KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS

PHYSUCS DEPARTMENT

SEMESTER (012)

PHYS-215
(ASTRONOMY)

Project

(The black holes)

Prepared For

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Sec # 01

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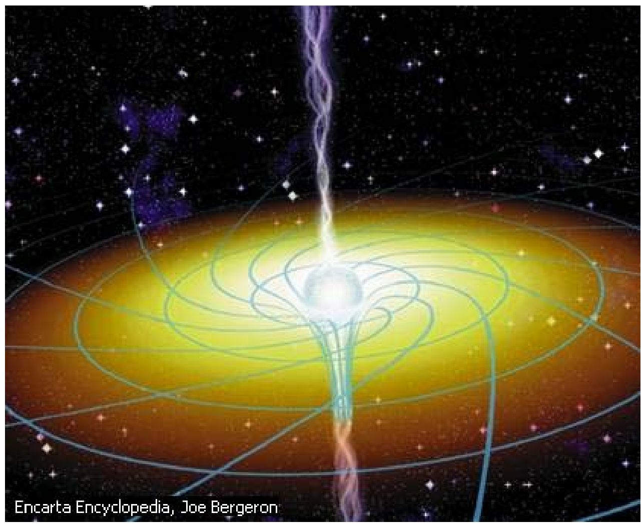
INTRODUCTION

Black Hole, an extremely dense celestial body that has been theorized to exist in the universe. The gravitational field of a black hole is so strong that, if the body is large enough, nothing, including electromagnetic radiation, can escape from its vicinity. The body is surrounded by a spherical boundary, called a horizon, through which light can enter but not escape; it therefore appears totally black.



Dragging Space and Time

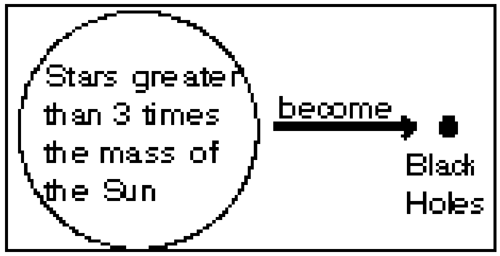
The results of two studies announced in early November 1997 provide unprecedented support for "frame-dragging," a concept predicted by physicist Albert Einstein's general theory of relativity. Frame-dragging describes how massive objects actually distort space and time around themselves as they rotate. One of the studies examined frame-dragging around black holes, an example of which is shown here in an artist's conception.

Also we can say that

-A black hole is one form of a "dead" star.

-A "dead" star may:

1. Shrink until it is a white dwarf, a few thousand miles across, about the size of the earth.
2. Shrink smaller than a white dwarf until it is a neutron star, about 20 miles across. Neutron stars have a huge density, about a million tons per square inch.
3. Keep on shrinking until it is just a point in space with an infinite density—a black hole.



-A star shrinks because gravity tries to pull the particles in the star together and make it collapse. If the star is less than two or three solar masses, it has enough exclusion principle repulsion to support it against gravity. If it is more than two or three solar mass units, it will probably collapse into a black hole.

-Common sense would say that a star with a smaller mass would be in the smallest form- a black hole. The reason it is the other way around has to do with more particles of matter attracting more gravity.

And a very important question arises which is

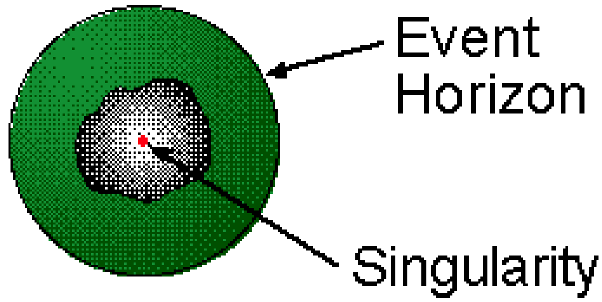
Are black holes really giant vacuum cleaners that suck in everything in sight?

-Black holes only suck in everything within a certain distance from its center. That distance is called the event horizon. If anything were to get inside the event horizon, there would be no return.

-If planets and stars are outside the event horizon, they would be safe. They would orbit the black hole just as planets in our galaxy orbit the sun.

What does a black hole look like?

-Nothing, it is just black.
-There are two parts to a black hole, the singularity and the event horizon. The singularity of the black hole is the center. Within a certain distance of the singularity, (the distance being called the event horizon), nothing would be able to escape the hole.
-If a black hole wasn't black, this is what it would look like:



PROPERTIES

The black-hole concept was developed by the German astronomer Karl Schwarzschild in 1916 on the basis of German American physicist Albert Einstein's general theory of relativity. The radius of the horizon of a Schwarzschild black hole depends only on the mass of the body, being 2.95 km (1.83 mi) times the mass of the body in solar units (the mass of the body divided by the mass of the sun). If a body is electrically charged or rotating, Schwarzschild's results are modified. An "ergosphere" forms outside the horizon, within which matter is forced to rotate with the black hole; in principle, energy can be emitted from the ergosphere.

According to general relativity, gravitation severely modifies space and time near a black hole. As the horizon is approached from outside, time slows down relative to that of distant observers, stopping completely on the horizon. Once a body has contracted within its Schwarzschild radius, it would theoretically collapse to a singularity—that is, a dimensionless object of infinite density.

