

## DSLR Star Spectra with a Star Analyser Objective Grating

Below are the steps to capturing the spectrum of a bright star with a Star Analyser grating mounted on your camera lens as an objective grating.

**Note:** Using a Star Analyser grating requires that you already be somewhat proficient at capturing images of stars. You need to be able to locate specific stars in the sky. And you will need to be able to capture images of them that are properly exposed, well-focused, and not smeared from their movement through the sky. We're happy to coach you on how to get started in astronomical imaging if you need to acquire these skills. It can be helpful to find a local astronomy club and seek out a mentor.

We encourage you to initially spend some time capturing visual images of some stars *without the Star Analyser*. This will familiarize you with the necessary imaging skills: finding targets, focusing, setting exposure levels for dim objects, etc.

If you have a tracking mount or can piggyback your DSLR on a tracking telescope, we encourage you to use them. Spectra captured without a tracking mount are called "drift spectra." Drift spectra can be considerably more difficult to capture than tracked spectra. But with some careful setup and technique, drift spectra can be captured. You may have to stack images in a third-party program.

A helpful video on DSLR spectroscopy can be found near the top of [www.rspectro.com/calculator](http://www.rspectro.com/calculator).

If you have any questions about the discussion below, please don't hesitate to contact us at [www.fieldtestedsystems.com/contact](http://www.fieldtestedsystems.com/contact).

You can use almost any DSLR for spectroscopy, including Canon, Nikon, etc.

- If your camera lens is 35 to ~100 mm, you should use a Star Analyser 200 grating ([link](#)).
- if your camera lens is 70 to 200 mm, you should use a Star Analyser 100 grating ([link](#)).

As shown below, you mount the grating on the camera's lens cap threads. You can use our AD-58 adapter (\$42, [link](#)). For non-Canon cameras, you may need an inexpensive thread adapter ring (\$13, [link](#)).



A Star Analyser mounted on a DSLR

It's *very important* to start with a bright Type A star like Vega that will have strong Hydrogen alpha absorption lines. The Appendix in the Star Analyser manual has a list of bright Type A stars: [link](#).

We also encourage you to download our *Getting Started* pdf from this [link](#).

Using remote control software for your camera makes imaging easier. You can use software provided by your camera manufacturer. Or, BackyardEOS ([link](#)) or BackyardNikon ([link](#)) are designed specifically for astronomical imaging and are more powerful and a bit easier to use.

## 1. Initial Setup

Mount your camera on a tracking mount or tripod. (See the appendix for additional notes on tripods.) Screw the AD-58 adapter snugly into the lens cap/filter threads of your DSLR. Although you can also use a fixed lens, a variable zoom will give you much more flexibility.

## 2. Mounting the Star Analyser Diffraction Grating

Screw the Star Analyser grating into the AD-58 adapter so that the marker line is at about 9 o'clock on the clock dial, as shown below.



Grating with alignment mark properly positioned

## 3. Getting Ready to Capture Spectra

It's not critical, but we recommend you fine-tune your 9 o'clock *grating rotation*. Although you can use our RSpec spectrum processing software to rotate your image later, having your initial spectrum oriented horizontally can make it easier when you're capturing and processing.

It's easiest to do fine-tuning using on a bright terrestrial target. You can do this in a darkened room with a white LED, or viewing an incandescent lamp or ambient light glimpsed through an almost-closed door, or even an outside street lamp at night, as shown in the example below.

Fine-tune the 9 o'clock orientation of the marker line that you set in Step 2 by rotating the Star Analyser grating until the rainbow spectrum is approximately horizontal on your camera's view finder.

Adjust your zoom so that the brighter spectra is about 250 to 400 pixels long.

Initially adjust your focus so that the lamp is sharp. Then make minor adjustment to your focus to sharpen the spectrum. You can repeat this step once you're capturing star spectra by viewing the spectrum graph in RSpec.



Above: Street light with grating properly rotated and good zoom

#### 4. Finding your Type A Star

Point your camera at a bright Type A star. To make the stars brighter and easier to see, you may want to remove the grating while you're finding your target.

If you're using a standalone mount without "GoTo" capability, you'll need to learn how to find specific stars in the sky. To help aiming your camera, you may want to add a laser pointer to using a *hot shoe* mount and ball joint. Below is a homemade laser pointer mount. **Be mindful of any local laws about laser pointers.** If you've never used a heads-up or finder scope, you can discuss the procedure with amateur astronomers online.



A homemade mounting for a laser pointer

Since a grating spreads out a star's photons across hundreds of pixels, you'll need longer exposures than required for imaging stars without a grating. With the grating in place, take a 15-second exposure of your target star at a high ISO.

If you can't see your target star in the resulting image, you may need to increase your exposure time.

## 5. Capture your Spectrum

If you removed the Star Analyser in the preceding step, remount it in the same orientation and lock it in place. Set your zoom to the level you noted in step 3.

If you are unable to get the spectrum bright enough by increasing your exposure time, you can increase the brightness by reducing the zoom level that so the spectrum is more compact on the sensor. But it shouldn't be shorter than 200 pixels or the resolution will be too low.

An ideal way to capture spectra is to connect the camera to a laptop in the field. As you take each image, download it to the laptop. You can then confirm that the spectrum is vertical, the star horizontal, and that the focus is sharp.

If you install the RSpec software on your laptop, you can actually determine the quality of the spectrum as you capture images by examining the profile graph for the deepest absorption lines. (Configure the RSpec "Image"-tab to automatically load images as they appear in a specific folder.)

