Neutron Stars

Neutron stars are city-size stellar objects with a mass about 1.4 times that of the sun. Born from the explosive death of other, larger stars, these tiny objects pack a punch. Let's take a look at what they are, how they form, and how they vary.

How do they form?

When stars four to eight times as massive as the sun explode in a violent supernova, their outer layers can blow off in an often-spectacular display, leaving behind a small, dense core that continues to collapse. Gravity presses the material in on itself so tightly that protons and electrons combine to make neutrons, yielding the name “neutron star.”

Neutron stars are not very massive but are extremely dense. Our Milky Way galaxy has about 100 million Neutron Stars.

Galactic Lighthouses

Pulsars are rotating neutron stars observed to have pulses of radiation at very regular intervals that typically range from milliseconds to seconds. Pulsars have very strong magnetic fields which funnel jets of particles out along the two magnetic poles.

These accelerated particles produce very powerful beams of light. Like a lighthouse they emit a beam of light that sweeps across the sky. When the beam crosses our line-of-sight, we see a pulse – in other words, we see pulsars turn on and off as the beam sweeps over Earth. All pulsars are neutron stars, but not all neutron stars are pulsars.

Magnetic Monsters

Magnetars are a kind of neutron star with a powerful magnetic field. In a typical neutron star, the magnetic field is trillions of times that of the Earth’s magnetic field; however, in a magnetar, the magnetic field is another 1000 times stronger.

In all neutron stars, the crust of the star is locked together with the magnetic field so that any change in one affects the other. The crust is under an immense amount of strain, and a small movement of the crust can be explosive. In a magnetar, movements in the crust cause the neutron star to release a vast amount of energy in the form of electromagnetic radiation called a starquake.

COM 205 - Neutron Stars Exercise. Copy provided by NASA.