Stellar Motion

This code loads the data and defines measurement parameters.

```
load starData
```

```
nObs = size(spectra,1)
lambdaStart = 630.02
lambdaDelta = 0.14
spectra
```

```
spectra = 357×10
10^-11  ×
     0.0309    0.0134    0.0060    0.0089    0.0109    0.0162    0.0039    0.0868    0.5208    0.2318
     0.0314    0.0134    0.0061    0.0090    0.0108    0.0163    0.0038    0.0867    0.5155    0.2288
     0.0310    0.0135    0.0062    0.0092    0.0110    0.0161    0.0037    0.0856    0.5104    0.2287
     0.0308    0.0136    0.0063    0.0093    0.0112    0.0159    0.0038    0.0848    0.5037    0.2276
     0.0309    0.0135    0.0063    0.0094    0.0112    0.0157    0.0039    0.0845    0.4987    0.2229
     0.0310    0.0134    0.0062    0.0093    0.0114    0.0159    0.0040    0.0845    0.4969    0.2222
     0.0312    0.0133    0.0062    0.0093    0.0114    0.0161    0.0040    0.0840    0.4982    0.2247
     0.0310    0.0132    0.0062    0.0092    0.0113    0.0161    0.0040    0.0832    0.4978    0.2268
     0.0308    0.0133    0.0063    0.0092    0.0112    0.0159    0.0039    0.0842    0.5012    0.2265
     0.0305    0.0133    0.0062    0.0092    0.0111    0.0158    0.0038    0.0858    0.5052    0.2248
        ⋮
```

Step 1

The `spectra` data were collected at evenly-spaced wavelengths (λ), and we know the starting wavelength ($\lambda start$), the spacing ($\lambda delta$), and the number of observations.

`lambdaEnd` (λend) contains the value of the last wavelength in the recorded spectrum. We can calculate `lambdaEnd` with the equation

$\lambda start + (nObs - 1)\lambda delta$

Then we use `lambdaEnd` to make a vector named `lambda` (λ) containing the wavelengths in the spectrum, from $\lambda start$ to λend, in steps of $\lambda delta$.

```
lambdaEnd=lambdaStart + (nObs-1)*lambdaDelta
lambda=lambdaStart:lambdaDelta:lambdaEnd
```

Step 2

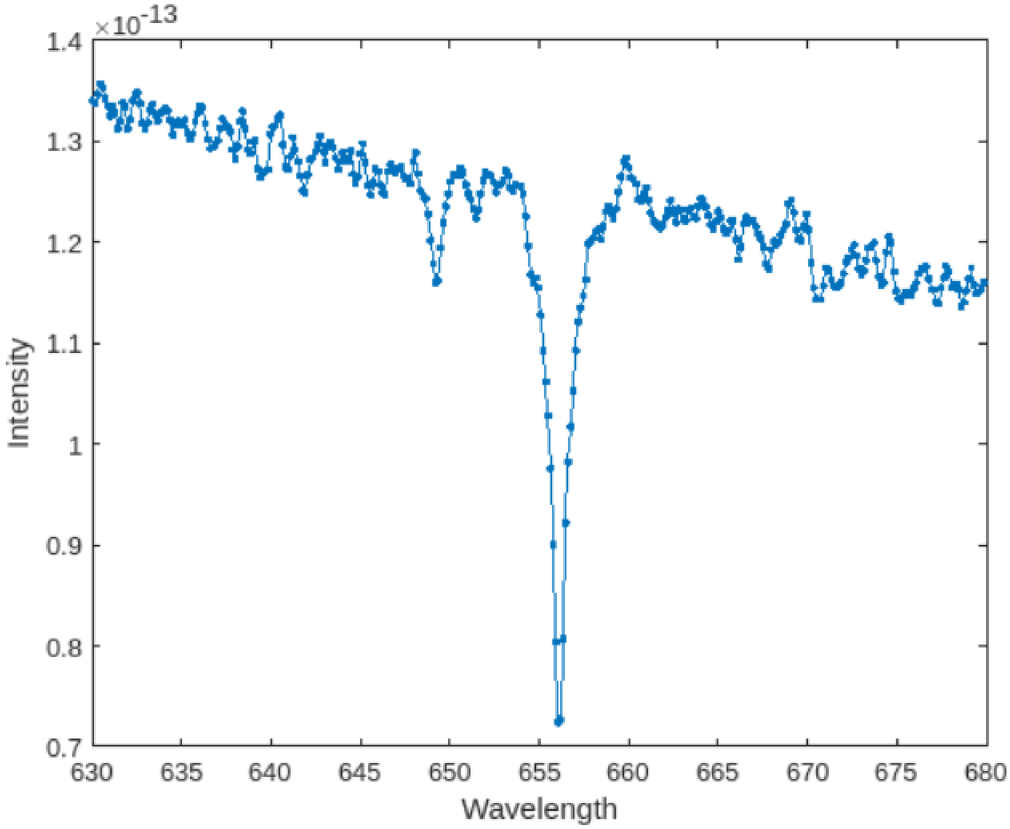
Each column of `spectra` is the spectrum of a different star. The sixth column is the spectrum of star HD 94028. We extract the sixth column of `spectra` to a vector named `s`.

```
s=spectra(:,2)
```

