In the name of god

Farzanegan2

Star Formation

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- ✓ *Special thanks to Ms sedaghat (head of the school) for always letting us follow our dreams.*
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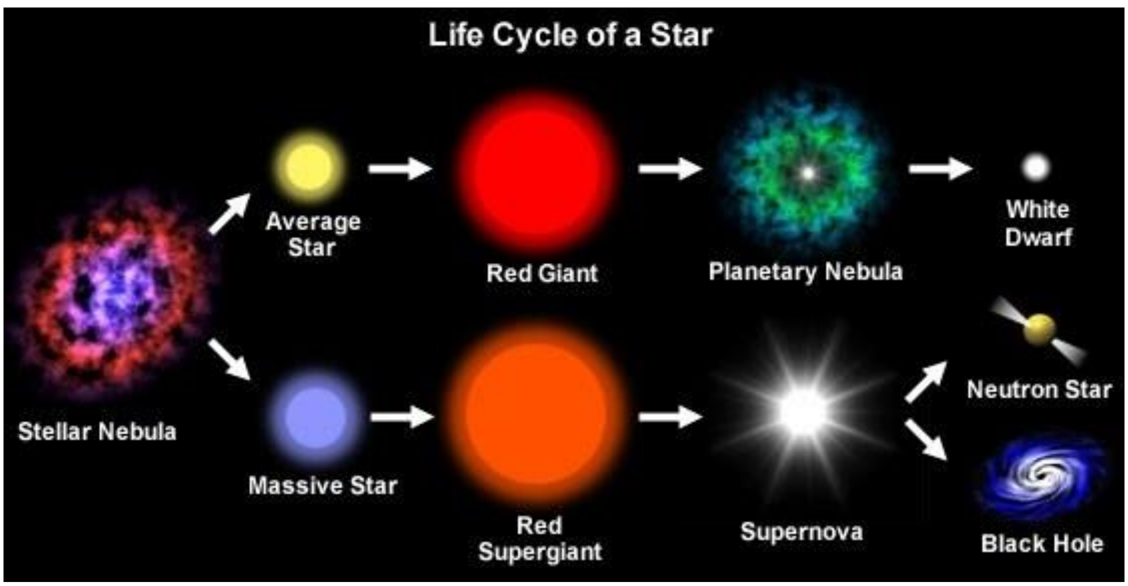
Abstract

All the stars are made by staller cloud. The stars provided by staller clouds divide in 2 groups. Group one, are the stars with low mass and Group two, the stars with high mass which we call them “Massive Stars” . After some time, it’s time for their death.

- Group one, turn into white dwarf which has high gravity.
- Group two, if their mass is 1/4 to 3 times the mass of the Sun, they’ll become a neutron star. If the massive star has the weight more than 3 times the mass of the sun, it will turn into a blackhole

