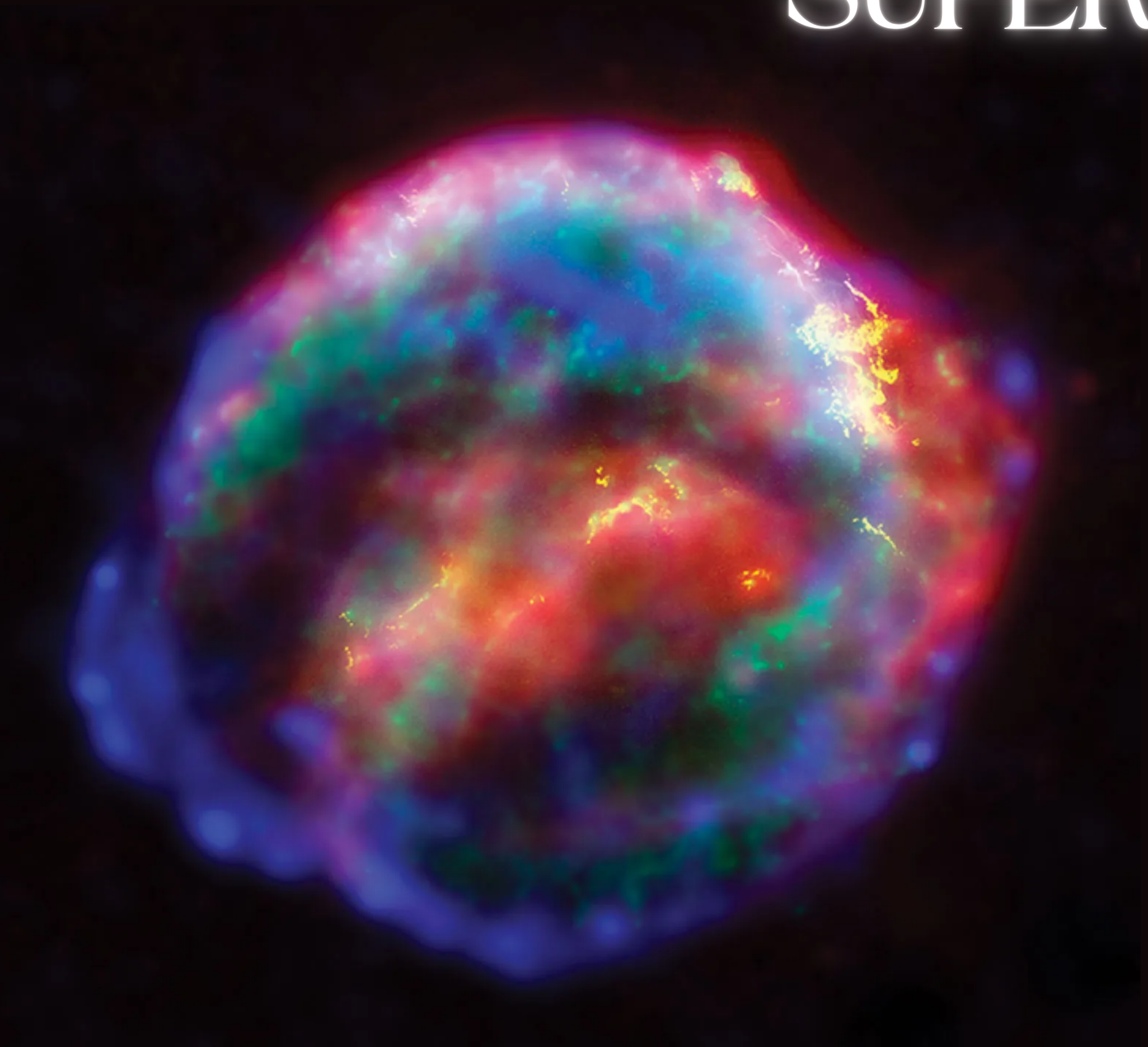
TYPE 1A SUPERNOVA

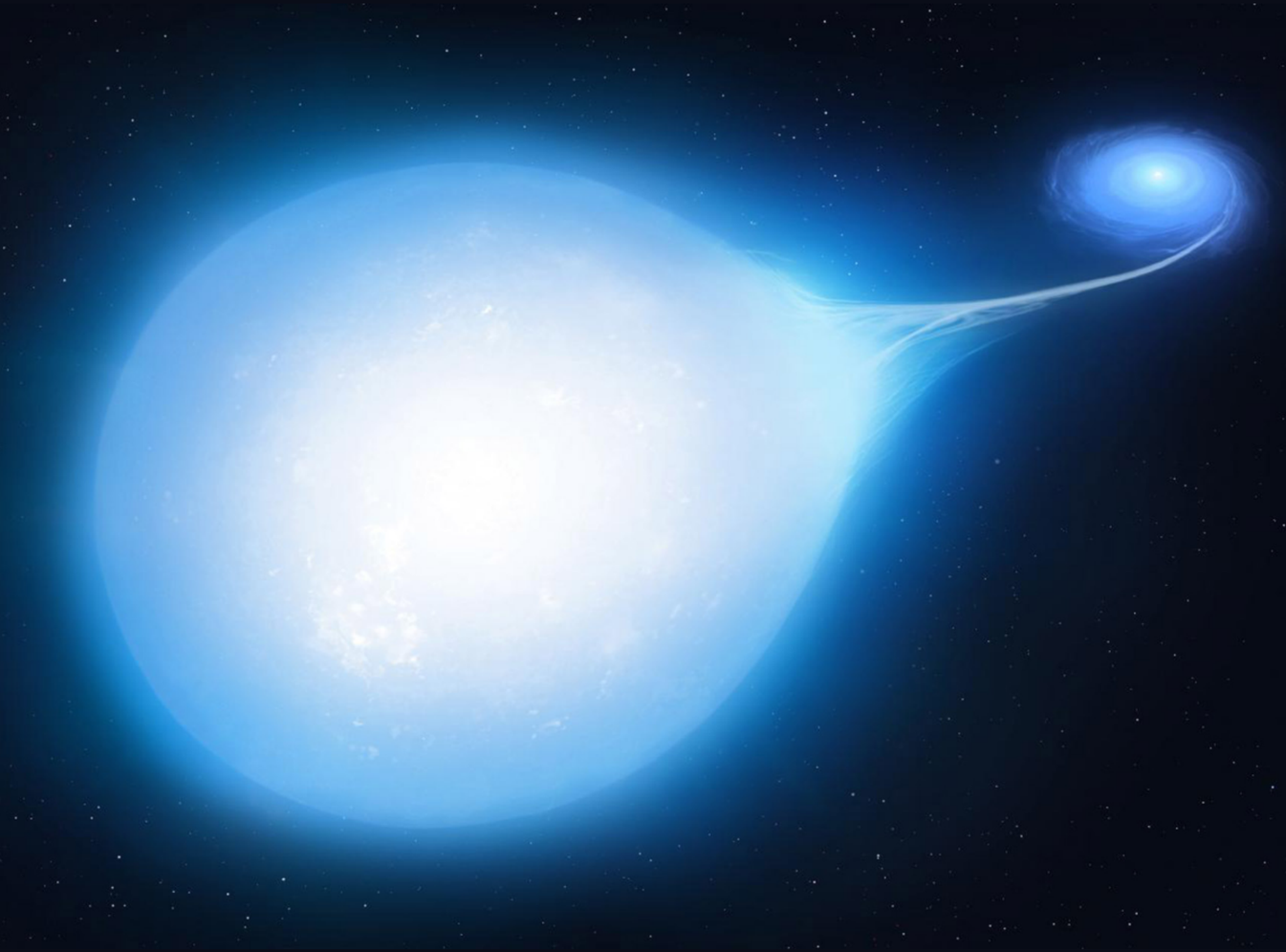
YASHWANTH KARUPARTHI

SUPERNOVA



- **Supernova** is collosal explosion in space that occurs during the final stages of a supermassive star
- They are sources of huge amounts of elements, radiation and neutrinos in our universe
- They are known as particle accelerators
- Stars at least eight times the mass of our sun can undergo this dramatic explosion

