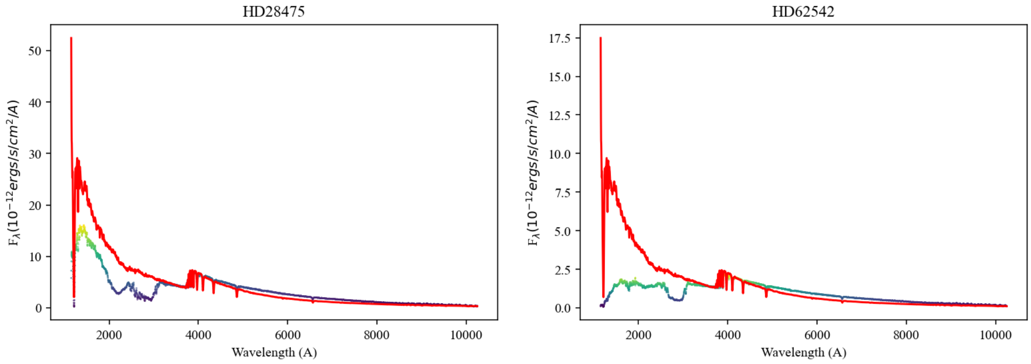
1 Problems

1.1

To find extinction, we can use: $\frac{A}{mag} = 2.5\log_{10}\left(\frac{F'_\lambda}{F_\lambda}\right)$. Using the scaling factors, we easily obtain a ratio of F'/F. Here are the initial graphs produced, with the scaled templates.



When producing the graphs, we simply scaled the template up or down to best fit the actual spectrum. However, We cannot use our scaling values for the flux ratios. We need to take the ratio of the *scaled* template spectrum emission in the V band to the actual stellar emission in the V band. This way we get a correct A_V value. The following code gives correct flux ratios, by taking the maximum values of the scaled and actual spectra and giving a ratio.

```
# -*- coding: utf-8 -*-
"""
Created on Wed Jan 29 15:05:27 2025

@author: cmark
"""

import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import os

os.chdir("C:/Users/cmark/Spyder/PHSCS 428/")

HD1data = pd.read_table("HD28745.txt", delim_whitespace = 'true')

HD2data = pd.read_table("HD62542.txt", delim_whitespace= 'true')

BVdata = pd.read_table("B57V.txt", delim_whitespace= 'true')

# setting fonts and stuff.
plt.rcParams['font.family'] = 'Times New Roman'


HD1_clean = HD1data[(HD1data['#Wavelength(Ang.A)'] >= 1200) & (HD1data['#
                                        Wavelength(Ang.A)'] <= 1800) ]
HD2_clean = HD2data[(HD1data['#Wavelength(Ang.A)'] >= 1200) & (HD2data['#
                                        Wavelength(Ang.A)'] <= 1800) ]
```

