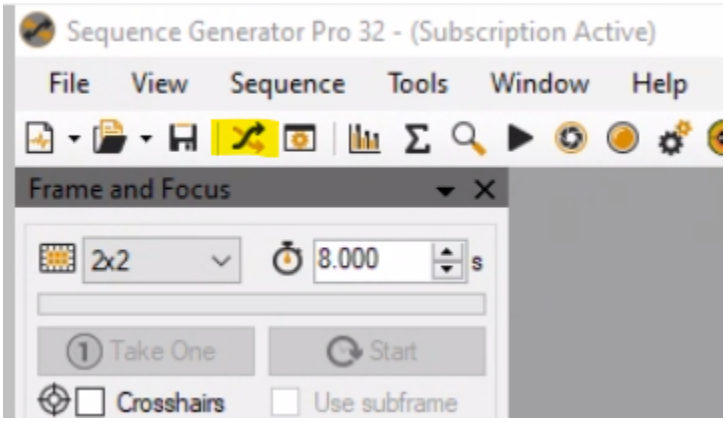
How to Use SGP to Prepare Your GEM Scope to Image Multiple Targets per Night

March 7, 2022 By Breanna Tornello and Jeff Lovelace

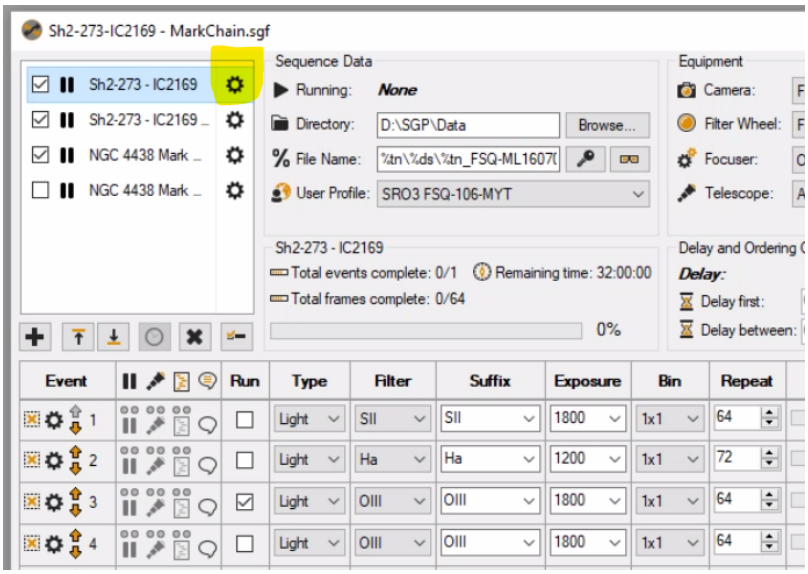
This article assumes that you have some familiarity with Sequence Generator Pro (SGP) and German Equatorial Mounts (GEMs). This approach works best for semi-permanent and permanent set-ups, such as backyard observatories and remote observatories, wherein the telescope is always precisely polar-aligned. This approach is designed to minimize sequence crashes due to auto-flip and auto-centering failures. In Jeff's experience, SGP's auto-flip and auto-centering features can fail roughly 10% and 20% of the time, respectively. The advantage of doing this manual approach means you can image two sequences per target per night.

We will use two targets for our example Procedure: SH2-273 and NGC 4438. They are prioritized in order as Sh2-273, then Sh2-273 West, then NGC 4438, and lastly NGC 4438 West.

