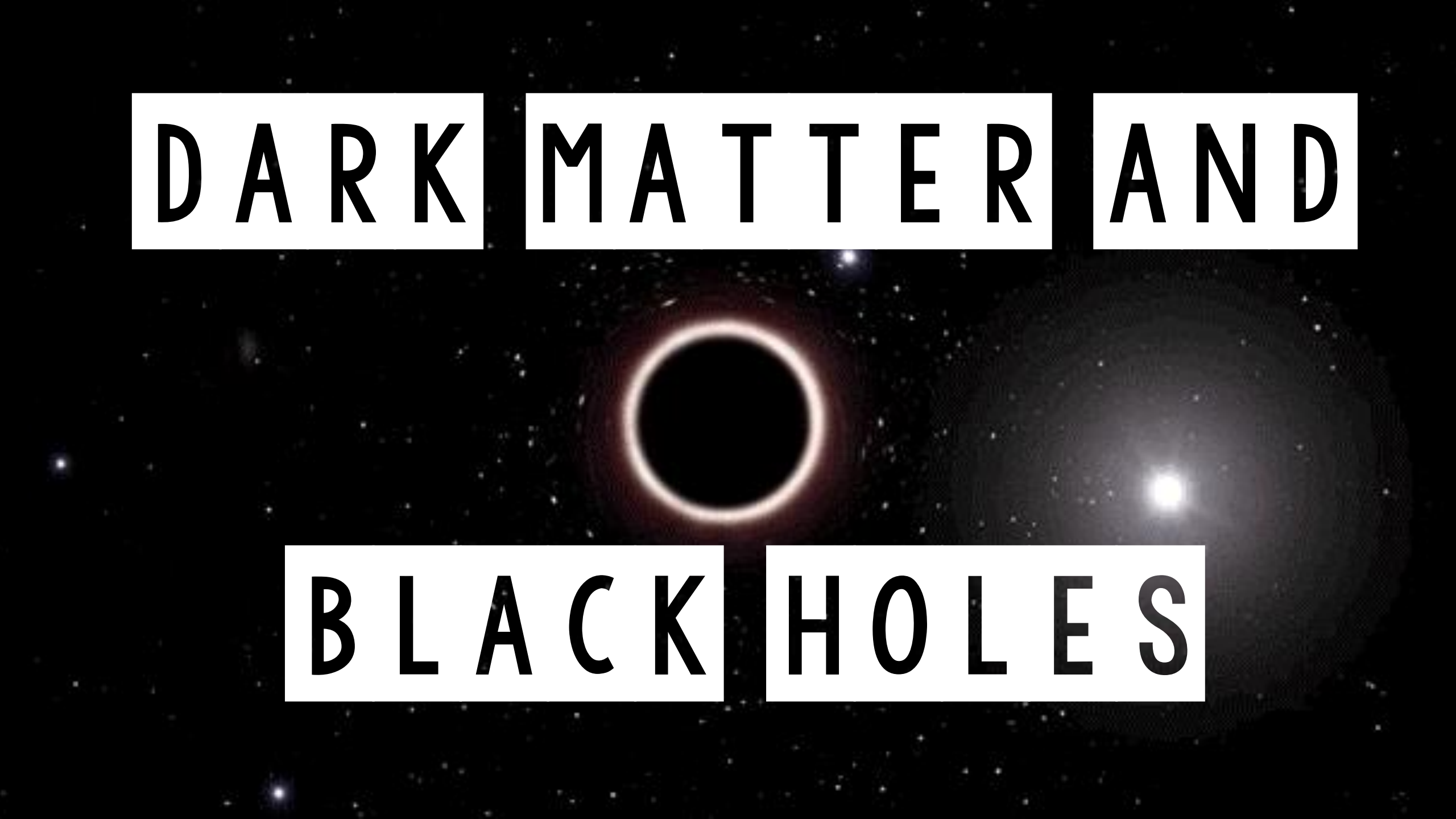
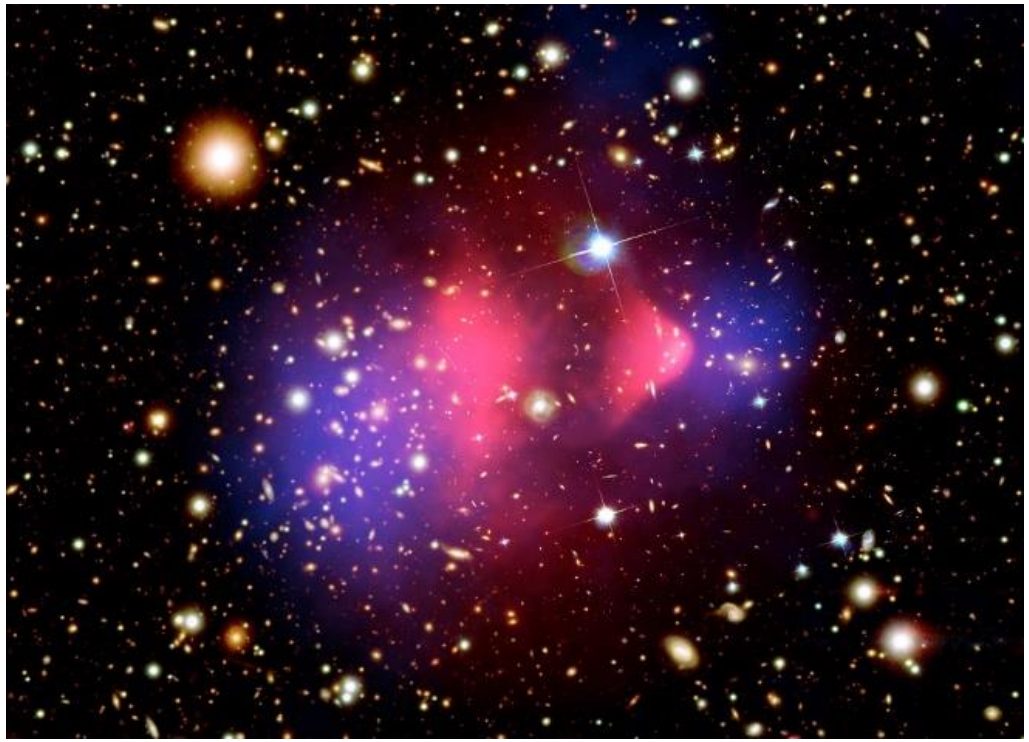
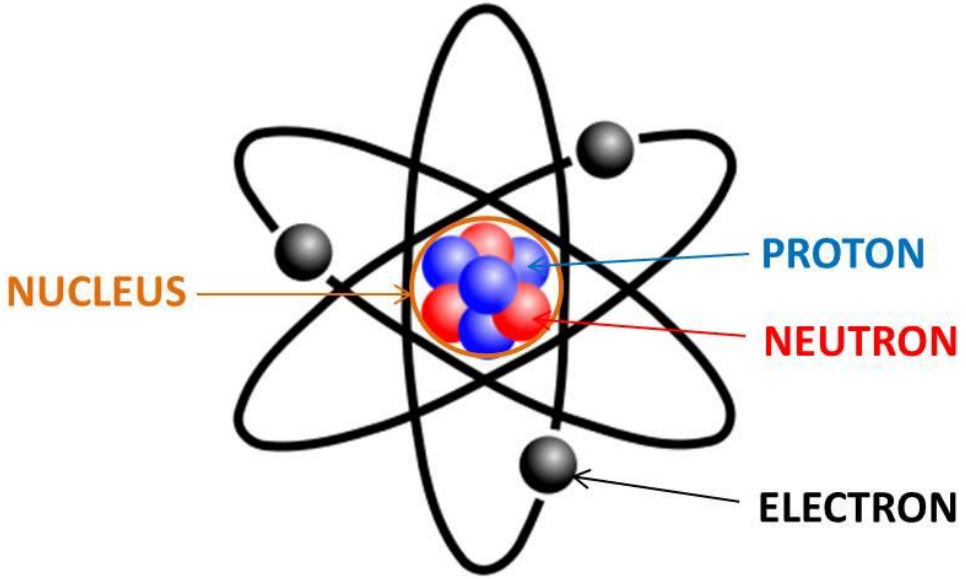
DARK MATTER AND BLACK HOLES



