ASTRONOMICAL SPECTROSCOPY

Erika Ordonez, Angel Hernandez, Lauren Flores

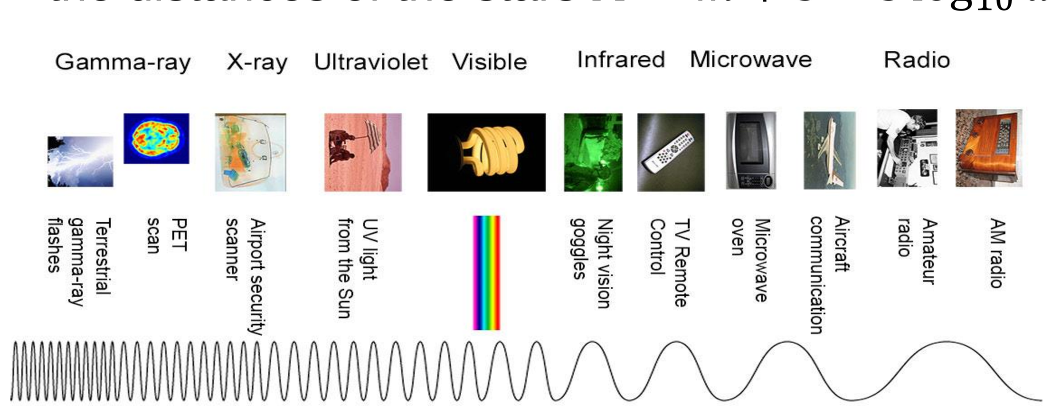
Thomas Edison High School

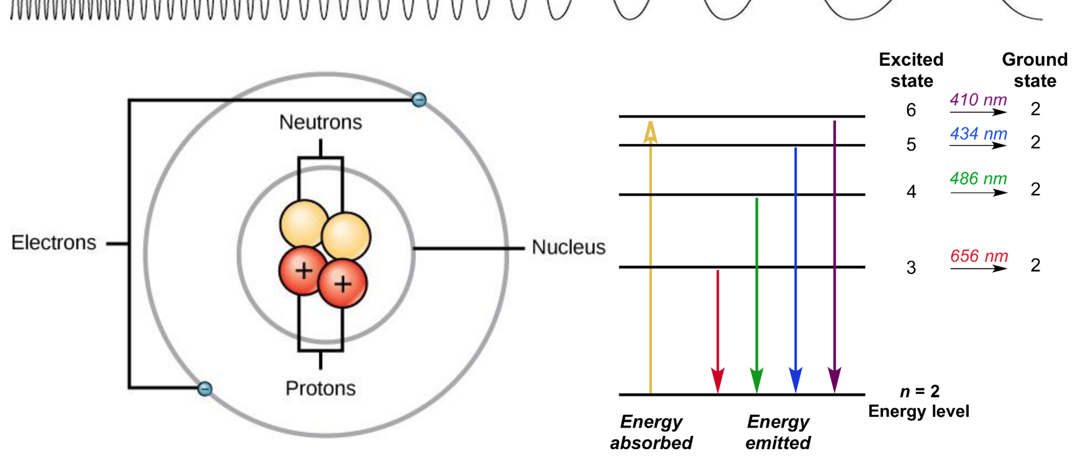
Abstract

In this project we investigated spectroscopy and its application to astronomy. We learned about the different analysis techniques and its relationship to light, matter, lab spectrum, stellar composition and its spectral type and temperatures. We took data from several discharge tubes to identify the unknown gases. In addition, we collected data using the virtual telescope, VIREO, to calculate distance to the stars. Finally, we were able to verify Hubble's law and estimated the age of the universe within an error of 2%.

