



GENERAL

Why Study Variable Stars





Overview

Over 3,000 years ago, Egyptians recorded the variability of Algol, B Persei. They called Algol, Horus, as a god that represented divinity and kingship. The period that they observed was 2.85 days between peaks of brightness.

Algol is now known as an Eclipsing Binary with a varying period over the years.

The science of Variable Star observing seeks to learn the behaviors of stars and refine our knowledge of stellar astrophysics through these observations.

This lesson will provide a general overview as to why we study Variables.





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Why Observe Variable Stars

Since we cannot "experiment" with the universe and touch stars and galaxies, observations of positions and light fluctuations can reveal the universe not only in visible light, but at nearly all wavelengths of the electromagnetic spectrum from radio waves to gamma rays.

These observations enable us to refine, validate, and propose new physical laws that govern the physical world apply equally everywhere in the universe.

Through the study of light variations we can apply physics on the Earth, to physics in the Universe:

- Same gravitational force that makes a ball follow an arc in the sky when you throw it also keeps the Earth and its Moon in orbit about one another and keeps the Sun in orbit about the center of the Milky Way galaxy.
- Same properties of gases that make hot air balloons rise off the ground also govern the motions of gases in the interiors of distant stars.
- Same properties of atoms that make "neon lights" shine in different colors also govern the spectral lines that we observe in light from distant stars and galaxies.



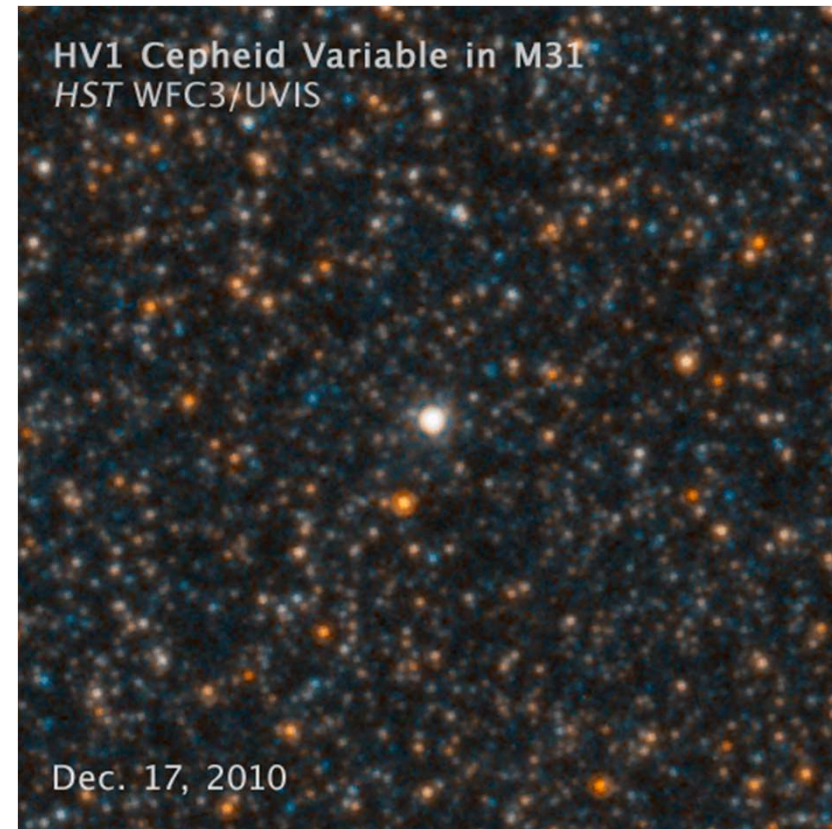
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What is a Variable Star

Variable stars are stars that change brightness ranging from a thousandth of a magnitude to as much as twenty magnitudes over periods from seconds to years.

The variations depend on the type of variable star: Intrinsic or Extrinsic.

Presently, there are over 150,000 variable stars known and catalogued, and many thousands more are suspected to be variable.



Source: AAVSO

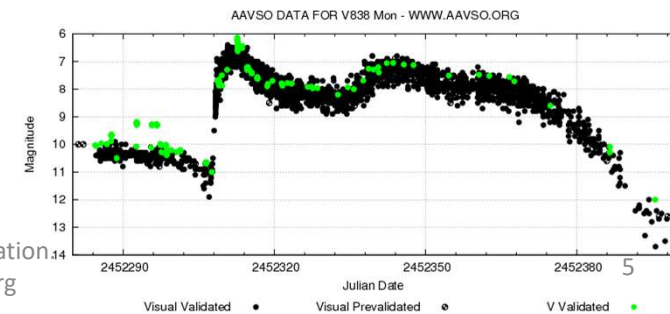
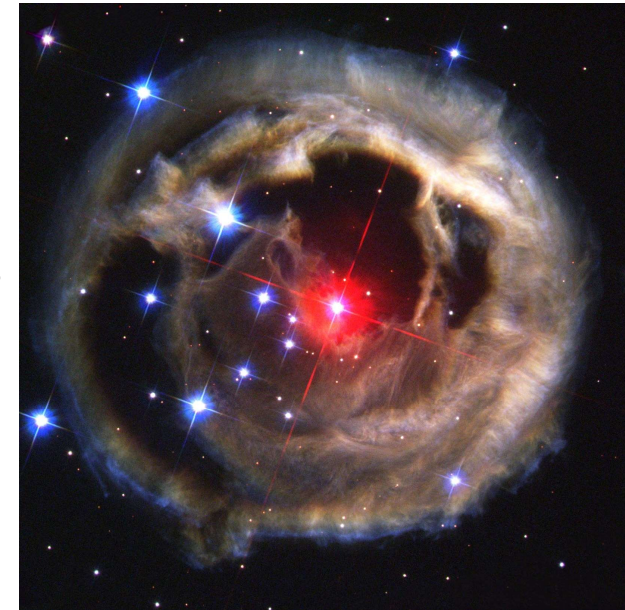