The Mystery of the Dark Universe

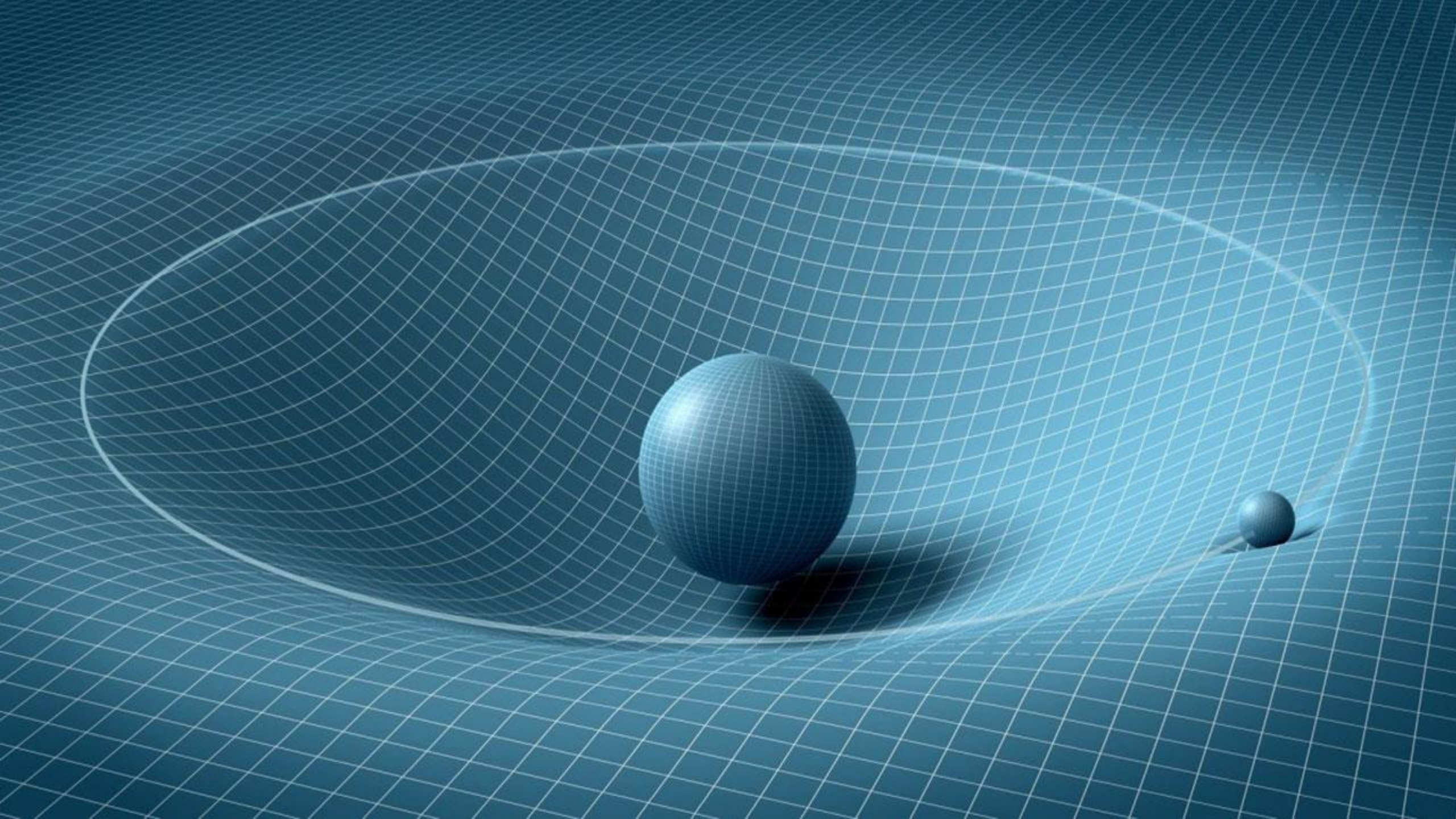
Ordinary matter makes up everything we can see, smell or touch. This matter – which is made from atoms – also makes up planets and stars.