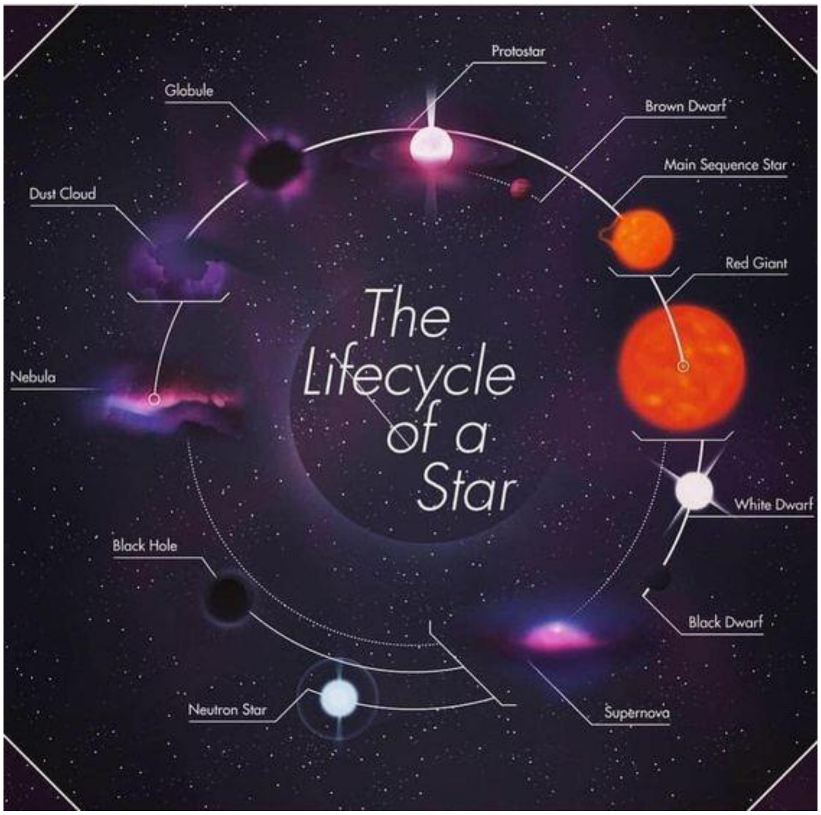


Introduction

Stars are the most widely recognized astronomical objects, and represent the most fundamental building blocks of galaxies. The age, distribution, and composition of the stars in a galaxy trace the history, dynamics, and evolution of that galaxy. Moreover, stars are responsible for the manufacture and distribution of heavy elements such as carbon, nitrogen, and oxygen, and their characteristics are intimately tied to the characteristics of the planetary systems that may coalesce about them.

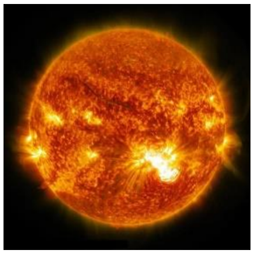
Consequently, the study of the birth, life, and death of stars is central to the field of astronomy. Throughout the Milky Way Galaxy (and even near the Sun itself), astronomers have discovered stars that are well evolved or even approaching extinction, or both, as well as occasional stars that must be very young or still in the process of formation.

The study of the formation and evolution of stars is a key research for all of the questions in astrophysics and cosmology, from the study of the planets in the Universe as a whole, through the evolution of our Sun and galaxies; for instance how was the birth of the sun? How will be its death? According to the fact that the life on earth depends on the sun do we still have time? In this project we are studying the formation of the stars, structures and evolution of massive stars and our own sun.



Stars formation

Evolutionary effects on the stars are not negligible, even for a middle-aged star such as the Sun. More massive stars must display more spectacular effects because the rate of conversion of mass into energy is higher.



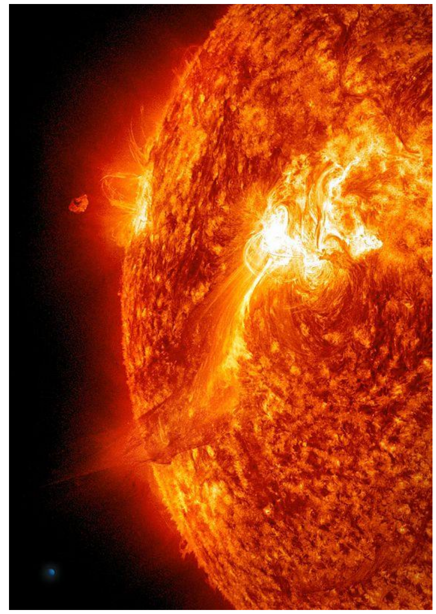
The mechanisms of formation of stars and indirectly planets, are studied using observations at different wavelengths of proto-planetary disks and jets of matter around stars in formation.

Stars are born within the clouds of dust and scattered throughout most galaxies. A familiar example of such as a dust cloud is the Orion Nebula. Turbulence deep within these clouds gives rise to knots with sufficient mass that the gas and dust can begin to collapse under its own gravitational attraction. As the cloud collapses, the material at the center begins to heat up. Known as a protostar , it is this hot core at the heart of the collapsing cloud that will one day become a star. It is predicted that the spinning clouds of collapsing gas and dust may break up into two or three blobs; this would explain why the majority the stars in the Milky Way are paired or in groups of multiple stars.

