Step by Step instructions for drift spectroscopy

Below are the steps to capturing a drift spectrum of a bright star with your DSLR and the Star Analyser grating. It can be difficult to capture spectra without a tracking mount. But with some careful setup, it's possible. You may have to stack images in a third-party program.

You can use almost any DSLR, including Canon, Nikon, etc. For best results use a Star Analyser 100 grating (link) if your camera lens is 35 – 100mm) or 200 grating (link) if your lens is 70 – 200 mm). But either grating should give you good results. To mount the grating on your camera lens, you can use an AD-58 adapter ($38, link) and a thread adapter ring if necessary ($5, link).

If you have any questions about the instructions below, please don't hesitate to contact us at www.rspec-astro.com/contact.

It's important to start with a bright Type A star like Vega that will have strong Hydrogen alpha absorption lines. The Appendix to the Star Analyser manual Appendix I has a list of bright Type A stars: link.

To get started, we suggest you practice capturing the image of stars without a grating using the steps below. That will teach you how to point and use your camera on astronomical objects

We also encourage you to use remote control software for your camera: either use software from your camera manufacturer, or preferably BackyardEOS (link) or BackyardNikon (link).

1. Initial Setup

Mount your camera on a tripod. (See the appendix for an additional note 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) gives 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 the top.

Figure 1. The Star Analyser grating is mounted on a DSLR lens using the AD-55 adapter.

Locking the grating from rotating

Use a piece of blue painting tape to lock your grating in place. Or, your Star Analyser grating came with an optional small lock ring which can be helpful in securing the grating in the proper 12 o'clock orientation. Some users

find it easier to use a small dab of silicon chalking, or a piece of plumbers (Teflon PTFE) tape on the threads. You can even just use a piece of blue painters tape.

3. Orienting the Star Analyser Grating

If you're using a good tracking mount (perhaps piggy-backed on a tracking telescope, simply orient the camera and grating so that the spectrum is horizontal with the star to the left in the viewfinder

If you're doing a drift spectra, point your camera at a terrestrial light source that is a point, like a small LED reading light across the room or a distant street light. Depending on your zoom setting, there will be two or more spectra visible in the viewfinder, on both sides of the light source. *Use the brightest of the two spectra that appear closest to the light source*.

Fine-tune the 12 o'clock orientation of the marker line that you set in Step 2 by rotating the Star Analyser grating until the rainbow spectrum is exactly vertical. (Fig. 2)

Adjust your zoom so that the length of the colorful spectrum is between about 250 and 400 pixels long on the sensor