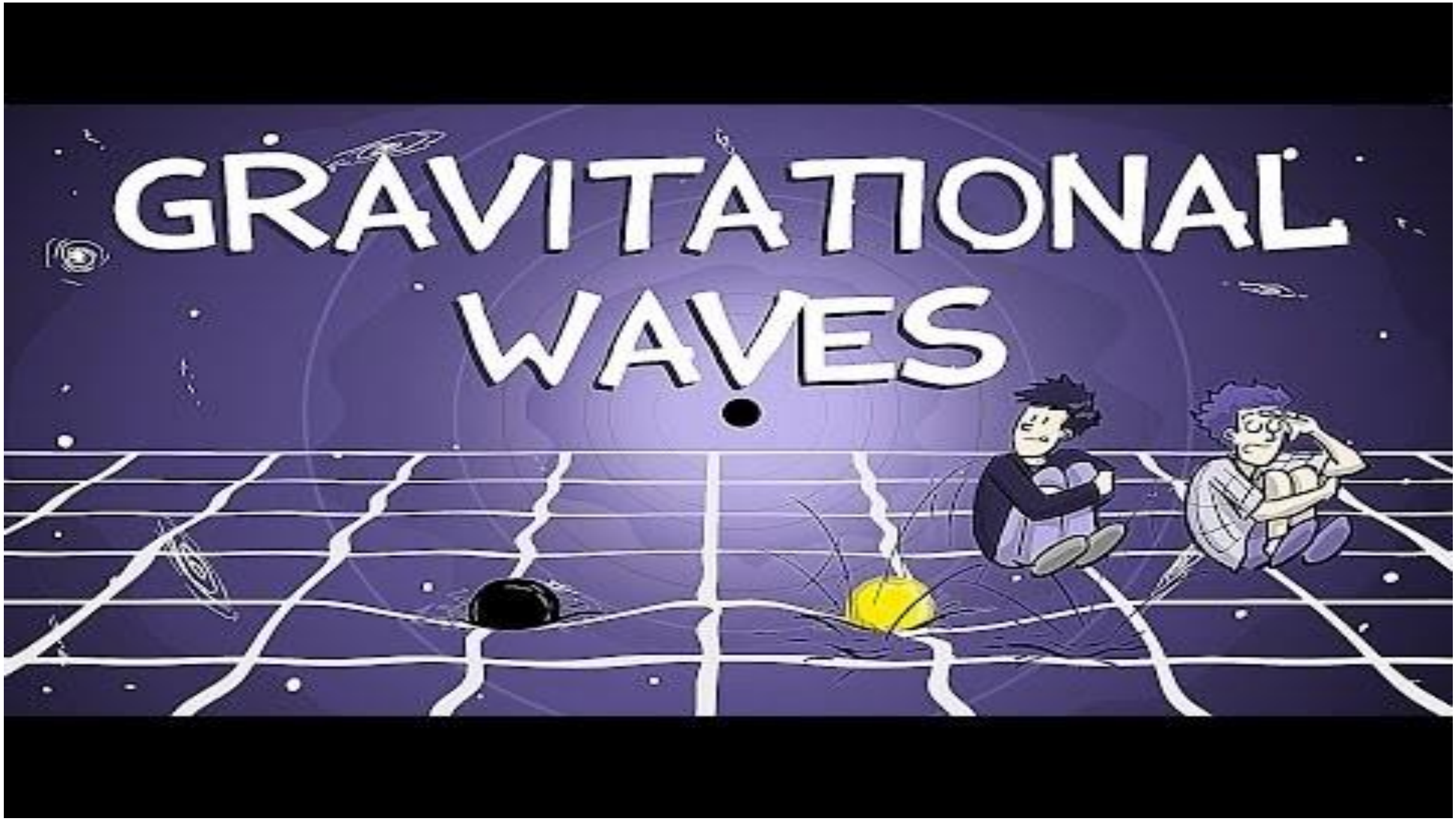




All objects made of atoms pull on each other according to how much matter they contain. This is the effect of gravity and is why a small, low mass object such as an apple falls towards a much more massive object - the Earth.

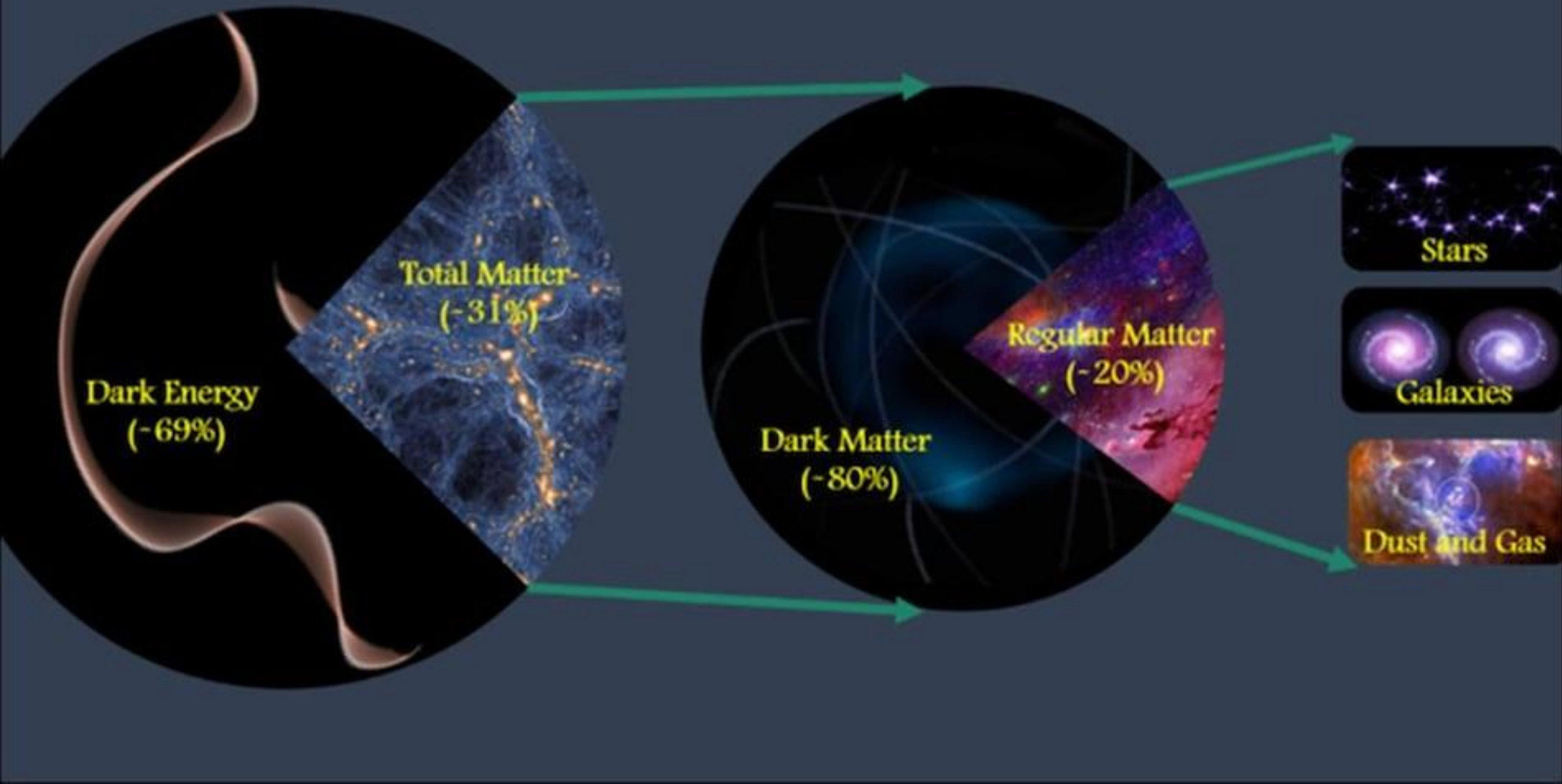
Gravity bends the fabric of space-time depending on its mass