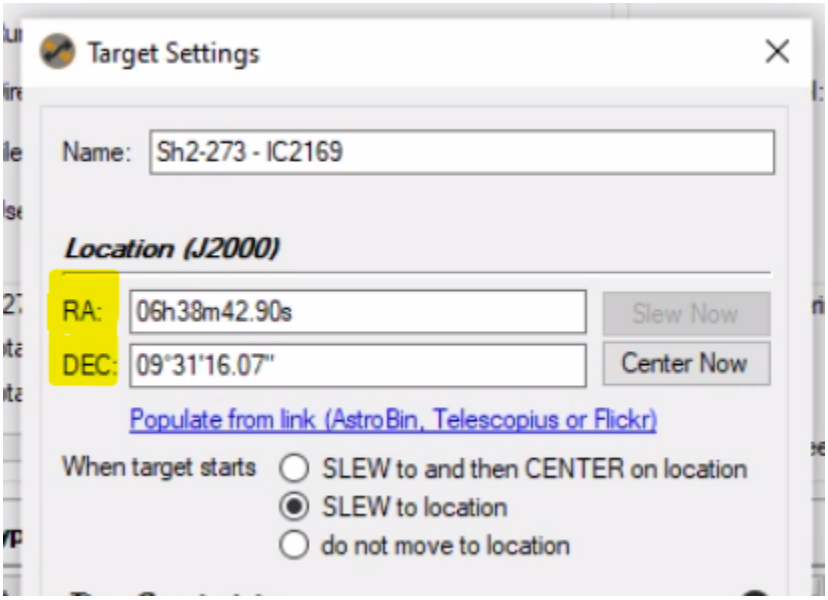
1. Begin by clicking the Sequence Icon in the upper left hand corner of SGP.



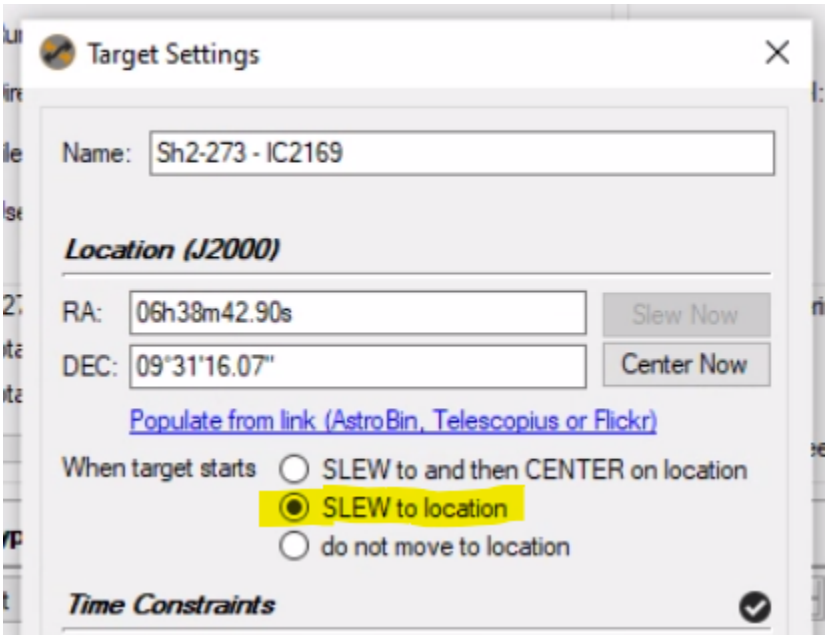
2. Click on the target's gear icon to view Target Settings.



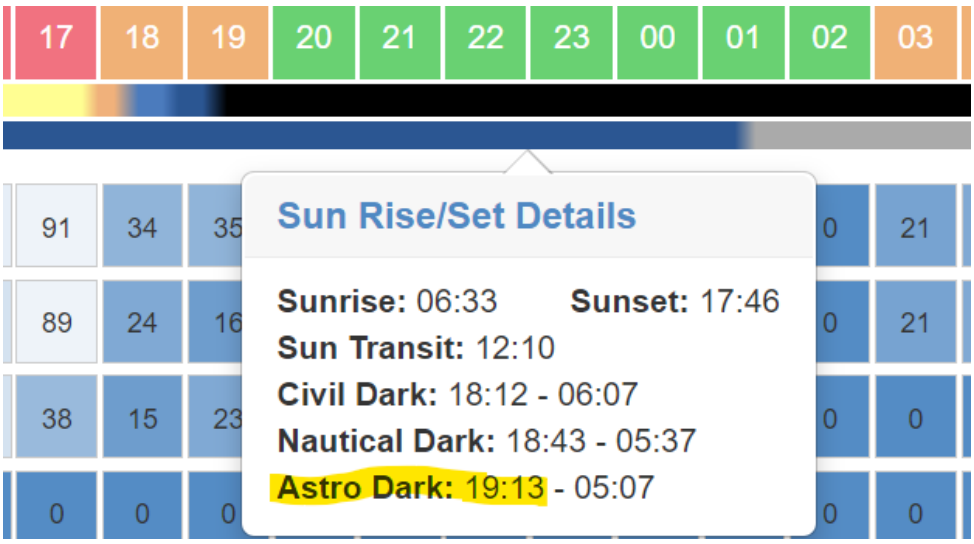
3. "RA" and "DEC" will need to be adjusted until the right centering is found. To start with this, use the center coordinates provided in applications such as Stellarium, Sky tools, Deep-Sky Planner, or Jeff's favorite: Astroplanner. Do this for each target and adjust as needed. This step may take a couple of nights/imaging sessions to get the right balance in your field of view.