FORMATION

Black holes may form during the course of stellar evolution. As nuclear fuels are exhausted in the core of a star, the pressure associated with their heat is no longer available to resist contraction of the core to ever higher densities. Two new types of pressure arise at densities a million and a million billion times that of water, respectively, and a compact white dwarf or a neutron star may form. If the core mass exceeds about 1.7 solar masses, however, neither electron nor neutron pressure is sufficient to prevent collapse to a black hole.

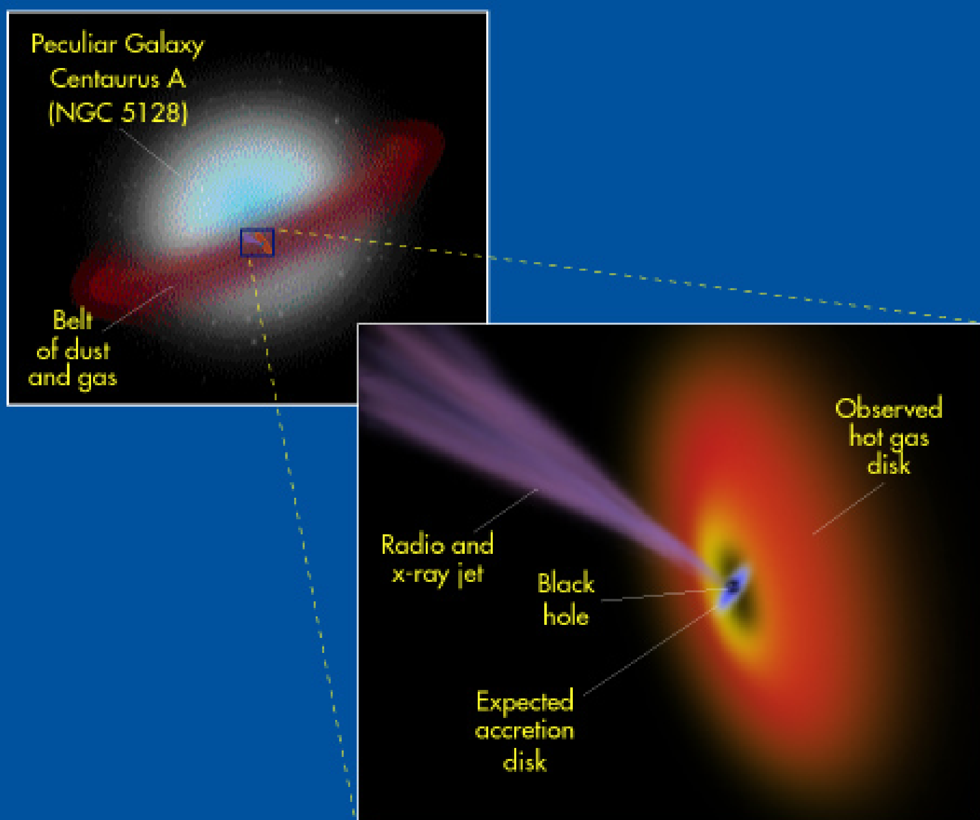
In 1994 astronomers used the Hubble Space Telescope (HST) to uncover the first convincing evidence that a black hole exists. They measured the acceleration of gases around the center of the galaxy M 87 and found that an object of 2.5 billion to 3.5 billion solar masses must be present. A second potential black hole at the center of the galaxy NGC 4258 was discovered in 1995 by astronomers using the Very Long Baseline Array (VBLA), an array of radio telescopes that spans a large geographical area. Also in 1995, astronomers used the HST to discover a third black hole near, but slightly displaced from, the center of the galaxy NGC 4261. In both of the 1995 discoveries, astronomers detected accretion disks, or disks of hot, gaseous material, circling the centers of the galaxies with accelerations that indicated the presence of a very massive object. In 1997 astronomers using the HST and ground-based telescopes in Hawaii announced that a census of nearby, ordinary galaxies shows that almost every galaxy may contain a massive black hole in its center. Knowing more about galactic black holes will help astronomers learn about the evolution of galaxies and the relationship between galaxies, black holes, and quasars.

The English physicist Stephen Hawking has suggested that many black holes may have formed in the early universe. If this were so, many of these black holes could be too far from other matter to form detectable accretion disks, and they could even compose a significant fraction of the total mass of the universe. In reaction to the concept of singularities, Hawking has also proposed that black holes do not collapse in such a manner but instead form so-called “worm holes” to other universes besides our own.

For black holes of sufficiently small mass it is possible for only one member of an electron-positron pair near the horizon to fall into the black hole, the other escaping (see X Ray: Pair Production). The resulting radiation carries off energy, in a sense evaporating the black hole. Any primordial black holes weighing less than a few thousand million metric tons would have already evaporated, but heavier ones may remain.

Hubble Finds Twisted Gas Disk from Galaxy Collision Fueling Nearest Active Black Hole

Using the infrared vision of NASA's Hubble Space Telescope to penetrate a wall of dust girdling the nearest active galaxy to Earth, astronomers have gotten an unprecedented closeup look at a super-massive black hole caught in a feeding frenzy triggered by a titanic collision between two galaxies.



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