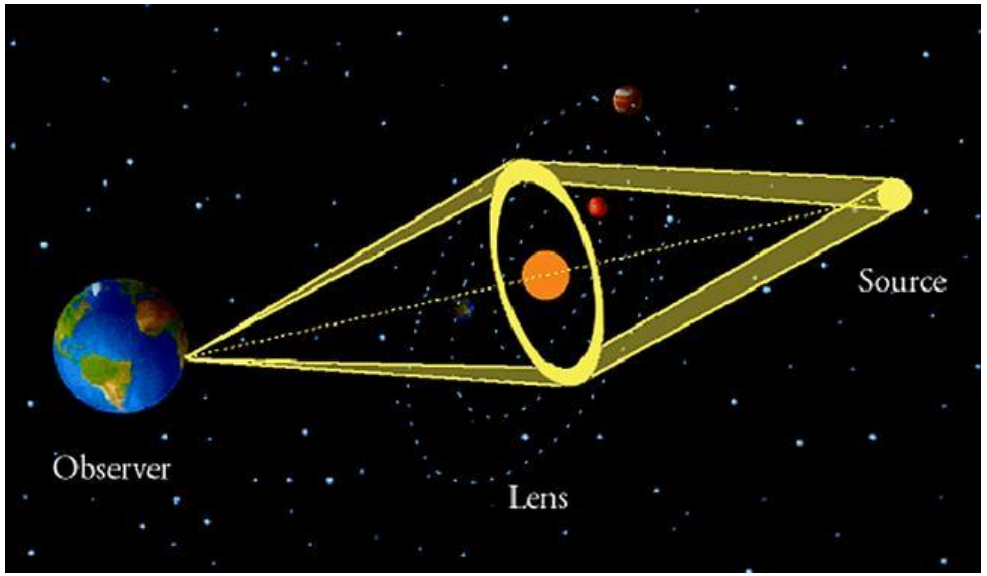



GRAVITATIONAL
WAVES

Astronomers believe that there must also be another kind of invisible "dark matter" which is spread throughout the Universe. By studying the Milky Way and many distant galaxies, they have found that visible matter alone cannot account for how fast stars rotate in them.

On its own, normal matter would not be able to create enough gravity to hold these galaxies together.


Dark Energy
(~69%)
Total Matter
(~31%)
Dark Matter
(~80%)
Regular Matter
(~20%)
Stars
Galaxies
Dust and Gas



Scientists can also tell that there is some unknown material in the space between the stars, because its gravitational pull influences the path of starlight travelling towards Earth.

Matter – both ordinary and dark – can act like a magnifying glass, bending and distorting light from galaxies and clusters behind it. Astronomers can use this effect, called gravitational lensing, to map the distribution of dark matter.

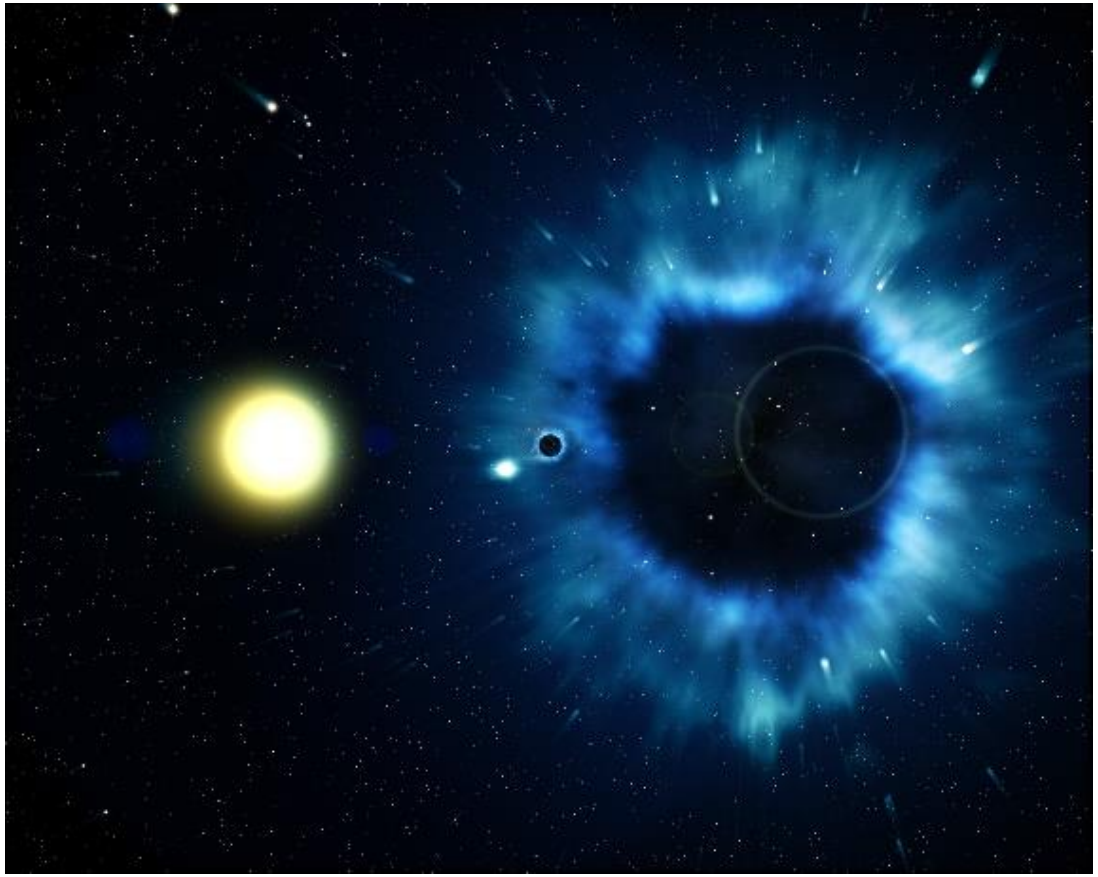
Only about 15% of the matter in the Universe is made of atoms. The remainder is dark matter. However, no one knows what dark matter is made of. We do know that it does not absorb, emit or reflect light, because none of our scientific instruments can directly detect it.

Many scientists believe that most dark matter is some unknown subatomic (smaller than an atom) particle that interacts only very weakly with normal matter.

