

Session 9: Galaxies



Afterschool Universe



This presentation supports the “Background” material in Session 9 of the Afterschool Universe program. This session is about galaxies.

The picture shows the Whirlpool galaxy, a large, iconic, spiral galaxy.

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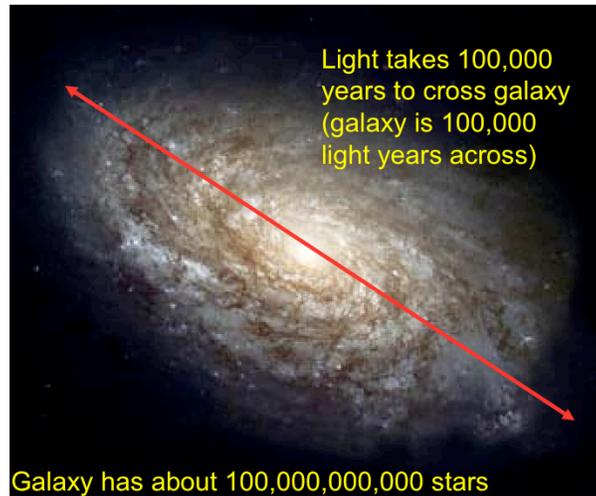
The Main Concepts...

1. A galaxy is a large collection of stars, gas and dust.
2. We live in a galaxy called the Milky Way.
3. Our Sun and planets are in the “suburbs” of the Milky Way.
4. There are billions of galaxies in the Universe.
5. Galaxies come in three basic shapes; spiral, elliptical and irregular.



Let us summarize the main concepts in this Session. We will discuss these in the rest of this presentation.

Composition and Size of Galaxies



A galaxy is a huge collection of stars, gas and dust.

A typical galaxy has about 100 billion stars (that's 100,000,000,000 stars!), and light takes about 100,000 years to cross a galaxy (in other words, they are typically 100,000 light years across). But some galaxies are much bigger and some are much smaller.

Our View of the Milky Way Galaxy

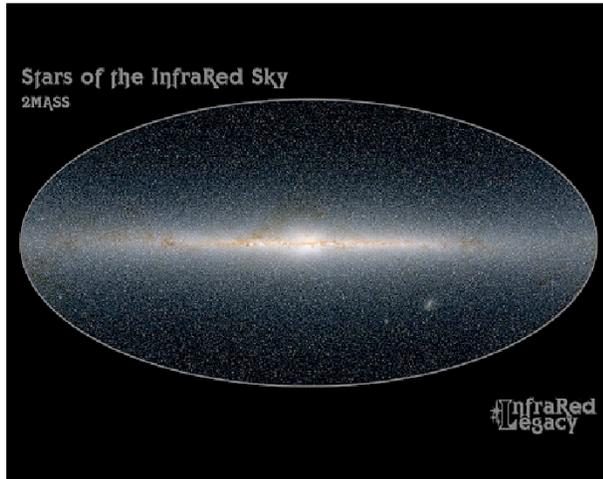


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If you look at the sky from a DARK location, you can see a band of light stretching across the sky which is known as the Milky Way. This is our view of our Galaxy - more precisely, this is our view of the disk of our galaxy as seen from the INSIDE.

Another View of Our Galaxy



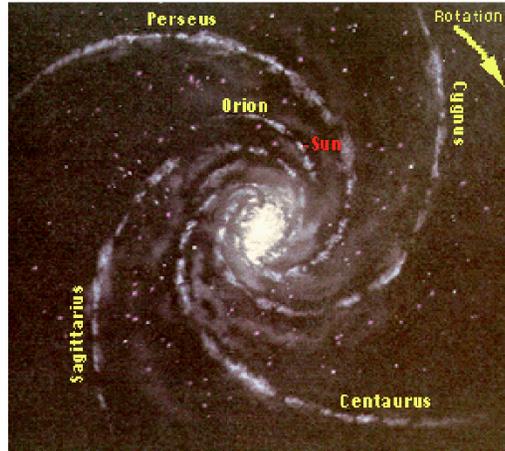
We live in the disk of our galaxy - so we see our galaxy edge-on.

To see our galaxy, we need to use light that can get through all the dust in the disk (for example, infrared).



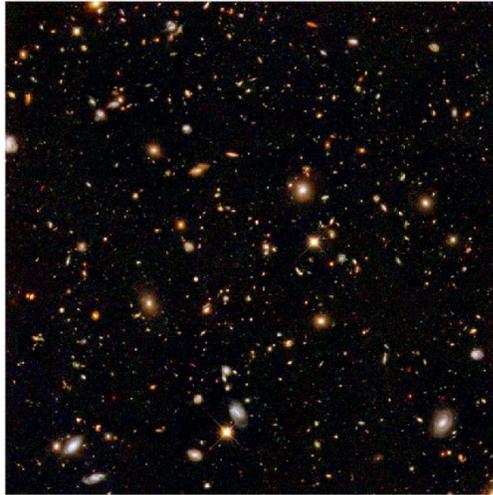
This picture shows another view of our galaxy taken in the infra-red part of the spectrum. The advantage of the infra-red is that it can penetrate the dust that pervades our galaxy's disk and let us view the central parts of our galaxy. This picture also shows the full sky. The flat disk and central bulge of our galaxy can be seen in this picture.