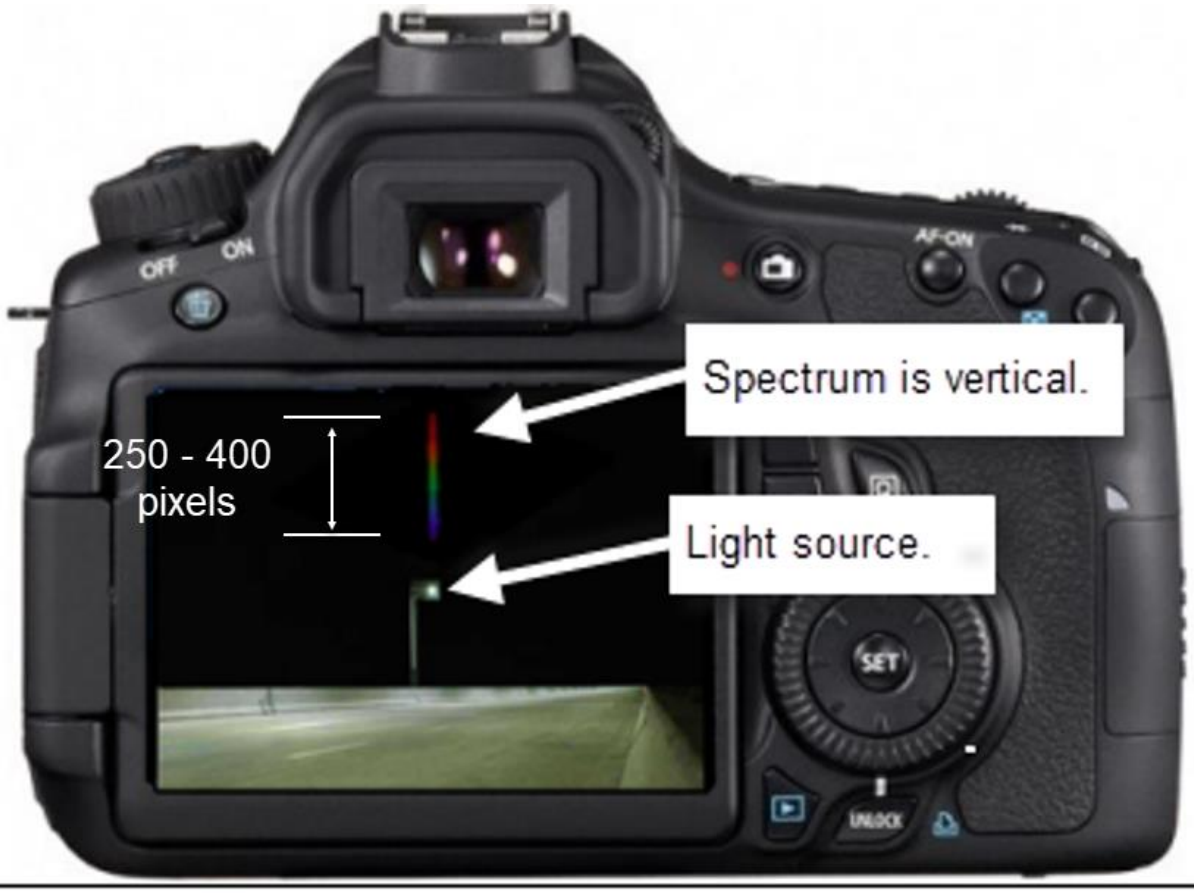


Figure 2. When the grating is mounted in the proper rotation, a spectrum appears vertically above a compact light source.

4. Orienting the Camera

Take a 15-second exposure of your target star. If you can't see your target star in the resulting image, you may need to increase your exposure time. (To make the star brighter, you may wish to remove the Star Analyser to first find the star.)

Using a series of trial-and-error images, lean your camera to the left or right (rotate counter-clockwise or clockwise) until when you capture an image, *the star image is spread horizontally across the image* as shown below:

Figure 3: When the camera is properly flipped, the star image will smear horizontally across the image in long duration exposures.

If you're a teacher, this step is a good way for your students to get some hands-on familiarity with the motion of the stars in the sky. At the meridian,

the camera will be oriented as shown in Fig. 2. Targets that are East of the meridian are still “rising” and will require the camera to be rotated counter-clockwise for the star motion to be horizontal in the viewfinder as shown in Fig 3.

Want to skip all the tracking hassle? Use a SkyTracker or similar tracking mount: link.

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 level to the level you noted in Step 3.

Take a series of trial-and-error time exposures of your target star using different durations until you get an image (Fig. 3) in which the spectrum is smeared across five, ten, or more pixels.

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 clear absorption lines. (Configure the RSpec "Image"-tab to automatically load images as they appear in a specific folder.)