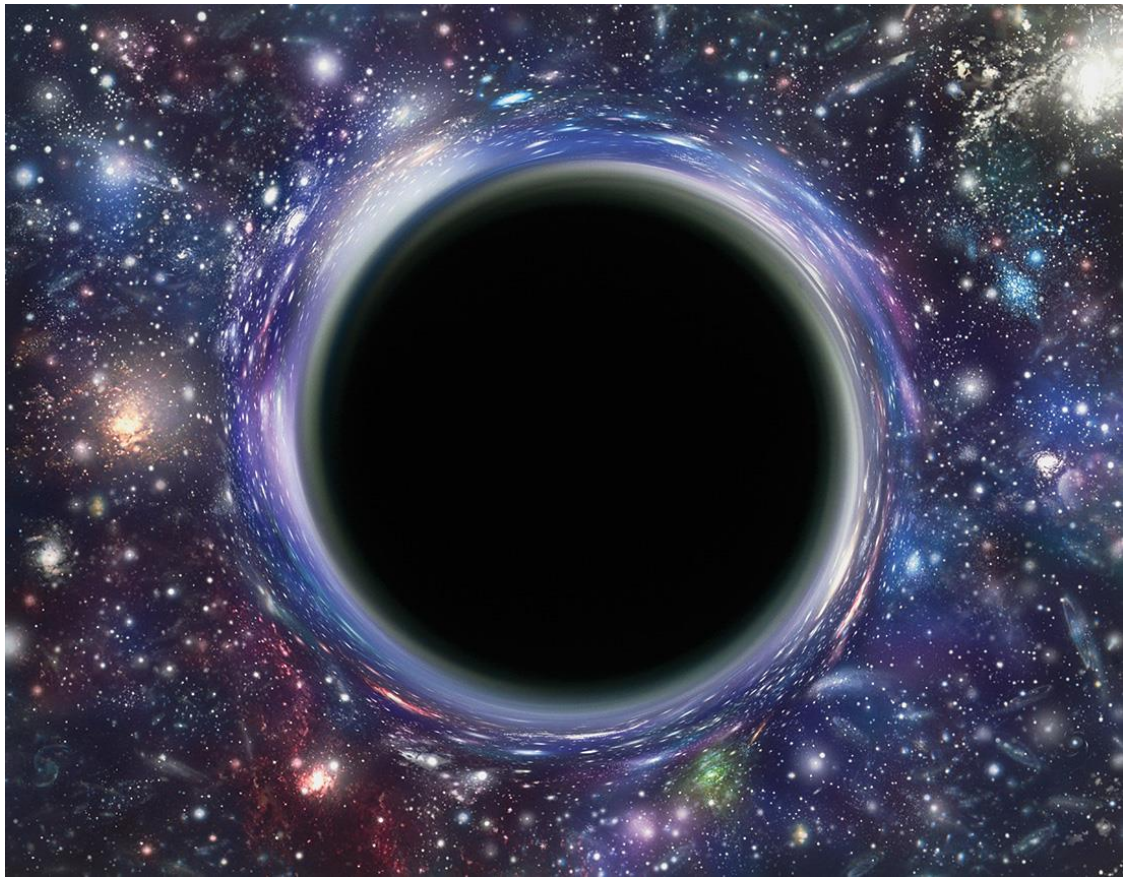
If this is true, billions of these particles will have passed through your body by the time you finish reading this article. Experiments buried deep underground may one day measure the presence of one such particle passing through, finally solving the mystery of what dark matter really is.

