

Why is a Black Hole, Black?

Before explaining why black holes appear to be black, we must know some of the properties of a black hole.

Mass and Volume of Black Hole

Black holes are very massive. A typical black hole has a mass about 10 times the mass of the Sun. To represent the mass of a black hole in kilograms, it is about 10^{31} kilograms. The volume of a black hole is proportional to the radius of black hole's horizon (also known as Schwarzschild radius).

Gravitational Force

In general physics, we learn that all light rays travel in straight line through the air. This is based on the assumption that the gravitational force exerted by the Earth is not strong enough to bend, or distort, the path of light rays. The escape velocity of the Earth is about 1.12×10^4 meters per second. That means, if an object can travel at or above this speed, the object will leave the Earth without falling back towards the Earth's surface. Light rays travel in a speed of 3.0×10^8 meters per second. This is why astronauts can see the brightness of the Earth during night time. Remember that gravitational force is directly proportional to the mass. Since black holes are so massive, a much greater gravitational pull and escape velocity are expected. The escape velocity is so fast that even light rays cannot escape from a black hole (escape velocity $> 3 \times 10^8$ meters per second). Since no light rays are coming out from a black hole, this helps to explain why black hole is appeared in black.

Resource:

Black Hole FAQ, UC Berkeley Cosmology Group
<http://cosmology.berkeley.edu/Education/BHfaq.html>