

Earth 101

Introduction to Astronomy

Galaxies

Instructor:
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OpenStax Ch 26
Galaxies

Photo/Material Credit:




- Fred Marschak
- Dr. Jatila van der Veen
- Erin O'Connor + others

Other Galaxies



Virgo Supercluster

General Characteristics of Galactic Types

Shape	Example	Features	Dust & Gas
Elliptical Galaxies		Largest & Smallest	Almost no dust and gas
Disk Shaped Galaxies		Spiral Arms	Dust & gas in arms
Irregulars		No overall structure	Very rich in dust & gas

Distance Techniques

Geometric
Method

Technique	Range	Example
Parallax	100's of LY's	Our Sun's neighborhood

Standard Candle
Method

A. Spectroscopic Parallax	Tens of thousands of LY	Within our Milky Way galaxy only
B. Main Sequence Fitting	Hundreds of thousands of LY	Within area of Milky Way
Cepheid Variables	Millions of LY	Other Galaxies

Add
2
rows



Henrietta Leavitt

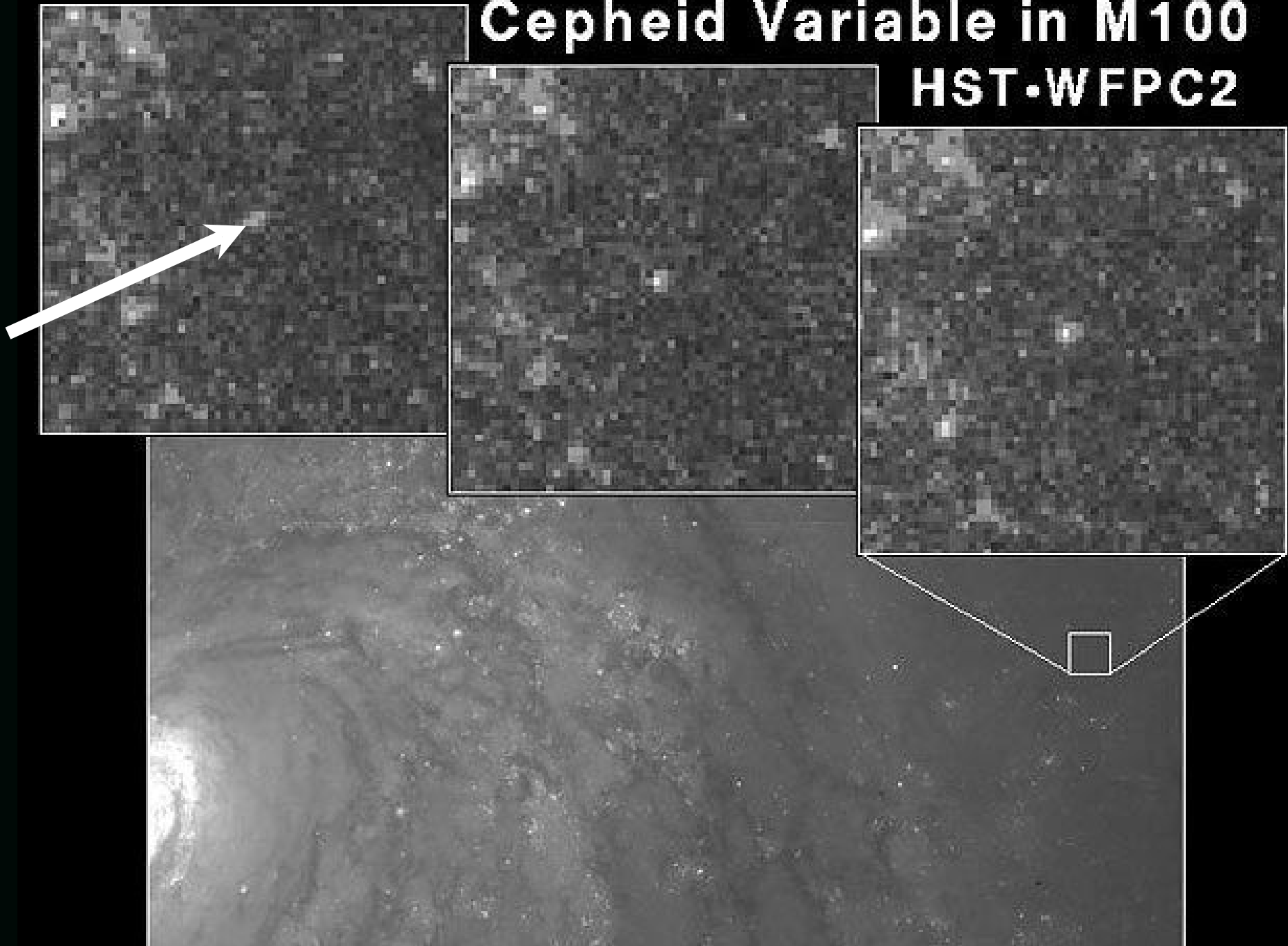
Annie Cannon

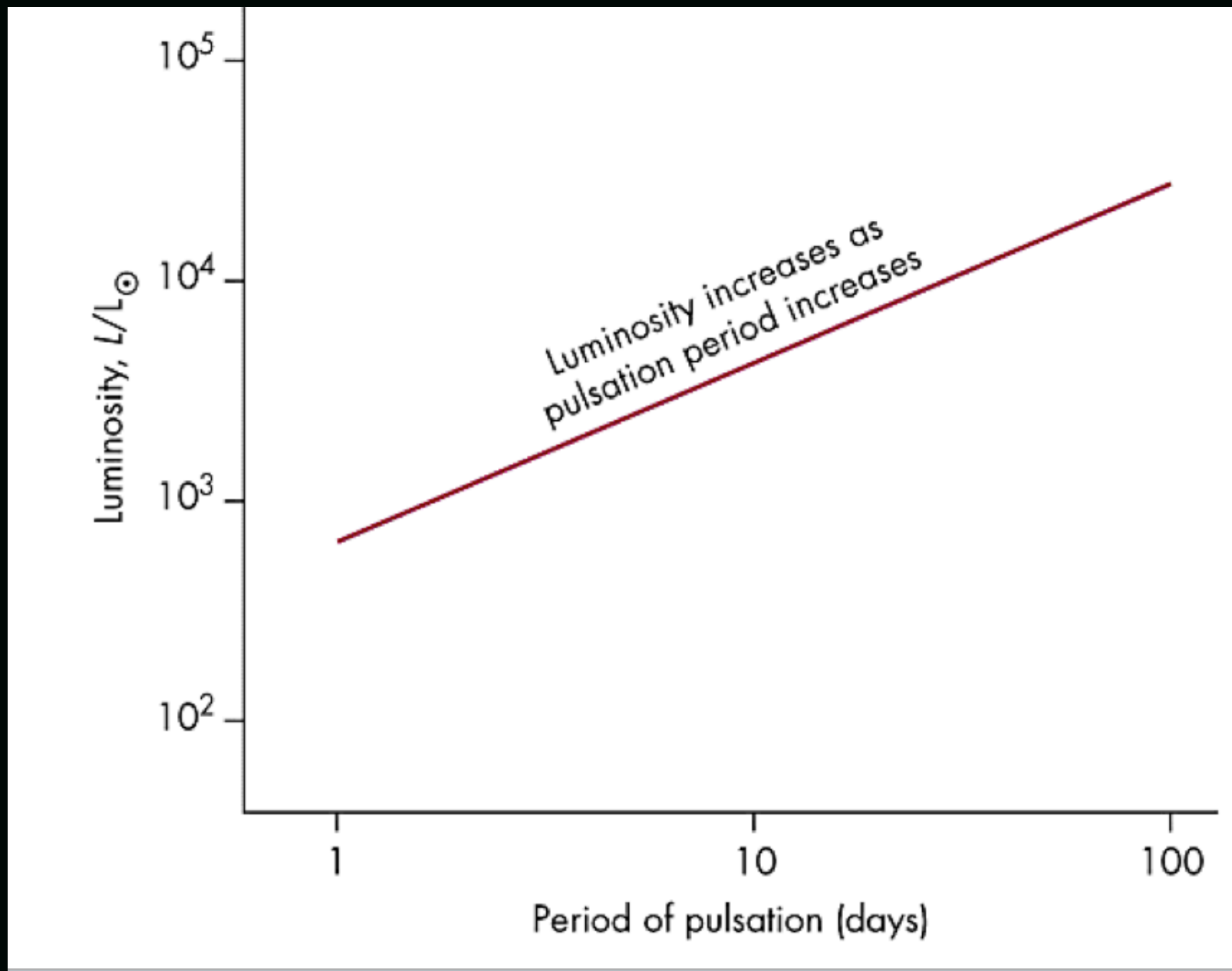


Discovered how to use Cepheid Variables
to determine the distance to galaxies

Cepheid Variable in M100

HST-WFPC2





Period - Luminosity Relationship of Cepheid Variables

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1. Anyone remember the difference between Type I and Type II Supernovae?

2. Anyone remember why a White Dwarf in a binary system can be a SUPERNOVA?

3. Why would Astronomers use a Type I and NOT a Type II Supernovae?



Supernovae Types

Type I Supernova

Binary System with a White Dwarf star

Type II Supernova

Guest Star of 1054

1845

72" Telescope
used to observe a
fuzzy spot in
Taurus.

Called it the ...
Crab Nebula



In 1885, astronomers observed



S - Andromeda



Why was this a VERY important event?

They had observed a ...

SUPERNOVA



A Supernova ...

...is as bright as 4 to 10 billion Suns

...emits the energy of 300
years of sunlight in just

ONE SECOND

Supernovae

Visibility in the Milky Way
averages 1 per 100 years

Last one was in 1604 - Tycho's Star

A supernova within 30 LY

- ✴ Would be seen in the daytime
- ✴ Blast of X-Rays and UV
- ✴ Earth's atmosphere destroyed
- ✴ Statistically, 6 SN's in Earth's lifetime

Are SN remnants observable?



Supernova Remnants

Veil Nebula

Supernova Remnants

Veil Nebula



Supernova Remnants

Cygnus Loop

- ★ Age: 50,000 years old
- ★ Distance: 2500 LY
- ★ Diameter: 70 LY

Angular Diameter
3 degrees

Supernova Remnants

Gum Nebula

© Dick Locke

Supernova Remnants

Gum Nebula

- ★ Diameter = 2400 LY
- ★ Distance from center = 1500 LY
- ★ Distance to leading edge is?