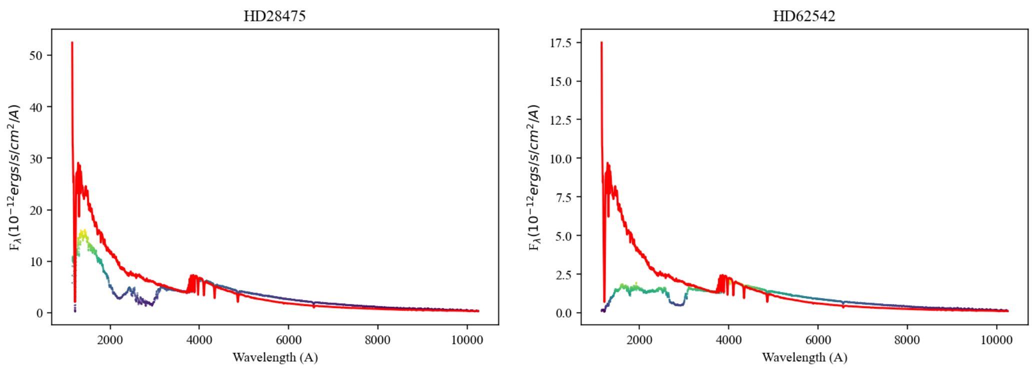
```
template_clean = BVdata[(BVdata['#Wavelength(Ang.A)'] >= 1200) & (BVdata['#
                                        Wavelength(Ang.A)'] <= 1800) ]

HD1max_clean = HD1_clean['F_lambda(10^-12ergs/s/cm^2/A)'].max()
HD2max_clean = HD2_clean['F_lambda(10^-12ergs/s/cm^2/A)'].max()
BVmax_clean1 = 2.4* template_clean['F_lambda(10^-12ergs/s/cm^2/A)'].max()
BVmax_clean2 = .8 * template_clean['F_lambda(10^-12ergs/s/cm^2/A)'].max()


# printing

print(f'HD 28475 Max: {HD1max_clean}')
print(f'HD 62542 Max: {HD2max_clean}')
print(f'Template 1 Max (Scaled): {BVmax_clean1}')
print(f'Template 2 Max (Scaled): {BVmax_clean2}')



ratio_actual1 = HD1max_clean / BVmax_clean1
ratio_actual2 = HD2max_clean / BVmax_clean2

print(f'HD 28475 Actual Flux Ratio: {ratio_actual1}')
print(f'HD 62542 Actual Flux Ratio: {ratio_actual2}')
```

The results:

Star	Spectral Type	Flux Ratio	A_V
HD 28475	B5V C	.5516	.645
HD 62542	B3V C	.1991	1.752

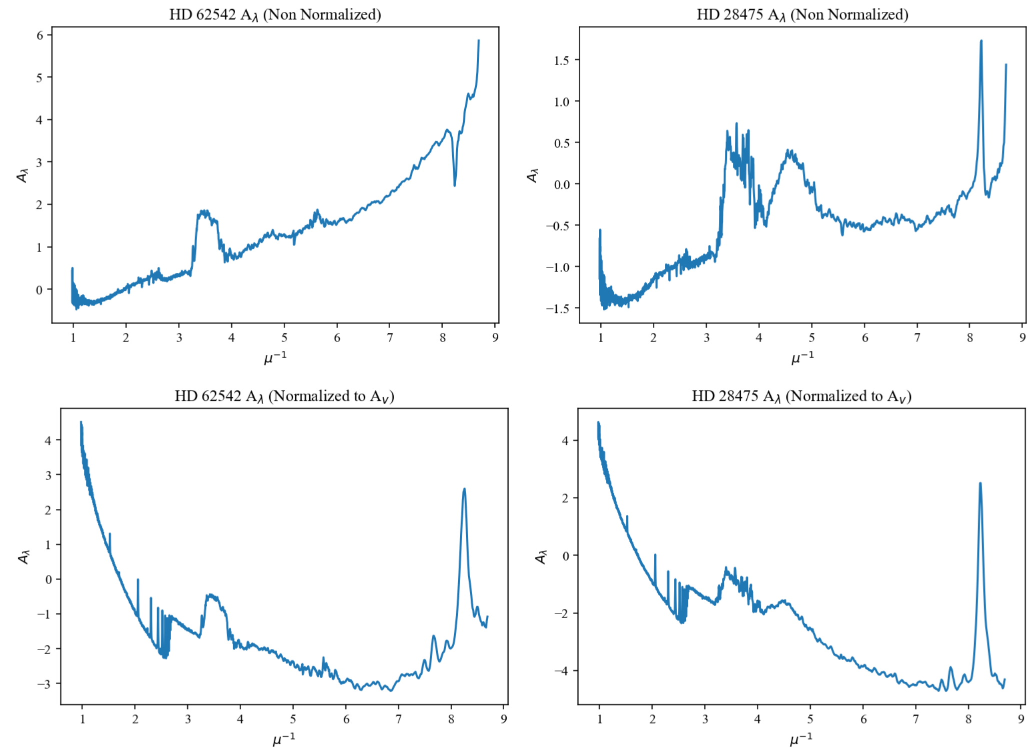
1.2

The graphs:



1.3

Here are the results.



