

Abstract

A spectrometer is a device used to measure the wavelength of light across the electromagnetic spectrum. There are various types of spectrometers, including mass spectrometers, optical spectrometers, and NMR spectrometers. Spectrometers have numerous applications, such as analyzing absorption and emission spectra, detecting the concentration of substances, and identifying impurities.

In this experiment, a simple spectrometer was constructed using cardboard, a CD, and two blades. Once assembled, the spectrometer allowed for the capture of spectra from various light sources using a mobile phone camera. Calibration of the spectrometer was achieved using appropriate computer code, such as Python. After calibration, the spectrometer was utilized to analyze spectra within the visible range.

Three light sources were examined: sunlight, blue LED light, and yellow CFL light. Sunlight emits a spectrum containing all wavelengths due to its blackbody radiation nature. In contrast, the spectra of the other two light sources do not encompass all wavelengths.

Methodology

Apparatus and accessories

- ❖ Cardboard
- ❖ Black tape
- ❖ Two blades
- ❖ A CD
- ❖ Paper cutter

Making spectrometer

1. Cut four cardboard strips, each approximately 30cm in length and 4cm in width.
2. Use the cardboard strips to form a cuboid shape, ensuring that all edges are covered with masking tape to prevent light from passing through.
3. Create a small square-shaped hole in the center of a cardboard square, with one side matching the width of the cuboid (4cm) and the length approximately 2cm to 3cm.
4. Affix two blades onto the cardboard square to form a slit using masking tape (refer to Figure 3).
5. Position the cardboard square with the slit onto the cuboid, ensuring that light can only enter through the slit while leaving the opposite side open.
6. Apply masking tape onto the readable side of the CD, then remove it to achieve a clear surface (refer to Figure 1).
7. Cut a piece of the cleared CD large enough to cover the open side of the cuboid.
8. Attach the CD onto the open side of the cuboid, ensuring that the grating lines of the CD align with the slit.
9. Cover the edges of the CD and the surrounding area with masking tape, leaving an aperture for the camera to capture images.

Capturing spectrums

1. Hold the mobile phone camera in front of the aperture and capture the sunlight (known source) by aligning it with the slit. Ensure that two spectrums are visible to the left and right of the captured image (refer to Figure 5).
2. Capture the spectrums of another light source with unknown wavelengths using the same procedure.
3. Calibrate and analyze the spectrometer using appropriate computer program code.

Figure Panel

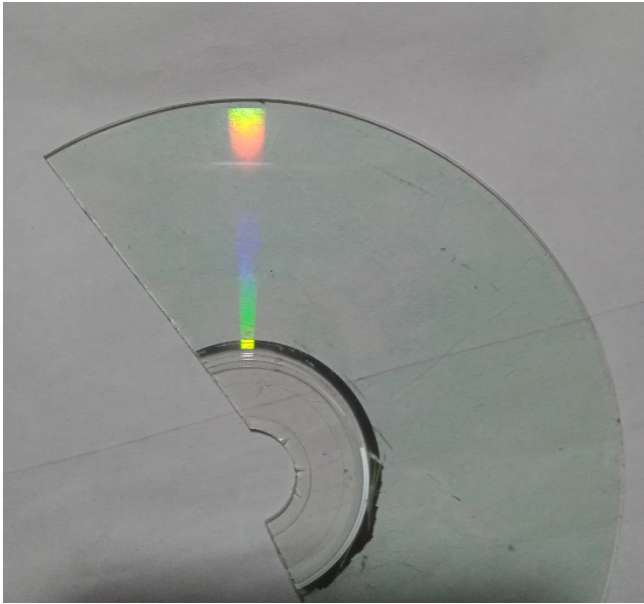


Figure 1 - The CD after removing the cover



Figure 2: Side view of the spectrometer covered by the piece of cleared CD.



Figure 3: This side contains the slit made with two blades. The light entering the spectrometer only passes through the slit.



Figure 4: This is the complete spectrometer.

