



Prize Winner

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Mysteries of the universe

DEATH OF A STAR

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Introduction

The Universe is full of stars and mysteries. Scientists still don't know so many things about the universe. They make guesses about what they don't know and use special telescopes to observe the Universe and infer what's happening. Scientists are researching the mysterious world of stars, and they still don't know a lot what happens when stars die. Here are some facts we know about the 'Death of Stars'.

Birth of a star

Let's start with how stars are born.

Most stars are born in nebulae. A Stellar Nebula is a great big cloud of dust and gas (Bolles, 2023). The Eagle Nebula is a famous stellar nebula in the Constellation Serpens, which has many baby stars inside about to become grown up stars. The Eagle Nebula was discovered by a Swiss astronomer called Jean-Philippe Loys De Chéseaux (Wikipedia, 2023). Figure 1 shows the picture of the Eagle Nebula.



Figure 1 The Eagle Nebula (Dunbar, 2018)

The birth of a star begins when a Stellar Nebula starts to shrink, then divides into smaller swirling clumps. These clumps contract because of gravity. This causes the centre to heat up and then become a Protostar. A Protostar is a very young star in the Universe that is still gathering mass from a stellar cloud. It was discovered in 1966 by the Japanese astrophysicist Chushiro Hayashi (Wikipedia, 2023). The Eagle Nebula has a spectacular star-forming region known as 'Pillars of Creation'. This is shown in Figure 2.



Figure 2 The Pillars of Creation (Mohon, 2018)

The Protostar shown in Figure 3 is in the Taurus star-forming region some 460 light-years from Earth.

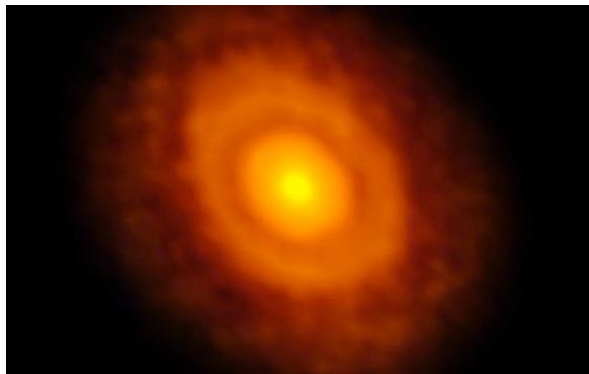


Figure 3 Protostar V883 Orionis in the Orion Constellation (Cieza, 2016)

Main Sequence Star

A Protostar will become hotter and hotter and one day it will become a star. It takes about 50 million years for the clump of gas to become a star like our Sun. This is a Main Sequence Star, which has a hot, dense core fusing hydrogen into helium to produce energy. Main Sequence Star can be of different sizes. Some are small known as Red

Dwarfs. These are about 10% of the Sun's mass. The lifespan of Red Dwarfs can be up to 10 billion years. On the other hand, there are massive stars known as Hypergiants that can be 100 or more times bigger the Sun. But their lifespan is only a few million years (Bolles, 2023). Different sizes of Main Sequence Star are shown in Figure 4. On the left hand are the Blue Supergiants, the hottest stars. On the right hand are the Red Dwarfs, the coldest stars (that is still 3500°C, too hot for humans).

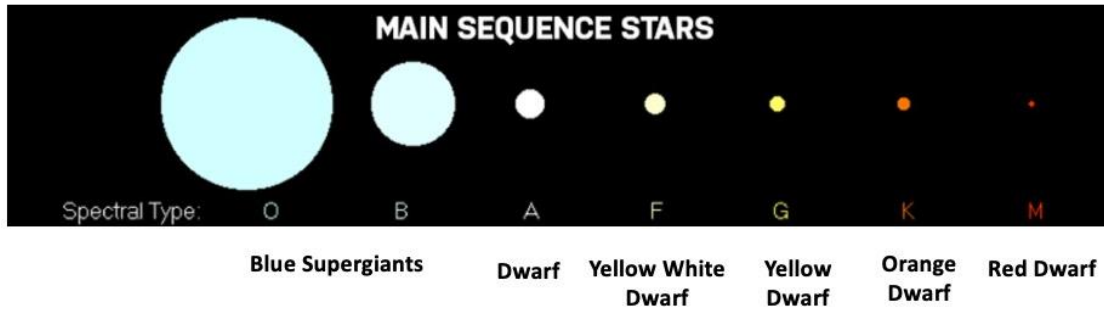


Figure 4 Main Sequence Stars Sizes (AstroBackyard, 2023)

Not all protostars become main sequence stars. The chart below shows the weight that is needed for Protostar to become Real Star. The information used in the chart is taken from (Gary, 2006).

