PHYS 130 - Section EF22

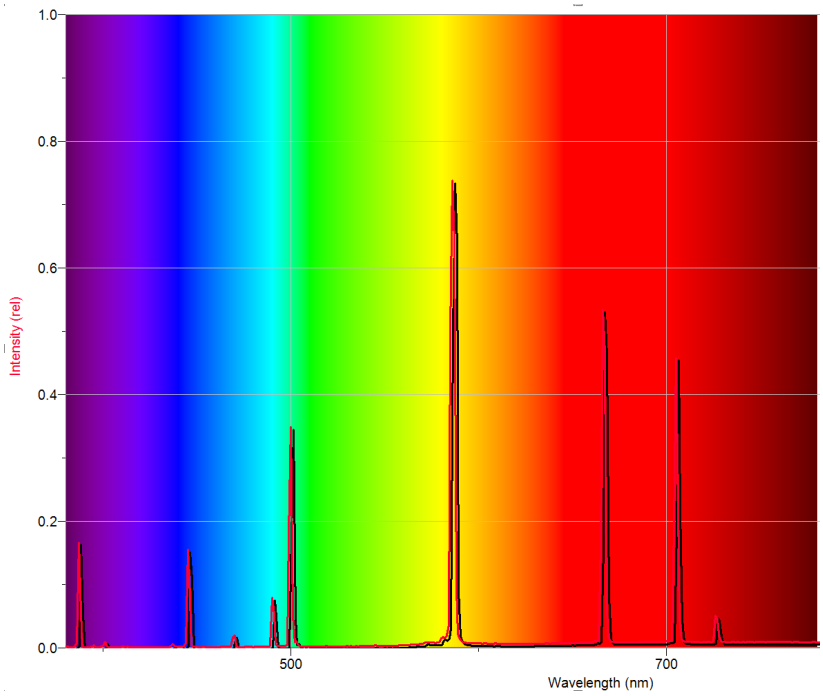
Lab 5: Diffraction Grating

Ben Fisher

November 25, 2022

Q1 - Helium Spectrum

Graph 1.1: Emission spectrum of a helium lamp comparing relative intensity of different wavelengths.



Q2 - Helium Image

Figure 1.1: Image of the inside of a 3d printed spectrometer observing a helium lamp

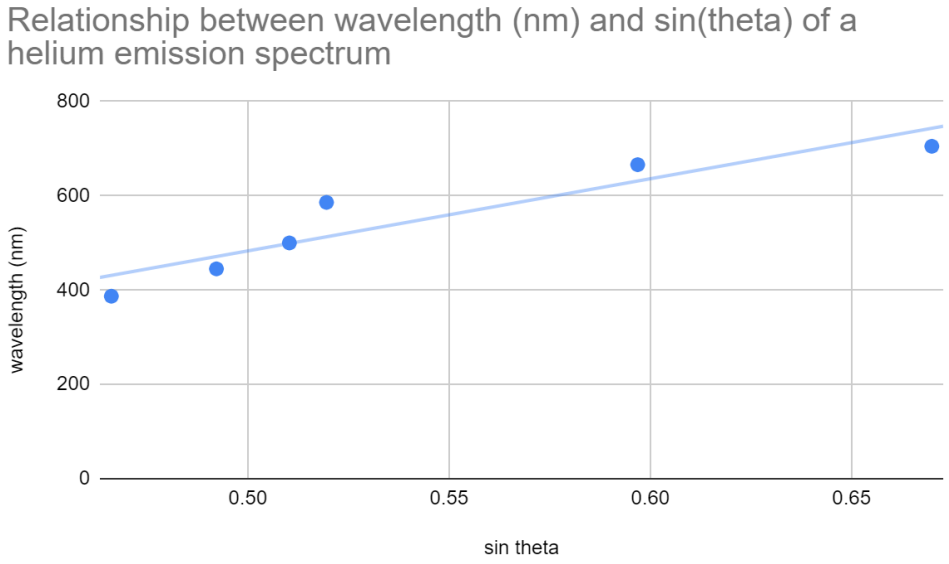
Q3 - Data Table

Table 1.1: Compilation of different wavelength spectral lines, their pixel distances and the related real distance as well as the angle in radians of each spectral line. Note: The slit height was 4.0cm/231px and the length of the tube was measured to be 26.0 cm

wavelength (nm)	spectral line pixel distance (px)	spectral line real distance (cm)	angle of spectral lines (radians)	sin theta
387	791	13.7	0.485	0.466
445	849	14.7	0.515	0.492
500	891	15.4	0.536	0.510
586	913	15.8	0.546	0.520
666	1117	19.34	0.640	0.597
705	1355	23.46	0.734	0.670

Q4 - Linearized Graph

Graph 1.2: Linearized relationship between the wavelength (nm) and the sin(angle) of spectral lines. Note that the linear relationship is $\lambda = d\sin(\theta)$ where d is the lines/mm of the diffraction grating. The slope was calculated to be 1530 ± 302 lines/mm through LINEST