As the cloud collapses, a dense, hot core forms and begins gathering dust and gas. Not all of this material ends up as part of a star — the remaining dust can become planets, asteroids, or comets or may remain as dust.

In some cases, the cloud may not collapse at a steady pace. In January 2004, an amateur astronomer, James McNeil, discovered a small nebula that appeared unexpectedly near the nebula Messier 78, in the constellation of Orion. When observers around the world pointed their instruments at *McNeil's Nebula*, they found something interesting — its brightness appears to vary. Observations with NASA's Chandra X-ray Observatory provided a likely explanation: the interaction between the young star's magnetic field and the surrounding gas causes episodic increases in brightness.

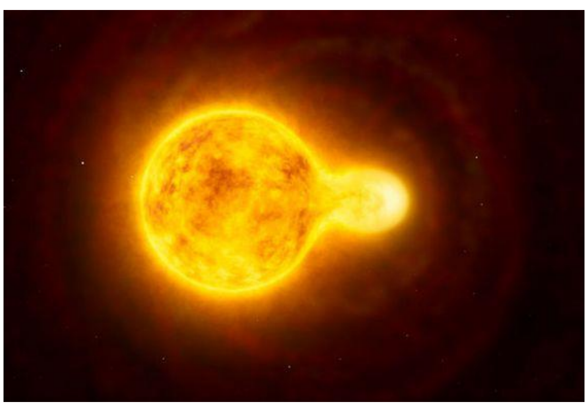
Main Sequence Stars



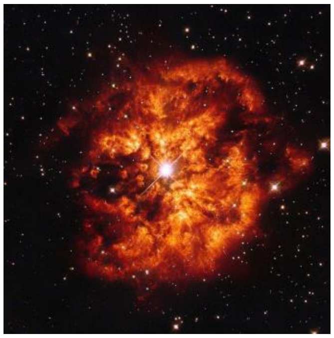
A star the size of our Sun requires about 50 million years maturing from the beginning of the collapse to adulthood. Our Sun will stay in this mature for approximately 10 billion years.

Stars are fueled by the nuclear fusion of hydrogen to form helium deep in their interiors. The outflow of energy from the central regions of the star provides the pressure necessary to keep the star from collapsing under its own weight, and the energy by which it shines.

As shown in the *Hertzsprung-Russell Diagram*, Main Sequence stars span a wide range of luminosities and colors, and can be classified according to those characteristics. The smallest stars, known as red dwarfs, may contain as little as 10% the mass of the Sun and emit only 0.01% as much energy, glowing feebly at temperatures between 3000-4000K. Despite their diminutive nature, red dwarfs are by far the most numerous stars in the Universe and have lifespans of tens of billions of years.



On the other hand, the most massive stars, known as hyper giants, may be 100 or more times more massive than the Sun, and have surface temperatures of more than 30,000 K. Hypergiants emit hundreds of thousands of times more energy than the Sun, but have lifetimes of only a few million years. Although extreme stars such as these are believed to have been common in the early Universe, today they are extremely rare - the entire Milky Way galaxy contains only a handful of hypergiants.



Stars and Their Fates

A star is born it lives and dies much like everything else in nature. Using observations of stars in all phases of their lives, astronomers have constructed a lifecycle that all stars appear to go through. The fate and life of a star depends primarily on it's mass.

In general, the larger a star, the shorter its life, although all but the most massive stars live for billions of years. When a star has fused all the hydrogen in its core, nuclear reactions cease. Deprived of the energy production needed to support it, the core begins to collapse into itself and becomes much hotter. Hydrogen is still available outside the core, so hydrogen fusion continues in a shell surrounding the core. The increasingly hot core also pushes the outer layers of the star outward, causing them to expand and cool, transforming the star into a red giant.