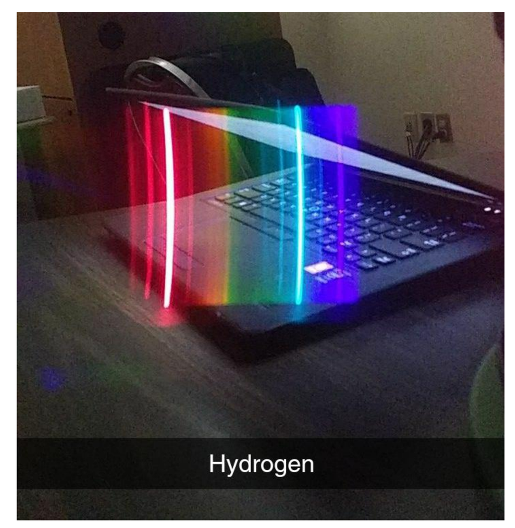
Background

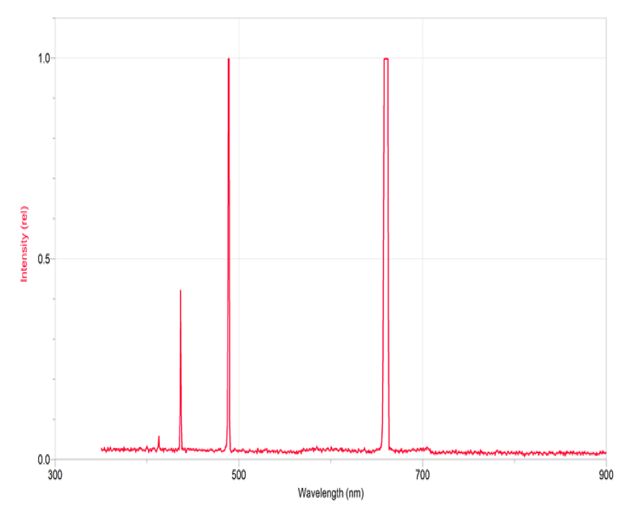
- Spectroscopy is a branch of science that studies interaction of light and matter. There's three different types of spectrums Continuous, Absorption and Emission
- We used Planck's equation, $E = \frac{hc}{\lambda}$ to calculate the energy required by an electron to transition from one energy level to another
- Hubble's law, $v = H_0 d$ is a relationship between how fast a galaxy is moving as a function of distance. We used the Hubble's constant (H_0) to estimate the age of the universe
- Annie Jump Cannon classified stars based on their temperature. The hottest star was labeled as O and the coolest star was labeled as M
- We used Wein's law to calculate the temperature of a star $\lambda_{peak} = \frac{0.0029}{T}$
- We used the magnitude relationship to estimate the distances of the stars $M = m + 5 - 5\log_{10} d$