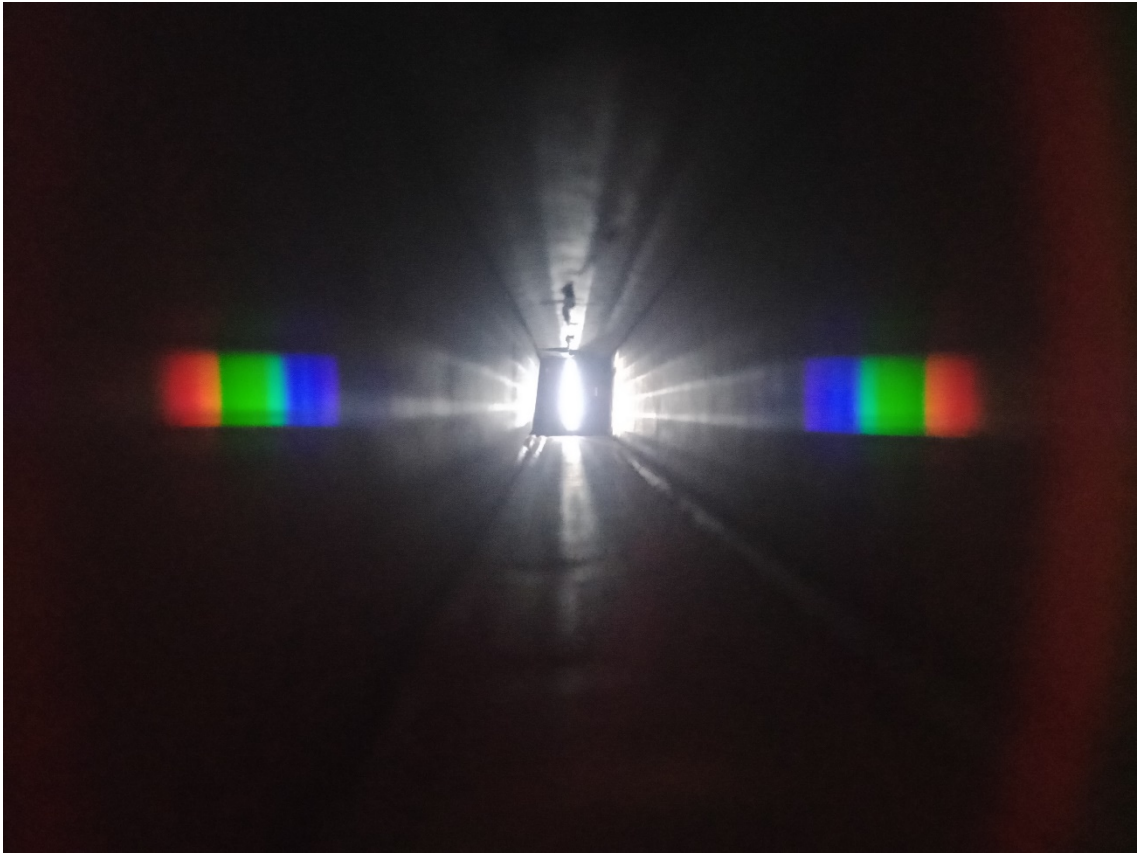


Figure 5: This is the visible spectrum of sunlight. The spectrometer can be calibrated using this spectrum.



Figure 6: This is the spectrum of a blue LED bulb.



Figure 7: This is the spectrum of a yellow CFL bulb.

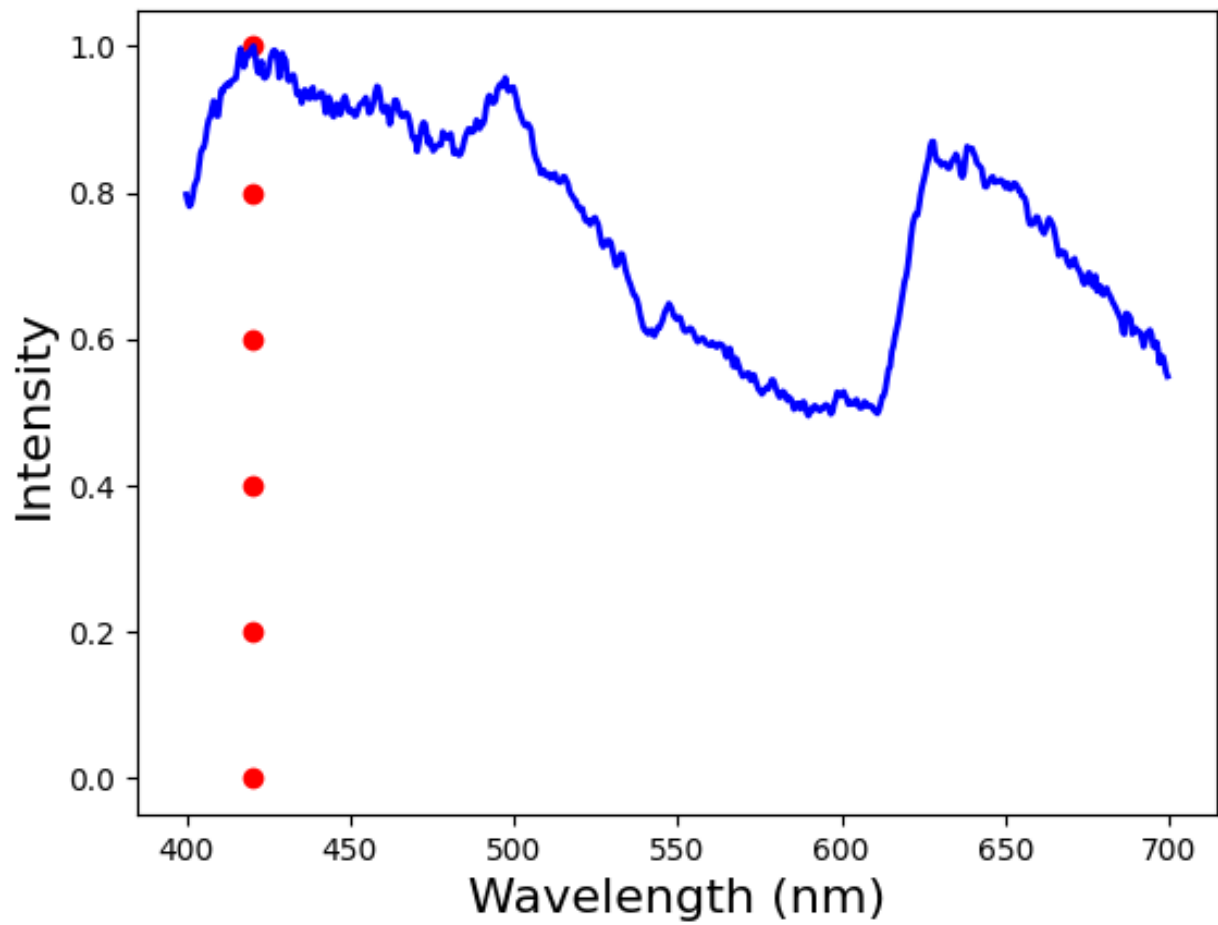


Figure 8: This graph represents the spectrum of sunlight obtained using Python.