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Amateur Studies of Variable Stars

V838 Monocerotis

- Red star about 20,000ly from the Sun
- Was an unknown star that experienced a major outburst in the early 2000s
- During this it was possibly one of the brightest stars, but only during the outburst.
- Light Curve studies disproved a Nova Eruption, but indicated it was an entirely new process
- The reason for the outburst is still uncertain, but variable star study is contributing to this mystery
- Changes:
 - Temperature has increased
 - Luminosity is $15,000 L_{\text{sun}}$
 - Radius has decreased 380 times
 - Material ejected is expanding covering a B-type stellar companion



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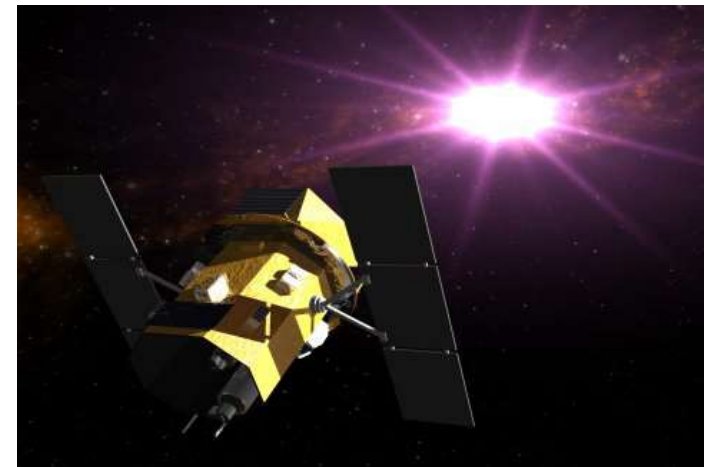
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Support Space Telescopes and Research Programs

Through Alerts and Special Notices, Variable Star observers participate in Space Telescope programs and higher institution studies

Examples:

- Observing light fluctuations thought to be related to exoplanet formations
- Gamma Ray Bursts



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Why study Variables

Physics laboratories

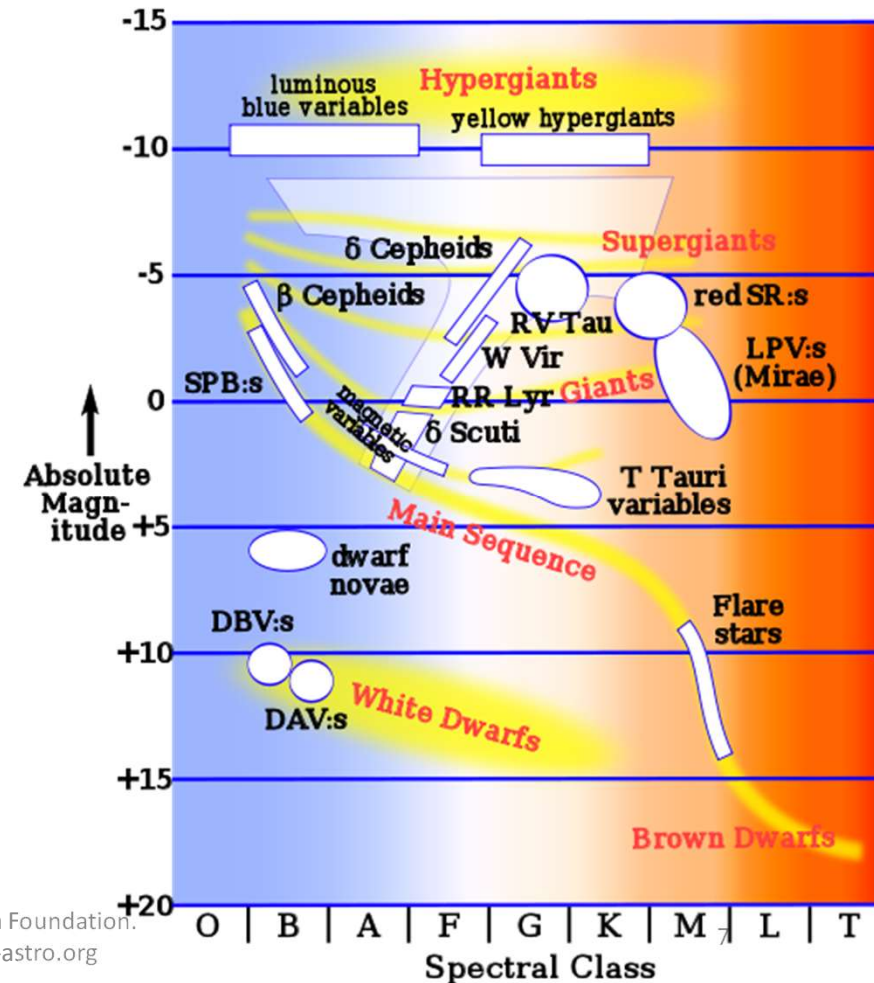
- Gravity, fluid mechanics, electromagnetism, light and heat, chemistry, and nuclear physics
- Learning how the light from a variable star changes, can learn more about how the universe works
- Observing how stars change over time, we can learn why they change