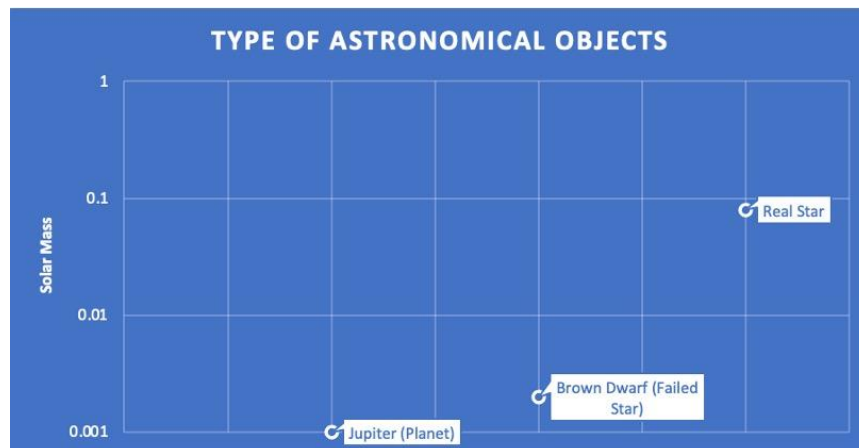


Figure 5 Which Protostar will become a Real Star?

Death of a Star

So, what happens when a star dies?

After several millions of years, a Main Sequence Star will start to die. This process can take several million to billion years. How a star dies depends on its mass. This is shown in Figure 6.

