

Figure 4.37 The Crab Nebula is the remains of a supernova observed in 1054. Chinese historical records from that year referred to it as a “guest star.”

neutron star a star so dense that only neutrons can exist throughout

black hole the remnant of a supernova explosion with a gravitational field so strong that nothing can escape its pull

Black Holes

The most spectacular deaths happen to stars whose initial masses are more than 20 solar masses. The remnant of the supernova explosion is so massive that nothing can compete with the crushing force of gravity. The remnant is crushed into a black hole. A **black hole** is a tiny patch of space that has no volume, but it does have mass. Therefore, there is still gravity. In fact, the gravitational force of a black hole is so strong that nothing can escape it. Even light cannot escape a black hole’s gravity.

Black holes are among the strangest objects in the universe. Astronomers predicted the existence of black holes before the first one was discovered. Recall how Mendeleev’s periodic table modelled the elements that were known at the time. Mendeleev’s model led to predictions of missing elements, which then led to discoveries. In a similar way, scientists build mathematical models of how stars evolve and eventually die. The models seemed to fit what scientists were seeing, so when the models pointed to the possibility that a strange object like a black hole could exist, scientists started looking for them.

When astronomers say they have detected a black hole, they do not mean that they have seen one. What they mean is that they have detected the gravitational effects of an object whose mass and size match those predicted by physics. For example, black holes that exist in congested regions of space sometimes swallow up matter and compress it until enormous temperatures are reached before it disappears. When this happens, the black hole emits intense radiation that uncloaks the normally invisible black hole. Astronomers look for the telltale signature of black holes devouring gas, dust, and stars using radio, X-ray, and gamma ray telescopes.

In 1972, Dr. Tom Bolton, of the University of Toronto, identified the first black hole. It is called Cygnus X-1 and is located in our Milky Way. Astronomers now know that, in the centre of most galaxies there are supermassive black holes with a mass millions of times that of the Sun’s.