

Fraser Heights Astronomy Club

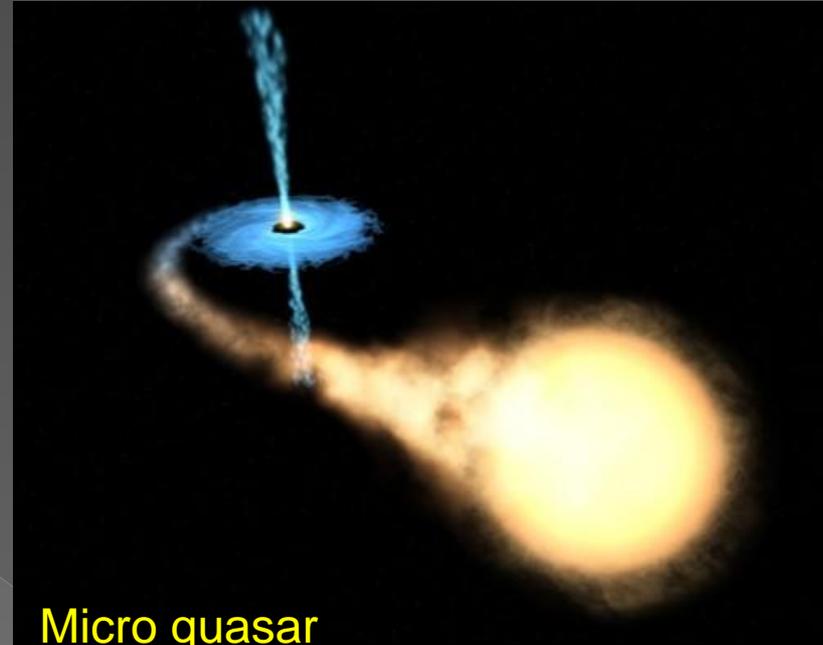
# Black Holes



# What is a Black Hole?

Black holes are one of the most powerful forces in the Universe.

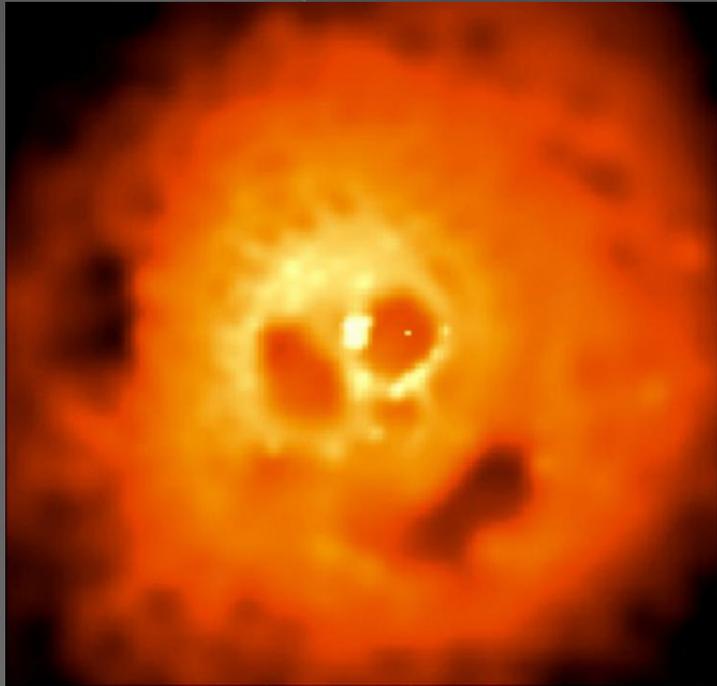
A black hole does not have a surface, like a planet or star. It is a region of space where gravity is so strong that even light cannot escape from it.



**Micro quasar**

This image shows a “micro quasar,” which is believed to be a scaled-down black hole the same mass as a star.

