2014

# Leo

Andrew P. Woolley
*Parkland College*

## Introduction

The purpose of this project was to gain a better understand on how information is gather about stars and galaxies, and to learn about a specific constellation. Some information gathered during this project was how a star's position can be used to calculate the length of the year, and how the mass and spectral type of a specific star can show when and how the star will die

← Messier 95: Located within the Leo constellation

## Length of a Year

To measure the length of a year, you must first measure the change in rise time of a star within the constellation once a week for five weeks.

We found the change in rise time by finding the specific rise time on each day and subtracting it from the following week.

| Date | Rise Time for Regulus | | |
|---|---|---|---|
| | Hour | Minute | Second |
| May 23 | 12 | 16 | 15 |
| May 30 | 11 | 48 | 43 |
| June 6 | 11 | 21 | 12 |
| June 13 | 10 | 53 | 40 |
| June 20 | 10 | 26 | 9 |

| Dates | Change in Rise Time | | Change in Time Decimal Minutes | Change in Time Per Day in minutes/day |
|---|---|---|---|---|
| | Minutes | Seconds | | |
| 5/23-5/30 | 27 | 32 | 27.53 | 3.93 |
| 5/30-6/6 | 27 | 31 | 27.52 | 3.93 |
| 6/6-6/13 | 27 | 32 | 27.53 | 3.93 |
| 6/13-6/20 | 27 | 31 | 27.52 | 3.93 |

After we had the change in rise time, we converted the times to decimal form. Then the average was found.

During the year, the rise time totaled to 24 hours, or 1,440 minutes. Then you divide that by the average change in rise time per day and you will come up with the numbers of days in a year.

$$\frac{1{,}440\ min}{3.93\ min/day} = 366.41\ days$$

## Percent Error

$$\text{Percent Error of Regulus} = \left[\frac{366.41-365.25}{365.25}\right] * 100 = .32\%$$

If the percent error is found to be fewer than 5.00% then it is thought of as a good estimate because it's not that far off the exact value.

## Error

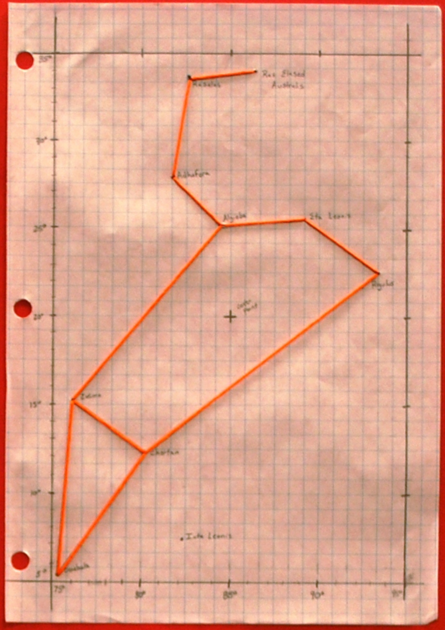
The error in this method would rely solely on the precision of measurements.


By: Andrew Woolley

## Mythology

Astronomy use to be known as a story way back when. Back then every constellation was a picture of something and they all had a tale that interacted with each other. The famous myth behind the constellation of Leo goes as such. Leo was a fearsome beast that terrorized the land, and killed all that came near. He was larger and stronger than all other lions and possessed magical skin that was impervious to metal, stone and wood. Killing the Nemean lion (or Leo) was the first of Hercules' twelve labors, although with the lions magic skin, Hercules was forced to wrestle the beast with his bare hands and strangle the animal to death. Once the mighty lion had fallen, Hercules saw the protective qualities of the pelt; he removed one of the lion's own claws, skinned the beast, and thereafter wore it as a cloak.

(http://www.heavens-above.com/myth.aspx?lat=51.450&lng=3.583&loc=Vlissingen&alt=0&tz=CET&cul=en&con=Leo)



## Discussion of 3-D Graph

| Star Name | Azimuth | Altitude | Distance |
|---|---|---|---|
| Adhafera | 81°59.47' | 28°00.06' | 274.08 ly |
| Algieba | 84°46.29' | 25°19.15' | 125.64 ly |
| Chertan | 80°12.19' | 12°24.29' | 165.06 ly |
| Denebola | 75°29.02' | 05°26.33' | 35.88 ly |
| Eta Leonis | 89°29.48' | 25°54.19' | 1269.09 ly |
| Iota Leonis | 82°33.21' | 07°31.51' | 79.05 ly |
| Ras Elased Australis | 86°15.08' | 34°03.24' | 246.71 ly |
| Rasalas | 82°57.54' | 33°57.21' | 124.11 ly |
| Regulus | 93°28.57' | 22°46.12' | 79.30 ly |
| Zosma | 76°05.40' | 15°33.39' | 58.43 ly |