## 7. Processing your Data

Use the Rotate command in the RSpec software to orient the spectrum so that it is horizontal, with the star on the left. If you didn't use tracking, or your tracking wasn't good, you may be able to improve the spectrum with the Slant feature on the RSpec Rotate screen.

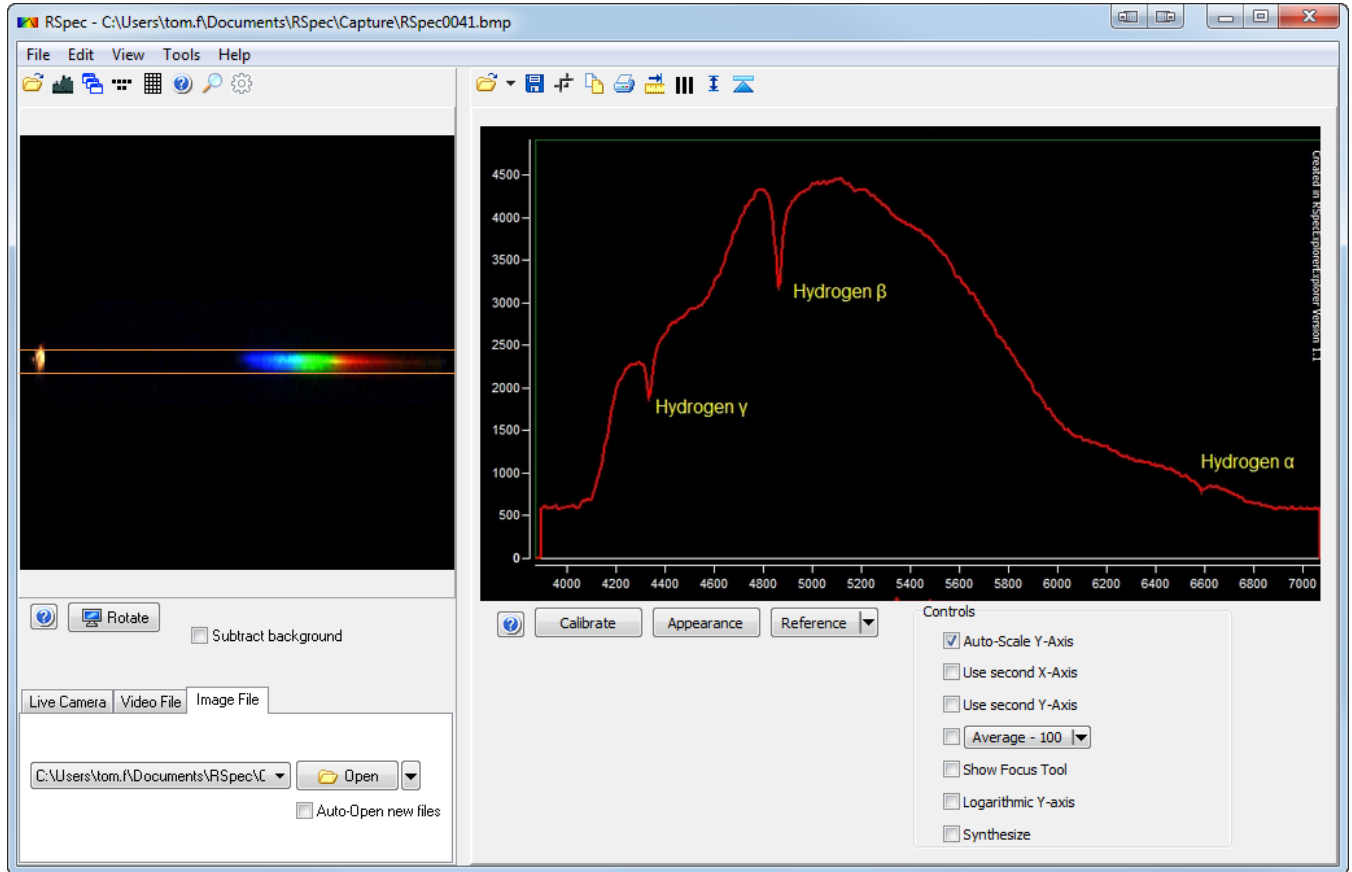
Use RSpec to calibrate the image in Angstroms or nanometers. As mentioned previously, start with a Type A star because these stars have very clear Hydrogen Balmer lines, making their spectra easy to calibrate. (After calibrating on a Type A star, as long as you don't change your lens' focal ratio (zoom), you can calibrate any star using RSpec's One Point Calibration method described in video #24 at [link](#).)

See the software tutorials in the Video Library at our astronomy site: [www.rspect-astro.com](http://www.rspect-astro.com).

If you have our classroom, gas tube spectrometer, you can enable the astronomy features its RSpec Explorer software on the Advanced tab of the Tools, Options screen.

## 8. Results

Below is a high-quality spectrum captured with a DSLR and a tracking mount. Multiple images were combined (stacked) to produce this.



Your initial images will probably be noisier than this. But you should be able to see absorption features and identify the Hydrogen Balmer lines even if they're not as sharp and deep as in this sample image.

Patience and experience (and perhaps a third-party stacking program) can yield results like these.

## Appendix

If you're using a non-astronomical tripod, a ball head adapter can make camera pointing much easier. To see how a ball head adapter works, watch the first minute of this YouTube video: [link](#). Here are some examples of adapters on Amazon: [link](#), [link](#), and [link](#). Here's an example of an inexpensive tripod with a ball head: [link](#).

Using an astronomical tracking mount makes capturing spectra with a DSLR much easier. You can add one like the SkyTracker to your current tripod: [link](#). We suggest you confer with a telescope store (online or local) for help selecting astronomical accessories like this.