Related theory

Galaxies are huge gravitationally bound collections of gas, stars, planets, ice and dust. There is a large variety of different shapes and sizes. Their size ranges from dwarf galaxies containing tens of millions (10^7) of stars, up to super giants containing up to a trillion stars (10^{12}). There is more than 170 billion (10^{11}) galaxies in the observable universe.

Our Galaxy, the 'Milky Way' is a typical large spiral galaxy. Its disk is about 100.000 light years in diameter and 3000 light years thick. Most galaxies in our Local Group are smaller than the Milky Way; their diameter is approximately ten times smaller.

Elliptical Galaxies

Elliptical galaxies have an ellipsoidal shape and a smooth distribution of light that is practically featureless. The shape of elliptical galaxies can vary from spherical to highly flat and it usually is a result of the collision of two galaxies. Depending on their size, they contain from a few hundreds of millions of stars, to over one trillion. This kind of galaxies is gas poor and as a result there is little strar formation going on in them. Elliptical galaxies are not the dominant type of galaxies in the universe although they make up roughly 10–15% of galaxies in the local Universe. They are usually found close to the centers of galaxy clusters.

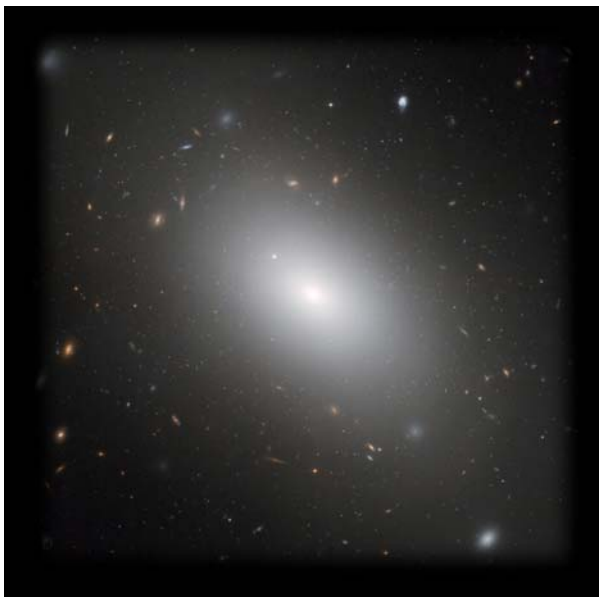

Figure 2. The elliptical galaxy NGC 1132 as observed from Hubble Telescope.

Spiral Galaxies

Spiral galaxies consist of a central bulge and a flat rotating disk that contains stars, gas and dust. There are spiral structures that begin from the central bulge and extend into the disk. As these structures are gas and dust rich, they are very active regions in terms of star formation. Spiral galaxies are

much more isolated than elliptical galaxies as they don't often appear in clusters.

Figure 3. The spiral galaxy M74 as observed from Hubble Telescope.

Barred Spirals

Many spiral galaxies, approximately two thirds of them, have a central bar-shaped structure that consists of stars and affects the motion of both stars and gas. The creation of this structure is thought to be the result of a density wave that radiates from the center of the galaxy and is thought to be a temporary phenomenon in the life of spiral galaxies. Bars decay and gradually transform the galaxy into a regular spiral galaxy.

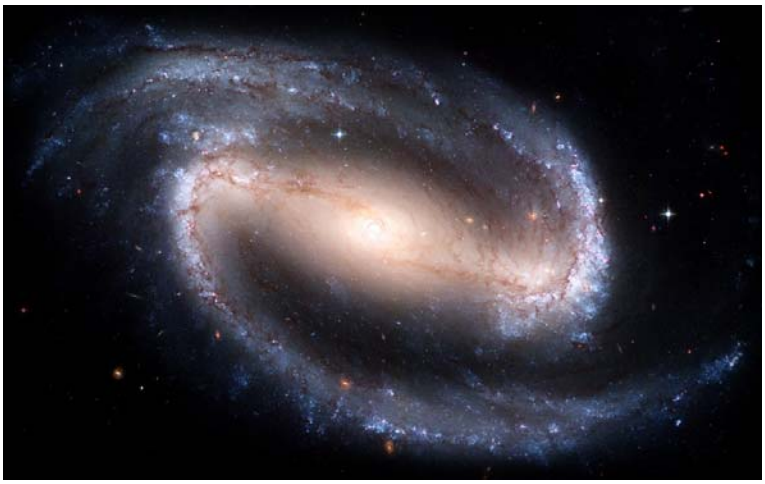

Figure 4. The barred spiral galaxy NGC 1300.

