1. **Introduction**

Light we receive from stars tells us a great deal about their nature. By analyzing stellar spectra, astronomers can determine a wide variety of stellar characteristics such as chemical composition, radial velocity, and surface temperature. Because of how much information we can extract from them, a great deal of work has gone into studying, analyzing, and classifying stellar spectra. One method of organizing stellar spectra is the use of spectral types, groups of spectra with similar characteristics. These classes are further divided into spectral types.

It turns out that there is a direct relationship between the shape of a star’s spectrum and its surface temperature. (Because of this, temperature and spectral type are equivalent representations of the x-axis on Hertzsprung-Russell diagrams.) This is because the overall shape of a star’s spectrum is defined by the Planck function:

where intensity in irradiance per meter per steradian is calculated given lambda (wavelength) in meters and temperature in Kelvins, and Planck’s constant , Boltzmann’s constant , and the speed of light are given below:

This function, however, is only an approximation of real stellar spectra. Stars are not perfect blackbodies. Light leaving the star shows absorption lines from stellar atmosphere and elemental composition.

In the first part of this lab, we [*give a brief description of what you did in part one.*] In the second part, we [*give a brief description of part two: what you did and how you did it*].

1. **Methodology**

In the first part of the lab, we plotted blackbody curves for a theoretical M0 star, the Sun, and an A0 star, of temperatures [*report temperatures used*]. To create this plot, we [*describe process of creating the plot (without going into Matlab details); give equations if used*]. The three curves are shown in Figure 1. We then compared a B0 star’s real spectrum to a theoretical spectrum based on Planck’s law, shown in Figure 2.

Figure 1: Blackbody Curves of M0 star, the Sun, and A0 star

Figure 2: Theoretical and Observed Spectra for a B0 Star

In the second part of the lab, we used a set of known spectral standards to classify five unknown stars. To do this, we first [*describe how you determined the two closest known spectra. Explain what characteristics you used to identify them*]. The spectra of Unknown 1 and its two closest standards, [*list standards*], are shown in Figure 3. After narrowing it down to two standards, we determined which of the two was a better match by analyzing the residuals, as described in Section 3.

Figure 3: Spectra of Unknown 1, [*Standard 1*], and [*Standard 2*]

1. **Analysis**

To determine which of two standards better modeled any given unknown star, we compared their residuals and their sums of squares. To find the residuals of an unknown spectra and a standard, we [*describe the process of calculating residual and plotting it; give equations if used*]. The residuals of Unknown 1 and its two closest standards, [*standard x and standard y*], are shown in Figure 4.

Figure 4: Residual of Unknown 1 and [*Standard x and y*]

To quantify how well a standard fit an unknown spectrum, we [*explain use of sum of squares to compare; give equations if used*]. The sum of squares for the potential standards for unknown one were [*report values for the two standards*]. Based on these values, we identified Unknown 1 as being closest to [*standard*]. The classifications for the remaining four stars are given below in Table 1.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Unknown Star | Closest Spectral Type | Sum of Squares | Second Closest Spectral Type | Sum of Squares |
| 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |

Table 1: Results of spectral classification for five unknowns

1. **Discussion**

[*Complete the discussion section on your own, as well as the cover page, abstract, and appendices*]