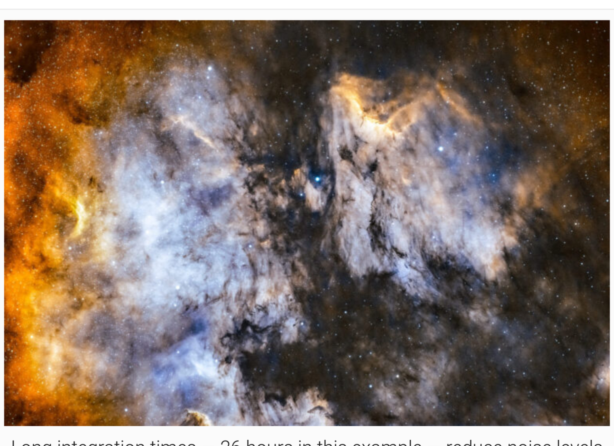
Boost Your Astrophoto Signal: How To Get Long Integration Times

By: Lee PullenPublished: Dec 05, 2021



Long integration times — 26 hours in this example — reduce noise levels and reveal faint details. Credit: Lee Pullen.

To make high quality photos of deep sky objects, we need to integrate. Integrating is sometimes called stacking, and involves taking lots of images – called subframes, or subs for short. You then must integrate (combine) the photos together to make one image that we go on to edit, using post-processing software. The integration time is represented with the amount of data you gather. Combine 10 one-minute photos, and your final image's integration time is 10 minutes.

Most beginner astroimagers are content with short integration times of just a few hours per target. But aiming for longer times – say, 10, 15, 20 hours or more – can take your pictures to the next level.

Why are long integration times needed?

Every individual image we take can be broken down into two categories: signal and noise.

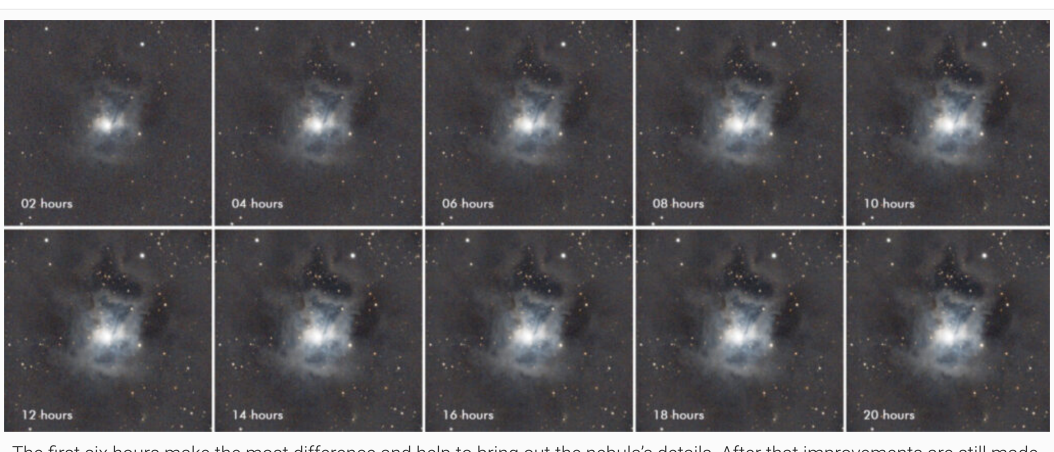
Signal is all the photons we want to record. If we're photographing a galaxy, all the light emitted by the galaxy that reaches our sensor, and is recorded, is signal.

Noise is everything our sensor records that we don't want. Our camera sensors themselves produce noise when in use. Light pollution can be thought of as noise, too.

We want our images to have the best possible signal-to-noise ratio (SNR) so that they will be smooth and crisp, with lots of detail. Integrating many images together improves the signal, while the noise, which is more random by its nature, gets smoothed out. So, long integration times = better SNR. However, SNR is proportional to the square root of integration time, meaning that the first few hours of data give the biggest leaps in quality. After that you still get improvements, just at an ever-diminishing rate.

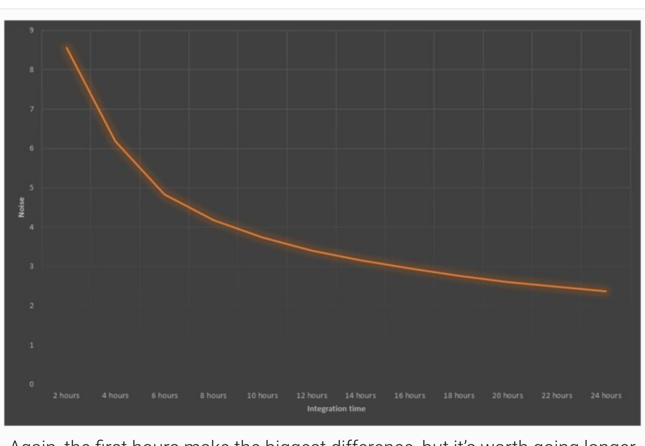
Although longer is always better, there isn't a universal set figure to aim for. It depends on your chosen target, equipment, and perhaps most importantly, how dark your skies are. The worse your light pollution is, the longer an integration time you'll need.

For an experiment, I took a series of photos of the Iris Nebula from my city-center location and integrated them in steps of two hours all the way up to 20. The results are shown here:



The first six hours make the most difference and help to bring out the nebula's details. After that improvements are still made, but the returns diminish. Credit: Lee Pullen.