Nova vs. Supernova

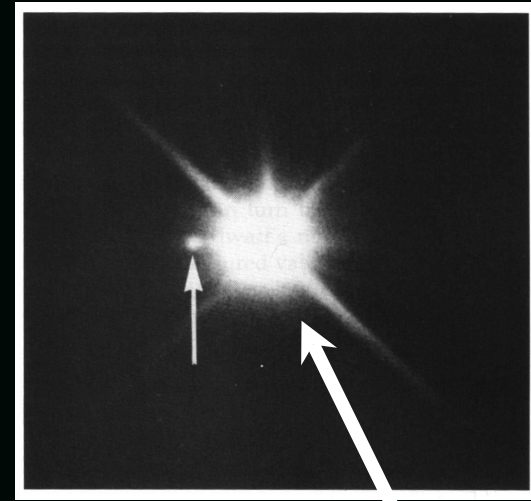


Nova

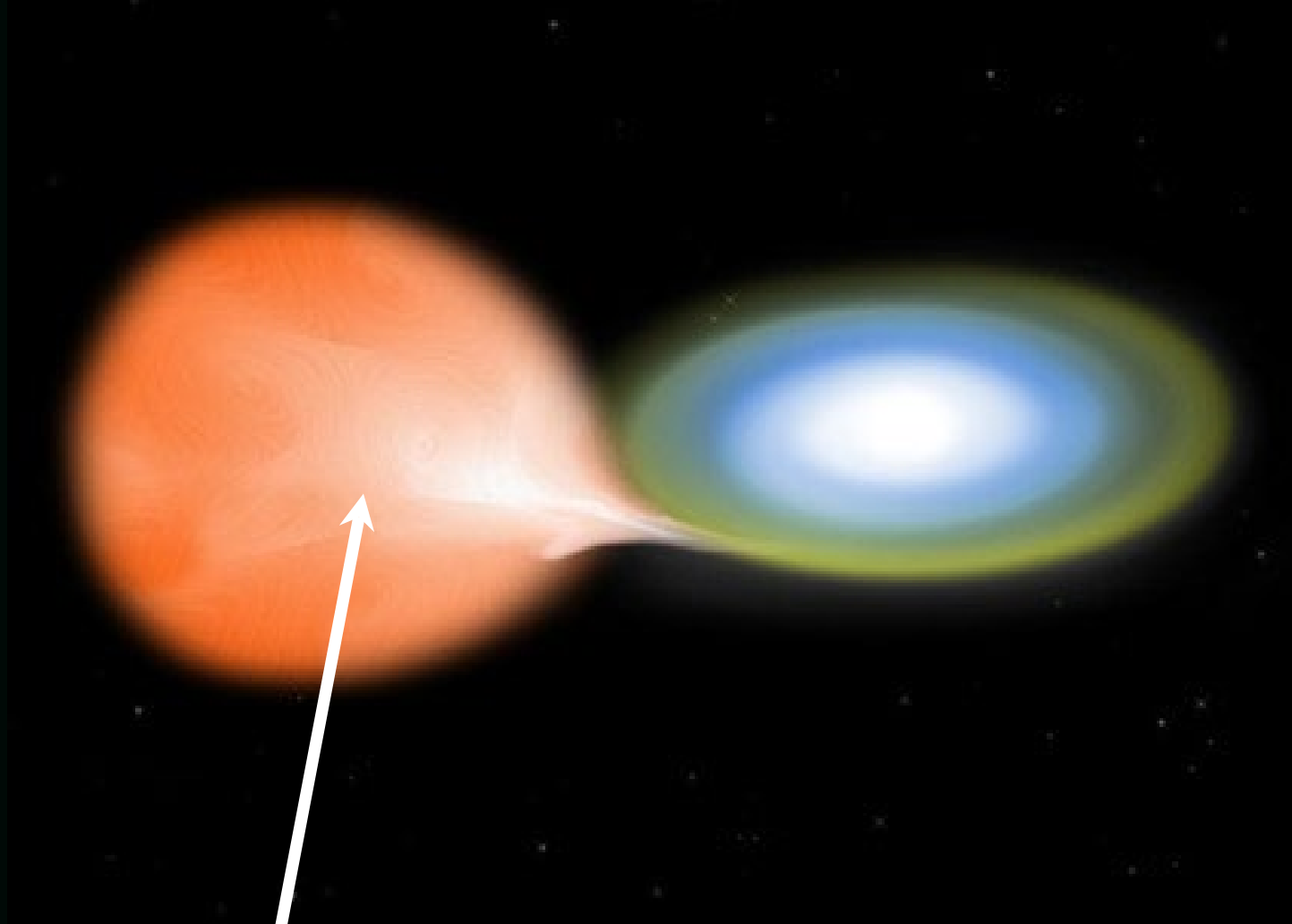
Stars in a binary system where:

- * The more massive star of the two has become a White Dwarf

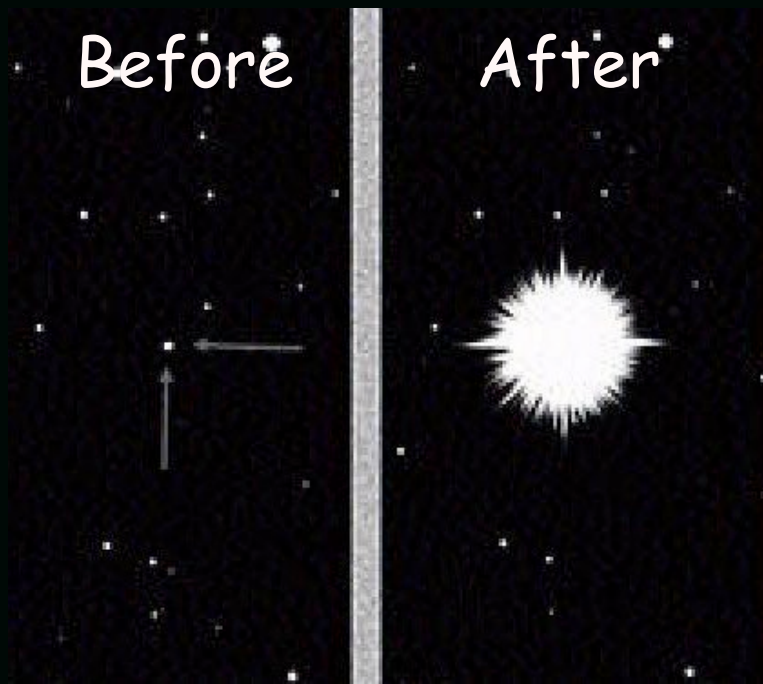
Given: This IS a White Dwarf. How do you know the other star is LESS massive than the parent of the White Dwarf Star was?



- * The less massive star is evolving to a Red Giant



* The Red Giant exceeds its Roche Limit and dumps material on the White Dwarf Star resulting...



...in a NOVA.

The white dwarf can repeat doing this many times over years until...

(HINT: the mass of White Dwarf will increase a little each time it goes 'Nova')

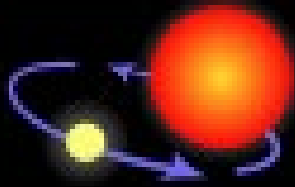
The White Dwarf 's mass may overcome Chandrasekher's Limit and will become a type of Supernova.

Type I Supernova

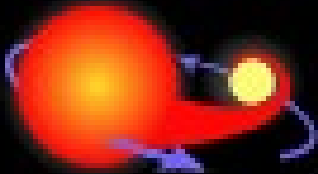
The progenitor of a Type Ia supernova



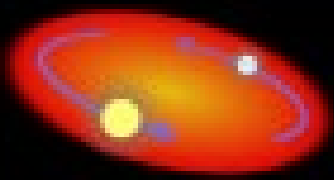
Two normal stars are in a binary pair.



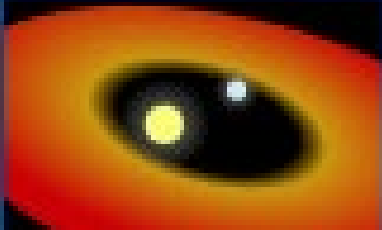
The more massive star becomes a giant...



...which spills gas onto the secondary star, causing it to expand and become engulfed.



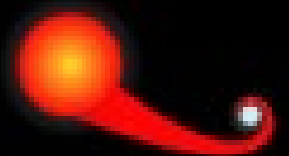
The secondary, lighter star and the core of the giant star spiral toward within a common envelope.



The common envelope is ejected, while the separation between the core and the secondary star decreases.



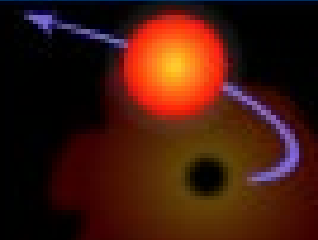
The remaining core of the giant collapses and becomes a white dwarf.



The aging companion star starts swelling, spilling gas onto the white dwarf.