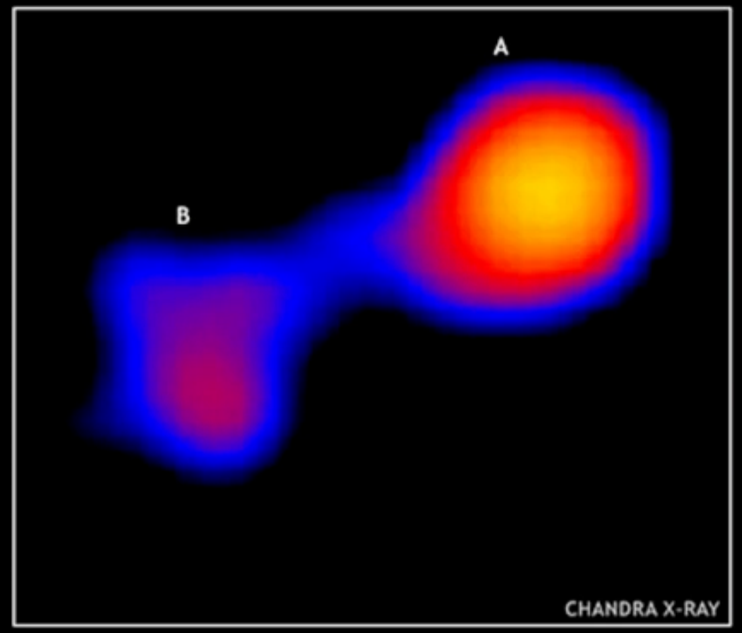
TYPE 1A SUPERNOVA



- **Type 1a supernova** are a class of supernova occurring in binary star systems: a **white dwarf** and a **giant star** (main-sequence star) or even a smaller white dwarf
- It is a subcategory in the Minkowski–Zwicky supernova classification scheme
- Generally lack hydrogen lines in their spectra and have a strong Si II lines at 615 nm
- They don’t involve core collapse of a massive star and are thermonuclear in nature
- Most supernovae grow brighter for 2-3 weeks after the explosion, remain bright for up to 3 months

The Origin

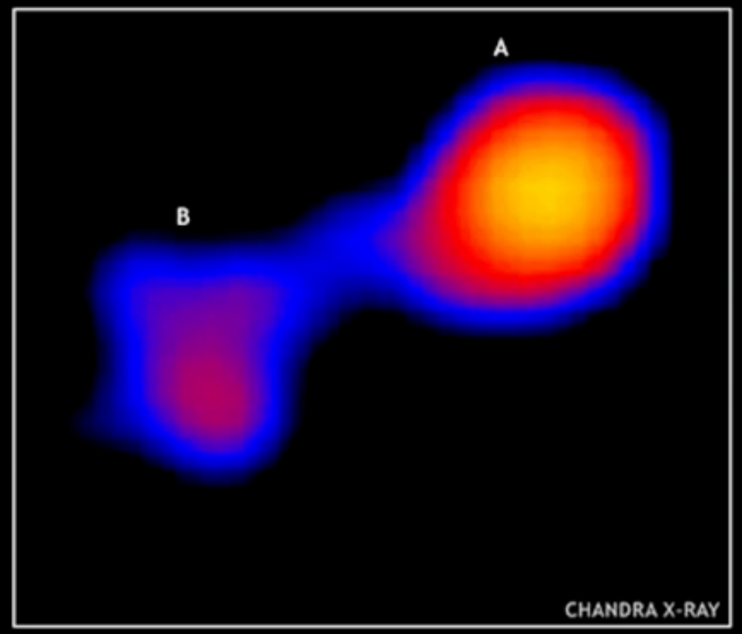
- The white dwarf orbits a companion star in a close binary system and accretes matter from it, steadily increasing the mass
- As the white dwarf gains mass, it approaches a critical limit where it becomes unstable



