1. **Introduction**

One of the most valuable plots in astronomy is the Hertzsprung-Russell diagram, named after its creators, Ejnar Hertzsprung and Henry Norris Russell. The former, an astronomer from Denmark, plotted the absolute magnitude of a set of stars against their color in 1911. The latter, an American astronomer, created a similar plot in 1913 showing absolute magnitude as a function of spectral class, independent of his Danish contemporary. Though using different quantities, the two demonstrated the same physical phenomenon: that there are relationships between a stars luminosity and temperature.

In addition to those chosen for the original H-R diagrams, there are several quantities that can be equivalently used for each axis. The x-axis, which represents temperature increasing to the left, can also be given in terms of color index or spectral class. Similarly, the y-axis can be luminosity, apparent magnitude, absolute magnitude, or brightness.

Regardless of axis choice, H-R diagrams show the same groups of stars, such as giants, white dwarfs, and most notably, main sequence stars. The main sequence, which represents stars that are fusing hydrogen in their cores, is where the majority of stars are typically found. The main sequence is particularly important on H-R diagrams because they can be used to determine the age of a group of stars, given the stars formed at the same time. [*Explain how the main sequence can represent age with turn off, and the physical reasoning for why this is possible].*

In this lab, we used main sequence fitting to determine the age of two star clusters, M41 and M67. We used a particular type of H-R diagram, called a color magnitude diagram, or CMD. Used often in observational astronomy, a CMD shows apparent magnitude as a function of color index for a set of stars that are at identical distances. [*explain why a CMD requires the same distance for apparent brightness to be used*.]

For open clusters, such as those mentioned above, the distance from Earth can also be determined. There should exist a single additive constant difference between the plotted apparent magnitude and their absolute magnitude which implies its distance. This difference, called the distance modulus. An object’s distance modulus is a function of the distance to it, related by the equation

[give distance modulus/distance equation, define variables]

Where [define variables]. Using this relationship, we determined the distance to M41 and M67, in addition to their ages.

1. **Methodology**

In the first part of the lab, we examined the data for M41, which consisted of [*describe the data that was given to you for M41*]. We constructed CMD of this data, shown in Figure 1, by [*describe how you constructed the CMD*]. Then we examined the blackbody spectrum of a particular star with a (B-V) of 0.5, shown in Figure 2. We looked at the B and V filters in relation to the spectrum [*explain the analysis of the blackbody spectrum in terms of color filters*.]

Figure 1: [*M41 CMD: Give this figure a relevant caption explaining what it shows*]

Figure 2: [*Blackbody curve and filter:* *Give this figure a relevant caption explaining what it shows*]

In the second part of the lab, we used a set of stellar evolution models to determine the age and distance to two open clusters, M41 and M67. The models used to do this, called isochrones, are [*describe what the isochrones are and in general how they’re used to analyze data*].

For each cluster, we first determined the age by [*explain the process of matching isochrones to determine the age*].

Additionally, we determined the distance to each cluster by [*describe the process of shifting the plots and calculating the distance; give equations as needed*]. The best matching isochrones with appropriate shifts for M41 and M67 are shown in Figures 3 and 4. Based on these matches, we determined that M41 is [*report distance and age*] and M67 is [*report distance and age*].

Figure 3: [M41 and isochrone fit: add appropriate caption]

Figure 4: [M67 and isochrone fit: add appropriate caption]

1. **Analysis**
2. **Discussion**
3. **Appendix**