If the star is sufficiently massive, the collapsing core may become hot enough to support more exotic nuclear reactions that consume helium and produce a variety of heavier elements up to iron. However, such reactions offer only a temporary reprieve. Gradually, the star's internal nuclear fires become increasingly unstable - sometimes burning furiously, other times dying down. These variations cause the star to pulsate and throw off its outer layers, enshrouding itself in a cocoon of gas and dust. What happens next depends on the size of the core.

Stars` fate after their death

1-AverageStars Become White Dwarfs

For average stars like the Sun, the process of ejecting its outer layers continues until the stellar core is exposed. This dead, but still ferociously hot stellar cinder is called a White Dwarf. White dwarfs are roughly the size of our Earth despite containing the mass of a star.

However why don`t they collapse further? What force supports the mass of the core? Quantum mechanics provided the explanation. Pressure from fast moving electrons keeps these stars from collapsing. The more massive the core, the denser the white dwarf that is formed. Thus, the smaller a white dwarf is in diameter, the larger it is in mass! These paradoxical stars are very common - our own Sun will be a white dwarf billions of years from now; But, before that happens, it will evolve into a red giant, engulfing Mercury and Venus in the process. At the same time, it will blow away Earth's atmosphere and boil its oceans, making the planet uninhabitable. None of these events will come to pass for several billion years. White dwarfs are intrinsically very faint because they are so small and lack a source of energy production, they fade into oblivion as they gradually cool down.

The energy output of a white dwarf is so small that the object can go on shining mainly by radiating away its stored energy until virtually none is left to emit. How long this might take is unknown, but it would seem to be on the order of trillions of years. The final stage of this kind of low-mass star is typically a ball not much larger than Earth but with a density perhaps 50,000 times that of water.

This fate awaits only those stars with a mass up to about 1.4 times the mass of our Sun. Above that mass, electron pressure cannot support the core against further collapse. Such stars suffer a different fate as described below.

2-White Dwarfs May Become Novae

If a white dwarf forms in a binary or multiple star system, it may experience a more eventful demise as a nova. Nova is Latin for "new" - novae were once thought to be new stars. Today, we understand that they are in fact, very old stars - white dwarfs. If a white dwarf is close enough to a companion star, its gravity may drag matter - mostly hydrogen - from the outer layers of that star onto itself, building up its surface layer. When enough hydrogen has accumulated on the surface, a burst of nuclear fusion occurs, causing the white

dwarf to brighten substantially and expel the remaining material. Within a few days, the glow subsides and the cycle starts again. Sometimes, particularly massive white dwarfs (those near the 1.4 solar mass limit mentioned above) may accrete so much mass in the manner that they collapse and explode completely, becoming what is known as a supernova.

3-Supernovae Leaves Behind Neutron Stars or Black Holes

Main sequence stars over eight solar masses are destined to die in a titanic explosion called a supernova. A supernova is not merely a bigger nova. In a nova, only the star's surface explodes. In a supernova, the star's core collapses and then explodes. In massive stars, a complex series of nuclear reactions leads to the production of iron in the core.

Having achieved iron, the star has wrung all the energy it can out of nuclear fusion - fusion reactions that form elements heavier than iron actually consume energy rather than produce it. The star no longer has any way to support its own mass, and the iron core collapses. In just a matter of seconds the core shrinks from roughly 5000 miles across to just a dozen, and the temperature spikes 100 billion degrees or more. The outer layers of the star initially begin to collapse along with the core, but rebound with the enormous release of energy and are thrown violently outward. Supernovae release an almost unimaginable amount of energy. For a period of days to weeks, a supernova may outshine an entire galaxy. Likewise, all the naturally occurring elements and a rich array of subatomic particles are produced in these explosions. On average, a supernova explosion occurs about once every hundred years in the typical galaxy. About 25 to 50 supernovae are discovered each year in other galaxies, but most are too far away to be seen without a telescope.