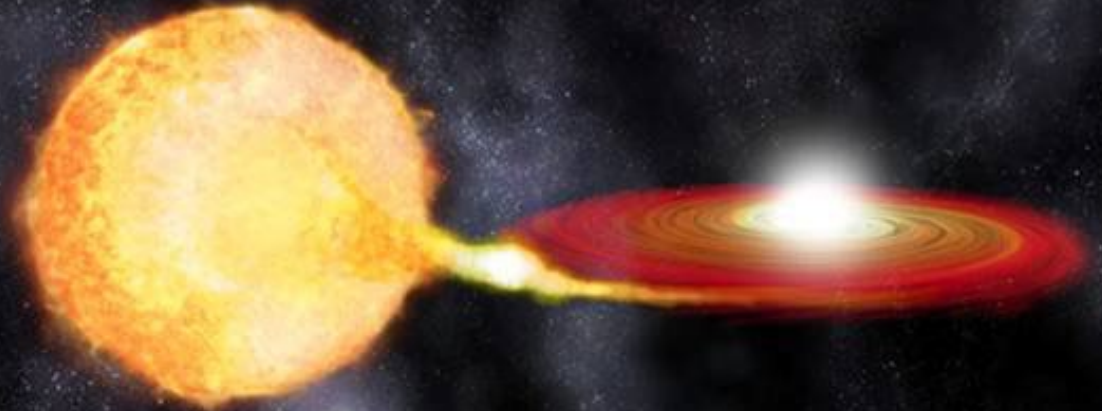


The white dwarf mass increases until it reaches a critical mass and explodes.

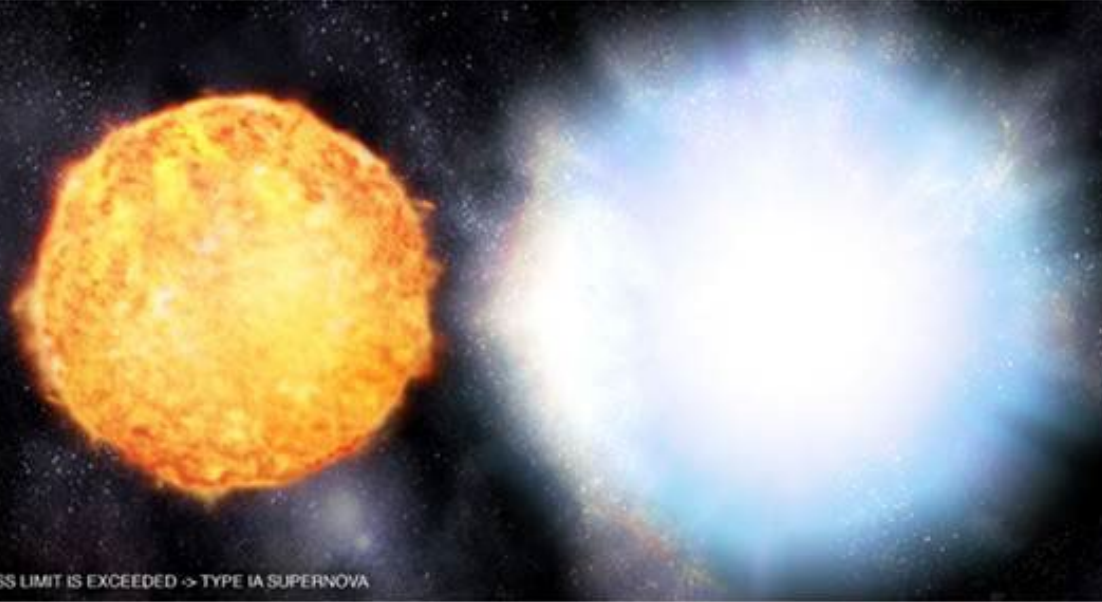


...causing the companion star to be ejected away.