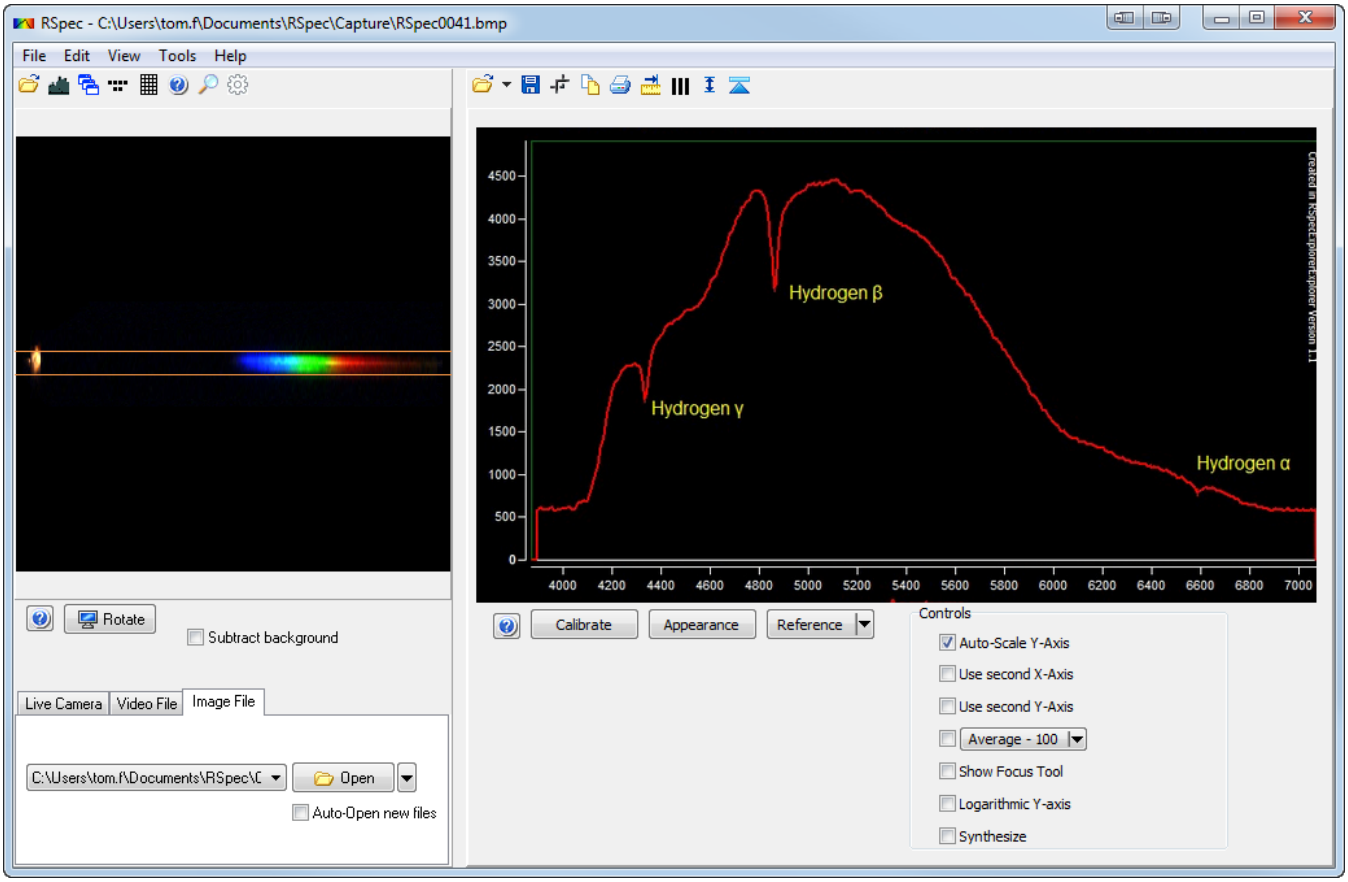
7. Processing your data

Use the Rotate command in the RSpec software to orient the spectrum so that it is horizontal, with the star on the left. If your camera and grating rotation weren't exact, you may be able to improve the spectrum with the Slant command on the RSpec Rotate screen.

Calibrate the image in Angstroms or nanometers. We strongly suggest you 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, 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.rspec-astro.com/more-videos/.

If you're running our RSpec-Explorer classroom version of our software, you can enable the astronomy features and switch to Angstroms on the Advanced tab of the Tools, Option screen.



If your spectra are too noisey, you might want to stack individual images with programs like Registax or Siril, both of which are free

Appendix

We suggest you begin by imaging stars *close to overhead (the meridian)* so you avoid the unwieldy need to steeply lean the camera way to the side. If you image stars close to the horizon, the camera needs to be leaned a large amount, as shown below:

For stars far off the meridian, the camera needs to be rotated quite a bit to the left or right off of the normal orientation.

If your tripod has difficulty flipping your camera to the side, you can add a ball head adapter. To see how a ball head adapter works, see 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 a tripod with a ball head: link.