4-NeutronStars

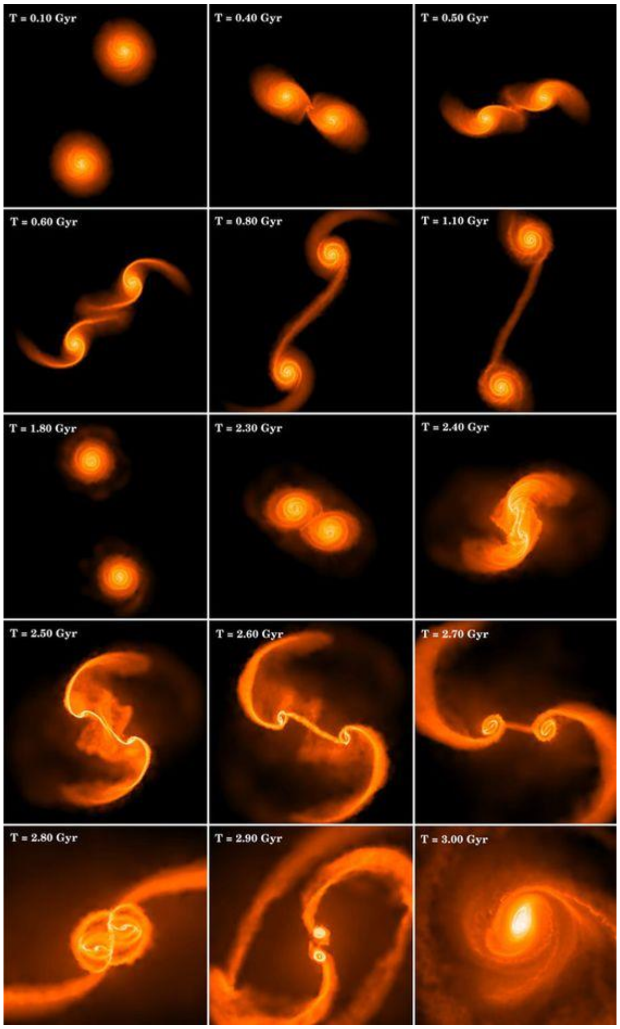
If the collapsing stellar core at the center of a supernova contains between about 1.4 and 3 solar masses, the collapse continues until electrons and protons combine to form neutrons, producing a neutron star. Neutron stars are incredibly dense - similar to the density of an atomic nucleus. Because it contains so much mass packed into such a small volume, the gravitation at the surface of a neutron star is immense. Like the White Dwarf stars above, if a neutron star forms in a multiple star system it can accrete gas by stripping it off any nearby companions. The Rossi X-Ray Timing Explorer has captured telltale X-Ray emissions of gas swirling just a few miles from the surface of a neutron star.

Neutron stars also have powerful magnetic fields which can accelerate atomic particles around its magnetic poles producing powerful beams of radiation. Those beams sweep around like massive searchlight beams as the star rotates. If such a beam is oriented so that it periodically points toward the Earth, we observe it as regular pulses of radiation that occur whenever the magnetic pole sweeps past the line of sight. In this case, the neutron star is known as a pulsar.

5-BlackHoles

If the collapsed stellar core is larger than three solar masses, it collapses completely to form a black hole: an infinitely dense object whose gravity is so strong that nothing can escape its immediate proximity, not even light. Since photons are what our instruments are designed to see, black holes can only be detected indirectly. Indirect observations are possible because the gravitational field of a black hole is so powerful that any nearby material - often the outer layers of a companion star - is caught up and dragged in. As matter spirals into a black hole, it forms

a disk that is heated to enormous temperatures, emitting copious quantities of X-rays and Gamma-rays that indicate the presence of the underlying hidden companion.

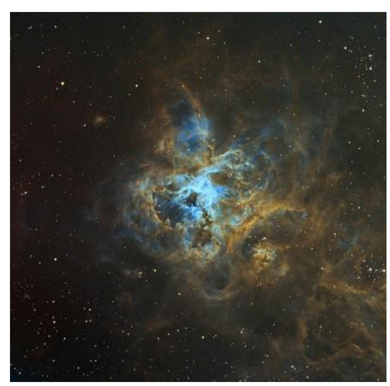


The existence of black holes is well established, both on a stellar scale, such as exists in the binary system Cygnus X-1, and on a scale of millions or billions of solar masses at the centre of some galaxies, such as M87.

