



Red Supergiant Star Betelgeuse

Why in News?

The **bright red star Betelgeuse**, known as '**Thiruvathirai**' or '**Ardra**' in Indian astronomy, captivates observers with its prominent position in the [constellation Orion](#).

- Recent research conducted by Japanese and Swiss researchers has shed light on the **star's pulsation patterns**.

What is Betelgeuse's Pulsation?

▪ About Betelgeuse:

- Betelgeuse is a **red supergiant star that is nearing the end of its life**. It is the **second-brightest star in the constellation of Orion, after Rigel**.
 - Scientists noticed that **Betelgeuse was mysteriously dimming in late 2019** following **a traumatic outburst caused by the star blowing off a large portion of its visible surface**.
- Betelgeuse varies in brightness because of two main factors: changes in its surface temperature and changes in its size.
 - As a red supergiant, **Betelgeuse has a very unstable outer layer that is prone to convection and pulsation**.

▪ The Pulsating Mechanism:

- The pulsation of Betelgeuse refers to the **periodic contraction and expansion of the star**.
 - Researchers have compared the observed pulsation of Betelgeuse to theoretical estimates, **indicating that the star is in its late carbon-burning stage**.
 - Pulsation periods provide valuable insights into the **star's radius, luminosity, and mass**, affirming its current phase of core carbon-burning.
- Similar to a pot's lid lifting to release steam, **red giant stars expand and contract due to heating and cooling of hydrogen in their outermost layers**.
 - The **star's outermost envelope contains cooler neutral hydrogen, which absorbs heat from the interior, causing the star to expand**.
- As the **temperature rises, hydrogen becomes ionised and can absorb more heat**, leading to a forceful expansion and ejection of the outermost shell.
- The cyclic nature of this process results in **periodic dimming and brightening of the star, observable from a distance**.

▪ Stages of Evolution:

- **Stars like Betelgeuse fuse hydrogen into helium during their initial stages**, which helps **maintain a balance between gravity and energy release**.
- Massive stars like Betelgeuse **run out of hydrogen fuel in a few crore years**, when they switch to using helium to make carbon. Helium runs out in about **10 lakh years**.
 - As each stage progresses, the **burning of elements becomes faster, with carbon burning in a few hundred years** and silicon burning in about a day.
 - Afterwards **red giants briskly consume one by one the elements of the periodic table**, until finally their core brims with iron.
 - Once the core is rich in iron, the temperature and pressure within the star drop. With nothing to stop it, **gravity compresses the core and turns it into a**

[neutron star](#) or a [black hole](#).

- **Betelgeuse's late-carbon stage signifies the terminal phase before the star's imminent collapse.**

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What is the Constellation Orion?

▪ Constellation:

- **A constellation is an area on the celestial sphere** in which a group of visible stars forms a perceived pattern or outline, **typically representing an animal, mythological subject, or inanimate object.**
 - They are useful in assisting astronomers and navigators to locate certain stars
- Officially, there are **88 recognized constellations in the night sky.** These constellations were defined and established by the [International Astronomical Union \(IAU\)](#).
 - **IAU was founded in 1919**, headquartered in Paris, France.

▪ Constellation Orion:

- It is a **prominent constellation that can be seen throughout the world.**
 - It is located on the **celestial equator and is best visible in the evening sky from January to April in the [Northern Hemisphere](#)**, and from **November to February in the Southern Hemisphere.**

January Evenings



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