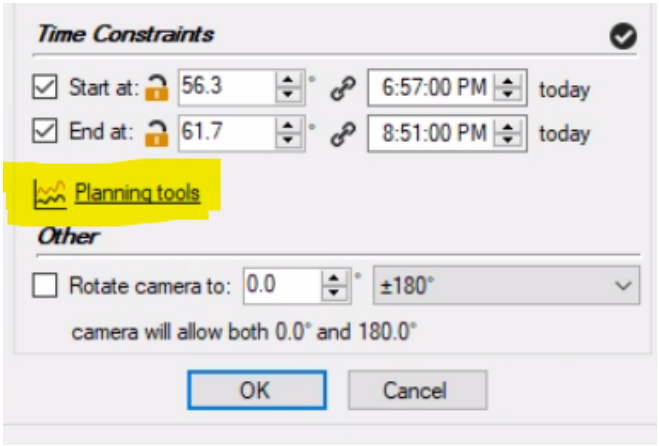
a. Note: Jeff prefers "SLEW to location". If you have an accurate mount it can provide an additional layer of dithering beyond that which is provided by your guiding software. Dithering prevents moire patterning. It also side-steps the possibility of plate solving failure during the centering process.



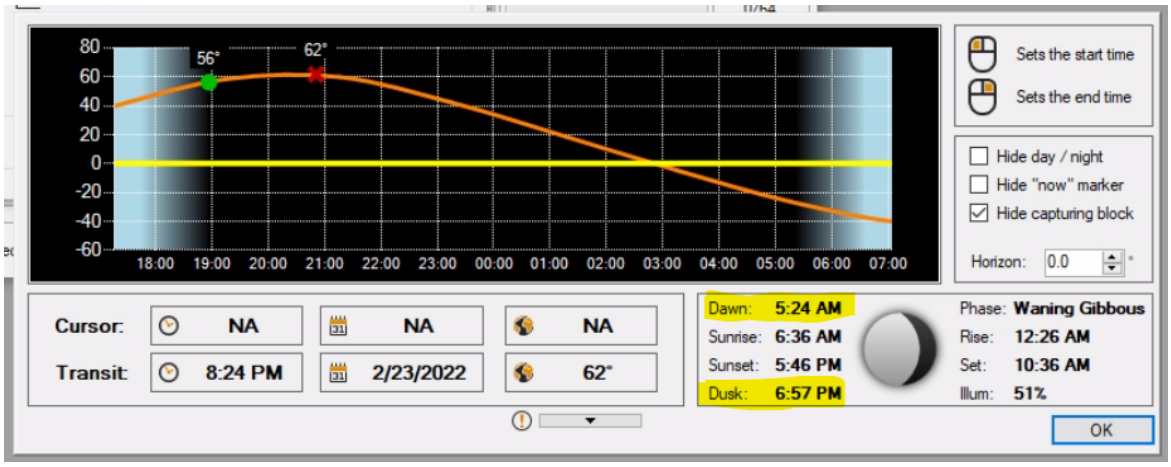
4. For the first half of our first target, **Sh2-273**, we will "Start at" either Dusk or Astronomical Dark. It is a personal preference. Jeff prefers to start at Dusk.
    a. Astronomical Dark: Visit ClearOutside.com and check the forecast for your exact location. For our location, Astro Dark begins at 7:13PM.



