

Q1: What is galaxy? What are the classification or types of galaxy?

Galaxy :-

A galaxy is a gravitationally bound system containing blackhole, stars, stellar remnants, interstellar gas and dust, dark matter, planets, dwarf planets, small solar system bodies, satellite, etc. are all within a galaxy.

The word galaxy is derived from the Greek word "galaxias", which literally meaning is "milky", a reference to the Milky way. Gravitational pull is being generated by a massive blackhole. The black-hole is located in the center of the galaxy. The Milky Way black-hole name is Sagittarius A*. The black-hole generates lots of masses pull and they have kept all the things in a system and all of these things revolved around the center of the galaxy. A black-hole is a massive object (or region) in a space that is so dense that within a certain radius, its gravitational field does not let anything escape from it, not even light.

Astronomers estimated that there are about 100 to 200 billion galaxies existed in the universe, other astronomers have tried to estimate the number of 'missed' galaxies in previous studies and come up with a total number of 2 trillion galaxies in the universe. {BBC - Sky at Night Magazine, Feb 10, 2023}

All these things - black-hole, stars, stellar remnants, interstellar gas and dust, etc. - collectively made galaxy and all the galaxies collectively made the whole universe. Galaxies are categorized according to their visual morphology: spiral galaxy, elliptical galaxy, lenticular galaxy, and irregular galaxy.

Example of Galaxy :-

1. Milky Way
2. Andromeda

Classification of Galaxy / Galaxies

According to the Hubble Tuning Fork diagram, the types of galaxies are as follow:

- 1- Elliptical Galaxy
- 2- Spiral Galaxy
- 3- Lenticular Galaxy
- 4- And most recently another type called "the Irregular" galaxies have also been added to the classification.

• Elliptical Galaxy :-

Elliptical galaxies are round collections of old stars. They contain very little gas and dust and have no features within them. They come in a range of different sizes and shapes, they can look circular, oval, or even rugby-ball-shaped. Elliptical galaxies are very old. They formed their stars a long time ago, with the gas and dust. There is no material left to make new stars, without any young, blue stars. Ellipticals look yellow-red. They are the most common type of galaxy found in clusters.

The smallest ellipticals are called dwarf ellipticals. They contain tens of millions of stars. The largest ones can contain over a trillion stars. Dwarf elliptical can be less than 10 percent of the size of the Milky Way. One of the most famous elliptical galaxies is Cygnus A, which is located roughly 600 million light-years from Earth and is an extremely bright radio source. Cygnus A is not only well-known to astronomers; but has a place in science fiction, featured in the 1985 novel "Contact", a Carl Sagan story that later inspired a Hollywood movie of the same name.

In 1926, Edwin Hubble presented a system to classify galaxies, known as the "Hubble sequence" or "Hubble tuning-fork", it organizes galaxies according to their shapes. Galaxies classified as:

- E0 appear to be almost perfect circles {remember, a circle is an ellipse}.
- While those listed as E7 seem much longer than they are wide.

- Ellipticals can also stretch more than a million light-years across, and contain more than ten trillion stars. M87, identified as one of the largest galaxies in the universe, is classified as an E0 elliptical galaxy.

Spiral Galaxy :-

Spiral Galaxies appear as flat, blue-white disks of stars, gas and dust with yellowish bulges in their centers. It has the diameter of 100,000 to 180,000 light years. It contains about 100-400 billion stars making it a giant galaxy. The bulge is made up of older, dimmer stars, and it is thought to contain a supermassive black hole.

The Andromeda and Milky Way - the galaxy that includes Earth and our solar system - is an example of a spiral galaxy. The Solar System is stationed in the Orion-Cygnus arm of the Milky Way galaxy {galactic disc} is roughly 27,000 light years.

The spiral galaxies are divided into two groups: normal and barred spirals.

- In barred spirals, the bar of stars run through the central bulge, and start at the end of the bar instead of from the bulge, forming stars and comprise a large fraction of all the galaxies in the local universe.
- In normal spirals, have a central bulge, spiral arms, and sparsely populated halos above and below the disc's plane.

Lenticular Galaxy :-

A galaxy having a central bulge surrounded by a flattened disk with no pattern of spiral arms. Lenticular galaxies are intermediate in

in the Hubble classification system between elliptical and spiral forms and are classified using the designation SO, or SBO if they have a bar of stars, gas, and dust through the nucleus.

The origin of SO galaxies are still unknown, but one idea is that they were originally spiral galaxies which either lost or used up their interstellar material through interactions with another galaxy.

If the central bulge is not very bright, it can be very difficult to tell the difference between a lenticular galaxy and an EO galaxy. Some lenticular galaxies have a bar, they are called "barred lenticular galaxies" and are denoted SBO. and normal lenticular galaxies are denoted SO.

Irregular Galaxy :-

Irregular galaxies have no particular shape. They are among the smallest galaxies and are full of gas and dust. Having a lot of gas and dust means that these galaxies have a lot of stars formation going on within them. The Large and Small Magellanic Clouds are examples of irregular galaxies.

These types of galaxies don't have a determined size, but the smallest can be around 3 kiloparsecs in diameter and commonly called dwarf irregulars. The diameter of larger irregular galaxies can be up to an amazing 10 kiloparsecs.

Hubble recognized two types of irregular: Irr-I and Irr-II.

1. Irr I: The Irr-I type is the most common of the irregular systems, and it seems to fall naturally on an extension of the spiral classes, beyond Sc, into galaxies with no discernible spiral structure. They are blue, are highly resolved,

and have little or no nucleus.

2- The Irr-II: The Irr-II systems are red, rare objects.

These systems {galaxies} are also called peculiar. They make up around 25% of all known galaxies. The closest galaxy to the Milky Way is an irregular galaxy called Canis Major Dwarf. It has only ~~or~~ 1 billion stars. It is thought to be falling towards the Milky Way, and may one day become part of our spiral arms.