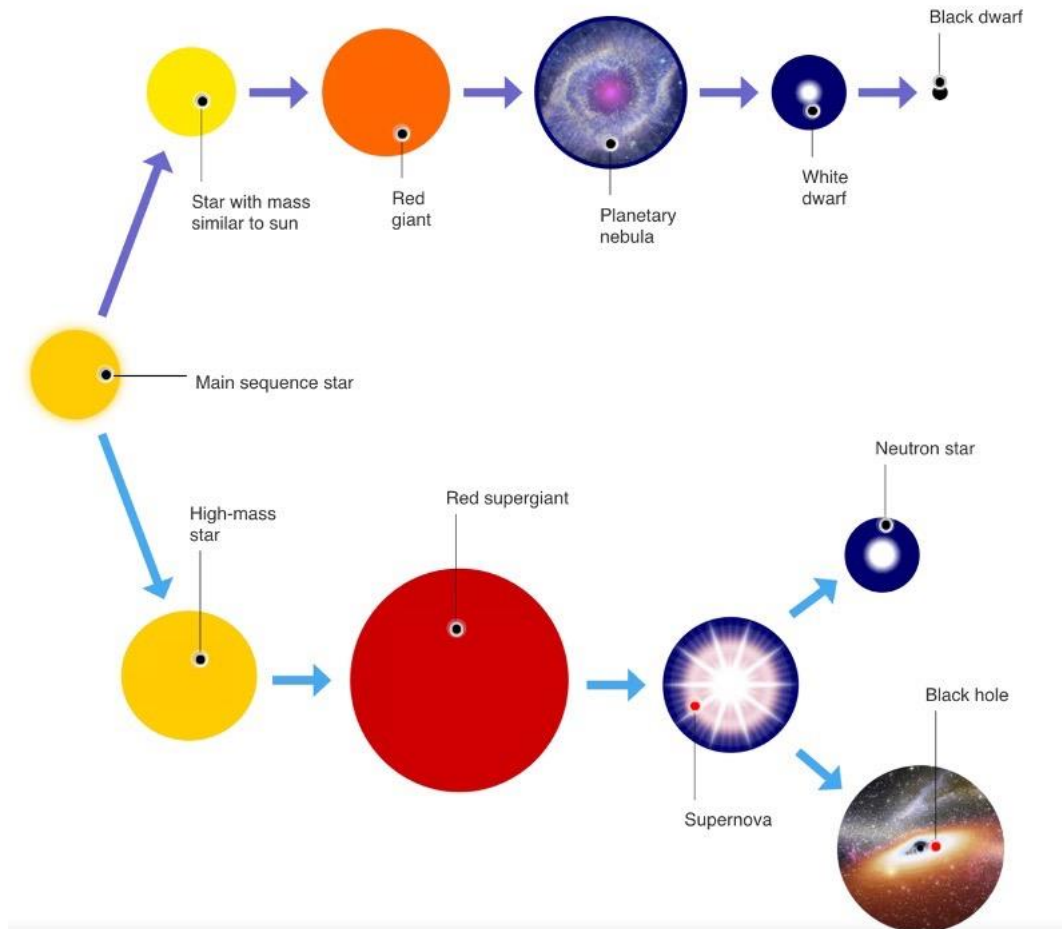


Figure 6 Death of different types of stars (Dorling Kindersley , 2023)

How do Average Stars die?

RED GIANTS

Stars die when their nuclear fuel runs out. When the star has used all the hydrogen in its core, nuclear reaction starts to cease. Because it has no fuel, the core collapses and becomes much hotter. Because of this the upper layers keep heating up. This makes the star expand and it becomes a Red Giant. This will happen to the Sun in 5 billion years. Scientists guess that the Sun will swallow Mercury, Venus, maybe Earth, but not Mars

(Landau, 2023). Our closest Red Giant, about 88.71 light years. Gacrux was discovered in the 19th Century by an American astronomy writer and cartographer Elijah Hinsdale Burritt (Wikipedia, 2023).



Figure 7 Gacrux Red Giant

WHITE DWARF

As the Red Giant's fuel runs out, the core will expand and cool. The upper layers will start to throw away the material that will collect around the dying star to form a Planetary Nebula. Finally, it will become a White Dwarf and then it'll eventually turn into a Black Dwarf. As the time taken to form a Black Dwarf is the more than the current age of the Universe, scientists don't think they will ever see a Black Dwarf.

Helix Nebula, shown in Figure 8, is the nearest planetary nebula to Earth, about 700 Light Years away. The Helix Nebula was discovered in 1823 by German astronomer Karl Ludwig Harding (Wikipedia, 2023). Helix Nebula is located to the center of the Milky Way.



Figure 8 Helix Nebula (NASA, 2017)

Sirius B is the nearest White Dwarf to Earth, about 8.6 light years away. It was discovered in 1844 by the German Astronomer Friedrich Wilhelm Bessel (Wikipedia , 2023). Sirius B is located in constellation Canis Major the Greater Dog.

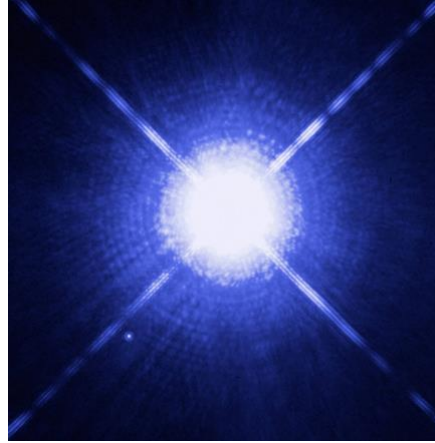


Figure 9 Sirius B: White Dwarf (NASA Content Administrator, 2017)

How do Supermassive Stars die?

When a high-mass star has no hydrogen in the core it expands and becomes a Red Supergiant. While smaller stars fade away into a Planetary Nebula, the Red Supergiants destroy themselves in a huge explosion called a Supernova (Dorling Kindersley , 2023). Supernovas are so bright that they can light their whole galaxy for a few days or even months. But Supernovas are very rare (NASA, 2021). Supermassive stars are located to almost every galaxy in the universe.



Figure 10 Supernova 1987A (May, 2013)

So, what happens to a star after it loses its outer layer?

It depends on its mass. The chart below shows different types of dead stars. The information used in the chart is taken from (Greicius, 2017).

