2019

Gemini

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GEMINI

Introduction

In this project from Astronomy 102, I selected Gemini as the constellation to study. I observed the constellation's position in the sky based on information I've learned in Astronomy 102. Gemini is most notable for the two bright stars, Castor and Pollux, that make up the heads of the twins in Gemini. The end goal is to determine their age and fate.

Determing the Length of a Year

Date	Rise Time for Castor (Apollo)		
	Hour	Minute	Second
May 23	08	19	09
May 30	07	51	38
June 6	07	24	06
June 13	06	56	35
June 20	06	29	04

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

To determine the length of a year, I began by marking the time that Castor rose above the horizon at the start of each week for five weeks. After taking the difference between each consecutive week, I divided these numbers by 7 for the number of days in a week. This resulted in a weekly average change of rise time for Castor of 3.93 minutes. We were able to estimate the number of days in a year at 366.4122 days by dividing the average change of rise time for Castor per day (3.93 minutes) by 1,440 minutes (the number of minutes in a given day). The tables above illustrate the results of my calculations.

Average change in rise time per day: 3.93

Calculated number of days in a year: 366.4122

Calculated percent error: 0.32%

A possible source of error in my calculations could be from not observing enough rises, there could have been greater variance in the rise times from day to day since we only observed and recorded each week over four sidereal weeks. Also, this estimation doesn't account for time zone changes and leap years, so that could also lead to inaccuracies. Given that the result is less than 1% of an error, using this method to estimate short periods of time would be a fine. However if used to calculate longer periods of time this would lead to some pretty big inaccuracies, because it doesn't account for changes in time zones, leap years, and your changing position on earth.

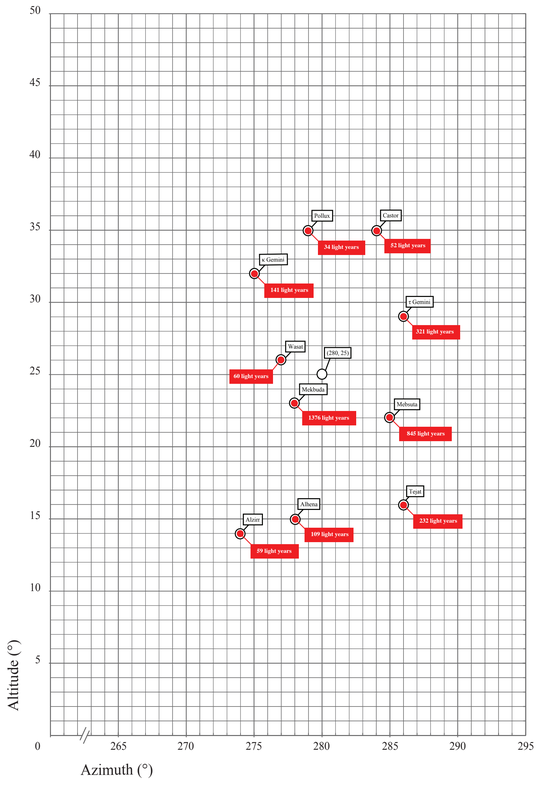
Arrangement of Stars

Observation position: Latitude 40° North, Longitude 88° West.

Date: May 23, 2019

Time: 9pm

The constellation of Gemini will feature this exact arrangement of stars in the sky based on the information above.



Relationship of Stars

Although the distance between stars appears close in our night sky, they aren't located close to each other in space. The reason they appear close together is because they have a differing amount of luminosity
and mass. The closer they are to Earth, the greater potential they have for appearing nearby. One of the most luminous stars, Mekbuda, is one of the furthest from Earth. It does not appear as bright as Castor, a star that is located much closer at 52 light years away and is an A1.5 IV star. The grouping of a constellation is based on their brightness that can be observed from Earth. This does not necessarily mean they are close together.

We know the stars in Gemini didn't form at the same time because they vary greatly in distance and age when compared to one another.

M-35, the Shoe Buckle Cluster is located approximately 2,800 light years from Earth and was discovered in 1764. (Gemini Constellations)

IC 443, the Jellyfish Nebula is located approximately 5,000 light years from Earth. The first sighting was in 1892 by Max Wolf and was later confirmed by E.E. Barnard. (Frommert, Hartmut)

Deep Sky Objects

The only Messier object in Gemini is **M-35**, which is the **Shoe Buckle Cluster**. If this region of the sky were observed with a research-grade telescope, you could expect to see more objects than the number catalogued by Charles Messier in the 18th century. The reason for this is that the M35 cluster is very large and modern telescopes are able to see much dimmer objects than previously possible. This is because there have been numerous technological advances over the centuries, improving our ability to observe the sky through telescopes.

M-35, Shoe Buckle Cluster — Constellation Guide

The Shoe-Buckle Cluster looks significantly dense with small stars compared to the surrounding space. The cluster seems to be brightest near the center with a hazy yellow glow and bright white and yellow spots that dim around the edges of the group.

An open star cluster is a group of many stars concentrated in a certain area. Open clusters form from a giant molecular cloud, so most of the stars contained in it are about the same age. The stars of the cluster hold gravitational pull on each other.