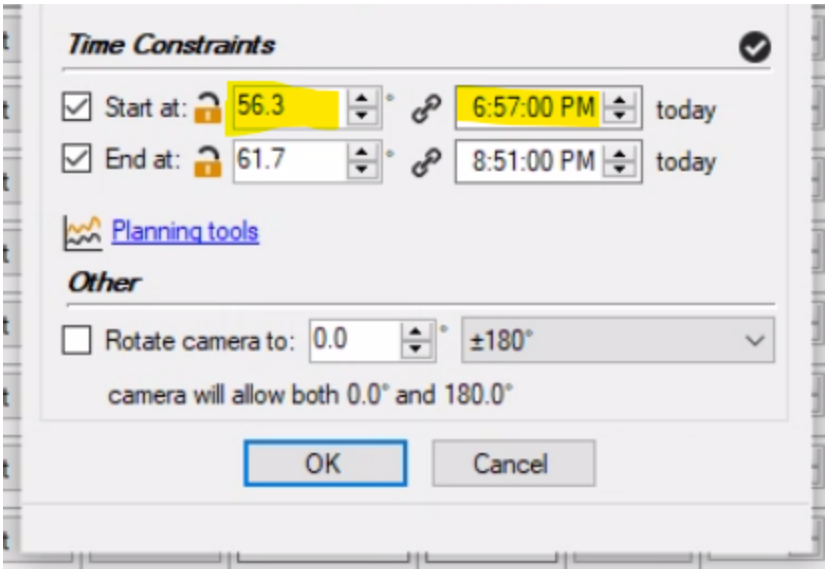
b. Dusk: Check SGP > Target Settings > Planning Tools.



c. For our location, Dusk begins at 6:57PM.



d. Since we prefer to use Dusk, **we will enter 6:57PM for our "Start at" time**.

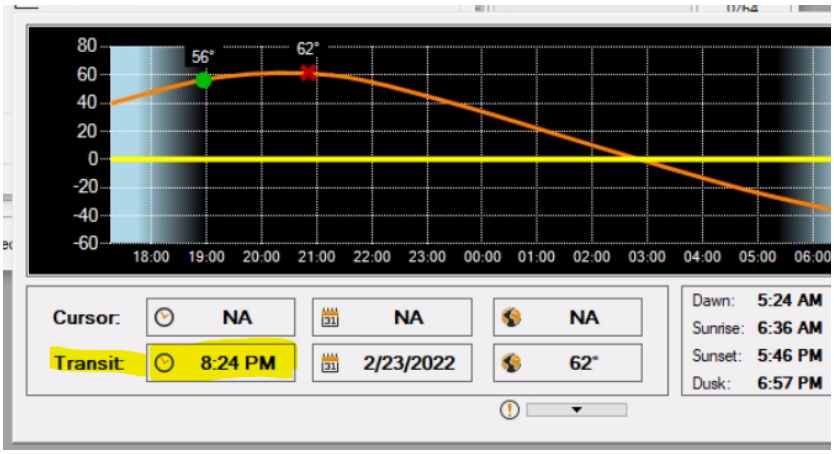


e. Notice that the corresponding starting altitude will be 56.3°. We need to keep in mind the minimum starting altitude for our scope in order to prevent bad seeing. In our case, the minimum altitude is 30°.
    i. If the "Start at" altitude was below 30°, we would adjust the starting time by the minute until it reached the minimum altitude.

f. Note: The minimum altitude for your scope is a matter of preference and a complicated choice based on many factors, but it comes down to the altitude below which you stop reliably producing sharp images (especially in the blue end of the spectrum due to extinction).
    i. For reference, here are the minimum altitudes Jeff uses:
        1. 40° for CDK14, CDK20, and EdgeHD11 (oversampled)
        2. 30° for FSQ106 and CCA250 (very undersampled)

5. For the first half of our first target, **Sh2-273**, we will "End at" the Transit time plus twenty-seven minutes.

a. See Planning Tools > Transit. For our target, the Transit time (or Meridian time) occurs at 8:24PM.