# Types of Black Holes

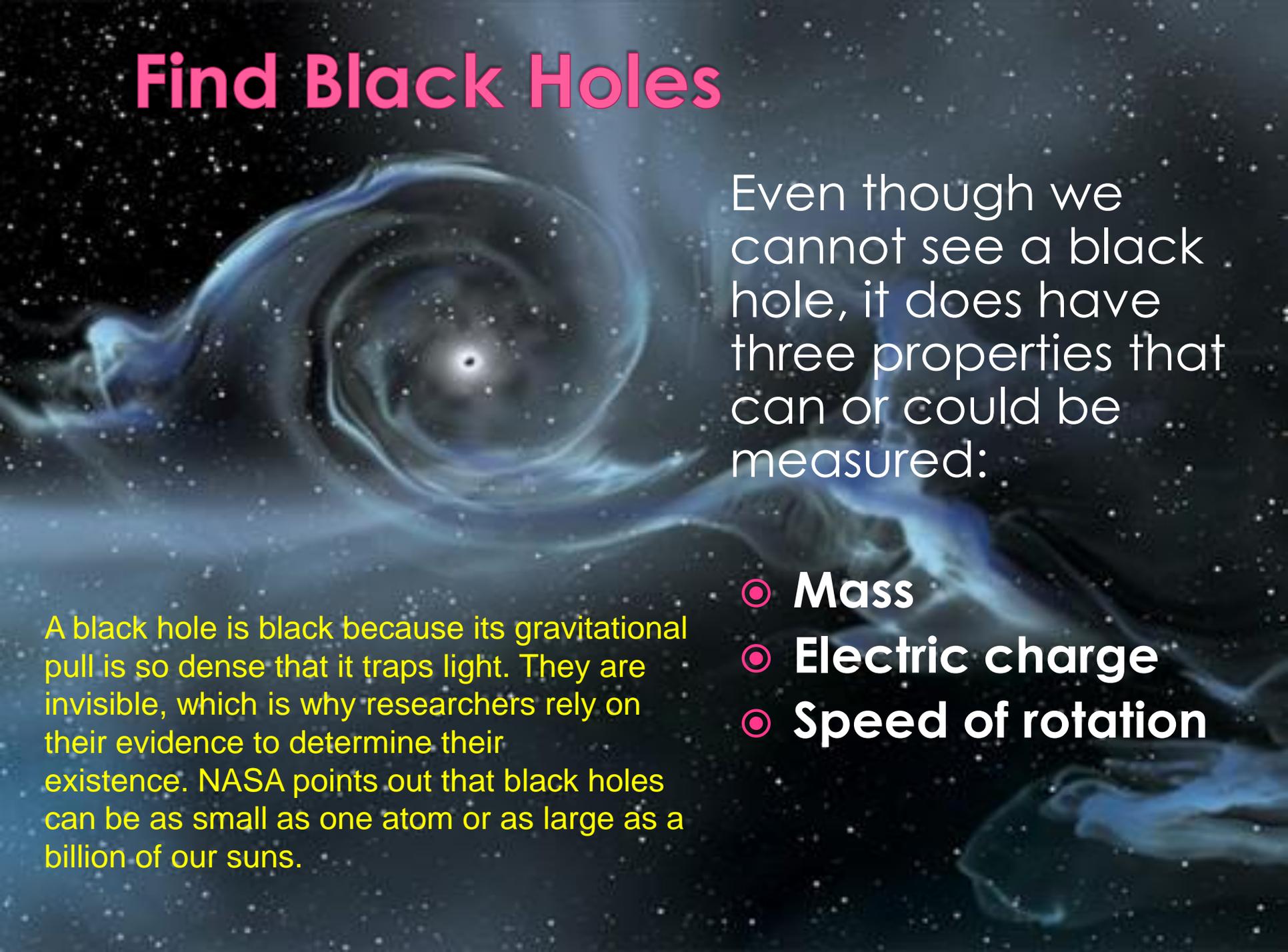


•Jets from a black hole created the eyes, nose, and mouth of this eerie flaming skull in the Perseus galaxy cluster. NASA

There are two types of black holes:

- **Schwarzschild** - Non-rotating black hole
- **Kerr** - Rotating black hole

# Find Black Holes



Even though we cannot see a black hole, it does have three properties that can or could be measured:

A black hole is black because its gravitational pull is so dense that it traps light. They are invisible, which is why researchers rely on their evidence to determine their existence. NASA points out that black holes can be as small as one atom or as large as a billion of our suns.

