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# Amateur Astronomy

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**Cover:** Drone's eye view of Barry Riu's Astro Complex



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# Creating a Custom Sky-Glow Flat

**Article by Michael Blaber**

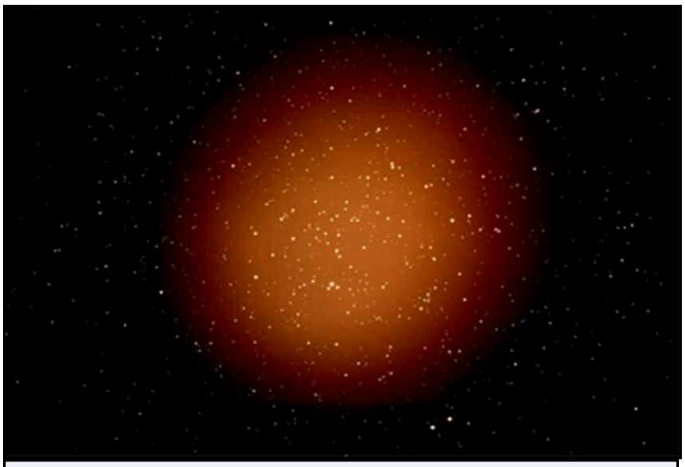

***Fig. 1***
*NGC752 imaged from downtown Tallahassee - the capital of Florida. The image suffers from vignette and pronounced sky-glow.*

***Fig. 2***
*The same image of NGC752 as in Fig. 1, but divided by a monochrome flat field to correct for vignette. A residual gradient of sky-glow, unique to the region of the sky being imaged, is apparent.*

It is not always easy or convenient to get to a dark sky site to do astrophotography, and light pollution, or sky-glow, can be a common companion. I live in downtown Tallahassee, the capital of Florida, with plenty of light pollution (including the football stadium of Florida State University) and images taken from my condominium typically look like that in Fig. 1. The bright imperfection is a combination of the vignette of the optical system and the particular attributes of the local light pollution (wavelength and gradient) in that part of the sky. Dividing by a monochrome flat field will address the vignette of the system, but will not address the light pollution. A flat-field corrected image is shown in Fig. 2

It would be great to have the ability to simultaneously correct for both vignette and light pollution; a custom

***Fig. 3***
*A stacked set of images, taken in the same sky location as Fig. 1, but with a small slew performed between each image. The stars on sequential images do not overlay; however, the sky-glow is consistent. Thus, a sigma clip will effectively eliminate all stars while retaining properties of the sky-glow (which also includes the characteristics of vignette for the optical system).*

***Fig. 4***
*The result of dividing the sky-glow flat from Fig. 3 into the original image of NGC752 in Fig. 1. If imaged with the same ISO and exposure, then the sky-glow flat is on the same absolute scale as the star image and the above image would also be produced by subtracting the sky-glow flat from the star image. The correction has accounted for the system vignette, as well as the unique sky-glow properties of the region of the sky being photographed.*

"sky-glow flat field" allows you to do this.

The basic procedure is to create a background image, capturing both the sky-glow property in the part of the sky you are imaging, as well as the vignette attribute of the optical system, but completely devoid of all stars. To create such an image, a series of pictures are taken using the same exposure and ISO setting as the star image. These pictures are taken in the vicinity of the object (star field) being imaged so as to reproduce the specific features of the sky-glow in that part of the sky. However, a small slew is introduced between each image, such that stars in the sequential images do not superimpose. When this set of images is stacked they are done so with no adjustment of alignment, and combined using a sigma clip. If 10 such images are taken, for example, at a specific position in the first image there might be a star; however, in all other images there will not be a star (and the pixels black) since the image was slewed between exposures. Thus, in a sigma clip the bright pixels at that location are a statistical outlier (90% of images are dark at that position) and will be rejected. However, the sky-glow properties will be essentially identical at each position in each image. Such a sigma clip produces the "sky-glow flat field" shown in Fig. 3. Usually 10 images stacked together are sufficient to eliminate all stars.

This "flat field" contains information about the sky-glow unique to that part of the sky (i.e., color and gradient), as well as the vignette properties of the optical system. If the images utilized in constructing this flat were collected using the same exposure time and ISO of the star image to be corrected, then the two images are on the same absolute intensity level - in which case, the flat can either be subtracted from the star image, or divided into it, and yield the same correction (Fig. 4). Images nicely corrected for both sky-glow and vignette can be obtained using this method - turning your downtown metropolitan location into a dark sky site! This procedure should also work for nebulae. In which case, imaging for the sky-glow flat field should probably be offset away from the nebula (or include a majority of images away from the nebula) - such that nebula intensity is statistically considered an outlier in the set of stacked images.