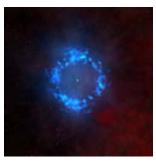


## X-Ray Astronomy Field Guide

## **Supernovas and Supernova Remnants**

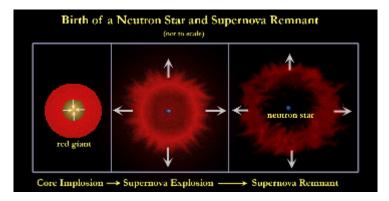


Animation of Supernova Explosion

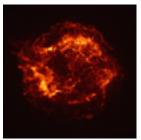
Every 50 years or so, a massive star in our galaxy blows itself apart in a supernova explosion. Supernovas are one of the most violent events in the universe, and the force of the explosion generates a blinding flash of radiation, as well as shock waves analogous to sonic booms.

There are two types of supernovas: **Type II**, where a massive star explodes; and **Type Ia**, where a white dwarf collapses because it has pulled too much material from a nearby companion star onto itself.

The general picture for a Type II supernova goes something like this. When the nuclear power source at the center or core of a star is exhausted, the core collapses. In less than a second, a neutron star (or black hole, if the star is extremely massive) is formed. As infalling matter crashes down on the neutron star, temperatures



rise to billions of degrees Celsius. Within hours, a catastrophic explosion occurs, and all but the central neutron star is blown away at speeds in excess of 50 million kilometers per hour. A thermonuclear shock wave races through the now expanding stellar debris, fusing lighter elements into heavier ones and producing a brilliant visual outburst that can be as intense as the light of several billion suns!



Chandra Image of Cassiopeia A (NASA/CXC/SAO)

The matter thrown off by the explosion plows through the surrounding gas producing shock waves that create a shell of multimillion degrees gas and high energy particles called a supernova remnant. The supernova remnant will produce intense radio and X-radiation for thousands of years.

In several young supernova remnants the rapidly rotating neutron star at the center of the explosion gives off pulsed radiation at X-ray and other wavelengths, and creates a magnetized bubble of high energy particles whose radiation can dominate the appearance of the remnant for a thousand years or more.

Eventually, after rumbling across several thousand light years, the supernova remnant will disperse.



Chandra Image of Crab Nebula (NASA/CXC/SAO)