

1. From the Astronomy folder on the desktop double click the CLEA\_SPE icon.
2. Click on "Log in..." from the menu bar and enter your name. When you are finished click on the "Ok" button.
3. Click on "Run" from the menu bar and select "Take Spectra".
4. Click on the "Dome" button to open the telescope and then click on the "Tracking" button. Before you can make any observations the telescope drive needs to be turned on.
5. From the Field menu make sure that Field1 is select. Field1 is a 5 by 5 degree section of sky centered on RA = 6<sup>h</sup> 12<sup>m</sup> and Dec = 32° 30'. The telescope field of view shows a 2.5 by 2.5 degree section of the field.
6. From the following observing list enter the coordinates of star #1 using the "Set Coordinates" button.
7. Click on the "Monitor" button to make sure that the star is centered in the slit of the spectrometer. The Monitor button shows a 15 by 15 arcminute section of the sky with the spectrometer slit at the center of the field.
8. Click on the "Take Reading" button to begin collecting the spectrum. The screen will change to a display showing the output of the spectrometer.
9. Allow the photon count to accumulate until the signal to noise ratio is at least 100. When you are finished select "Stop Count" from the menu bar, and then select "Save" from the menu bar. Use the object number in the lower left part of the screen to enter for the object id.
10. Select "Return" from the menu bar to go back to the telescope view.
11. Repeat steps 6 through 10 for the rest of the program stars.

ID	Program Stars	
	RA	Dec
1. (494)	6h 14m 26s	32d 29' 20"
2. (54)	6h 15m 50s	33d 33' 46"
3. (277)	6h 15m 50s	34d 11' 03"
4. (218)	6h 20m 26s	34d 20' 14"

5. (477)	6h 18m 29s	32d 50' 43"
6. (108)	6h 15m 31s	32d 54' 23"
7. (264)	6h 16m 52s	32d 52' 26"
8. (487)	6h 15m 33s	32d 31' 09"
9. (230)	6h 17m 50s	32d 22' 51"
10. (379)	6h 18m 40s	31d 56" 20"

### Classification of Spectra

There is no one single path to a correct spectral determination! Certainly, skillful pattern recognition is heavily involved. The following general guidelines may help. Table 1 lists some of the distinguishing features of main sequence spectral types.

To get an approximate identification use one or more of the following:

1. The general appearance of the continuum (slope and smoothness)
2. The strength (and presence or absence) of key spectral lines- the Balmer lines of hydrogen, Calcium H and K, molecular bands, etc.
3. Use the difference feature. Pay attention to differences in the continuum (primarily slope) as well as the lines.

To get a precise determination:

1. Compare the shape and depth of the most prominent spectral lines (especially H and Ca H and K).
2. Look at differences in spectral lines, which only exist over a narrow range of spectral types.

1. Select "Run" from the menu bar and select "Classify Spectra".

2. Select "Load" from the menu bar and select "Atlas of Standard Spectra". Next select Main Sequence from the scrolling window and click on the "Ok" button.

3. Click on the "Load" button again and select "Unknown Spectrum", and then select "Saved Spectra". Select one of your spectra from the scrolling window by clicking once on it and then clicking on the "Ok" button. The file names of your spectra will consist of your first name and the object number.

4. The Main Sequence window can be minimized by clicking on the down arrow button at the upper right corner of the window which will reduce the window to an icon.

5. Use the "Up" and "Down" buttons to scroll through the standards. When you think you have a close match move the standard to the top of the window and click on the

"Difference" button, which will subtract your spectrum from the standard spectrum. If the two match the red tracing at the bottom of the window will be fairly flat.

6. If none of the main sequence standards match exactly then your spectrum lies between two of the main sequence stars or it may belong to a different luminosity class (you can check this by loading in the standards for other luminosity classes).

7. Record the spectral types and luminosity classes for your stars in the following table.

Table of Spectral Types and Luminosity Classes

- |               |                |
|---------------|----------------|
| 1.(494) _____ | 6.(108) _____  |
| 2.( 54) _____ | 7.(264) _____  |
| 3.(277) _____ | 8.(487) _____  |
| 4.(218) _____ | 9.(230) _____  |
| 5.(477) _____ | 10.(379) _____ |

Spectral Type	Surface Temp. (K)	Distinguishing features
O	> 30,000	Lines of ionized helium (He II).
B	30,000 – 10,000	Lines of neutral helium (He I), moderate hydrogen lines (Balmer lines).
A	10,000 – 7,500	Very strong hydrogen lines.
F	7,500 – 6,000	Moderate hydrogen lines, moderate lines of ionized calcium (Ca H and K).
G	6,000 – 5,000	Weak hydrogen lines, strong lines of ionized Ca.
K	5,000 – 3,500	Lines of neutral and singly ionized metals, some molecular lines.
M	< 3,500	Molecular lines strong (TiO, G band).

Table 1

References

“Contemporary Laboratory Experiences in Astronomy” See <http://www.gettysburg.edu/academics/physics/clea/CLEAsoft.overview.html>