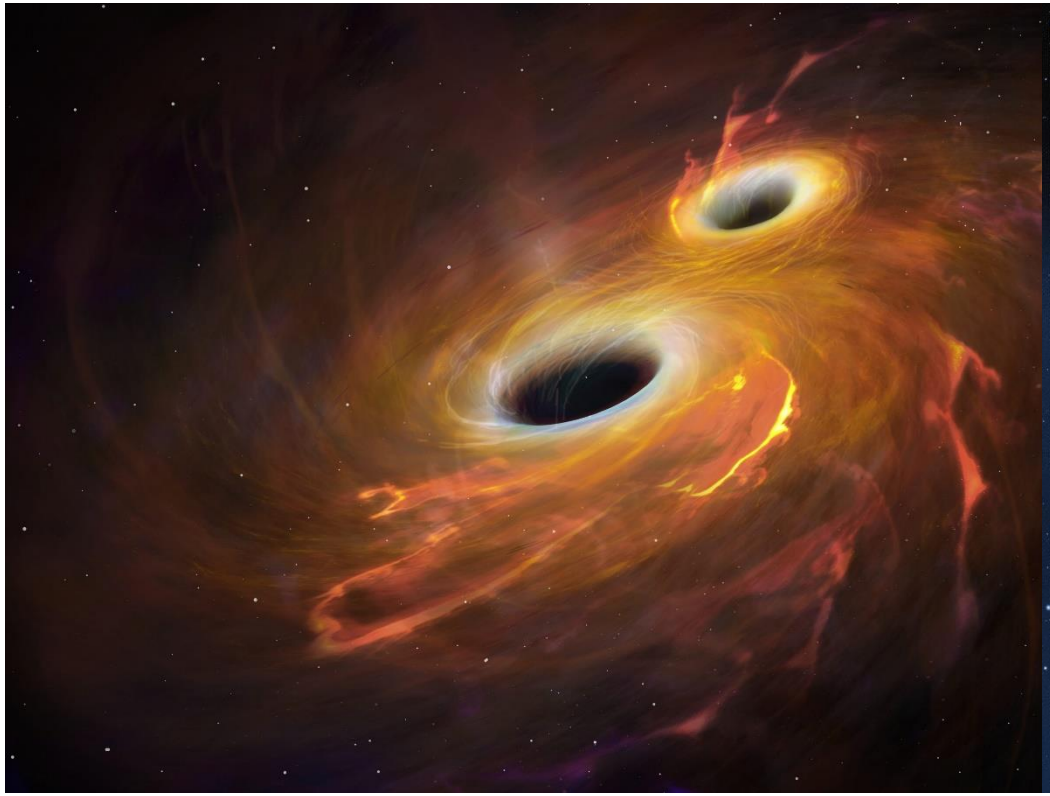
Black Holes

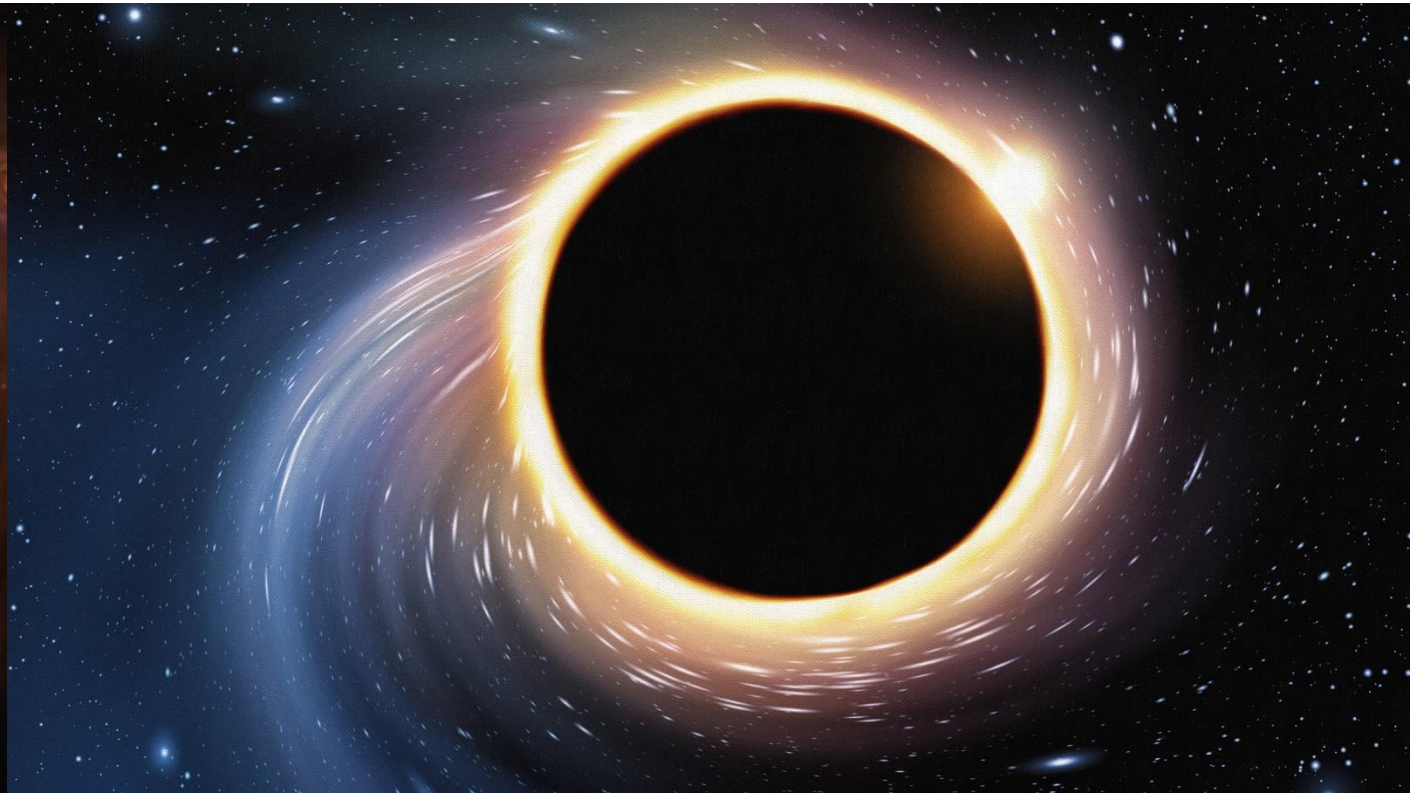
Black holes are the strangest objects in the Universe. A black hole does not have a surface, like a planet or star. Instead, it is a region of space where matter has collapsed in on itself.



This catastrophic collapse results in a huge amount of mass being concentrated in an incredibly small area. The gravitational pull of this region is so great that nothing can escape - not even light.