Lenticular Galaxies

Lenticular galaxies are another class of galaxies which are among elliptical and spiral galaxies. Their morphology presents a disk like spiral galaxies do, however, they've used all their gas and thus there is little stars formation going on, just like in elliptical galaxies.

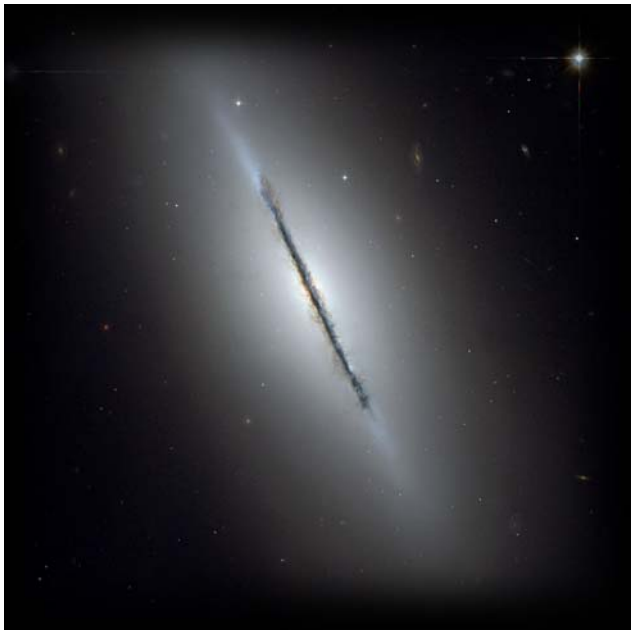

Figure 5. The lenticular galaxy NGC 5866

Irregular Galaxies

Irregular galaxies do not have a regular shape and they make up about one quarter of all galaxies. Their shapes are the result of interactions between galaxies and they are believed to be very similar to the first galaxies that populated the Universe. This is why there are thought to be very important as they may help astronomers understand the overall evolution of galaxies.

Figure 6. The irregular galaxy NGC 1427

The Hubble Classification Scheme

The most popular galaxy morphological classification system was developed by Edwin Hubble in 1936. Due to its shape, it is also known as the 'Hubble Tuning Fork'. Based on their visual appearance, Hubble divided galaxies in there main categories: Elliptical, Spiral and Lenticular galaxies.