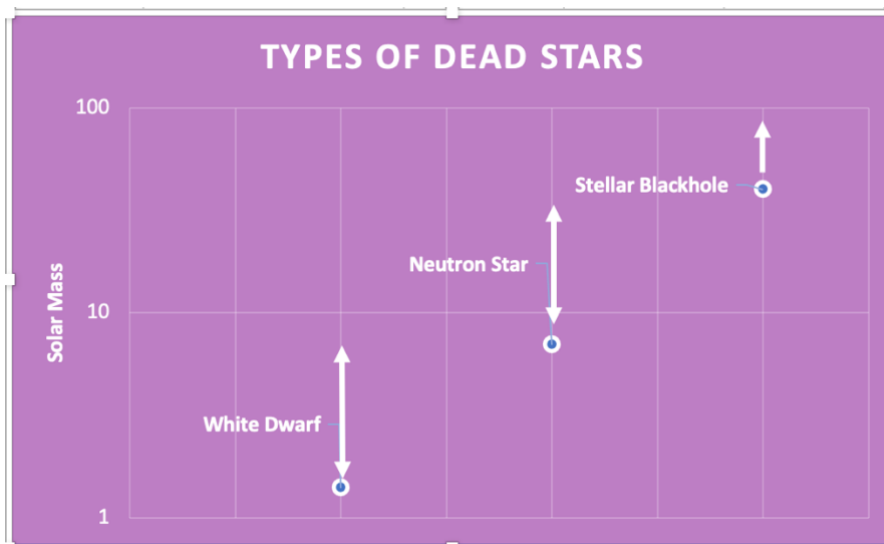


Figure 11 Types of Dead Stars

NEUTRON STAR

Neutron Stars are formed after Supernovas, when stars are about 7 times to 40 times the Solar Mass. RX J1856.5–3754 is the nearest Neutron Star to Earth, about 400 light years away. The Neutron Star was discovered in 1967 by the English Astrophysicist Jocelyn Bell (Wikipedia, 2023). Supernovas are located to Pinwheel Galaxy.

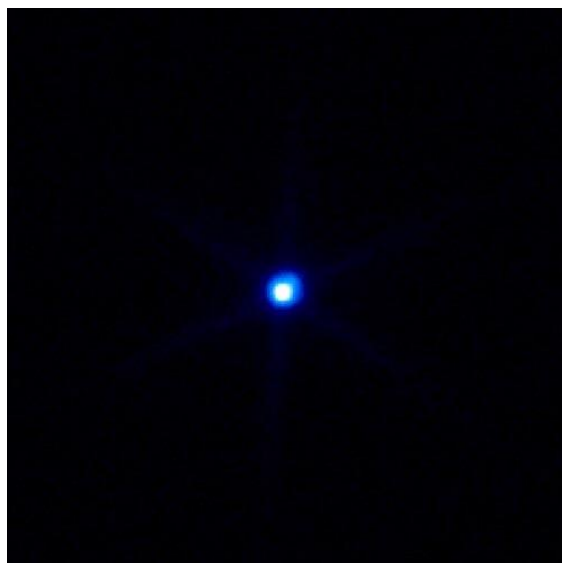


Figure 12 Neutron Star (Wikipedia, 2023) (Wikipedia, 2023)

BLACK HOLE

Black Holes are formed from after Supernovas, when the star are more then 40 times the Solar Mass. The nearest Black Hole to Earth is Gaia BH1 in the constellation Centaurus, About 1600 light years away. Gaia BH1 was discovered in 2022 by the European Space Agency Scientist Tineke Roegiers. Gaia BH1 was discovered along with another Black Hole called Gaia BH2. As black holes are invisible, scientists cannot take a picture. So, they guessed that these were blackholes by looking at the star that seemed to be orbiting something invisible and massive (ESA , 2023). These are shown in Figure 13. Scientists also managed to take a picture of a Black Hole in 2022, shown in Figure 14.

