

## Galaxies

- 1) **What are galaxies?**
- 2) **The birth of galaxies**
- 3) **Classification of Galaxies**

### 1) **What are Galaxies?**

Galaxies are collections of gas, dust, stars and ?? held together by gravity.

It is estimated that in the observable universe there are some 200 billion to 2,000 billion galaxies.

Most galaxies are between 3,000 and 400,000 light years in diameter and can contain billions or trillions of stars.

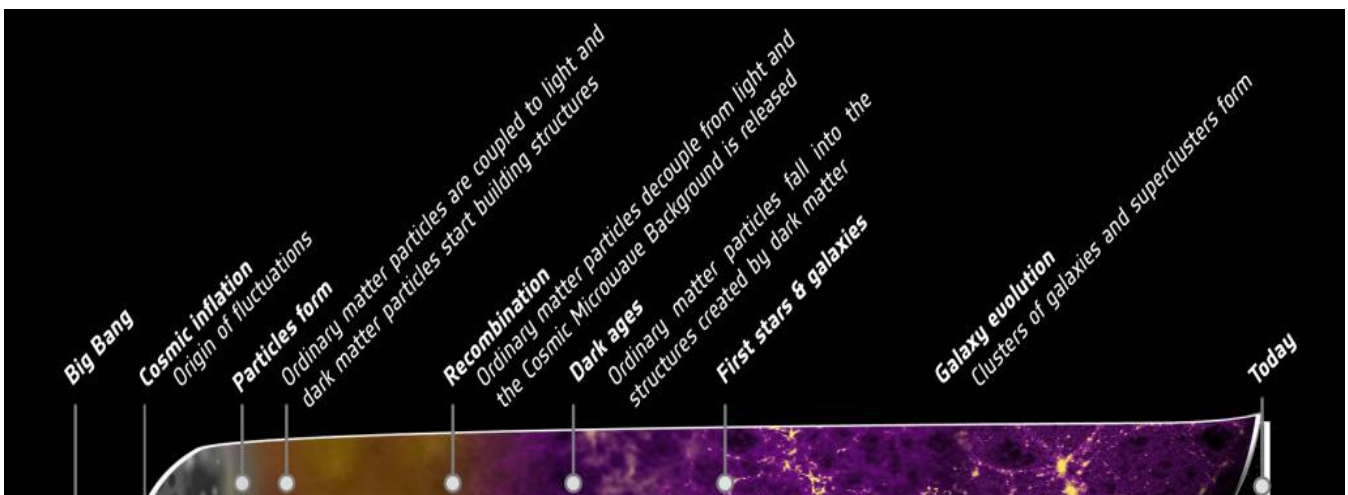
The Milky Way, our galaxy, is thought to be between 100,000 and 200,000 light years in diameter and contain between 100 and 400 billion stars, the most ancient of which are 13.7 billion years old.

Our galaxy is then part of the Local Group of around 54 galaxies, which is part of the Virgo Super Cluster of over 100 galaxies which is, in turn, part of the Laniakea Super Duper Cluster with approx 100,000 galaxies.

The majority of mass in a galaxy appears to be Dark Matter.