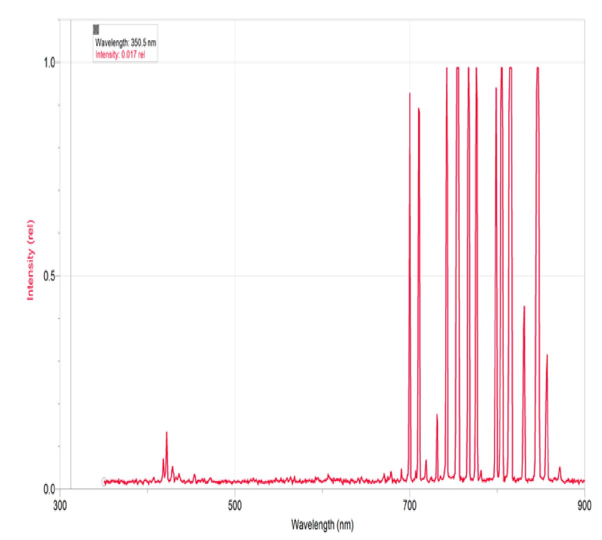




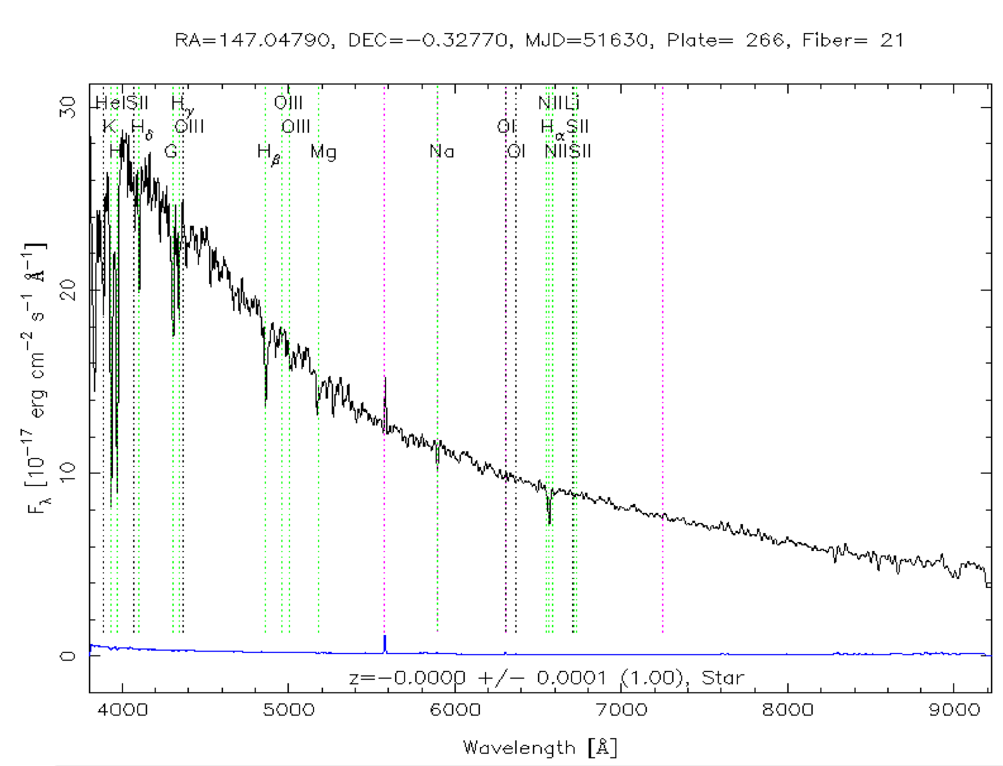
Results and Conclusion



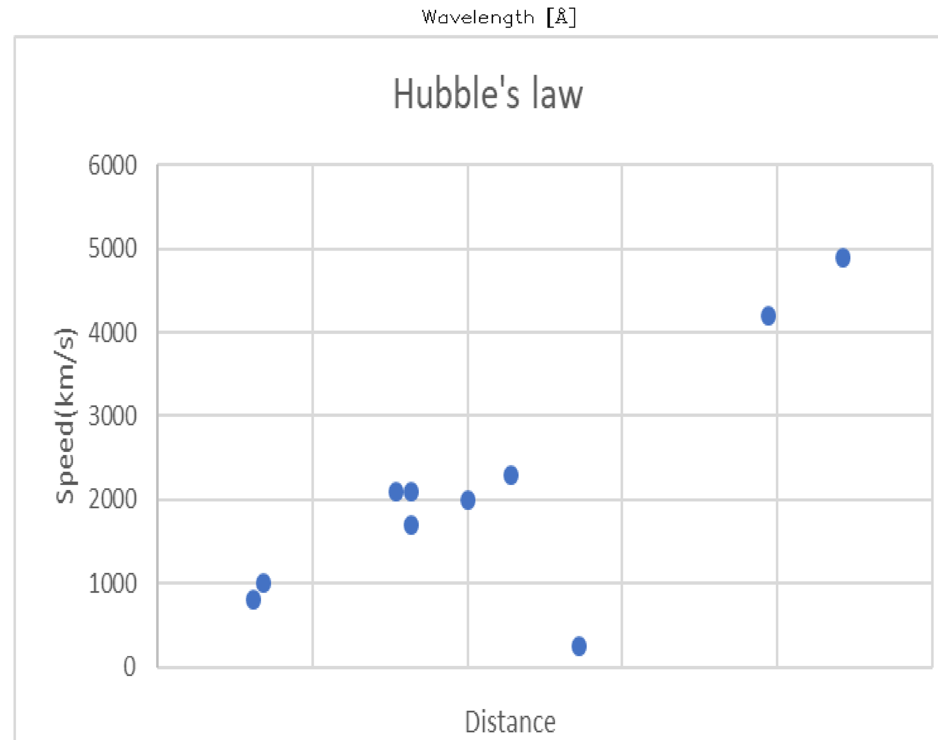




Here we have two examples of the lab spectrums we did as part of our investigation into spectroscopy. What is seen here is the emission spectrums of two different gases that have been excited by an electrical charge in a glass tube. Each gas has its own unique emission spectrum. The graph show the same spectrum but in analysis mode. the peaks on the graph represent the emission lines.