IC 443, the Jellyfish Nebula — Constellation Guide

The Jellyfish Nebula is a supernova remnant. It looks like a much larger group of stars with a similar density to the Shoe Buckle Cluster's density with pretty even spacing. Near the center of the Jellyfish is a large cloud with varying yellow, red and orange portions. The brightest part of the cloud is very red and yellow. There is very bright star called Propus near the outside of the cloud, but still within the overall grouping of stars.

Supernova remnants are the remains of an exploded star which went supernova. The explosion of the supernova star spreads material outward in a shockwave, heating up other material nearby.

Fates of Stars

The following chart illustrates the fates of Castor, Tau Geminorum, and Alzirr. Each of these stars will result in a White Dwarf because they will become less than 1.4 solar masses. Tau Geminorum has the shortest remaining lifetime while Alzirr will go on for much longer. Castor overall has the shortest total lifetime

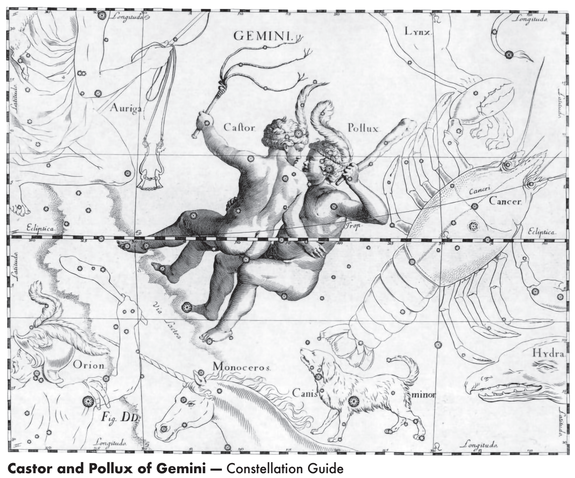
Name	Spectral Type	Luminosity Class	Mass	Stages Completed	Completed Lifetimes	Remaining Stage	Remaining Lifetimes	Stellar Core Fate	Mass Range
Castor	A1.5	IV	4.7	Main Sequence	462,000,000	Red Giant, Planetary Nebula, White Dwarf	46,200,000	White Dwarf	Under 1.4 solar masses
Tau Geminorum	K2	II	3.4	Main Sequence, Red Giant	952,000,000	Super Giant, Planetary Nebula, White Dwarf	8,650,000	White Dwarf	Under 1.4 solar masses
Alzirr	F5	IV-V	2.1	None	2,270,000,000	Main Sequence, Red Giant, Planetary Nebula, White Dwarf	227,000,000	White Dwarf	Under 1.4 solar masses

It is possible for a luminosity class III star to have a longer remaining lifetime than a class V star because the class III star is not burning through its fuel as quickly as a massive class V star. This is because there is generally more material contained within the star class V star. A class III star will not burn through its hydrogen fuel as quick as a class V star. The graph below shows examples of this point.

All ten of the stars observed end as white dwarfs.

Most stars in the galaxy are less massive than our sun, so it would be a fair assumption that anything less than 8 solar masses would become a white dwarf. Therefore, I think the fate of my stars are not that far off and that stars that will not result in a white dwarf are quite rare.

Star Name	Spectral Type	Luminosity Class	Mass	Main Sequence Lifetime (years)	Completed Lifetime (years)	Remaining Lifetime	Death Order	Fate of Stellar Core
Castor	A1.5	IV	4.7	462,000,000	462,000,000	46,200,000	5	White Dwarf
Pollux	G9	III	2.3	1,890,000,000	1,890,000,000	189,000,000	7	White Dwarf
Alhena	A1.5	IV	4.7	462,000,000	462,000,000	46,200,000	5	White Dwarf
Wasat	F2	V	1.5	4,440,000,000	none	4,890,000,000	10	White Dwarf
Mebsuta	G9	Ib	3.8	693,000,000	762,000,000	6,930,000	1	White Dwarf
Mekbuda	G1	Ib	2.6	1,480,000,000	1,630,000,000	14,800,000	3	White Dwarf
κ (Kappa) Geminorum	G9	III	2.3	1,890,000,000	1,890,000,000	189,000,000	7	White Dwarf
Tejat	M3	III	4.8	434,000,000	434,000,000	43,400,000	4	White Dwarf
Alzirr	F5	IV-V	2.1	2,270,000,000	2,270,000,000	227,000,000	9	White Dwarf
τ (Tau) Geminorum	K2	II	3.4	865,000,000	952,000,000	8,650,000	2	White Dwarf



Castor and Pollux of Gemini — Constellation Guide

Mythology

Gemini is Latin for twins, and the constellation represents the two twin brothers, Castor and Pollux. They are the sons of Leda but have two different fathers: her husband, Tyndarus of Sparta, and Jupiter, who appeared to her in the form of a swan. Pollux was immortal and his brother, Castor, was mortal. Pollux was known for his strength and Castor for his skill with horses. They both fought in the Trojan War to bring back their sister, Helena, from capture. They typically depicted carrying spears and riding matching horses. The mythiological reason for them appearing in the stars is that Pollux was grieving the loss of his brother, Castor, and asked his father, Jupiter, to share Pollux's immortality with his brother, Castor. Because of the heroism displayed by both brothers, Jupiter granted them both immortality in the stars (Bell, Cathy).

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Poster by: Michael Dalton