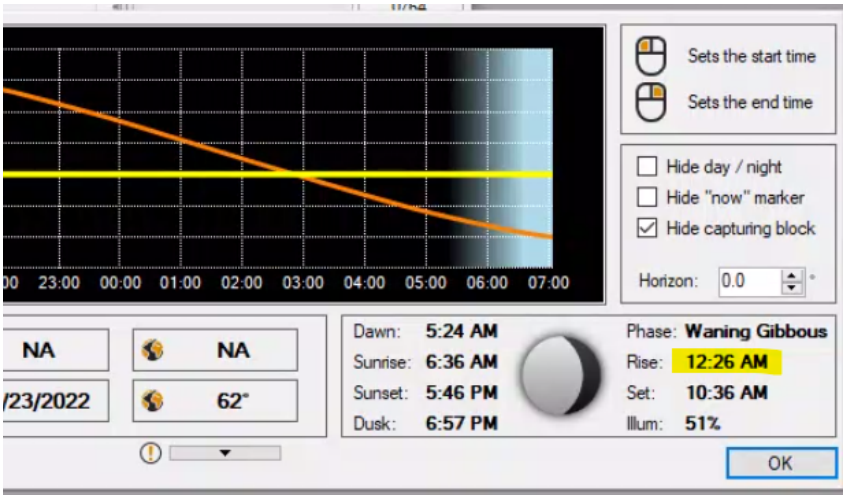


b. Note: The GEM can image up to 60 minutes after the Transit time before crashing into the pier. To be safe, only image up to twenty-five minutes after the Transit time.
    i. Note: If the scope happens to finish imaging for the Eastern sky right at the time of transit, and then starts imaging for the Western sky right at the time of transit, SGP and/or the telescope's drivers may become confused and continue imaging from the East side of the pier, causing a pier crash. This is why we add 2 extra minutes after the Transit time–so that the scope orients itself correctly for the Western flip.
c. So, the "End at" time will be 8:24PM plus 25 minutes plus 2 minutes: **We will end the first half of the target Sh2-273 at 8:51PM.**

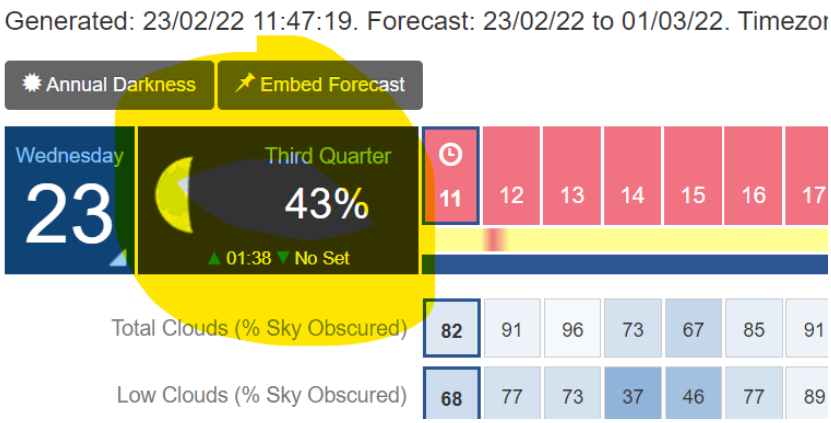
7. For the Western part of our target, labeled **Sh2-273 West**, **we will "Start at" the Transit time plus two minutes: 8:26PM**. Keep in mind the altitude at this time, making sure it remains above the minimum.

8. For the Western part of our target, labeled **Sh2-273 West**, we will ideally "End at" the minimum altitude (30°). However there are some things to consider:

a. You may discover that Dawn occurs before 30° is reached. In this case, you will "End at" Dawn.
b. We must also keep the Moon in mind.
    i. Note: Ignore what Planning Tools says for the Moon Rise. There is an actual error that has not yet been resolved. SGP considers calendar days instead of imaging days. Imaging days involve two calendar days (the night of one and the morning of the following). Calendar days are singular. If the moon happens to rise after 12AM on any one day, the time shown in SGP's Planning Tools will be for the previous calendar day and not the time for the Moon Rise on your night's imaging day.
        1. We see that in Planning Tools, for our example, the Moon Rise is set for 12:26AM. This is incorrect.