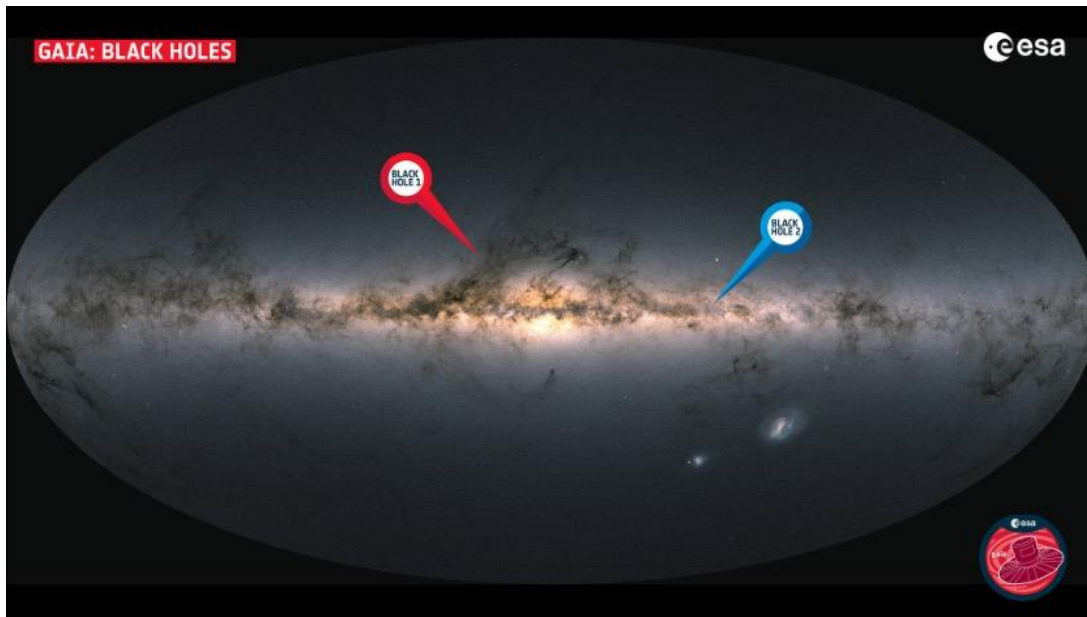


Figure 13 Gaia's Black Holes (ESA , 2023)

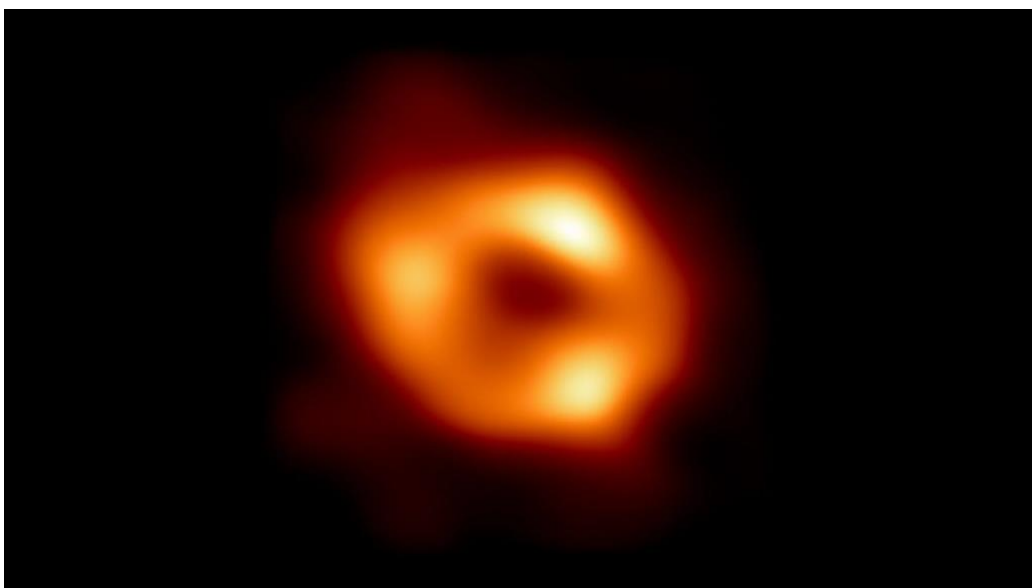


Figure 14 Blackhole at the core of Messier 87 (Wikipedia, 2023)

What Scientists Don't know yet?

Scientists still don't know a lot about the death of stars. For e.g., they're still guessing about the Black Dwarfs. They don't know what Black Holes look like or how were they formed from stars. They don't even know much about how Supernovas explode. But they are working to discover more about the universe. I hope they find more about these interesting questions.

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