Drawing of Our Own Galaxy...



We live in the suburbs of our galaxy. The Sun and its planetary system are about 25,000 light years from the center of the galaxy. This is about half way out to the edge of the disk. Our galaxy has four main spiral arms called the Cygnus Arm, Perseus Arm, Sagittarius Arm and Centaurus Arm. As we said before, we live inside our galaxy so we cannot get a “top-down” view of it. However, we can map out the velocities of stars and can start to get a sense of the structure even though we are “on the inside”.

There Are Billions of Galaxies



Small patch of the sky as seen by the **Hubble Space Telescope** (Ultra Deep Field)

Almost every point of light here is a galaxy!



There are many billions of galaxies in our Universe. In fact, there are probably about as many galaxies in the Universe as there are stars in a galaxy (100 billion). A sense of just how many galaxies are out there can be seen in this very sensitive Hubble Space Telescope image of a **SMALL** and **AVERAGE** piece of the sky.

Three Basic Shapes for Galaxies

1. Spiral galaxy

- A flat disk with a central bulge
- Often has spiral pattern in the disk
- The disk spins like a wheel
- Our own galaxy, the **Milky Way**, is a spiral galaxy



Galaxies come in three basic varieties.

Firstly, there are spiral galaxies (sometimes called disk galaxies). These have a flat circular disk with a central bulge (in other words, they have the shape of a fried egg) . The disk spins (taking hundreds of millions of years to go around once) and often has a spiral pattern imprinted into it, leading to the name “spiral galaxies” . Our galaxy, the Milky Way, is a spiral galaxy.

We live in a spiral galaxy called the Milky Way

Spiral Galaxies from Different Angles

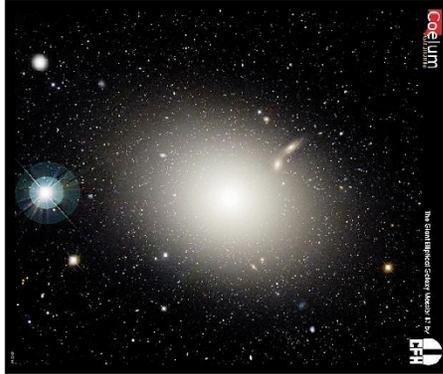


Let us look at a few spiral galaxies. Some of these galaxies look rather different, but the main difference is the angle at which we are viewing them. If we look at the disk from the top, we see a nice round galaxy with prominent spirals. If we look from the edge, the disk appears as a thin linear structure. The dark regions seen in some of the pictures are dust lanes in the galaxy.

Three Basic Shapes for Galaxies

2. Elliptical galaxy

Large round/elliptical “balls” of stars



**Giant Elliptical
Galaxy M87 in Virgo**



The second type of galaxies are called elliptical galaxies. These are basically big balls of stars - they have no disks and typically do not spin.

The biggest galaxies in the Universe are elliptical galaxies. Shown is a beautiful example of a nearby giant elliptical galaxy, M87 in the constellation of Virgo.

Three Basic Shapes for Galaxies

3. Irregular galaxy

Everything that is not a spiral or an elliptical galaxy!

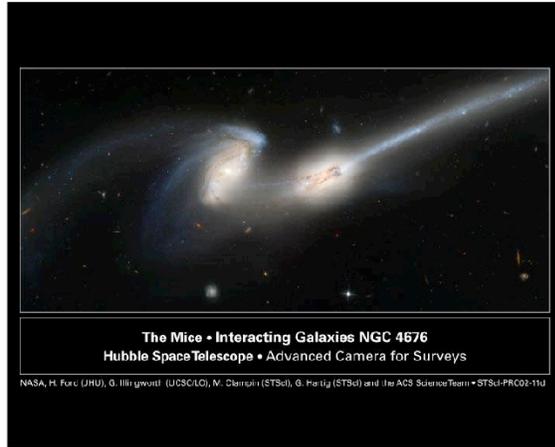
Large Magellanic Cloud



Finally, there are galaxies that are hard to classify as either spiral or elliptical. These odd-balls are put in the final category of irregular galaxies.

This example is a very nearby small irregular galaxy, the Large Magellanic Cloud, which can be easily seen with the unaided eye from the southern hemisphere. The Large Magellanic Cloud is a satellite galaxy of the Milky Way and orbits the Milky Way just as the moon orbits the Earth. There is also a Small Magellanic Cloud, which is not shown here. This is also an irregular galaxy and is a satellite galaxy of the Milky Way.

Interacting Galaxies



“The Mice”, an example of two galaxies that are colliding with each other.



Galaxies frequently collide with each other. When they do so, the stars do not collide as there is so much space between the stars. But the gas within the galaxies interact and this frequently triggers star formation. Shown in the slide is a beautiful example of two colliding galaxies, called “The Mice” because they look like two mice with their tails.