable)
- **White Balance:** Daylight or Incandescent or Kelvin 3500 – 4500. If shooting in RAW then can be adjusted in post but still nice to see on back of camera while shooting
- **Long Exposure Noise Reduction (LENR) / High ISO Noise Reduction:** Can be left on but some post processing tools do a better job. You should test with your camera and post processing tool. I usually turn off and adjust in post.
- **Focal Length:** The wider the angle the better.
- **Focus:** Manual at infinity
- **IS or VR (Image stabilization):** Off
- **Mirror Lockup:** OK – every little vibration can add up.
- **Shutter Speed:** Set longest shutter speed possible using 500 rule.
- **Aperture:** Wide open to get the most stars, but stop down for DOF or if needed to reduce coma
- **ISO:** 800 – 6400 as needed. Set this last as it is the only destructive / noise inducing setting

When taking the picture use your cameras timer or remote shutter release. Do not press the shutter directly on the camera as this will create unnecessary vibration.

A good starting point, assuming effective focal length of 14mm on a full format camera

- Shutter: 30 Seconds
- Aperture: F/2.8
- ISO: 3200

Some cameras have custom setting that you can program, I suggest you set one for Milky Way settings using the above.

Star Trails

First things first, determining the type of trails you want in your composition. To take circular trails you will want to point the camera north and possibly have the north star (Polaris) in your composition. For arcs point east or west. Pointing southeast or southwest towards the equator can produce arcs going clockwise and counterclockwise as you will pick up stars in both the southern and northern hemispheres.

Star Trail photography is more forgiving than Milky Way photography. A fast lens is still recommended. Multiple fully charged batteries as you will be shooting over time ranging from 30 minutes to 4 hours. You could take multiple exposures and blend in post or one long exposure. A single long exposure is not recommended as the star trails will not be able to transverse the entire composition of the photo. Instead, these star trails will resemble long streaks of light in the sky.

The total time or number of exposures required is difficult to determine. This is dependent on your composition. I suggest a minimum of 30 minutes but would recommend 3-4 hours, as this would capture enough single exposures to produce some nice star trails. Most likely you will have more photos than required. These can be discarded later on. You will be able to better judge this with more experience as to what you like to see.

I highly suggest using a camera timer or intervalometer. Some cameras have an interval timer mode built into them, this works as well.

After calculating the elapsed shooting time, adjust your camera to mimic these settings. Input the following settings into your camera timer / intervalometer.

- **Exposure Time:** The length of each exposure. For example, you may choose an exposure time of 2 minutes.
- **Time Between Each Exposure:** I would suggest using 1 second between each photo.
- **Elapsed Shooting Time / Total Number of Exposures:** The total length of time that your camera will be taking or the total number of photos you would like your camera to take. For example, you may want to take 100 exposures at 30 seconds each, with 1 second between each shot.

When taking the picture use either a 2 or more second delay or remote trigger / cable. Do not press the shutter directly on the camera as this will create unnecessary vibration.

Camera Settings

- **Camera Mode:** Manual
- **File Format:** RAW (preferable)
- **White Balance:** Daylight or Incandescent or Kelvin 3500 – 4500. If shooting in RAW then can be adjusted in post but still nice to see on back of camera while shooting
- **Long Exposure Noise Reduction (LENR):** Off.
- **High ISO Noise Reduction:** Off
- **Focal Length:** For star trails any focal length will work. The larger the focal length the longer your star trails will appear over a shorter amount of time.
- **Focus:** Manual at infinity
- **IS or VR (Image stabilization):** Off

- **Mirror Lockup:** OK (but not if there is a delay before lockup) – every little vibration can add up.
- **Shutter Speed:** Anywhere from 30 seconds to 5 minutes. For brighter, denser star trails use many shorter exposures. For dimmer, less dense star trails, use fewer longer exposures.
- **Aperture:** f/2.8 – f5.6 The aperture setting is not as important in star trail photos as in Milky Way photos. You can experiment to what works best.
- **ISO:** ISO settings for star trail photography depend on how much ambient light is present. You can shoot star trails when the moon is visible, just make sure to shoot in the opposite direction of the moon. Keep the ISO as low as possible. Start at 300 increasing as required but do not exceed 800.

A good starting point, but depends on ambient light

- Shutter: 5 Minutes
- Aperture: F/5.6
- ISO: 400

Some cameras have custom setting that you can program, I suggest you set one for Star Trails settings using the above.

There are various tools you can use to stack your multi pictures to create longer star trails. (See attached) Most of these tools will make use of “dark frames” (same as the real shot but with the lens cap on) to aid in the process and reduce noise.

Light Painting

Light painting uses external light sources providing light to objects in your photo composition that you would like to stand out. These objects would otherwise be so dark that the camera could not correctly expose them.

When done correctly, light painting can work very well. When done incorrectly, light painting can look unnatural and ruin the photo.

Light painting is not something that should be used on every photo, but in specific cases it is required.