2. Instead, we will always refer to what ClearOutside.com says is the Moon Rise. It says the Moon will rise tonight at 01:38AM:



ii. Note: There are some Moon Rules that Jeff abides by that may benefit you:
   1. If the illumination is over 33%, Do Not Image after the Moon Rise.
   2. If the illumination is between 20% and 33%, only image using the SII, NII, and Hα filters.
   3. Illumination under 20% is ideal for imaging with all narrowband filters (SII, NII, OIII, Hα).
   4. Illumination under 10% is ideal for imaging with broadband filters (LRGB).

c. When we input 30° for our "End at" time, we see that our target **Sh2-273 West** will end at 12:19AM tonight, which is well before Moon Rise and Dawn. For those reasons we can disregard the Moon Rise and its illumination as well as Dawn time. **We will "End at" 12:19AM.**

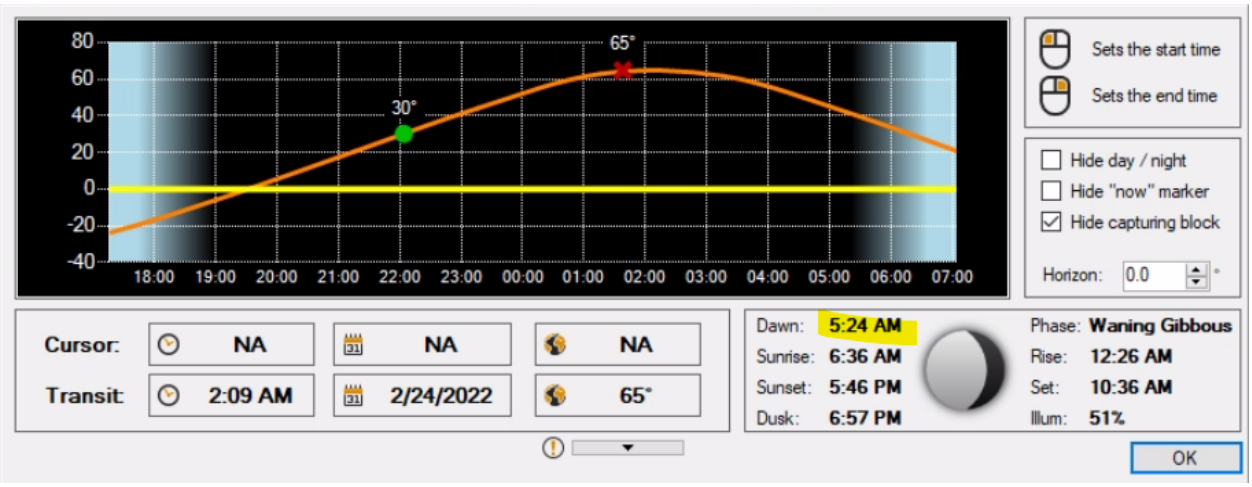
9. For the first half of our second target, **NGC 4438**, we will ideally "Start at" 30°. For tonight, this altitude coincides with 10:04PM, which is well after Dusk and well before Moon Rise, and well above the minimum altitude. **So we will "Start at" 10:04PM**.

10. For the first half of our second target, **NGC 4438**, we will "End at" the Transit time plus twenty-seven minutes, same as with our first target. The transit time of this target happens to be 2:09AM. So we *should* end at 2:36AM. However, let us not forget the Moon Rise, Dawn, and minimum altitude:

I. In the previous figure we can see that the Moon's illumination is at 43% tonight! So we will not want to do any imaging for any filter after it rises. **So we will cut back our end time to 01:38AM**.

11. For the second half of our second target, **NGC 4438 West**, we would ideally "Start at" the Transit time plus 2 minutes, which is 2:11AM. However, because the Moon rises before the Transit time, this part of the imaging session will be canceled. Leave NGC 4438 West un-checked.

12. For the second half of our second target, **NGC 4438 West**, we would ideally "End at" either 30° or Dawn, whichever occurs first. On SGP > Planning Tools, Dawn occurs at 5:24AM. This time coincides with an altitude of 40.5°, which is well above the minimum altitude. So, if the Moon Rise had not canceled our imaging session, we would "End at" 5:24AM for this last half of the target.



14. A brief recap:

i. In an ideal scenario where the sky is moonless and the target remains visible throughout the night, you would want to begin imaging at the minimum altitude OR the start of Dusk. You would want to ultimately end the night's imaging session at the minimum altitude OR the start of Dawn.

ii. You will want to break up your target(s) into East and West sub-targets for your GEM scope. End the first half at Transit time plus 27 minutes. Start the second half at Transit time plus 2 minutes.

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