Stellar Corpses: An Overview

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Abstract
Stellar corpses, also known as dead stars, are the remnants of stars that have died as a result of exhausting their nuclear fuel. Understanding the properties and behavior of stellar corpses is crucial for unravelling the mysteries of our universes and comprehending the life cycle of stars. Stellar corpses are mainly classified into black holes, white dwarf stars and neutron stars. This paper will look into the characteristics and formation processes of these three types of stellar corpses.

Keywords: stellar corpses, dead stars, nuclear fuel, life cycle, black holes, white dwarf, neutron stars

The finite amount of nuclear fuel stars possess leads to them dying sooner or later, forming stellar corpses. Their aftermath depends primarily on their masses. A star with a mass comparable to that of the sun will develop into red giants, shed its outer layers, and eventually collapse into a white dwarf. A star with more mass, on the other hand, will experience a supernova explosion and produce a black hole or neutron star as a byproduct. Hydrogen fusion ignites at the hot, dense centers of stars, giving them life. The energy created during fusion pushes outward against the gravitational pull of the star's entire mass, establishing a delicate balance that can last for trillions of years. [1].

By definition, a blackhole is a cosmic body with an incredibly strong gravitational field from which nothing, not even light, can escape. Based on their masses, they are divided into stellar mass, supermassive mass, and intermediate mass black holes. Each group's mass ranges are approximations, and scientists are always reevaluating where the boundaries should be drawn. The mass ranges that define each type of blackhole are approximate, and scientists are constantly reassessing where the boundaries should be set and the criteria used to classify them. When a massive star runs out of fuel, it is no longer capable of producing the heat and pressure needed to counteract the force of gravity. The core of the star breaks down under the force of gravity, creating a black hole. The dying star is compressed to a point of zero volume and infinite density known as the singularity because the core becomes so dense due to the crushing weight of constituent matter falling in from all directions. The singularity is surrounded by an event horizon, called as the point of no return for anything that gets within its proximity. As the surface of the star nears this fictitious surface, the event horizon, time on the star slows relative to the time kept by observers far away. Time stops when the star's surface hits the event horizon; as a result, the star becomes a frozen, collapsing entity. Even light rays cannot escape inside the event horizon because the escape velocity is faster than light. Due to their small size and the absence of any visible light from them, black holes are typically impossible to view directly. However, their massive gravitational fields can be "observed" via the effects they have on adjacent matter. According to Einstein’s general relativity theory, at the core, all the matter and energy that fall into the black hole get compressed into an infinitesimally small nib. The problem with this prediction is that it implies that physics ceases to exist at the core, rendering it impossible to describe what occurs there and therefore inaccessible. Assuming that the laws of physics imply in black holes there are three possible scenarios. One possible scenario is that as the object will undergo spaghettification. The object will become spaghetti-like as a result of gravity's rapid acceleration. The difference in gravity imposed on various parts of the objects would stretch them out like spaghetti until they were torn apart by tidal forces. Another possibility is that strong radiation will cause the object to vaporize. As an object spirals around the black hole, an accretion disc —a big, thin disc— is created. The friction and heat in this disc would produce enormous amounts of electromagnetic radiation. The object may experience quantum effects, which would be a third potential consequence. According to quantum mechanics, information about physical systems can neither be created nor destroyed. In opposition, according to Einstein's general relativity, anything that falls into a black hole loses all its information to an outside observer. Due to this paradox, physicists have argued that any information about an object's shape or charge distribution will be "shaved" down to its mass, charge, and spin when it enters the black hole [2].

White dwarf stars are the final evolutionary state of stars whose mass is not high enough to become either a neutron star or a black hole. White dwarf stars, so called because of the white color observed in the first few that were discovered. They are distinguished by a modest luminosity, a mass similar to the Sun's, and a radius similar to Earth's. When a star dies, white dwarfs are produced. There are two types of white dwarfs, namely, carbon-oxygen white dwarfs and neon-oxygen white dwarfs. Lighter mass stars that never get around to burning carbon in their cores give birth to carbon-oxygen white dwarfs. Stars having a minimum initial mass of four solar masses are necessary for the formation of neon-oxygen white dwarfs. A star balances gravity and the pressure of the surrounding gas over the majority of its life. Helium is created when hydrogen nuclei combine due to the pressure of a few octillion tons of gas pressing down on the core. Nuclear fusion is the term for this. The star is kept from collapsing on itself thanks to the constant emission of thermonuclear energy from this process. A star's core, however, eventually runs out of hydrogen. After that, the process switches to fusing helium into carbon and oxygen, with hydrogen fusion moving to the core's outer shell. The star then expands and inevitably turns into a red giant. The star enlarges, stellar winds accelerate and become more violent, and the outer layers start to defy gravity. The exposed core of the red giant star is left behind when it disintegrates. Thus, a newly born white dwarf. While solitary white dwarfs fade gradually, a white dwarf that orbits another star is highly explosive. Hydrogen is sucked from its companion and spills onto the surface of the white dwarf through a gaseous bridge. And when the hydrogen builds up, it eventually reaches a flash point in terms of temperature and density. An enormous quantity of energy is released in a nova as the entire shell of recently obtained fuel violently fuses. The white dwarf suddenly bursts with the brightness of 50,000–100,000 suns before gradually fading back into obscurity [3,4].

The neutron is assumed to make up the majority of neutron stars, which are extremely dense, compact stars. The mass of these extraordinarily small, dense, and compact objects is at least 1.4 times that of the sun, but their diameter is only a few tens of kilometers. Pulsars, magnetars, quark stars, binary neutron stars, and hybrid stars are the several types of neutron stars. Just like the previously discussed stellar corpses, when a star, if a greater mass, between one and three solar masses, runs out of fuel, the newly generated neutrons can arrest the collapse, leaving behind a neutron star. Every proton and electron at the very center of the star collide to form a neutron as it collapses. Since neutron stars started out as stars, we can discover them distributed around the galaxy in the same locations where we find stars. Like stars, they can be found alone or in binary systems with a partner. Because they do not release enough radiation, many neutron stars are probably not observable. However, under certain conditions, they can be easily observed [5,6].

References

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