The idea is to try and light your subject with as soft and natural glow as possible.

Tips

- You should never point your light directly at the object you are trying to illuminate and always use a diffuser.
- You could bounce the light off your hand or the ground around the object. Also you could shine the main beam of your light above the subject, some of the light rays will still fall on the subject.
- Shine the light from the side to create more shadows, never in line with the camera.
- Always keep your light source moving, to prevent hot spots
- It is not always necessary to light paint the subject over the entire exposure. When taking Milky Way photos at very high ISO (2000 – 6400) you may only need to light paint the subject a quarter to a half of the total exposure time.
- Try taking several shots and review. Example if you are taking a 30 second exposure, try light painting for 15 seconds (counting in your head), review picture and adjust light paint time up or down depending on whether you want more light on the subject or not.
- Try different photos changing the direction of the light, left, right, up, down, bouncing, etc. This can lead to some very dramatic results.
- If there is a moon this could also work very well for light painting. It provides soft and natural glow that cannot be matched by an artificial light source.
- To ensure focus throughout your composition, you could take a couple of shots, focusing at infinity for the stars, then at the subject you are light painting and use focus stacking to blend these photos in post.

Recommended Flashlights for Light Painting

- Incandescent – Maglite
- Xenon – Streamlight Scorpion
- Nichia 219 High CRI – Eagletac D25LC2

Generally, most LEDs are too cool/blue around 8000 kelvin, unless used with an orange gel / filter. You will want lights in the 3000 – 4000 kelvin range – Xenon is perfect at 3500 kelvin. Also important to have a diffuser for the light. A white handkerchief works great.

Advance Techniques

Exposure Blending

The 500 Rule is only necessary because the stars are moving relative to us. Since the foreground / landscape we are taking photos of is not moving, we really don't need to use the 500 Rule to capture the entire photo, only the sky and stars. For this reason, Exposure Blending works very well to obtain higher image quality in the foreground / landscape portions of the night photos.

Here are the steps required for Exposure Blending

- Once you're done capturing the Milky Way, Star Trail or sky portion of your composition, leave the focal point and focal length as they are.
- Re-adjust the exposure time, ISO, and aperture, allowing you to take a long exposure of the landscape. You could use a several minute exposure at a much lower ISO (100 – 800 range) and a slightly higher aperture (f/3.2 – f/4 range) to increase your depth of field.
- Now that you have the two photos taken, one for the sky and one for the landscape, they can be blended together in Photoshop or other post processing software.

Panoramic Images

Panoramic images are a subject that requires a great deal of practice and previsualization. This is doubly true when photographing at night but can lead to some amazing images.

POST PROCESSING

Post processing and editing in the digital photography world is just as important as capturing the images. You can be the best photographer in the world, but, if you're not able to translate your vision from a RAW image file into the final work of art, then all is lost.

Out of scope for this workshop, but our club does offer two Special Interest Groups (SIG) on post processing. One for beginners and one more advanced; I encourage you to attend the one that suited to your experience level.

SOME USEFUL WEBSITES

PHOTO SUPPLIES & INFO

- B&H Photo: <http://www.bhphotovideo.com>
- Headlamp: <http://www.petzl.com/us>
- Camera lens field of views: <http://www.mat.uc.pt/~rps/photos/angles.html>

PROCESSING SOFTWARE

- Adobe Lightroom: <http://www.adobe.com/Lightroom>
- Adobe PhotoShop: <http://www.adobe.com/Photoshop>
- Gimp (FREE): <http://www.gimp.org>
- StarTrails software (FREE): <http://www.startrails.de/> (PC)
- StarStax software (FREE): <http://www.markus-enzweiler.de/software/software.html> (PC & Mac)

SKY / LAND SOFTWARE & WEBSITES

- Stellarium (FREE): <http://www.stellarium.org/>
- Sky Maps (FREE): <http://www.skymaps.com>
- Photographers Ephemeris (FREE): <http://stephentrainor.com/tools/>
- Latitude & longitude from your address: <http://geocoder.us/>

SKY EVENTS WEBSITES

- Upcoming Events: <http://www.creators.com/lifestylefeatures/astronomy/stargazers.html>
- Satellite Info: <http://www.heavens-above.com>
- Vandenberg rocket launches: <http://www.spacearchive.info/index.htm>
- Auroras at low latitudes: <http://www.dennismammana.com/skyinfo/gazingtips/auroras.htm>
- Eclipses: <http://www.mreclipse.com>
- Meteors showers: http://en.wikipedia.org/wiki/List_of_meteor_showers

WEATHER

- National Weather Service forecast: <http://www.weather.gov/>
- SoCA satellite photo: <http://sat.wrh.noaa.gov/satellite/1km/Sandiego/VIS1SAN.GIF>

SKY PHOTOS

- The World at Night: <http://www.twanight.org>
- Astronomy Picture of the Day: <http://antwrp.gsfc.nasa.gov/apod/astropix.html>