

# Stellar Spectroscopy Using a Digital Camera

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## Introduction

The goal of this project is to develop an attachment for cameras and telescopes which can easily and effectively produce spectral data from images.

Most spectrometers use a fiber optic cable, which captures light, but fails to produce full images. Our design can acquire high resolution images along with the image's spectrum in the same frame as the desired astronomical object.

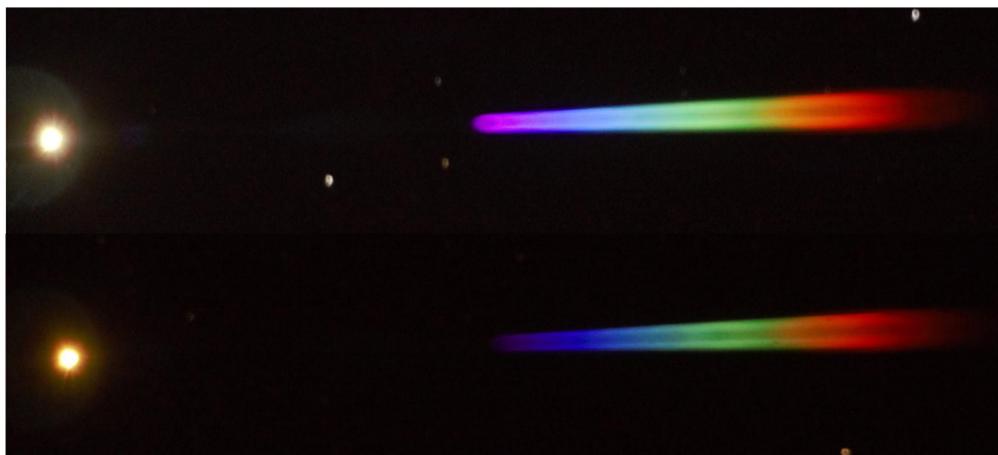
Once the image's spectrum is produced, it can be used in a variety of ways such as studying blackbody temperatures, determining stellar composition, searching for exo-planets, and studying redshift of astronomical objects.

## Design

- Sony A7 camera
- Celestron 14" Telescope
- 50X50 mm transmission grating with 1200 lines/mm
- 3D printed grating housing and telescope adapter
- Python Script

## Methods: Astronomy

The light from the image will pass through the transmission grating and break apart into its spectrum, as seen below. The camera's CCD will collect the intensity of the light and save the data as a RAW image. The image is then passed through the python script.

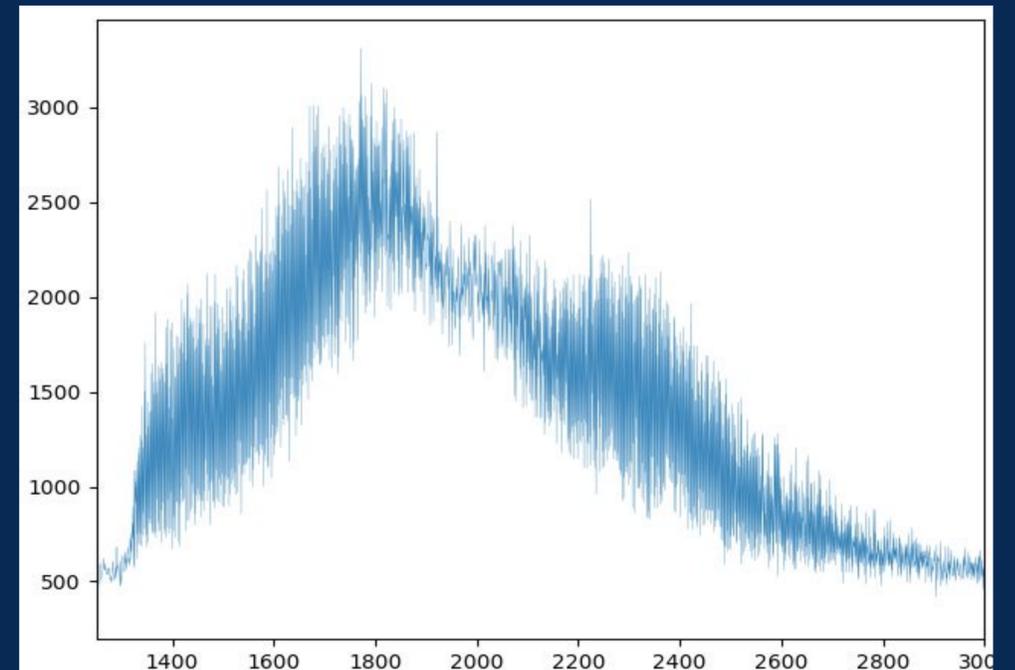


Top: Capella and its spectrum. Bottom: Betelgeuse and its spectrum.

## Methods: Python Script

The script will parse out the RAW data produced by the camera and extract the spectral data. To do this, it will hold a value on the y-axis fixed and will plot the intensity of the x-axis as seen on the right.

## Capella: Intensity vs. CCD Position



## Results

As seen above, Capella's spectrum is displayed as an intensity vs position graph, where the position corresponds to the wavelength.

As we see in the pictures on the left, Capella has very intense light between violet and green-yellow light, wavelengths of about 400 to 550 nm. This is reflected in the data above.

High intensities in these ranges are indicative of the presence of Oxygen and Carbon.

## The Next Step

As my project proceeds, my next goal is to refine the data collection process. Moving the grating farther from the CCD will allow us to achieve a higher resolution spectrum.

I'm also plan to automate the python script. Currently,, I can only analyze one spectrum at a time by hand.

In the future I would like to a more detailed program which can automatically generate the spectrum of an image.