- **Mass**
- **Electric charge**
- **Speed of rotation**

# Parts of Black Holes

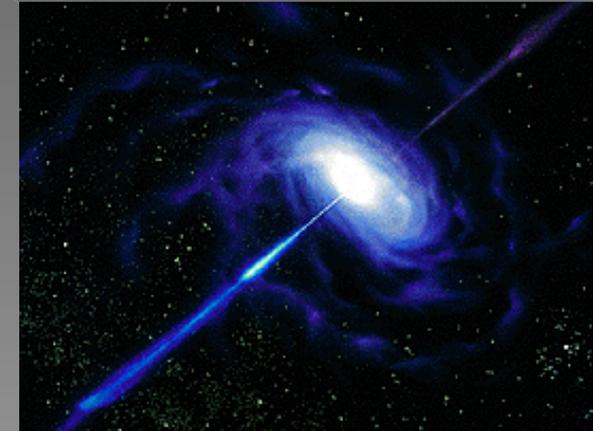
•**The Singularity:** This is the center of the black hole where all the mass of the black hole has been compressed down to nearly zero volume. The singularity is where the material pulled into the black hole is crushed until it takes up no space and creates an enormous gravitational force.



•**The Event Horizon:** This is the "point of no return". At the event horizon, objects and light disappear into the singularity and are never seen again.



•**The Accretion Disk:** Swirling disk of hot gas, dust and stellar debris. Material in the accretion disk orbits the black hole spiraling closer until it crosses the event horizon.

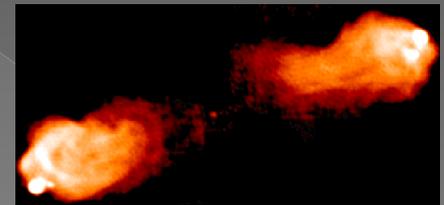
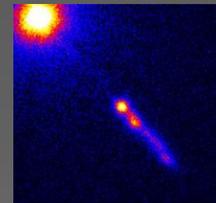


# More parts of the Black Hole!

• **Host Galaxy:** A galaxy where a quasar is found. Quasars are found at the center of host galaxies.

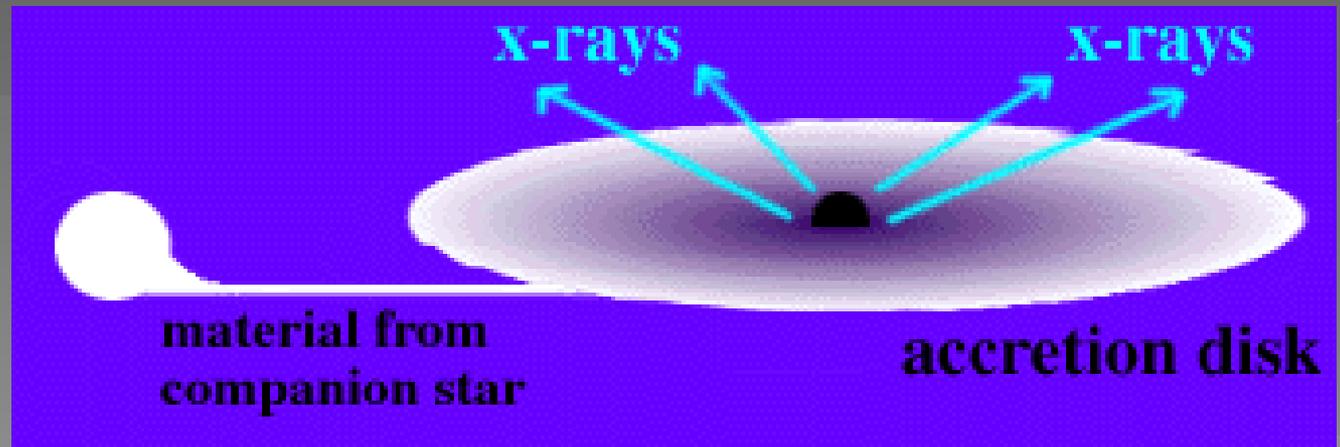
• **X-ray Jet:** Long stream of hot gas. Jets of X-ray emitting hot gas from the quasar shoot

• **Radio Jet:** Stream of energetic electrons. Jets of electrons spiral out from the quasar along magnetic field lines and create enormous glowing clouds.