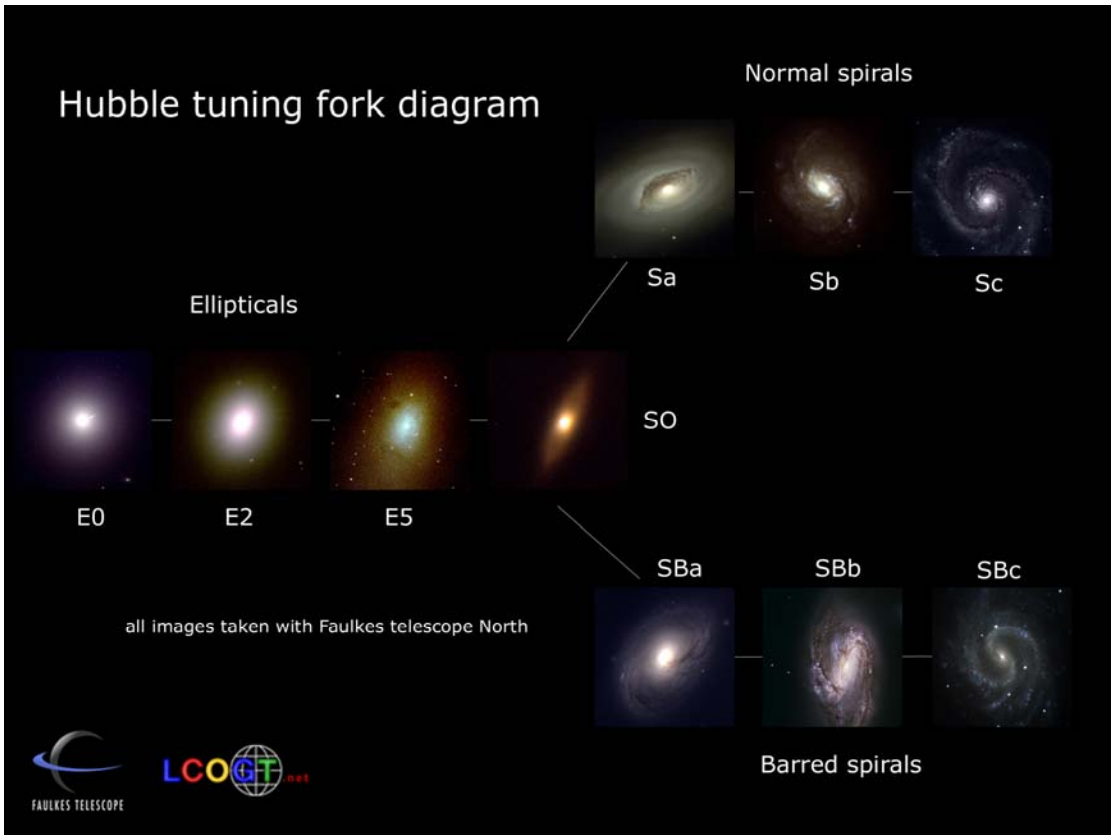

Figure 7. The diagram of the Hubble galaxy morphological classification.

Elliptical galaxies are denoted by the letter, E followed by a number which indicates their degree of ellipticity. "E0" galaxies are near circular while the

most flattened galaxies that have ellipticity of e=0.7 are galaxies "E7". Lenticular galaxies which are between elliptical and spiral are labelled as S0.

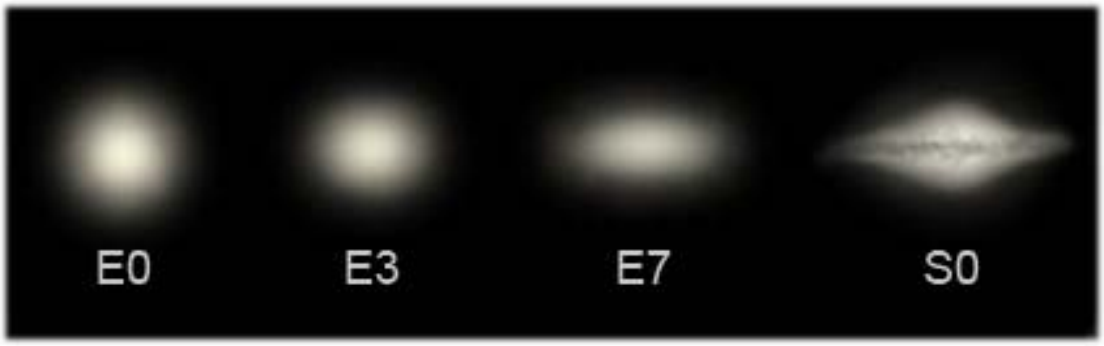

Figure 8. The classification of elliptical galaxies.

Spiral Galaxies are given the letter S and are also denoted by letters a, b or c. 'Sa' galaxies have very tight spiral arms and a bright central bulge. 'Sb' galaxies have less tight spiral arms and a fainter central bulge whereas 'Sc' galaxies have loose spiral arms and their central bulge is smaller and fainter.

Figure 9. The classification of spiral galaxies.

Barred spiral galaxies are categorized in the same way as non-barred spiral galaxies. 'SBa' galaxies have tight spiral arms and a large central bulge. 'SBb' galaxies have looser arms and a fainter central bulge. 'SBc' galaxies have very loose spiral arms and a faint central bulge.

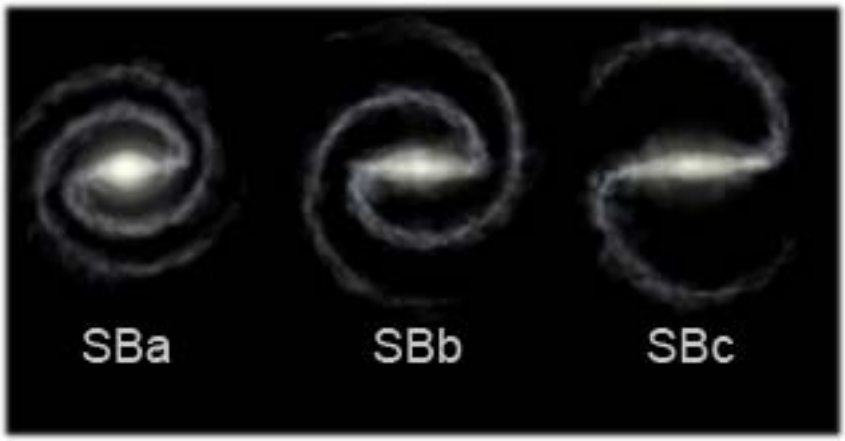

Figure 10. The classification of barred galaxies.