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Black Holes

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A **black hole** is a place in space where gravity is so strong that even objects moving at the speed of light cannot resist it, including the particles of light themselves. This gravitational attraction occurs because matter has been compressed into a tiny space. It is believed that such phenomena occur when stars die. Because no light can escape this region, black holes are literally invisible. However, space telescopes with special equipment are able to detect them. For example, you can capture the unusual behavior of objects that are close to a black hole (Fig.1).

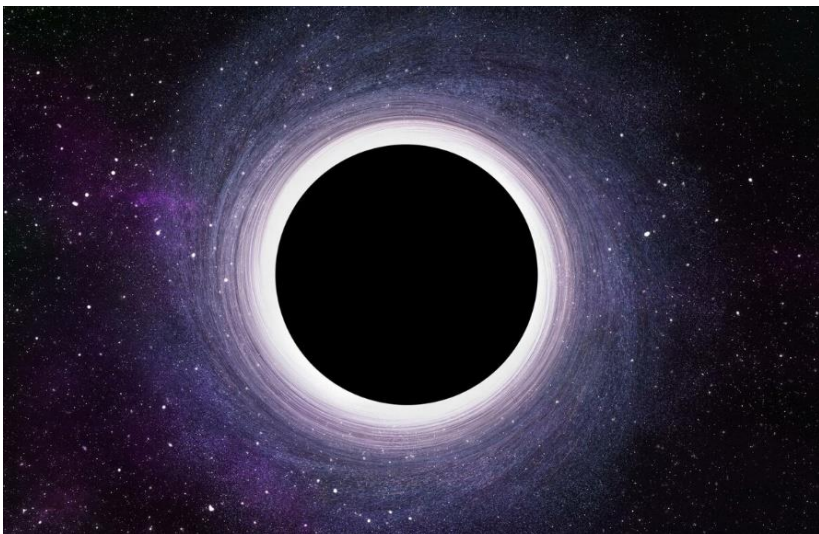


Fig. 1 – Black hole

Scientists believe that the smallest black holes, only one atom in size, could have arisen in the first moments of the existence of the universe. Similar conditions are created at the Large Hadron Collider, and the public fears that this could lead to the emergence of a black hole. Another type of black hole is called "stellar". Their mass can be 20 times the mass of the Sun. In our galaxy, the existence of many stellar-mass black holes is possible. The largest black holes are called "supermassive". They have masses that are over 1 million suns. Scientists have found evidence that every large galaxy contains a supermassive black hole at its center. Such an object at the center of the Milky Way galaxy is called Sagittarius A. It has a mass equal to about 4 million Suns [1].

How black holes are formed

Large objects like stars have a lot of gravity. All the matter of a star is always attracted to the center, but thermonuclear reactions do not allow it to collapse. That is, on the one hand, attraction works, and on the other, pressure, which holds the shape of a star. The most popular theory is that a black hole is the final stage in the life of a star with a very large mass, exceeding at least the mass of 20 Suns. When thermonuclear reactions stop inside such a star (the fuel runs out), then under the influence of its huge gravity, it is rapidly compressed into a neutron star. Depending on its initial mass, it can remain a super-dense neutron star or continue to shrink with such force that even light cannot leave its limits – this will be a black hole. There is another scenario, when all the same processes occur with interstellar gas, which is at the stage of transformation into a galaxy or some kind of cluster. If the internal pressure cannot compensate for gravity, then all matter begins to shrink, which leads to the formation of a black hole (Fig. 2).

How scientists learn about black holes

A black hole does not emit or reflect light like most other objects in the universe. But scientists can see how strong gravity affects the stars and gas around a black hole. According to the behavior of objects near which there is a black hole, one can actually prove its existence. Stars revolve around the center of gravity. If there is nothing in this place, then there is a possibility that this is a black hole. From the surrounding

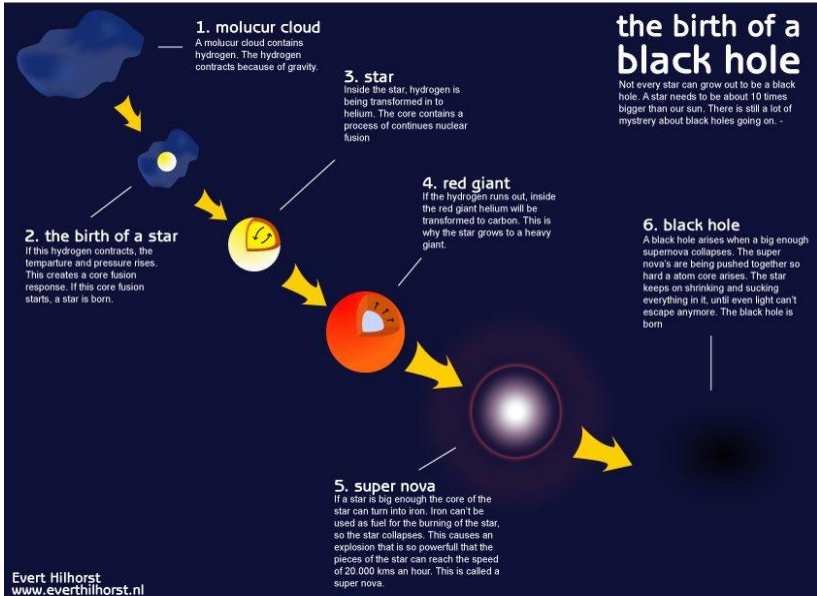


Fig. 1 – The birth of a black hole

space, a black hole constantly attracts matter. Cosmic dust, gas, the matter of nearby stars - all this falls on it in a spiral, forming an accretion disk. Experiencing acceleration, the particles generate radiation in the characteristic spectrum. In the area where this radiation came from, there is probably a black hole [1].

Inside black holes, the laws of physics we are accustomed to do not apply

Everything that happens inside a black hole remains a giant mystery to modern science. For example, time stops inside a black hole, but how put it in our head, when we are all used to the fact of inexorable movement into the future without the ability to influence the past? Black holes are mysterious gravitational monsters that exist contrary to the laws of physics and someone's wishes [2].

References:

1. What is a black hole [Electronic resources]. – Mode of access: <https://topor.info/news/chyornaya-dyra>. – Date of access: 25.03.2022.
2. Inside black hole [Electronic resources]. – Mode of access: <https://zen.yandex.ru/media/thespaceway/chtto-imel-v-vidu-einshtein-skazav-chernye-dyry--eto-mesto-gde-bog-delitsia-nol-614dc3390491a456aed63ffe>. – Date of access: 25.03.2022