I then used Pleiades Astrophoto's PixInsight software (MSRP $263) to graph how noise levels change as an image is integrated all the way up to 24 hours:



Again, the first hours make the biggest difference, but it's worth going longer to reduce noise levels. Credit: Lee Pullen.

Remember also that you want quality as well as quantity; only allow good quality subs into your integration. Processing software packages have methods of achieving this. PixInsight's SubframeSelector function is particularly good, allowing you to weed out poor subs using a variety of criteria.

After conducting these experiments, I decided to aim for around 20 hours of high-quality integration time per target, and longer if possible. It's worth conducting similar experiments for yourself given what a difference local sky conditions make.

If you're currently getting integration times of just a few hours, jumping to much longer times may seem impossible. Here are five top tips to help:

Tip 1: Use remote automation
Remote automation is essential for racking up long integration times. It means you can set up an imaging run and leave your system collecting photons *all night* without any input from you. It also allows for plate solving, which is a superb technique for automatically finding targets in the night sky, making it easy to image the same object over multiple nights. There are many remote automation options available, such as ZWO's ASIAIR Plus (MSRP $299), Main Sequence Software's Sequence Generator Pro (MSRP from $149.00 initially then $59.00 a year), and Voyager System Integration and Astrophotography Automation Software (MSRP from $147).

Tip 2: Plan your imaging sessions
It's important to choose a target that will be visible in your sky for as long as possible between sunset and sunrise. Ideally, you want to be collecting your target's photons as soon as it gets properly dark, and right through until pre-dawn twilight. Avoid anything that's going to dip below the horizon after a few hours of imaging. Likewise, don't waste precious hours of darkness waiting for your target to rise. Free Planetarium software Stellarium is useful for planning.

Tip 3: Optimize your set-up and pack-down
It's critical to have an efficient set-up and pack-down procedure. The more hassle it is to get your kit ready to image, the less likely you are to actually do it. Automated domes are the ultimate solution, but there are cheaper alternatives. Personally, I have a mount permanently installed on a pier in my garden, covered with a Cygnus Astro Heavyweight Cover (MSRP from $34 to $75 depending on size) when not in use. Can you get your set-up routine down to 20 minutes? Great, now aim for 15. Then 10. Then 5…

Tip 4: Shoot short subs (if your camera has a CMOS sensor)
Older CCD sensors need sub lengths of many minutes — think 10, 20, even more. Modern Astro-cameras have a new type of sensor called CMOS, which work well with much shorter subs, such as a minute or two, or even in the range of seconds. The important thing is the total integration time; how you get there doesn't matter so much. There are practical benefits to shooting short subs instead of long ones:

- The shorter your sub is, the less accurate your mount's tracking needs to be. Shooting a one-minute sub requires far less precision than a 10-minute sub.
- If you have occasional mount wobble or other issues, it's better to have one short sub ruined rather than one long sub.
- Shorter subs mean you can take advantage of gaps in the cloud to keep gathering data.

Tip 5: Commit to it!
It takes dedication to achieve long integration times. There's always the temptation to call it quits and move on to another target. Beginners, in particular, do tend to get itchy feet; after all, there's just so much out there to image! This feeling will fade after you get a few long integration images and realize that the end product is much better as a result.

You also need to avoid making excuses to *not* image. It's cold out, conditions aren't perfect… forget all that. Don't use the weather as an excuse to avoid aiming high either; I live in the south-west UK where the skies seem perpetually covered in cloud, but using the tips outlined here I produce around 16 20-hour images a year.

Take every available opportunity to collect photons, and your images will improve astronomically!

Long integration times are particularly important when imaging faint objects from a light-polluted location. Credit: Lee Pullen.

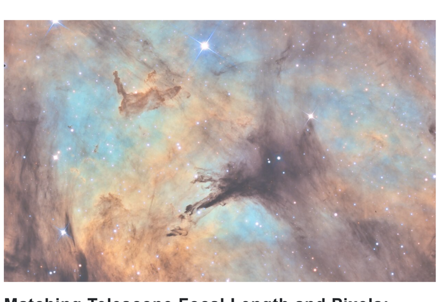
Read more in Urban Astrophotography's article How to Get Long Integration Times.

About Lee Pullen

http://urbanastrophotography.com

Lee Pullen is a science writer and communicator from the city of Bristol, UK. He has a degree in Astronomy and a master's in Science Communication. He began his career writing for organisations including the Hubble European Space Agency Information Centre and the European Southern Observatory, as well as becoming Staff Writer for the International Year of Astronomy 2009, the world's largest ever science outreach initiative. Lee runs the website UrbanAstrophotography.com

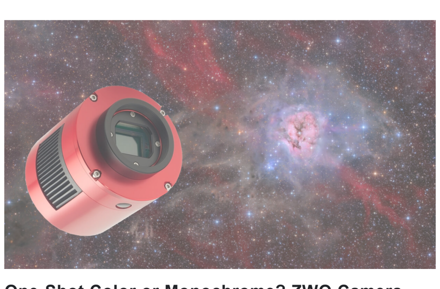
RELATED POSTS



Matching Telescope Focal Length and Pixels: Designing an Optimized System

There are several factors to consider when designing a deep sky astrophotography setup, including image scale, resolution, sampling rate, and atmospheric conditions...

Read More →



One-Shot Color or Monochrome? ZWO Camera Matchup

This article was originally published on AstroGear Today on July 2, 2021 Astrophotography beginners often ask, "Should I get a monochrome or a...

Read More →

Astrophotography: A Guide to Beating Light Pollution, Part 2

In Part 1, we looked at light pollution and its effects on broadband and narrowband images, and the filters that are most effective at...

Read More →