Supermassive Black Holes

6-From the Rest, New Stars Arise

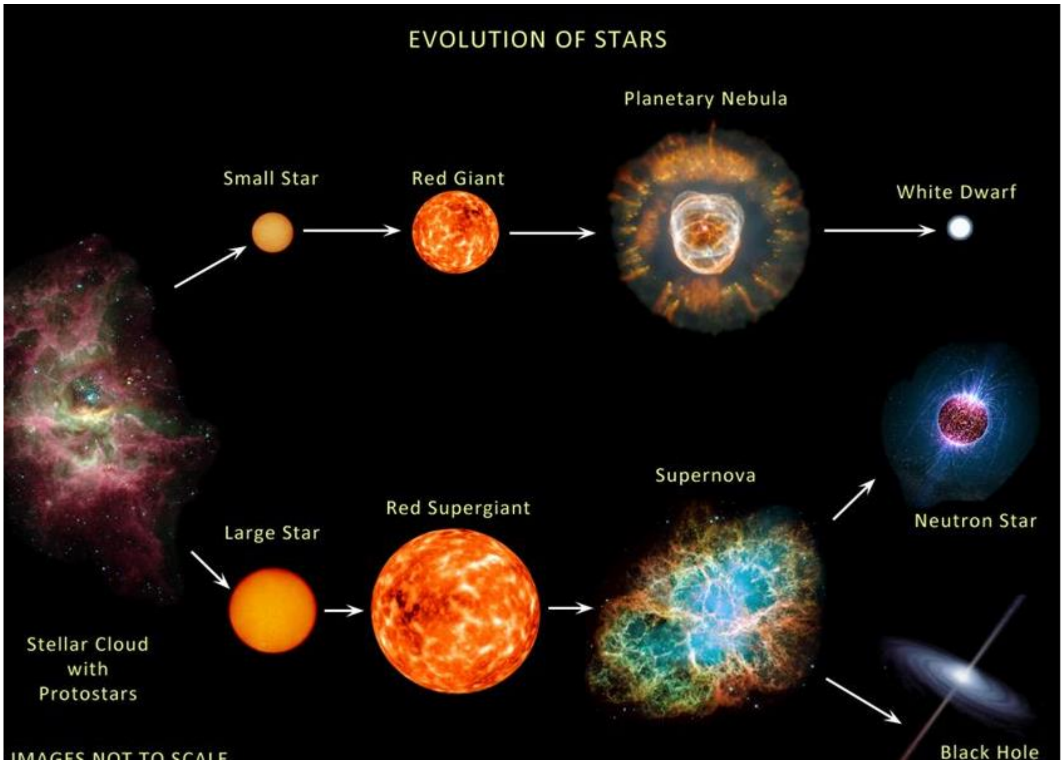
The dust and debris left behind by novae and supernovae eventually blend with the surrounding interstellar gas and dust, enriching it with the heavy elements and chemical compounds produced during stellar death. Eventually, those materials are recycled, providing the building blocks for a new generation of stars and accompanying planetary systems.



Conclusion

The studies showed that in formation of stars some factors including dusty clouds, turbulences, gravity, sufficient mass, collapses and heat are effective. Thus, stars' longevity in general depends on their sizes: the larger a star is, the shorter is its life, however the most massive stars live for billions of years. The research showed that the main effect of stars' death depends on their mass. When a star has fused all the hydrogen in its core, nuclear reactions cease then the core begins to collapse into itself and becomes much hotter. The hot core pushes the outer layers outward, therefore they`ll expand and cool, transforming the star into a red giant.

If the star is massive, the collapsing core may become hot enough to support more exotic nuclear reactions that consume helium and produce heavier elements like iron. Star's internal nuclear fires become increasingly unstable. These variations cause the star to throw off its outer layers, enshrouding itself in a cocoon of gas and dust. What happens next depends on the size of the core which may turn into a white dwarf, supernova, neutron star or a black hole.



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