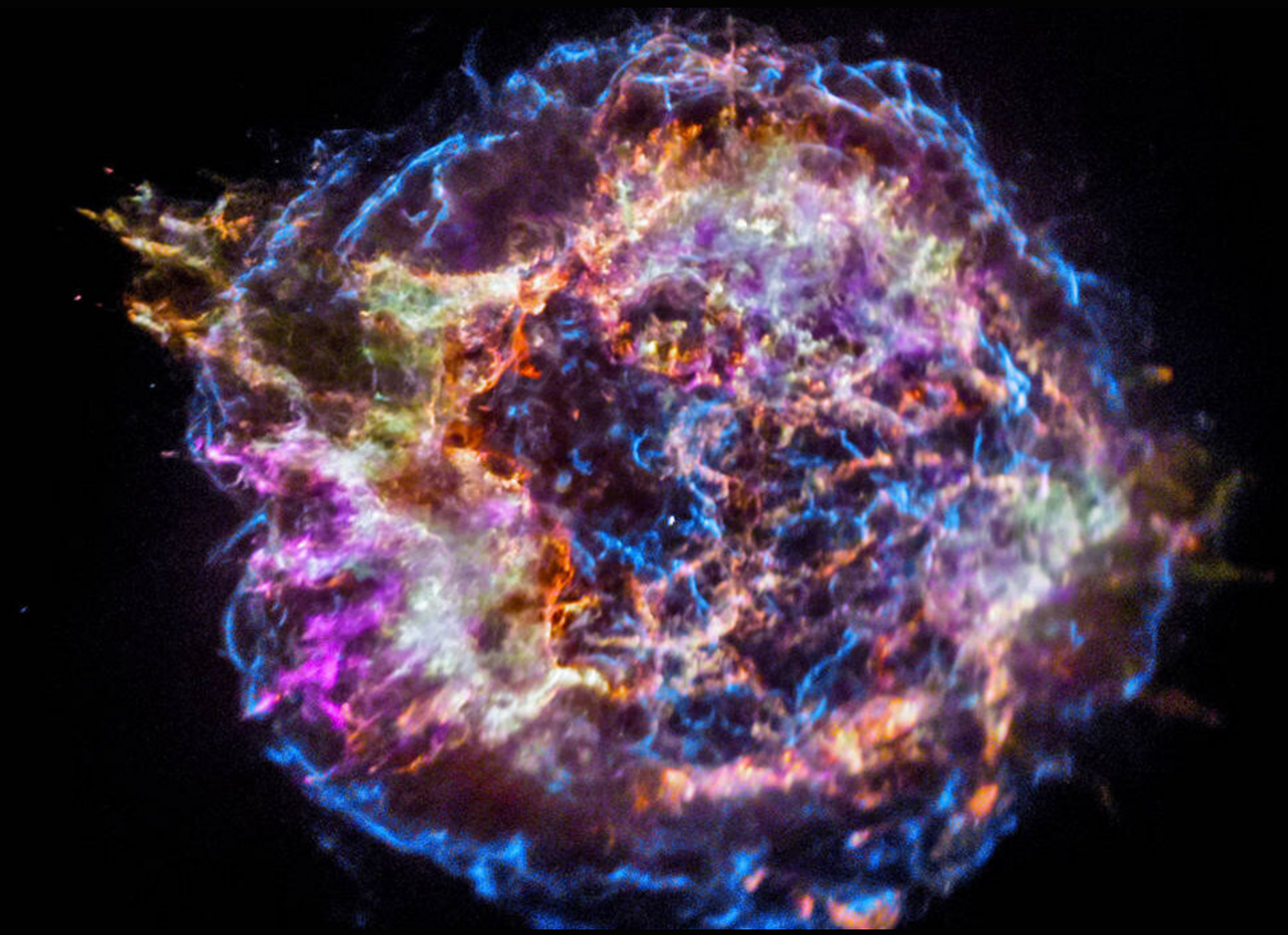
The Origin

- The white dwarf orbits a companion star in a close binary system and accretes matter from it, steadily increasing the mass
- As the white dwarf gains mass, it approaches a critical limit where it becomes unstable