Step 3

Ploting the spectra (`s`) as a function of wavelength (`lambda`) using point markers (`.`) and a solid line (`-`) connecting the points.

```
plot(lambda,s,".-")
xlabel("Wavelength")
ylabel("Intensity")
```



Step 4 :

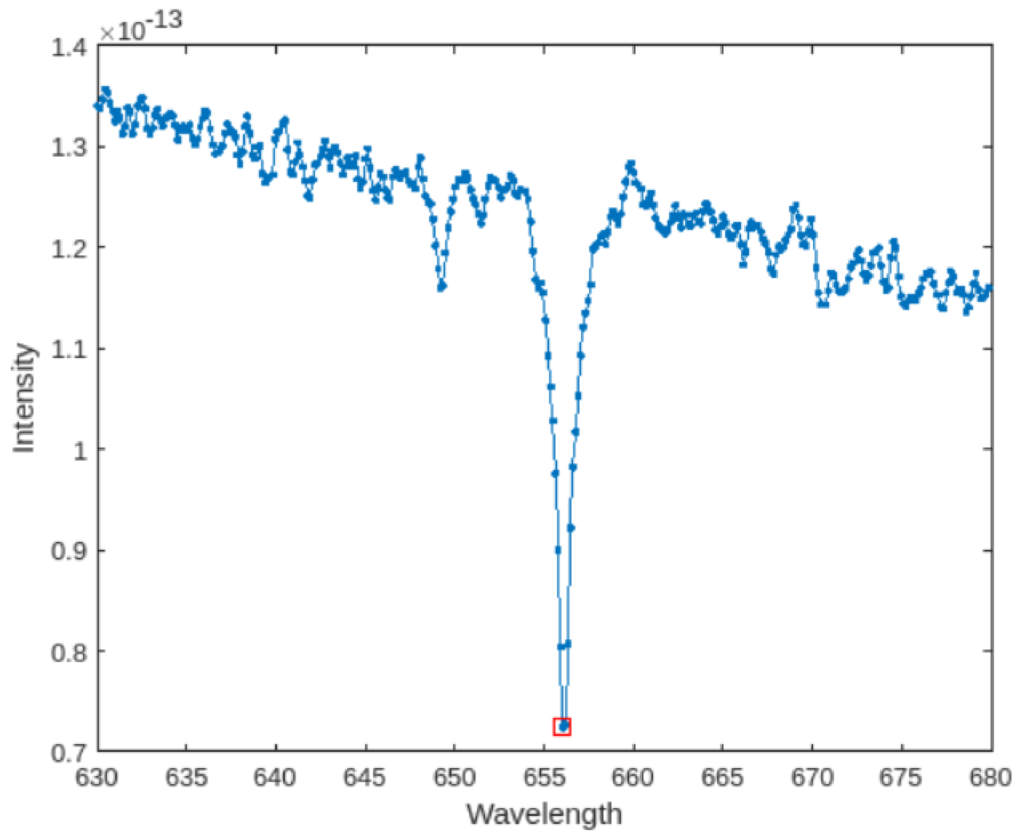
Creating two variables, `sHa` and `idx` that contain the minimum value of `s` and the index where the minimum value occurred and using `idx` to index into `lambda` to find the wavelength of the Hydrogen-alpha line. Store the result as `lambdaHa` (λHa).

```
[sHa idx]= min(s)
lambdaHa=lambda(idx)
```

Step 5

The point (`lambdaHa`,`sHa`) is the location of the Hydrogen-alpha line. Adding the point to the existing graph.

```
plot(lambda,s,".-")
xlabel("Wavelength")
ylabel("Intensity")
hold on
plot(lambdaHa,sHa,"rs","MarkerSize",8)
hold off
```



Step 6

If we zoom in on the plot, we can see that the wavelength of the Hydrogen-alpha line of HD 94028 is 656.62 nm, which is slightly longer than the laboratory value of 656.28 nm.

Using the Hydrogen-alpha wavelength of the star, we can calculate the *redshift factor* (the speed of the star relative to the earth) using the formula

$z=(\lambda Ha/656.28)-1.$

We can then calculate the speed by multiplying the redshift factor (z) by the speed of light (299792.458km/s).

```
z=(lambdaHa/656.28)-1
speed=z*299792.458
```

```
z = -3.3522e-04

speed = -100.4973
```