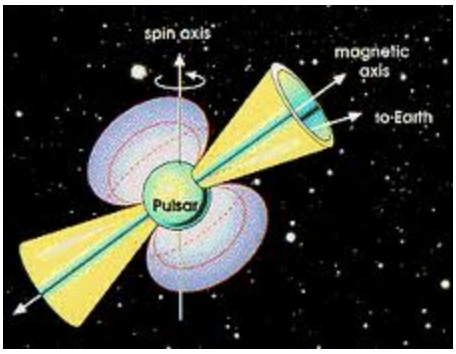
PULSARS

Pulsars are among the strangest objects in the universe. In 1967, at the Cambridge Observatory, Jocelyn Bell and Anthony Hewish were studying the stars when they stumbled on something quite extraordinary. It was a star-like object that seemed to be emitting quick pulses of radio waves. Radio sources had been known to exist in space for quite some time. But this was the first time anything had been observed to give off such quick pulses. They were as regular as clockwork, pulsing once every second. The signal was originally thought to be coming from an orbiting satellite, but that idea was quickly disproved. After several more of these objects had been found, they were named pulsars because of their rapidly pulsing nature. Bright pulsars have been observed at almost every wavelength of light. Some can actually be seen in visible light. Many people tend to get pulsars confused with quasars. But the two objects are totally different. Quasars are objects that produce enormous amounts of energy and may be the result of a massive black hole at the center of a young galaxy. But a pulsar is a different animal entirely.

A pulsar is a neutron star that emits beams of radiation that sweep through Earth's line of sight. Like a black hole, it is an endpoint to stellar evolution. The "pulses" of high-energy radiation we see from a pulsar are due to a misalignment of the neutron star's rotation axis and its magnetic axis. Pulsars seem to pulse from our perspective because the rotation of the neutron star causes the beam of radiation generated within the magnetic

field to sweep in and out of our line of sight with a regular period, somewhat like the beam of light from a lighthouse. The stream of light is, in reality, continuous, but to a distant observer, it seems to wink on and off at regular interval.

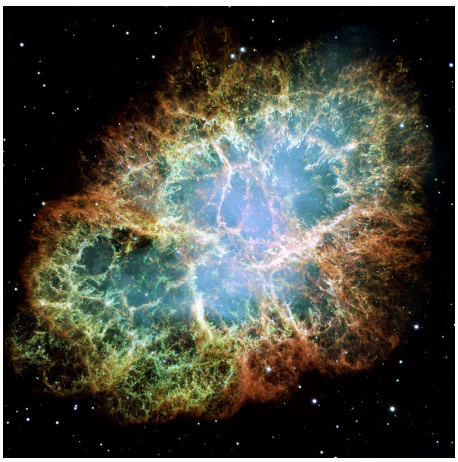


Simply put, pulsars are rotating neutron stars. And pulsars appear to pulse because they rotate!

A neutron star is the highly compacted core of a dead star, left behind in a supernova explosion. This neutron star has a powerful magnetic field. In fact, this magnetic field is about one trillion times as powerful as the magnetic field of the Earth. The magnetic field causes the neutron star to emit strong radio waves and radioactive particles from its north and south poles. These particles can include a variety of radiation, including visible light. Pulsars that emit powerful gamma rays are known as **gamma ray pulsars**. If the neutron star happens to be aligned so that the poles face the Earth, we see the radio waves every time one of the poles rotates into our line of sight. It is a similar effect as that of a lighthouse. As the lighthouse rotates, its light appears to a stationary observer to blink on and off. In the same way, the pulsar appears to be blinking as its rotating poles sweep past the Earth. Different pulsars pulse at different rates, depending on the size and mass of the neutron star. Sometimes a pulsar may have a binary companion. In some cases, the pulsar may begin to draw in matter from this companion this can cause the pulsar to rotate even faster. The fastest pulsars can pulse at well over a hundred times a second.

Discovering Pulsars

Pulsars are still found today by using large radio telescopes. The largest radio telescope in world is located at Arecibo in Puerto Rico. It has been a key tool in the search for pulsars. Several new pulsars have been discovered in the past few years. The famous Crab Nebula (M1) has a pulsar inside it. The nebula is the shell of gas that was exploded out in a supernova when the pulsar formed. The pulsar illuminates the nebula as it pulses at a rate of 33 times per second.



Crab Nebula

Recently, the 1000th pulsar was discovered in Australia using a new radio telescope technology known as a multibeam receiver system. This device allows radio telescopes to scan the skies with up to 13 beams at the same time. Today, new pulsars are being discovered at ten times the rate they were in the 1970s and 1980s. Pulsars make incredibly accurate timekeepers. Their pulses are so consistent that they can be used to tell time with an accuracy much greater than atomic clocks, which are currently the most accurate timekeeping devices on Earth. The fastest know pulsar, known as PSR1937+21, has a pulse period of over 1.56 milliseconds, or 640 times per second. The strongest pulsar found so far is known as PSR 0329+54. It has a very slow pulse period of only 0.715 seconds. Some recently discovered pulsars, such as PSR 1257+12, are believed to have planets orbiting them.