CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

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Project Number

38569

Project Title

Building a Bench-Mounted Fiber Spectrograph

Abstract

Objectives/Goals

A spectrograph separates light into its component wavelengths in order to measure the relative intensity of each color. Spectroscopy can be used in astronomy to identify the chemical composition, movement, temperature, and magnetic fields of objects in space. When light encounters certain elements in its path, some of the photons are absorbed at certain wavelengths, resulting in dark lines in the spectrum. The goal of this project was to build a spectrograph optimized to see the Fraunhofer absorption lines in a solar spectrum.

Methods/Materials

I designed and built a spectrograph and connected it to my telescope that I built a few years ago. This design consists of a narrow entrance slit, a collimating lens, a diffraction grating, which disperses the light into its component colors, and a camera. Spectrographs are optimized for a balance between spectral resolution (the ability of the system to resolve spectral lines) and throughput (the amount of light that is imaged on the detector). This system was designed for high resolution in order to produce a Fraunhofer spectrum. The large instrument is connected to the telescope using an optical fiber in a "bench-mounted" configuration. I wrote a code in Python to analyze the spectra and produce a plot of wavelength versus intensity.

Results

The bench-mounted fiber spectrograph successfully images Fraunhofer lines in daylight, sunlight, and lunar spectra. The system also produces absorption and emission spectra of household light sources. All of the spectra are successfully plotted by the Python code.

Conclusions/Discussion

Optimizations to the system, particularly concerning the entrance slit, improve the Fraunhofer spectra beyond the design quality. The ability to obtain a lunar spectrum also demonstrates the capabilities of the spectrograph, which is optimized for a solar spectrum.

Summary Statement

I designed and built a spectrograph, connected it to a telescope I built a few years ago, and wrote a code in Python to analyze the data in order to ultimately see the Fraunhofer absorption lines in a solar spectrum.

Help Received