# How are Black Holes Detected?

- Black holes are detected as surrounding material is funneled by the force of gravity into a disk around the black hole, called the “Accretion Disk”.
- The gas molecules in the disk swirl around the black hole so fast that they heat up and emit X-rays. These X-rays can be detected from Earth.

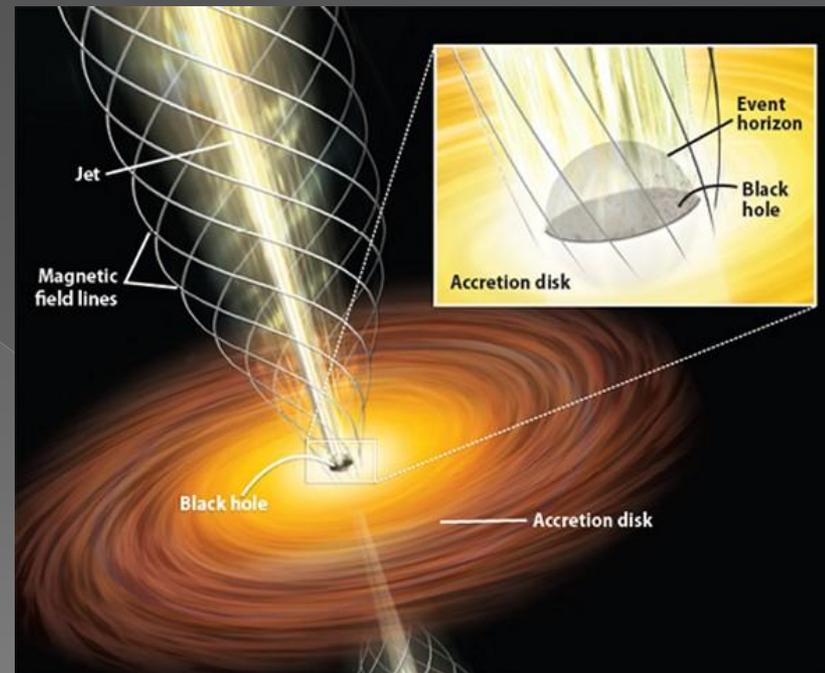


# How are they formed?

- Black holes are formed when giant stars explode at the end of their lifecycle. This explosion is called a supernova.
- If the star has enough mass, it will collapse on itself down to a very small size. Due to its small size and enormous mass, the gravity will be so strong it will absorb light and become a black hole.

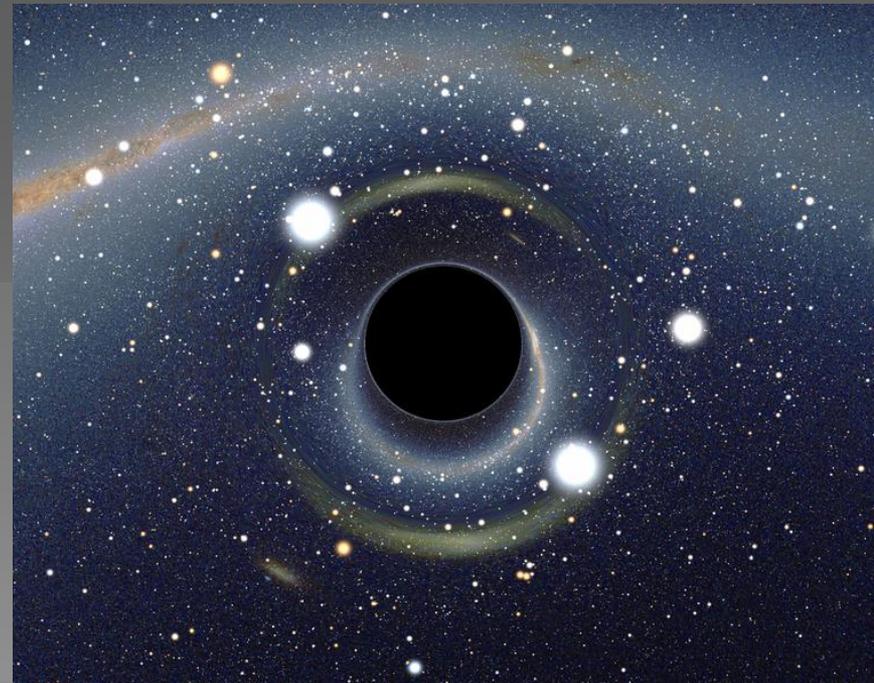
# Black Hole or Neutron Star?