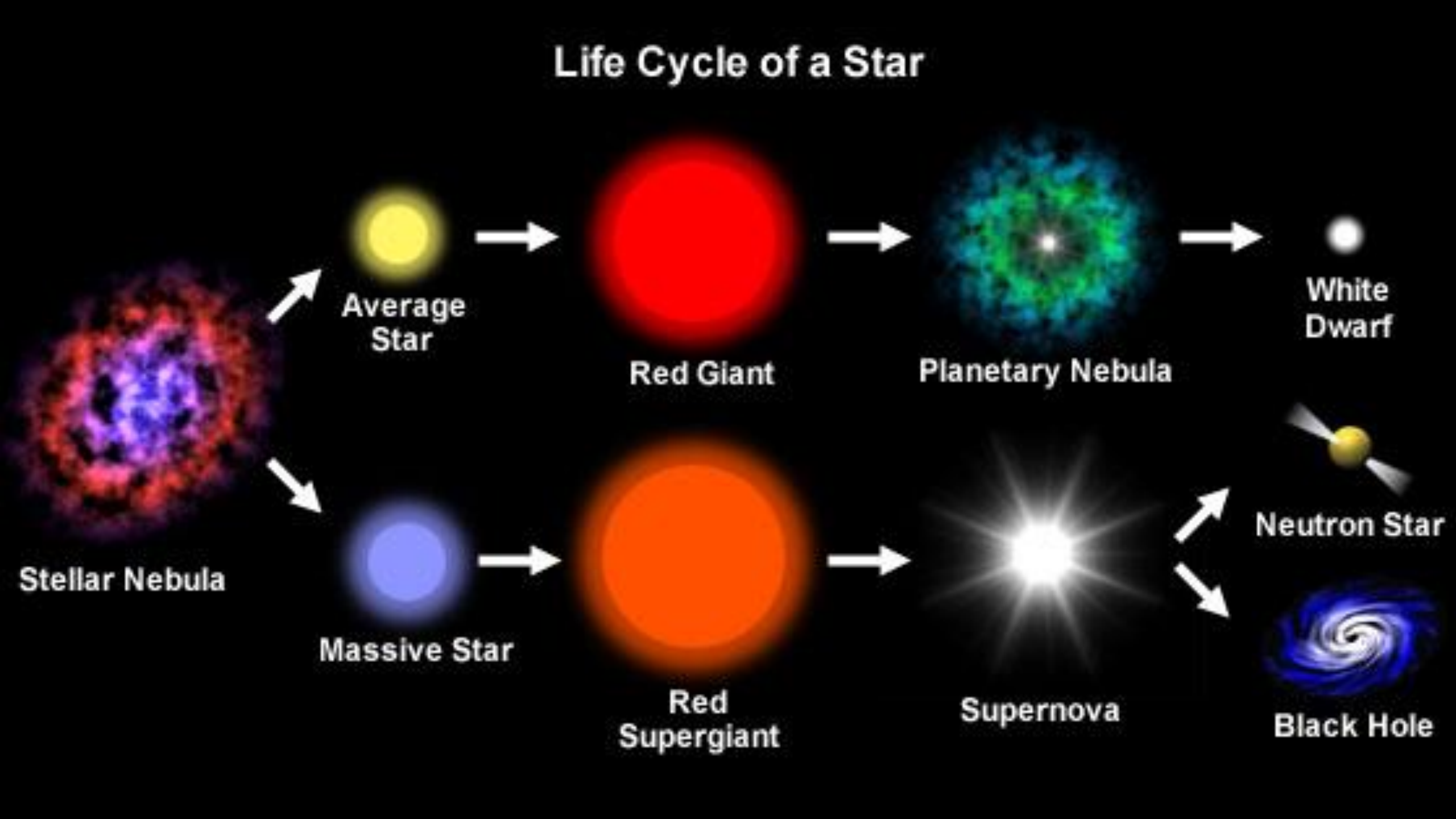


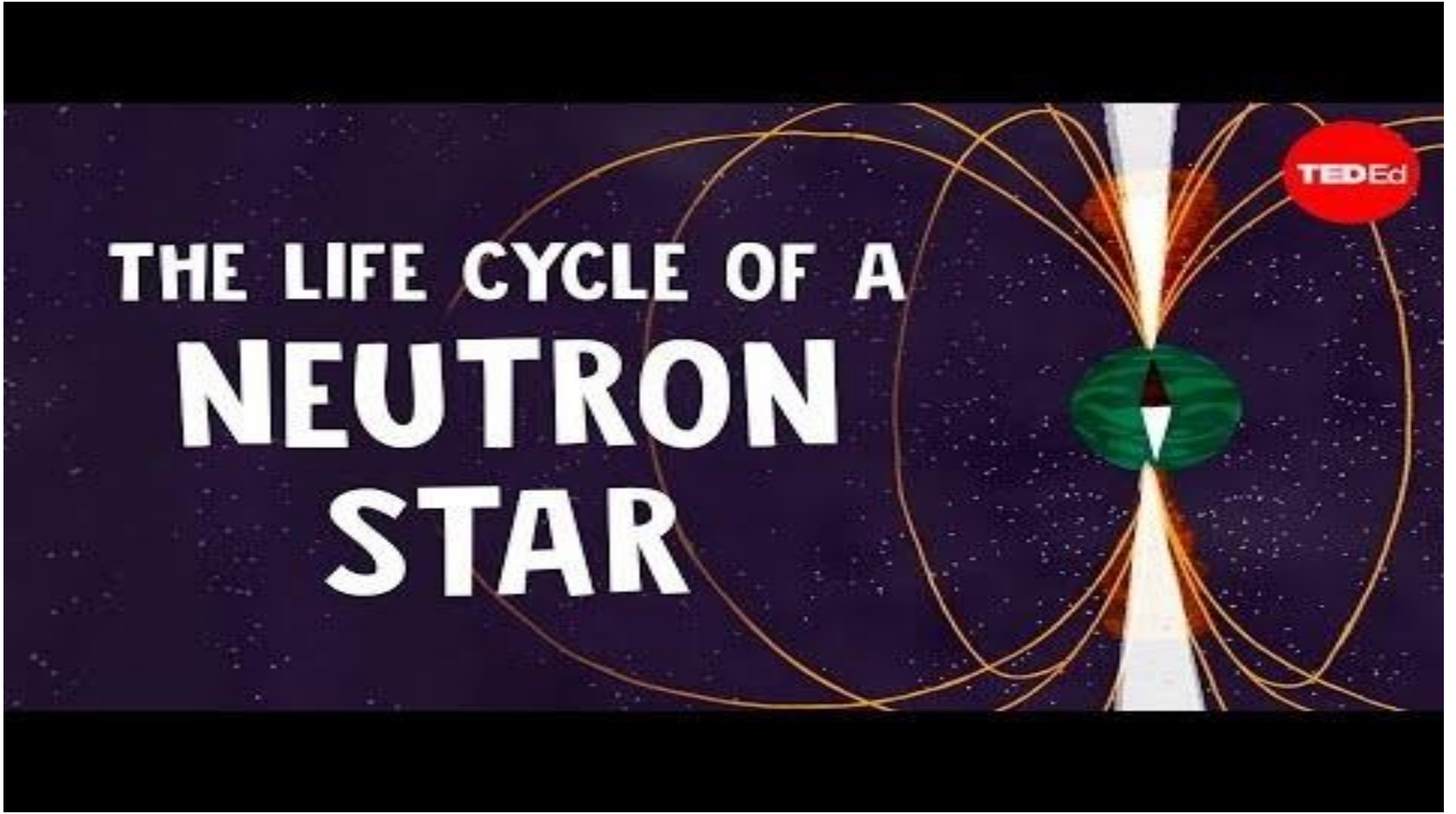


Although black holes cannot be seen, we know they exist from the way they affect nearby dust, stars and galaxies. Many of them are surrounded by discs of material. As the discs swirl around them like a whirlpool, they become extremely hot and give off X-rays.

Black holes come in many different sizes. Many of them are only a few times more massive than the Sun. These 'stellar-mass' black holes form when a heavyweight star, about 10 times heavier than the Sun, ends its life in a supernova explosion. What is left of the star - still several solar masses - collapses into an area only a few kilometres across.