And the code:

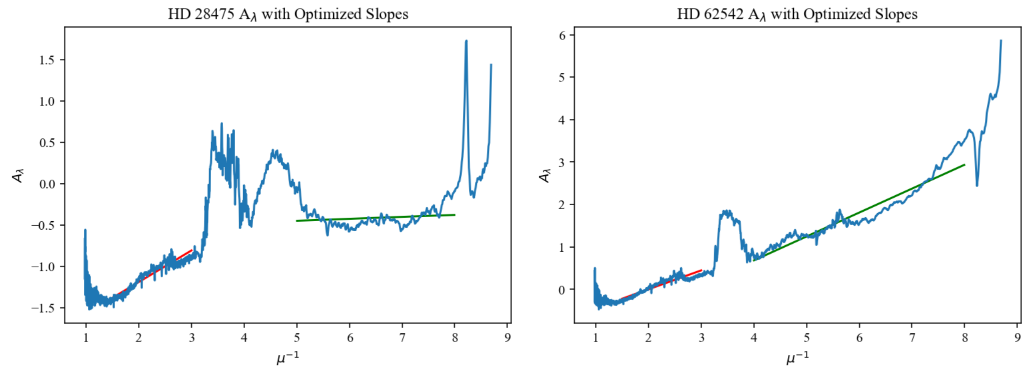
```
# ...
#%%
HD1conv = HD1data.copy()
HD1conv['#Wavelength(Ang.A)'] = HD1conv['#Wavelength(Ang.A)'] * 1e-4
x = 1 / HD1conv['#Wavelength(Ang.A)']

Alambda1 = -2.5 * np.log10(HD1data['F_lambda(10^-12ergs/s/cm^2/A)'] / 2.4*
                                                BVdata['F_lambda(10^-12ergs/s/cm^2
                                                /A)'])

plt.figure()
plt.title('HD 28475 A$_{\lambda}$ (Normalized to A$_v$)')
plt.xlabel('$\mu^{-1}$')
plt.ylabel("$A_\lambda$")
plt.plot(x, Alambda1)

#%%
HD2conv = HD2data.copy()
HD2conv['#Wavelength(Ang.A)'] = HD2conv['#Wavelength(Ang.A)'] * 1e-4
x = 1 / HD2conv['#Wavelength(Ang.A)']

Alambda2 = -2.5 * np.log10(HD2data['F_lambda(10^-12ergs/s/cm^2/A)'] / .8*
                                                BVdata['F_lambda(10^-12ergs/s/cm^2
                                                /A)'])

plt.figure()
plt.title('HD 62542 A$_{\lambda}$ (Normalized to A$_v$)')
```

```
        plt.xlabel('$\mu^{-1}$')
        plt.ylabel("$A_\lambda$")
        plt.plot(x, Alambda2)
```

1.4

Knowing that $R_V = \frac{A_V}{E(B-V)}$, we can read R_V from the slope. We exclude the ranges $\approx 120nm \approx 8.3$ and $241nm \approx 3.5$. We obtained slopes of:

Star	RV 1	RV 2
HD 28475	0.3816	0.02365
HD 62542	0.4444	0.5638



1.5

The increase in A_λ at about 4.5 may be due to a number of factors. It corresponds to a wavelength of about 200 nanometers.

1. Dust grain size along our line of sight to HD 28475 may be of similar size to that wavelength.
2. There may be more dust along our line of sight.
3. Dust or molecular compound properties may be of the optimal absorbing size.

1.6

Differences between the curves may be due to generl abnormalities in the dust. We also are only accounting for one kind of extinction, which may not be entirely accurate. Another instance of discrepancy may be due to our use of templataes. I only scaled until it seemed visually correct. I also just used a standard value for color excess that may not be entirely accurate for the stars. The slopes I calculated are also linear approximations and therefore not as accurate as we would hope.