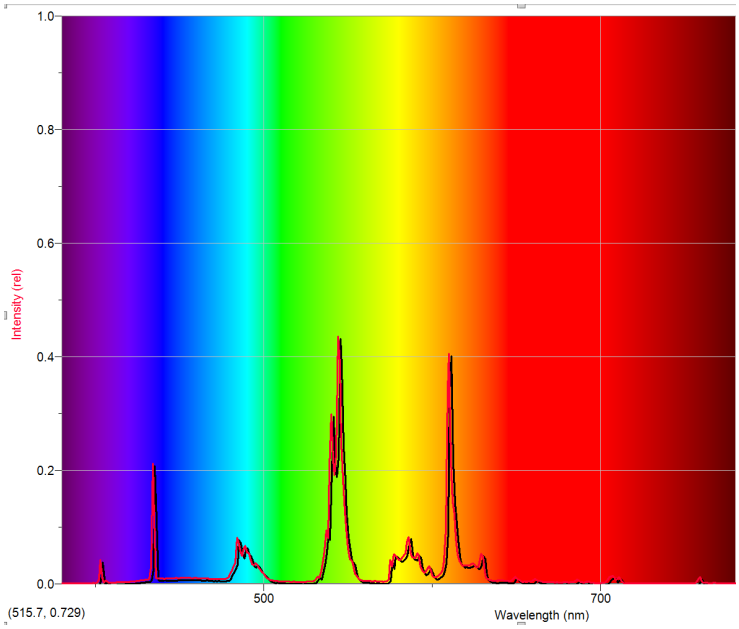


Q5 - Comparison of d

The experimental value of d was calculated using LINEST to be 1530 ± 302 lines/mm which in comparison to the manufacturer value of 1000 lines/mm is within 2 error intervals. As such, the experimental result is in moderate agreement with the original value.

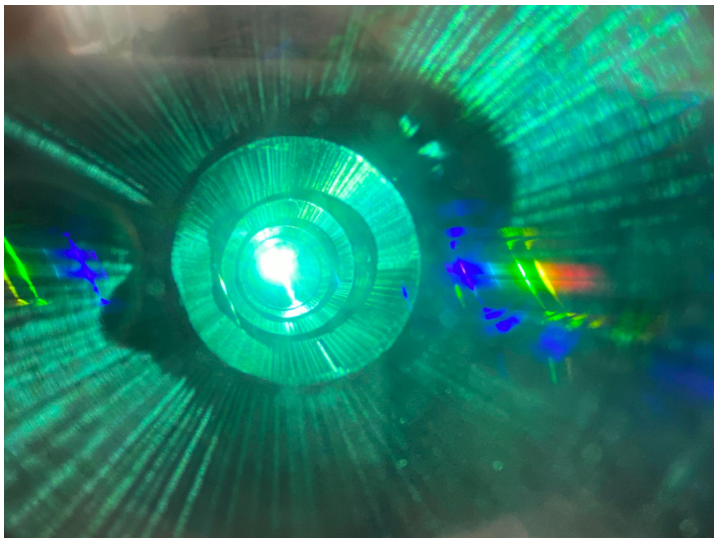
Q6 - Chosen Spectrum

Graph 1.3: The emission spectrum of the room lights in the lab comparing relative intensity to wavelength.



Q7 - Chosen Image

Figure 1.2: Image taken of the inside of the 3d printed spectrometer observing the emission spectrum of hydrogen.



Q8 - Discussion of Chosen Light Source

For both the room lights and hydrogen there appears to be blue, green and red wavelengths present in the spectrum. Furthermore, due to the discrete peaks and spectral lines present in both figures it is safe to assume that the sources have discrete spectrums. One difference is that it appears that the room lights have relatively wide spectral lines for the colour green and narrow lines for red/blue while hydrogen seems to have narrow lines for all colours, though it is difficult to tell the exact width in Figure 1.2. Thus it is safe to assume that the light being emitted from both sources is rather discrete and only certain wavelengths are being emitted rather than a continuous spectrum of light.

Q9 - Discussion of Colour

The most prominent colours emitted from the computer screen were red, green and blue, parallelling a computer's typical RGB nature. One important takeaway from this nature is that green is used over yellow for computer monitors, suggesting that humans have an easier time distinguishing green than they do yellow. Furthermore, it also demonstrates how one only needs a couple of different wavelengths to be able to produce a wide swath of colours through changing their relative intensity.

References and Acknowledgements

This lab report referenced the following for all equations used in this report:
Isaac, et al. 2022. Lab Manual PHYS 130. Edmonton: University of Alberta, Department of Physics.

This report acknowledges that the data used in this report was gathered with the assistance of fellow lab partner Bhuvish. This report also acknowledges TA Rishap Lamichhane for providing assistance in both providing and using the 3d printed spectrometers.