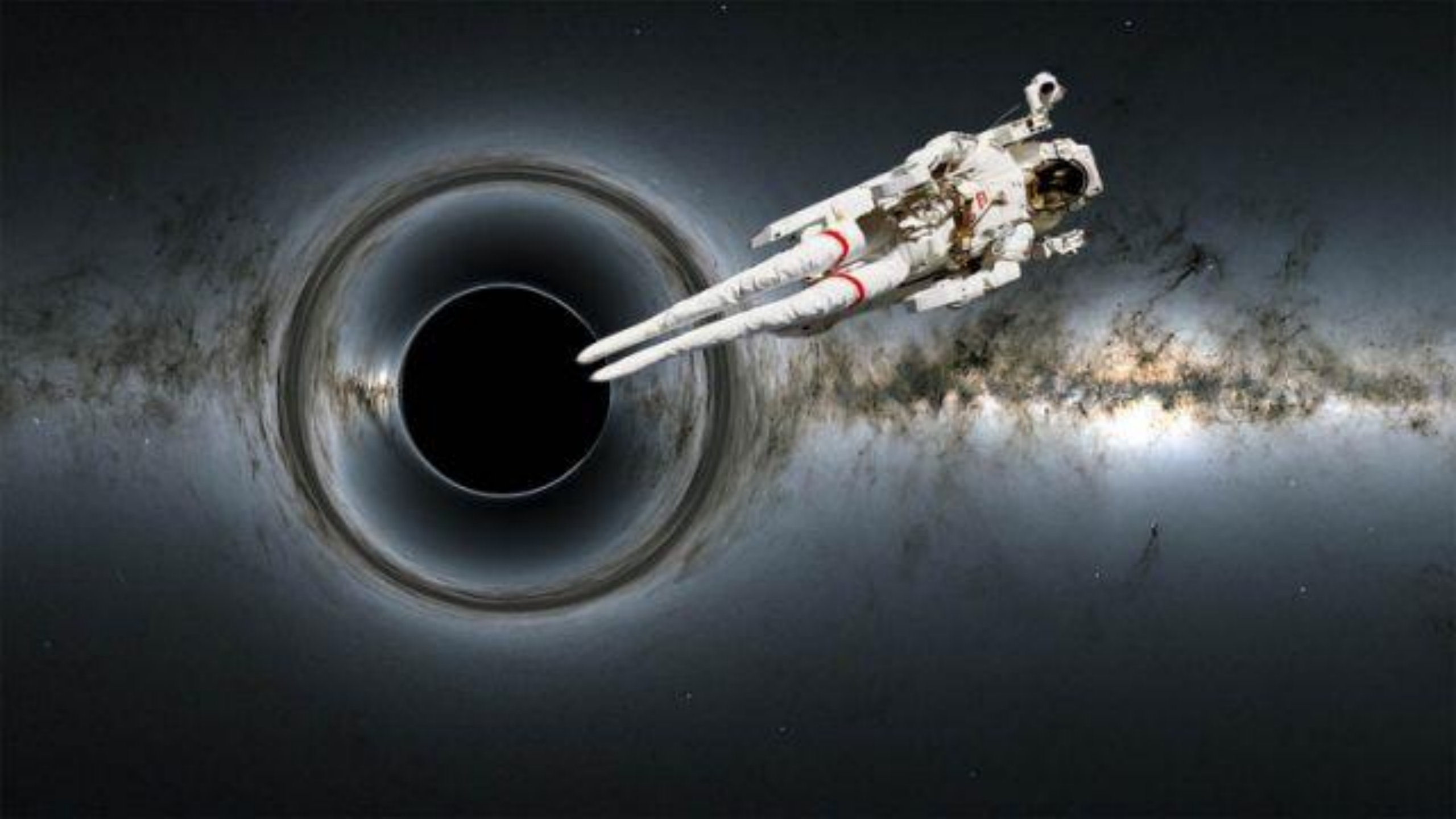
Life Cycle of a Star

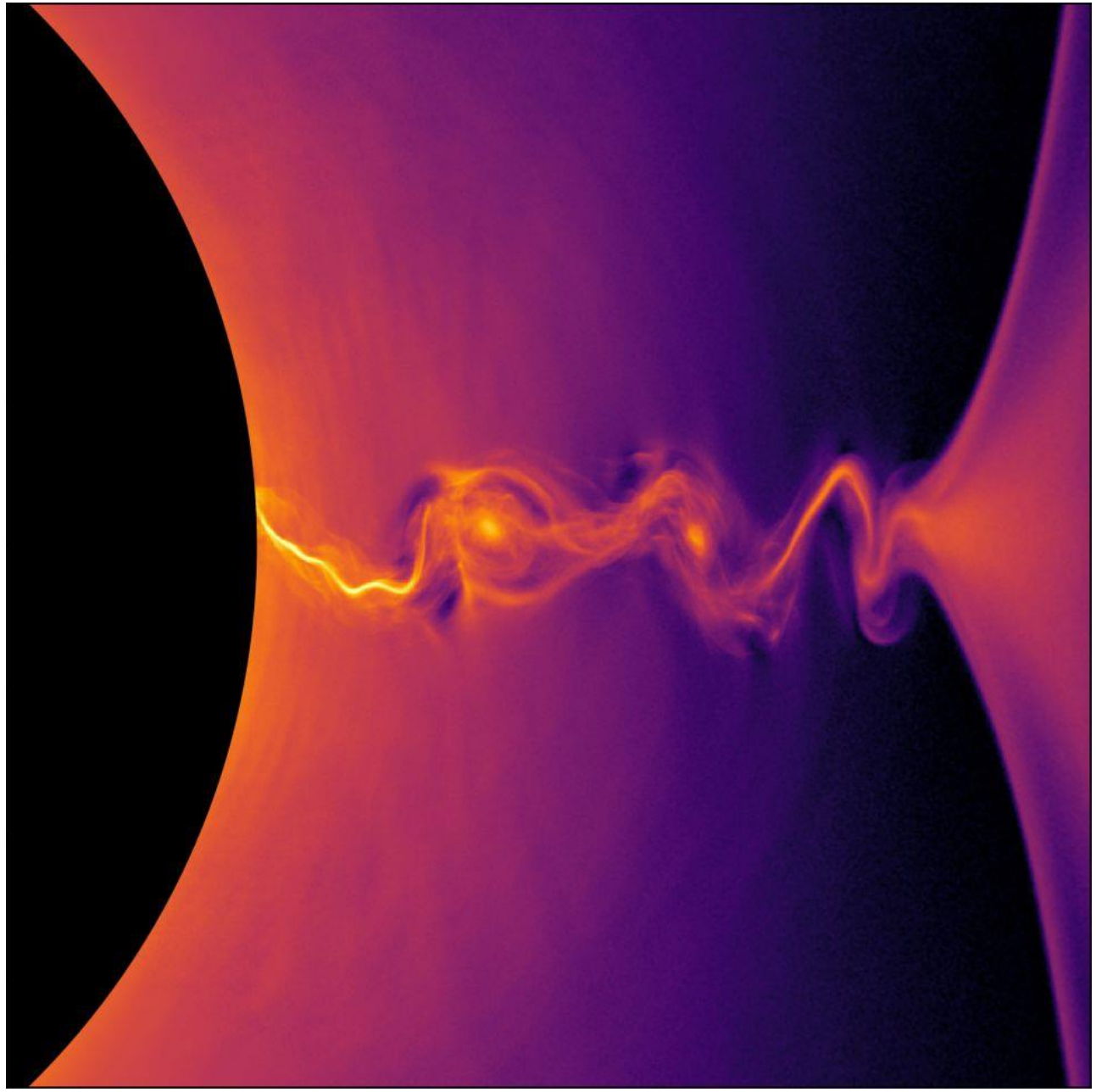



THE LIFE CYCLE OF A
NEUTRON
STAR
TEDEd

Most galaxies, including the Milky Way, have supermassive black holes at their centers. These may be millions or billions of times heavier than our Sun. Supermassive black holes also power active galaxies and ancient galaxies known as quasars. Quasars may be hundreds of times brighter than even the largest ordinary galaxies.

Objects that fall into black holes are literally stretched to breaking point. An astronaut who ventured too close and was sucked into a black hole would be pulled apart by the overpowering gravity. This is called being spaghettification!





The 'event horizon' is the boundary defining the region of space around a black hole from which nothing (not even light) can escape.