Stellar Evolution & Life Cycles:

- Tell about the circumstances under which stars form, live their lives, and eventually evolve and die
- Mapping surface features

Cosmic Distance Ladders

- Cepheid
- RR Lyrae



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Groups & Classes of Variable Stars

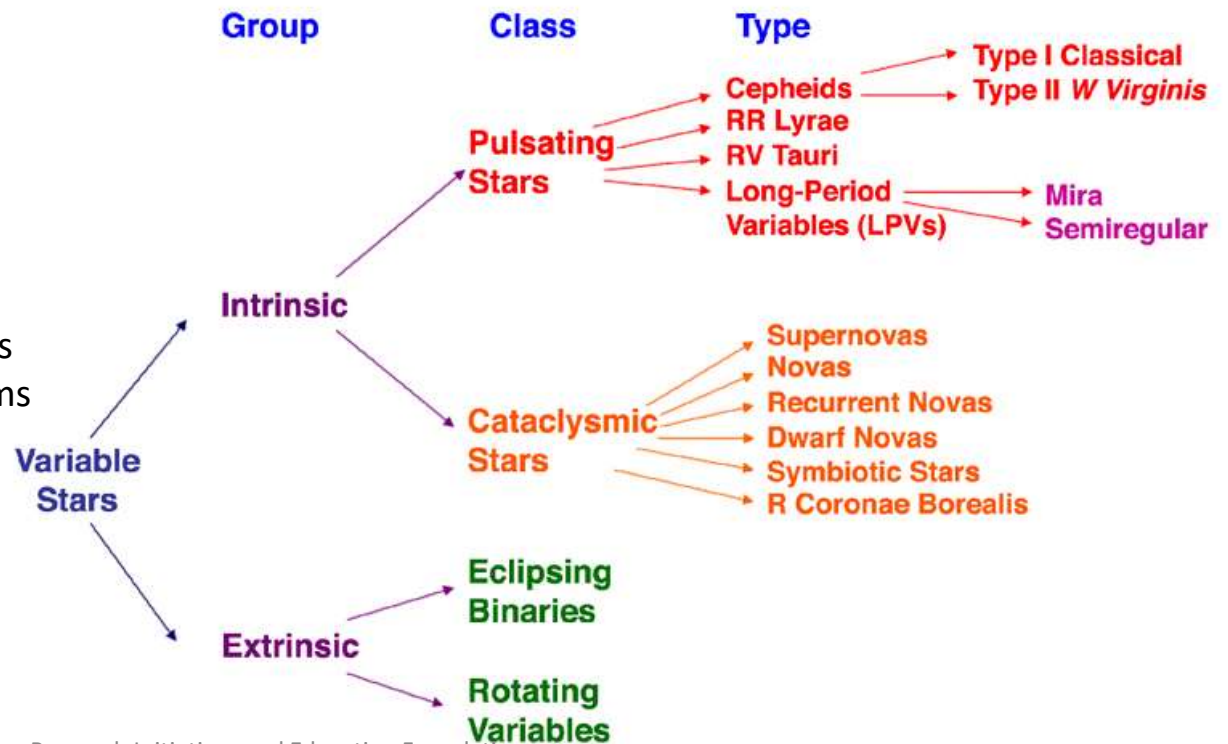
Groups

- Intrinsic: Due to internal factors
- Extrinsic: Due to external factors

Classes

- Pulsating: Internal Processes
- Cataclysmic: Violent Outbursts
- Eclipsing: Close Binary Star Systems
- Rotating: Star Spots & Close Systems

Variable Star Classification



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Summary

Variable stars allow us to refine our current understanding of astrophysics and the properties that govern astronomical processes through out the universe.

These can be used to apply our knowledge of the Sun to other stars, to measure distances to galaxies, to discover new planets, to understand how new planets are formed, to understand how new stars are formed, etc.

Variable star study gets to the heart of how our universe works.



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Questions?