

Brief Guide to Astrophotography (Without a Star Tracker)

The following bullet points are the key things to remember when doing astrophotography with a digital camera. You don't need to use a stacking program for your images, if you have a fast lens and your camera produces clean images at high ISOs, you may get away with a single image.

- Due to the length of exposures a tripod is essential and a cable release is useful to avoid touching the camera.
- Decide whether you want a wide star field (wide angle lens), e.g. to capture whole constellations or the Milky Way, or to concentrate on a particular part of the sky, e.g. a nebula with a telephoto lens. This has a bearing on how long an exposure you can have before you start to see star trails.
- As the Earth rotates long exposures will create star trails (which may be what you want, but that's another subject altogether). To avoid star trails there's something called the '500 rule' - you divide 500 by your lens's focal length, e.g. $500 / 24\text{mm} = 20.8$ seconds. This is a bit optimistic and you usually need a shorter exposure. A better method is the NPF rule. For a 24mm lens the NPF rule gives 7.14 seconds (NPF calculators are available online or in the PhotoPills app). Longer lenses need shorter exposures to prevent star trails, for example a 400mm lens can have an exposure no longer than 0.52 seconds.
- It's because exposures cannot be very long with long lenses that you need to stack images. One exposure may only be half a second, but if you take 100 images you'll have an effective exposure of 100×0.5 seconds = 50 seconds; 200 images is 100 seconds, and so on.
- Check your camera and lens settings.
 - Ensure that any in-camera noise reduction is turned off.
 - Set your camera to manual.
 - Ensure images are being saved as Raw.
 - Turn off any vibration compensation / image stabilisation.
 - Turn off auto focus.
- The aim is to capture as much light as possible during each exposure, so open the aperture to the lens's maximum and set the ISO to the maximum you think you can get away with. The higher the ISO, the more noise will be introduced into your images. I generally use 1600 and go no further than 3200, but your camera may perform better at higher ISO values – experiment.
- Set up your camera on the tripod, point it towards what you want to photograph, switch on live view, find a star and magnify as much as possible. Then manually alter the focus until the star becomes the smallest point you can achieve. Unless you're using back button focussing it's essential you turn off auto focussing otherwise the camera will try and focus itself when you take a photo - very frustrating.

- Once you're happy with the focus and that your subject is framed you can start taking pictures. If you're using a cable release you can lock it so the camera keeps taking shots one after the other. You'll need to keep checking your subject is still framed. If it starts to move close to the edge of the frame you'll need to re-centre it.
- Theoretically there's no limit to the number of images you take – the more the better. In practise more images will take longer to process and available disc space and memory on your computer will be limiting factors too.
- After you've finished the star images (or light frames), put the lens cap on and, using the same exposure, aperture, ISO and focal length settings, take 10 or 20 pictures. These are your dark frames and will be used when processing to help reduce image noise.
- Additionally you can, optionally, take bias frames (use the highest speed on your camera, e.g. 1/4000th second and the same ISO you used to take your star images) and flat frames (stretch a white cloth in front of your lens, then shoot something luminous (e.g. a bright white light) and let the camera decide the exposure time). Take 10 to 20 of each.
- Once you've got your images you'll need to load them into a stacking program – for example [DeepSkyStacker](#), which is a free download.
- [Instructions](#) about how to use this program, plus the use of dark, flat and bias frames are covered on the DeepSkyStacker website. Don't worry too much about the various settings – I've left them at the defaults.
- Finally I recommend taking a look at this YouTube video from [Nebula Photos](#). This is quite lengthy, but he covers all the above points, plus how to edit the final image in Photoshop.