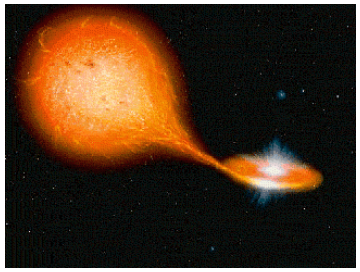
Types of Supernovae

There are 2 different main types of Supernovae:

Type I



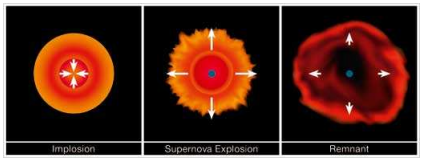
ircamera.as.arizona.edu/NatSci102/images/lec22_07.gif

A white dwarf is an old star, about the size of Earth.

In a binary star system the white dwarf will start drawing material off the companion star if they are close to each other . This is due to its high density.

If the white dwarf reaches the Chandrasekhar limit, 1.4 times the mass of the Sun, the pressure in the core will cause carbon and oxygen atoms to fuse resulting in an explosion!

Type II



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These Supernovae are formed by the process described opposite, in the section “What is going on?”

What is a Supernova?

A supernova is an exploding star. They occur in all galaxies and release tremendous amounts of energy.

Super fact

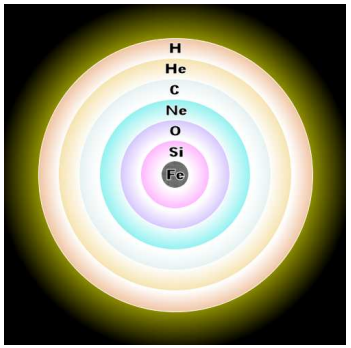
Supernovae last for about a week but can be as bright as a galaxy of 100 billion stars!

What is going on?

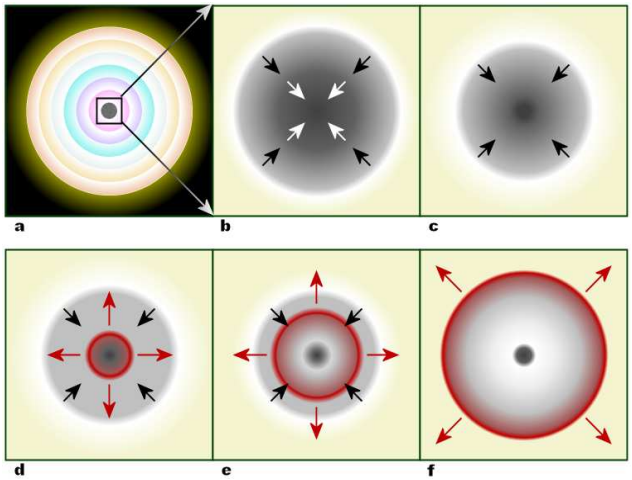
During the lifetime of all stars, hydrogen is converted to helium by thermonuclear fusion.

This process involves gravitational force within the star and intense heat to force hydrogen atoms together.

When most of the hydrogen is used up, the helium is converted into carbon using the same process.



Design by RJ Hall, December 18 2006



Design by RJ Hall, December 18 2006

In stars that are 8 or even 10 times more massive than the Sun, the process continues:

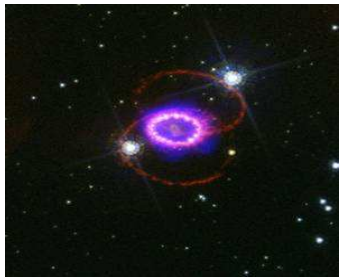
- The carbon core shrinks under its own weight.
- Its temperature rises high enough to fuse carbon into oxygen, neon, silicon, sulphur and eventually iron!

This star shell is shown above.

Now, the outward pressure produced by the reactions no longer balances the gravitational attraction between the atoms.

The core collapses under its own weight causing the star to implode, which transforms gravitational potential energy into kinetic energy.

The core then recoils resulting in the explosion seen opposite. The whole process can be seen above.



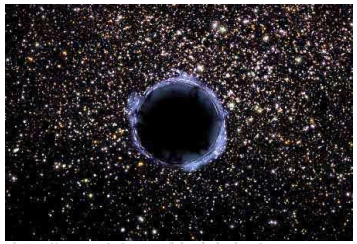
NASA/STScI/Cfa/P. Challis

What happens next?

All supernova release clouds of debris and large amounts of energy.

Type I supernovae completely destroy the star but Type II supernovae leave behind the star core, which becomes a Neutron star.

This is a star made up of neutrons caused by protons and electrons combining from the force of the star collapsing.



http://www.ciai-s.net/black-holes.jpg

If the original star was more than 10 times the mass of the Sun, the core will keep collapsing due to its own gravitational pull.

The core becomes so small and dense that its gravitational pull is so strong, not even light can escape.

It has now become a Black hole!

NOVAE

G STARS!

Where did it all begin?

As far back as AD184 in China astronomers have been able to observe and record supernovae.

October 1604 was the last time a supernova in the Milky Way galaxy became visible on Earth . It was measured in detail by the German mathematician, Johannes Kepler, who noted that it was bright enough to see at night for a whole year!

One of the most important supernova of the 20th century exploded on 28 March 1993 in the galaxy M81. Scientists were observing a red giant which was behaving strangely when it suddenly exploded. They were then able to track the characteristics of a supernova.

Super fact

We have not observed a supernova in the Milky Way galaxy since the invention of the telescope.

Super fact

A supernova seen by Chinese astronomers in AD 184 was thought to be such a bad omen that it sparked off a palace revolution!

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Why are Supernovae so super?

- Scientists can learn about the final evolutionary path of stars.
- The origin of chemical elements that make up stars, planets and even life can be found from supernovae.
- Distance to galaxies with supernovae can be measured using information from supernovae.

Further Reading

- Laurence A Marschall, The supernova story, 1994, Princeton University Press.—a book on background theory, specifically to do with supernovae.
- Brecher, Kenneth. "Supernova." World Book Online Reference Center. 2005. World Book, Inc. http://www.worldbookonline.com/wb/Article?id=ar540310.—an article on basic definitions produced by NASA.
- Asimov, Isaac, The Birth and Death of Stars, 1989, Milwaukee, Gareth Stevens, Inc.—a book that describes the life cycle of stars.

SUPER

EXPLODIN