



How to photograph deep space objects by [Eddie Trimarch](#)

Photographing deep space objects satisfies my innate desire to see first-hand what is 'out there'. As an amateur astronomer, long-exposure photography is the only way to see and capture colour views of our dim and distant neighbourhood. The increasingly advanced processing options make every image of a familiar deep space object seem new and exciting.

Getting the gear

As an absolute minimum you need a digital single lens reflex (SLR) camera, a telephoto lens or telescope and an equatorial mount.

An astronomical charge coupled device (CCD) camera with regulated cooling reduces the noise caused by long exposures and filters that shut out all but a very narrow band of visible light help to tackle light pollution. Hydrogen alpha (H-alpha) filters transmit only the glow of distant HII nebula, while images captured through ionized sulphur (SII), ionized oxygen (OIII) and H-alpha filters can be combined to create colour views.



A mapped colour image, created by mapping SII filtered data to the colour red, H-alpha data to green and OIII data to blue

I use a cooled 6-inch primary mirror Newtonian telescope with a focal length of 900 mm, an SBIG 10-megapixel CCD camera and a robust, polar-aligned equatorial mount controlled from my PC.

Picking the place

Assuming you cannot get to the top of an extinct volcano surrounded by ocean, head for high ground as far as possible from major light sources and polluted air. The Moon can cause more light pollution problems than nearby cities, making the time around the new moon ideal for deep space observing and imaging.

My own observatory is sandwiched between two cities near sea level, meaning I cannot take true colour images or shoot near the horizon. I plan my targets in

advance and experiment with narrowband filter combinations and colour processing to get the best results.

Taking the shot

To manually set your focus, select a moderately bright star within your image frame and choose the shortest exposure which will show the star without saturation. Take some test shots, tweaking your focus by very small amounts while watching the image's histogram. You will be close to focus when the pixel value is at its highest.



Use an online exposure calculator, such as those provided by [Starizona](#) or [CCDWare](#), to identify the optimal minimum exposure time where the sky background overwhelms the inherent noise. This will ensure you have the best possible noise reduction options when you process the images later. If, like the Orion nebula, your subject ranges widely from very dim to very bright, take optimal exposures for the dim areas and shorter exposures for the brighter sections.

To record noise from the camera's electronics, take multiple 'dark frame' calibration images, using the same settings but with the shutter or lens covered. 'Flat field' images of evenly-illuminated flat light sources should also be captured, to identify non-uniformities in brightness across the pixels of your CCD chip.



Processing

Use [CCDStack](#) software to process your calibration shots and create master frames with which to remove equipment irregularities and noise from your raw images. Align the calibrated images within CCDStack or [PixInsight](#) and use normalization to equalize the range of brightness levels across all the shots. Then apply min/max clip or sigma rejection to get rid of any unwanted data. When I combine these stacked frames to create master images I usually create three combinations, using the sum, average and median tools. The sum version

The Trifid nebula taken with a remote telescope at a very dark site. The low light pollution levels made for relatively quick and easy colour processing

generally gives the greatest pixel values, providing the best canvas for applying sharpening algorithms; if you have not used a good noise rejection method, the average version is more appropriate.

If you have masters of filtered images, you can combine them into a colour image using your image-processing software's colour combination procedure. Then use the deconvolution function and wavelet processing to sharpen the image and reduce noise, before experimenting with the curves and levels functions to brighten the image. Be careful not to go too far: keep a watchful eye on the image and its histogram, and undo any process that decreases resolution, clips the data or increases noise.

My top tip: never throw an image away

Back in 2007 I was experimenting with a new moderately-priced lens in the Queensland wilderness, where I captured a four-part mosaic of the central Milky Way. Back home, I realized the images had terrible edge distortions. There was no way to align the stars at the edge of each shot, so I consigned the images to my file archive and gave up on the lens. About 18 months later, I came across the test images again while tidying up my hard drive. Over the intervening period I had discovered Adobe Photoshop®'s free transform/warp function. It turned out to be an excellent tool for matching the distortions in each shot. The beautiful end result became the July image for Astrovisuals' 2009 astronomy calendar.



An expanded skillset enabled me to breathe new life into this Milky Way mosaic 18 months after I had given up on the shots

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