

Death of large stars

Agenda
 Supernova Ia
 Death of high mass stars:
 Neutron stars
 Pulsars
 Video: neutron stars and black holes
 Black holes

Mass Exchange between Close Binary Stars

- 1 Held in a gravitational embrace, the pair of stars in Phi Persei have lived normal lives for the last 10 million years.
- 2 The duo's quiet lives end when the more massive star enters its twilight years. The aging star swells as it runs out of the fuel — hydrogen — which powers its thermonuclear furnace.
- 3 As the aging star expands, it begins dumping its mass onto its companion.
- 4 The more massive star sheds practically all of its mass, leaving its hot, bright core exposed.
- 5 The smaller companion, on the other hand, has captured most of its partner's excess mass and changes its identity from a mild-mannered, moderately massive star to a massive, hot, rapidly spinning star.
- 6 In fact, the star is spinning so rapidly that its shape is distorted into a flattened spheroid. The rapid rotation also causes the star to dump its hydrogen gas, which has settled into a broad ring — like the rings of Saturn — around the star.

May result in Super nova type Ia

Sirius and White Dwarf

Sirius B, a white dwarf, at the five o'clock position

Both are hot blackbodies and strong emitters of X rays

Nova Herculis 1934

Shortly after peak brightness as a magnitude -3 star.

Two months later, magnitude +12.

Structure of an Old High-Mass Star

1.6 billion kilometers

A supergiant star

Central region of a supergiant star

Jupiter's orbit

Stage	Central temperature (K)	Central density (kg/m ³)	Duration of stage
Hydrogen fusion	4 × 10 ⁷	5 × 10 ³	7 × 10 ⁶ yr
Helium fusion	2 × 10 ⁸	7 × 10 ³	5 × 10 ⁵ yr
Carbon fusion	6 × 10 ⁸	2 × 10 ⁸	600 yr
Neon fusion	1.2 × 10 ⁹	4 × 10 ⁸	1 yr
Oxygen fusion	1.5 × 10 ⁹	1 × 10 ¹⁰	6 mo
Silicon fusion	2.7 × 10 ⁹	3 × 10 ¹⁰	1 d
Core collapse	5.4 × 10 ⁹	3 × 10 ¹²	0.2 s
Core bounce	2.3 × 10 ¹⁰	4 × 10 ¹⁷	milliseconds
Supernova explosion	about 10 ⁹	varies	hours

Supernovae Proceed Irregularly

Silicon d Calcium e Iron

An X-ray picture of Cassiopeia A taken by *Chandra*

Radio image produced by the Very Large Array (VLA)

Supernova Light Curves

Recording a Pulsar

PSR 0329+54