•Black holes and neutron stars form when stars die. While a star is burning, the heat in the star pushes out and balances the force of gravity. When the star's fuel is spent, and it stops burning, there is no heat left to counteract the force of gravity. Whatever material is left over collapses in on itself. How much mass the star had when it died determines what it becomes. Stars about the same size as the Sun become white dwarfs, which glow from left over heat. Stars that have about 3 times the mass of the Sun compact into neutron stars. And a star with mass greater than 3 times the Sun's gets crushed into a single point, which we call a black hole.



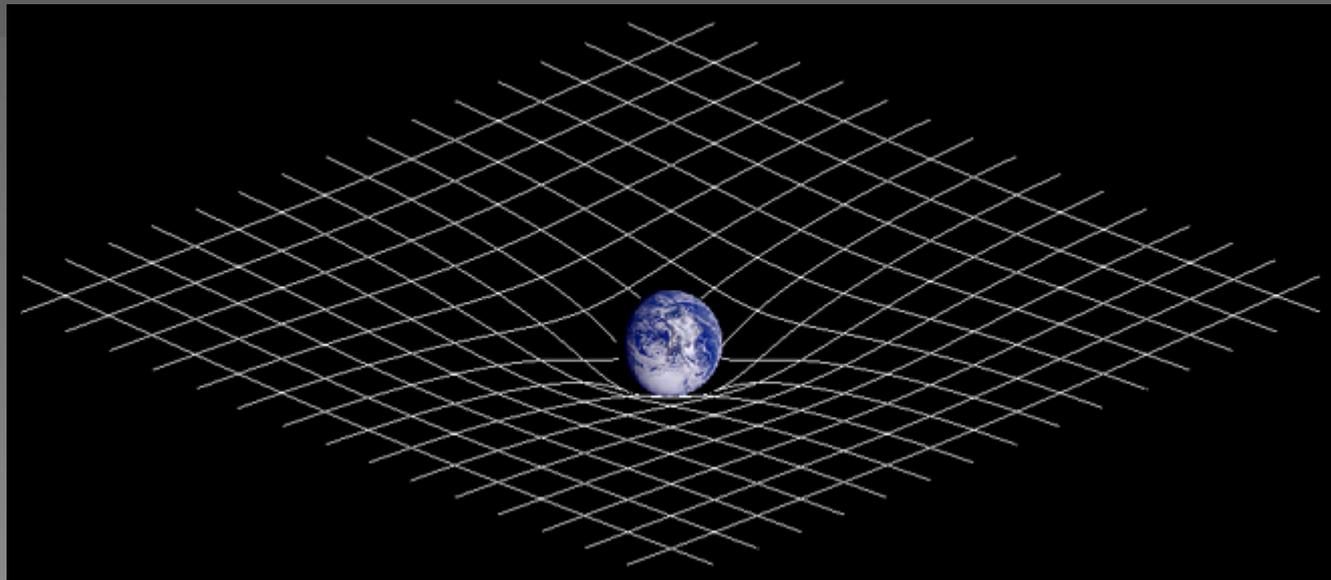
# Can we see them?

- Black holes are truly invisible. We can't actually see black holes because they don't reflect light.
- Scientists know they exist by observing light and objects around black holes.



# Could the Sun become a black hole?

- ◉ No, the Sun is much too small to ever become a black hole. A star has to be much more massive than the Sun before it can collapse into a black hole.



# Milky Way

- ◉ There is a super massive black hole at the center of the Milky Way galaxy. It weighs in at about 4 million solar masses. Luckily, there is no reason to worry. This giant sucker is over 30,000 light years away.