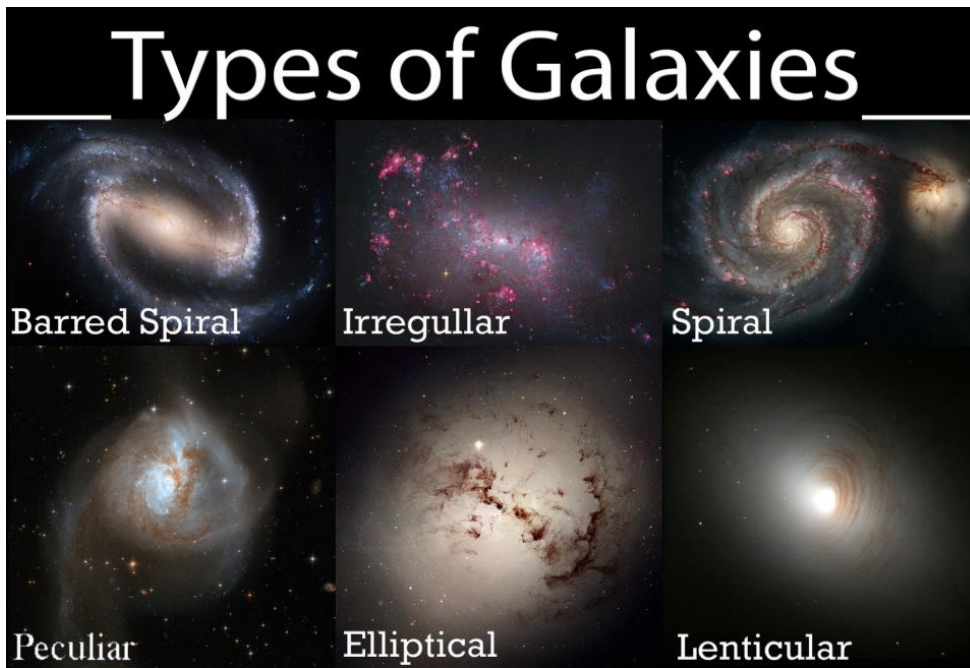
Most large galaxies have a super massive black hole in their centre.

### 2) **The Birth of Galaxies**



- When a galaxy forms, it has a disk shape and is called a spiral galaxy due to spiral-like "arm" structures located on the disk. There are different theories on how these disk-like distributions of stars develop from a cloud of matter: however, at present, none of them exactly predicts the results of observation.
- In the 1960s and 1970s a top-down model of galaxy formation was proposed. In this model it was thought that as a giant gas cloud collapsed so mass was pulled to the centre and, as the rotation speed increased. As the disc cools the cloud breaks producing new star forming areas. This theory is not widely accepted now.
- The current favoured hypothesis is the Lambda cold dark matter model, Lambda-CDM. This is also known as the standard model of big bang cosmology. [VIDEO from Project Illustris](#) This model assumes quantum fluctuations in the earliest moments of the universe. These fluctuations then grow into clumps and the clumps merge to form galaxies. Dark matter provides the web on which these earliest clumps and galaxies formed.

### 3) Classification of Galaxies – (one of many)



#### **Elliptical Galaxies:**

These tend to be the largest.

Generally, galaxies of this type are older and have no overly defined structure, they are about 6 M Lyrs across).

They don't contain many star forming regions, as they have used the bulk of their stellar material early in their formation. The massive size of galaxies of this type can be attributed to several galactic mergers, an event prone to advancing star formation activity

#### **Spiral and Barred Spiral Galaxies:**

Our galaxy, and our closest neighbour (Andromeda), are among this type. The Milky Way was thought to be an ordinary now it now seems we have a large bar near the nucleus where the spiral arms branch. Galaxies of this type have a large central bulge, expansive disks, and a halo. They have bright central regions, where intricate filaments of stellar materials extend from. Some of their arms can extend hundreds of thousands of light-years across (the Milky Way is about 100,000 Lyrs across, all in all), and they have stars of various ages scattered about. The material is organized in a way that is conducive to star formation, as something called "density waves" cause the material to circulate through the spiral arms like circling waves, where they ultimately squeeze and collapse, creating new stars.

#### **Lenticular Galaxies:**

These have central bulge with no spiral arms. Many astronomers believe they are the evolutionary bridge between a spiral and elliptical galaxy. They can often be misidentified as either/or, depending on our frame of reference (if we are seeing the galaxy edge or face-on)

#### **Irregular Galaxies:**

Many galaxies that have interacted or merged do not have predictable structures. Some resemble birds or cigars (like M82, or the Cigar Galaxy), while others look like giant blobs of glowing dust.

#### **Dwarf Galaxies:**

There may be trillions of dwarf galaxies in the universe, most in orbit around other galaxies. The Milky Way may have as many as 26 of them bound to it.