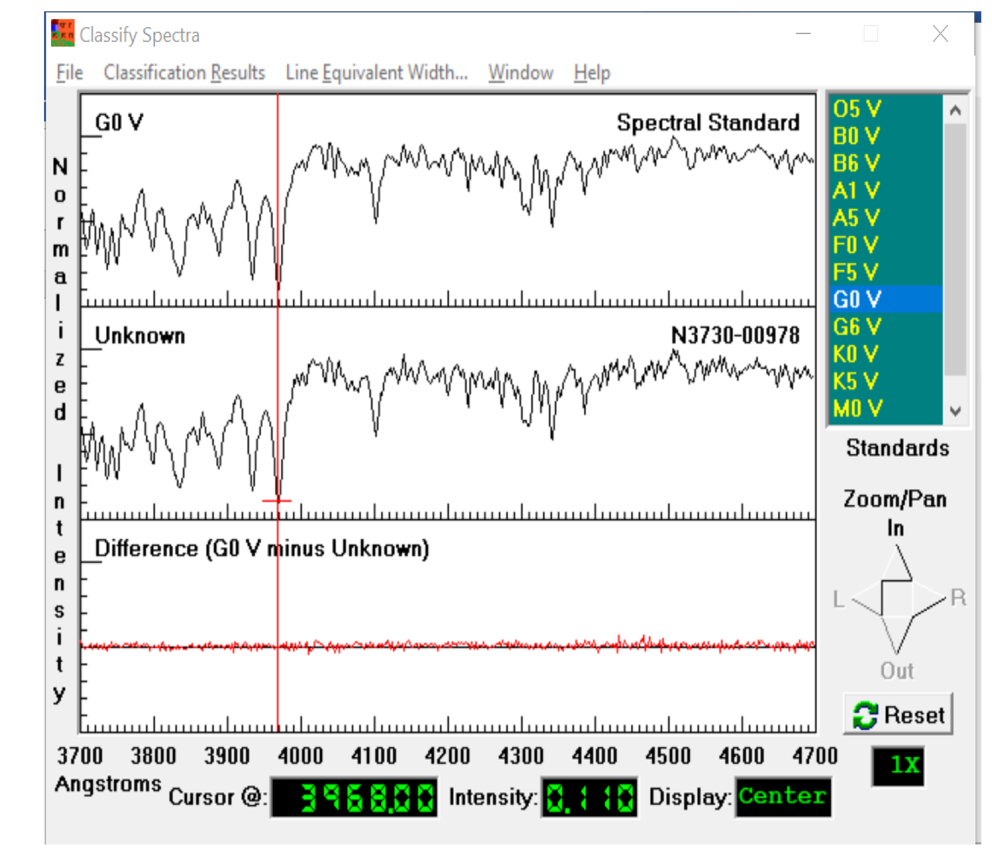


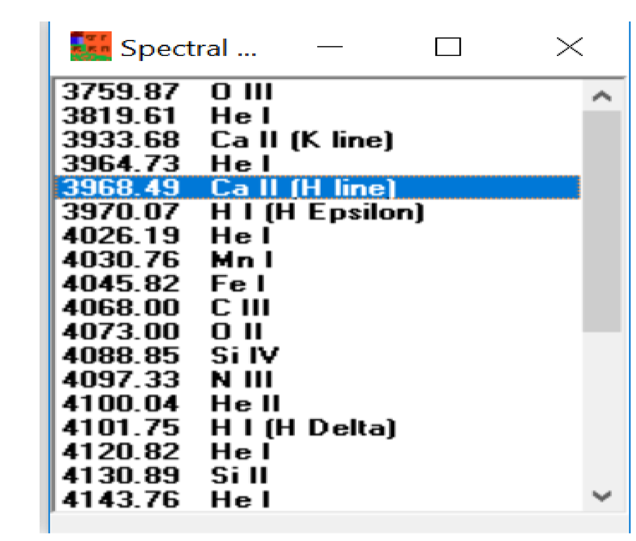
The figure to the left represents absorption spectrum for a specific star. The peak wavelength was used to calculate the temperature. The peak wave length indicates the maximum emission which determines the color. Using Wein's law, $\lambda_{peak} = \frac{0.00029}{T}$, we calculated the temperature of the star which is $7{,}225\ K$. With the temperature we can determine that this is an F type star.



This figure to the left is data collected from different galaxies, using the spectrum red shift of these galaxies, their velocities were calculated and the Hubble's law was recreated. The Hubble's constant was also calculated which was used to estimate the age of the universe to 13.6 billion years, this age was within an error of 1.45%.

Results and Conclusion





Using VIREO software, an unknown star was classified as G0 V star with strong Ca (K) emission line

References and Guide

- VIREO, CLEA software
- SDSS Spectral Line
- Vernier spectrometer

Acknowledgements