Chandrasekhar limit = 1.44 solar mass



The Origin

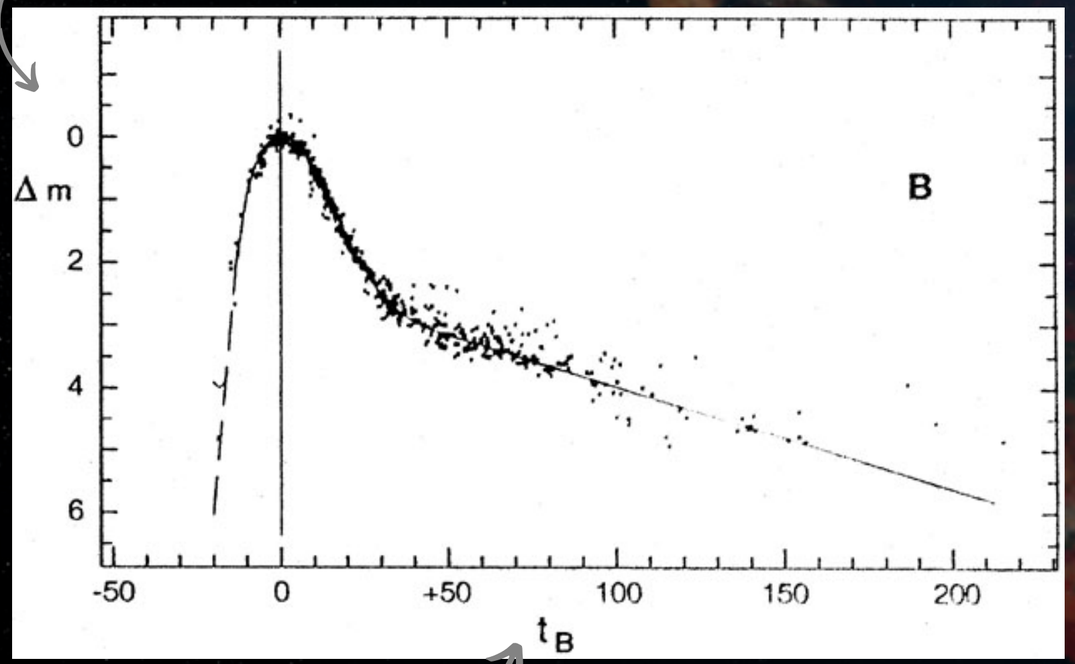


- Carbon-oxygen white dwarfs have low rate of rotation which allow them to exist only below the critical limit
- When the mass exceeds its limit, the electron degeneracy pressure can no longer balance the gravity
- This triggers a runaway thermonuclear fusion reaction and gets ignited in an uncontrolled explosion

THEIR SIGNIFICANCE

- Type 1a Supernova are used as distance indicators due to their consistent peak luminosity and same amount of brightness emitted after the explosion. By measuring their distance, we also get the distance of the galaxy it has occurred in

Apparent magnitude



Time

Light curve

- By measuring the distances and their redshift, astronomers can determine the cosmic expansion rate
- They provide insights into the life cycles of stars
- Release vast amounts of energy and heavy elements that help us understand the history of galaxy formation and their evolution

MEASURING DISTANCE OF NEARBY GALAXIES

apparent magnitude

distance of (celestial) object from Earth

$$m - M = 5 \log(d) - 5$$

absolute magnitude

MEASURING DISTANCE OF NEARBY GALAXIES

Distance of a Type 1a Supernova can be measured using Distance Modulus:

$$m-M = 5 \log(d) - 5$$

m = apparent magnitude
M = absolute magnitude
d = distance to object from Earth

- Absolute Magnitude is defined to be -19.3±0.3 which is derived using the light curve
- Apparent Magnitude is measured using photometric instruments


THANK YOU