ACCRETION SCENARIO



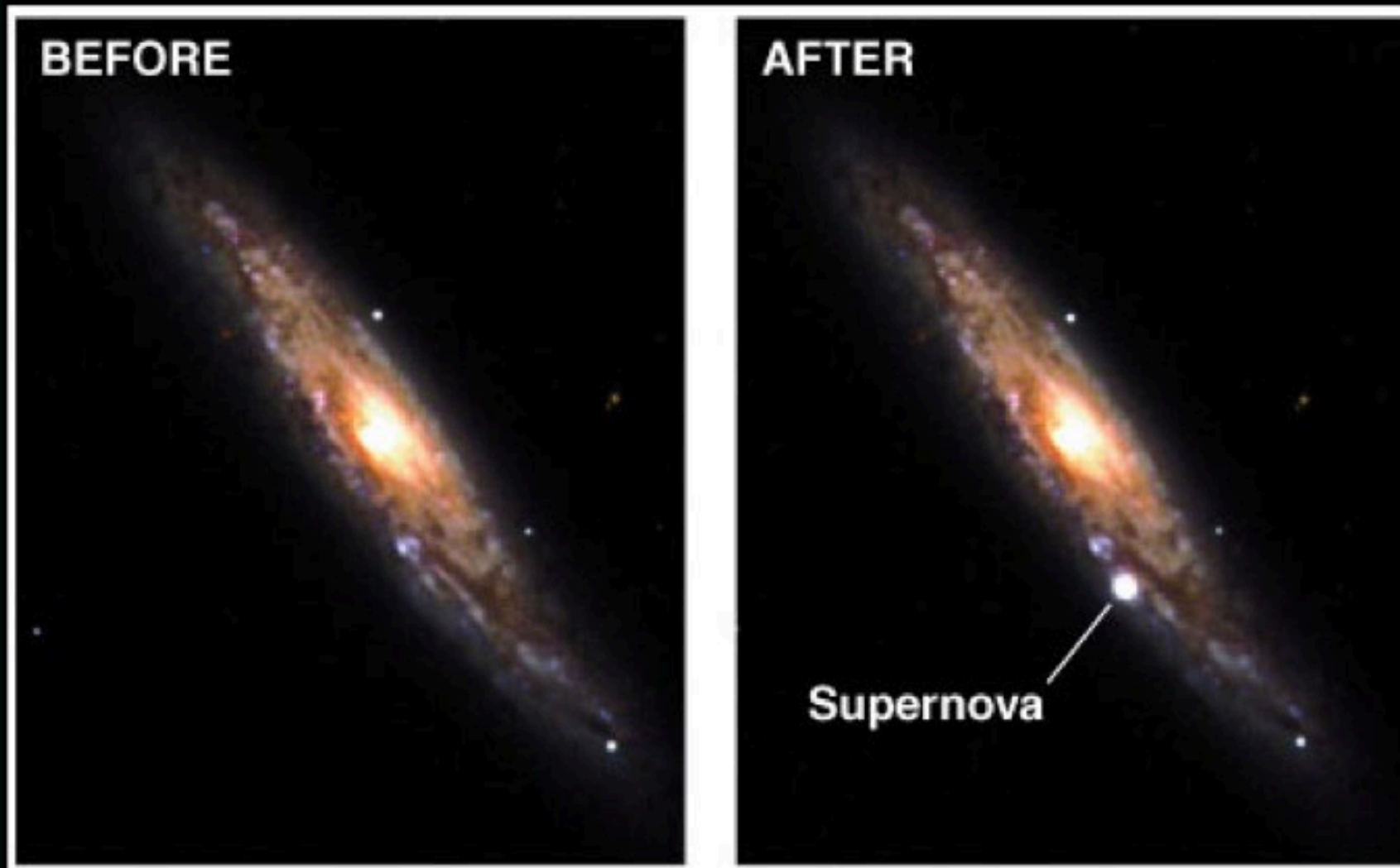
WHITE DWARF GROWS IN MASS



MASS LIMIT IS EXCEEDED -> TYPE Ia SUPERNOVA

Distance Techniques

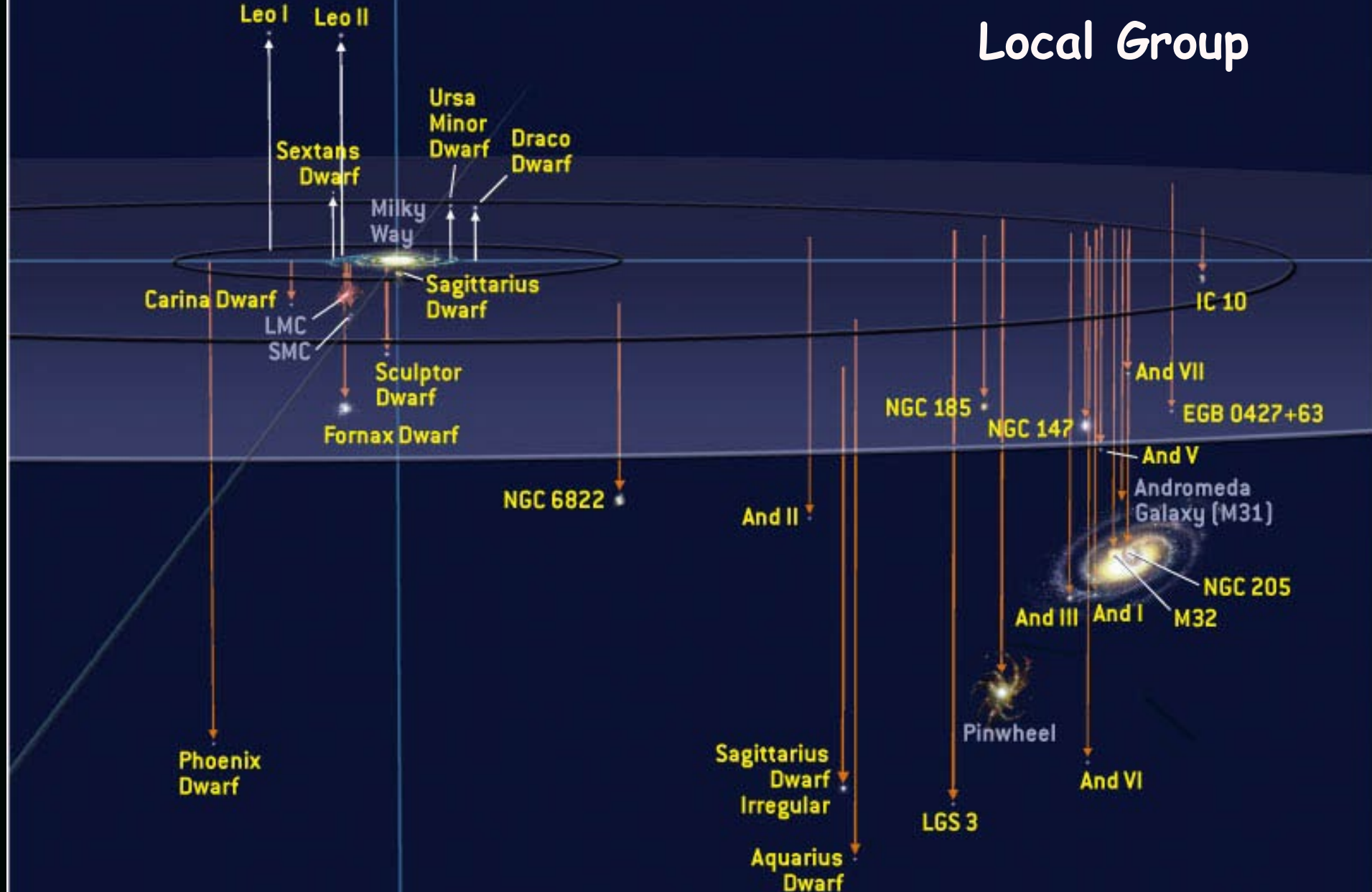
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Supernova Type I	Billions of LY	Crab Nebula



Type I Supernova

Galaxies in our neighborhood...

Local Group





The Small and Large Magellanic Clouds



Which type has the least dust?

- A. Irregulars
- B. Ellipticals
- C. Disk Shaped

Which type is the Milky Way?

- A. Irregulars
- B. Ellipticals
- C. Disk Shaped

Which type of supernova do we use for most distance finding (Standard Candle)

- A. Type III Supernova
- B. Type II Supernova
- C. Type I Supernova
- D. trick question: all 3 can be used

Cepheid Variables can be used as a
Standard Candle because of their:

- A. Mass-Luminosity Relationship
- B. Period-Luminosity Relationship
- C. Equivalence Relationship
- D. Mass Relationship
- E. Light Speed Relationship