When you look up into the night sky you see sets of stars grouped together in what we call constellations. These stars are all paired together because they appear to be close to each other from our two dimensional point of view on Earth. However, all the stars in the sky are three dimensional bodies flying around in space. So when we compare their distances (or depth) to one another, you can see that they are not close together at all. If we could rotate the constellation 90 degrees, we would be able to see how dramatically separated all these stars are. Like Denebola which is only about 36 light years from Earth, compared to Eta Leonis which is about 1,269 light years away.


| Star Name | HIP # | Spectral Type | Mass | Main Sequence Lifetime | Remaining Lifetime | Death Order | Fate of Stellar Core |
|---|---|---|---|---|---|---|---|
| Eta Leonis | 49583 | A0Ib | 11.5 | 78600000 years | 786000 years | 1 | Neutron Star |
| Rasalas | 48455 | K0III | 2.3 | 1890000000 years | 189000000 years | 5 | White Dwarf |
| Zosma | 54872 | A4V | 2.1 | 2270000000 years | 250000000 years | 10 | White Dwarf |

## Fate of three Stars

The main sequence is the model for which stars are distributed on the Hertzsprung-Russell (or HR) Diagram based upon their spectral type, luminosity, temperature, and mass. Each star has an estimated lifetime that corresponds with their position on the main sequence and a total lifetime. At the end of a stars lifetime there are three outcomes: White Dwarf, Neutron Star, or Black Hole.

1. Eta Leonis: Eta Leonis is a star that has a solar mass of 11.5, this means that it's mass is 11.5 times larger than the Sun. It has a main sequence lifetime of only 78,600,000 years and a remaining lifetime of 786,000 years, which is not a lot of time for a star. At the end of its lifetime it will become a Neutron Star. A Neutron Star is the remnant of a supernovae, or exploding star. Typically, only the more massive stars end this way as the star becomes unstable due to its size and the lack of fusion in its core. The size range for a star to form into a Neutron Star when they die is between 8 and 25 solar masses. What is left after the supernovae is the dense nucleus of the star, hence the word neutron, and a cloud of planetary dust. New Stars are often formed from the remnants of Neutron Stars due to its gravity and abundance of planetary dust.
2. Rasalas: Rasalas has a solar mass of 2.3 and a main sequence lifetime of 1,890,000,000 years. It has a remaining lifetime of 189,000,000 years once it leaves the main sequence. At the end of its lifetime it will become what is known as a White Dwarf. A White Dwarf is a small very dense star that is typically the size of a planet. They are formed when a low-mass star has exhausted all its central nuclear fuel and can no longer create fusion in its core. Once fusion has ceased, the star will lose its outer layers as a planetary nebula. Stars that are 8 solar masses and under will turn into a White Dwarf when they die.
3. Zosma: Zosma has a solar mass of 2.1, a main sequence lifetime of 2,270,000,000 years, and will live for another 227,000,000 years once it leaves the main sequence. Since it has a solar mass of 2.1, it too will end its life as a White Dwarf.

The third option for a star after death is turning into a Black Hole. None of the observed stars in the constellation of Leo will end their life in this way, because in order to become a Black Hole a star must be over 25 solar masses. A Black Hole is defined as a singularity in space time that occupies zero volume, but has infinite density. In other words, it is a point in space that has such a great mass that it warps the fabric of space time so much that not even light can escape its gravity. Black Holes were first observed by noticing X-ray light coming from invisible objects in space. Today Black Holes are universally accepted and it turns out that our own Milky Way Galaxy lies pry to a Super Massive Black Hole (that's about 4 million solar masses) located in the middle of the galaxy.

| Star Name | HIP # | Spectral Type | Mass | Main Sequence Lifetime | Remaining Lifetime | Death Order | Fate of Stellar Core |
|---|---|---|---|---|---|---|---|
| Adhafera | 50335 | F0III | 5.3 | 359000000 years | 35900000 years | 3 | White Dwarf |
| Algieba | 50583 | K0III | 2.3 | 1890000000 years | 189000000 years | 5 | White Dwarf |
| Chertan | 54879 | A2V | 2.5 | 1600000000 years | 160000000 years | 8 | White Dwarf |
| Denebola | 57632 | A3V | 2.4 | 1740000000 years | 1910000000 years | 9 | White Dwarf |
| Eta Leonis | 49583 | A0Ib | 11.5 | 78600000 years | 786000 years | 1 | Neutron Star |
| Iota Leonis | 55642 | F2IV | 3.2 | 977000000 years | 97700000 years | 4 | White Dwarf |
| Ras Elased Australis | 47908 | G0II | 2.1 | 2270000000 years | 22700000 years | 2 | White Dwarf |
| Rasalas | 48455 | K0III | 2.3 | 1890000000 years | 189000000 years | 5 | White Dwarf |
| Regulus | 49669 | B7V | 4.5 | 494000000 years | 543000000 years | 7 | White Dwarf |
| Zosma | 54872 | A4V | 2.1 | 2270000000 years | 250000000 years | 10 | White Dwarf |