

14.0: The Growth of Structure Introduction



Video Transcript

Mapping Our Universe: Transcript

Our story begins on a blue planet called Earth, in the United States, in southern New Mexico; home of Apache Point observatory, site of the Sloan Digital Sky Survey.

Inside this structure is two-and-a-half meter telescope which is being used to construct the largest map of the Universe ever made. When the survey is completed in the next few years, it will provide a three-dimensional atlas of nearly a million galaxies. Let's take a look at what they have found so far.

We begin our journey looking back at the Sun. Moving outward, we see thousands of nearby stars, many of them just like our own Sun. As we continue to pull away from the Sun, we see that these stars are part of a much larger spiral-shaped collection of a hundred billion stars, a galaxy called the Milky Way.

Moving outward from the Milky Way, we begin to see the nearest galaxies mapped by the Sloan Digital Sky Survey. Galaxies come in a variety of shapes, sizes, and colors, from typical blue spiral galaxies like our own Milky Way to giant red elliptical galaxies.

Now hundreds of millions of light-years from Earth, we see that galaxies are not randomly distributed throughout the Universe; they collect together in groups of different sizes ranging from clusters of hundreds of galaxies to huge web-like structures stretching across hundreds of millions of light-years.

The survey is being carried out in thin slices across the sky like pieces of a watermelon. When completed, these slices will merge together to form a three-dimensional map of the Universe.

Beyond the Sloan Survey, we reach the cosmic microwave background radiation as mapped by NASA's WMAP satellite. This radiation gives us a picture of the temperature of the temperature Universe when it was only 400,000 years old.

By combining these observations, cosmologists are closing in on a consistent picture of how the Universe evolved from its earliest moments to the present day.

Whether you live in a big city, a small town, or in the countryside, a view of the stars presents a reminder of the vast Universe in which we reside. You may be able to pick out some constellations, point in the direction of star clusters or even view the Milky Way stretch across the sky. It is human nature to try to understand the pattern of stars, grouping them into familiar constellations and inventing clever stories to explain the shapes we see.

With bigger and better telescopes, our view of the Universe has grown past these individual stars to the galaxies beyond. Of the billions of galaxies scattered throughout the observable Universe, some look similar to our own while others look quite different. On the largest scales, the Universe looks like a giant cosmic web with bright spots along stringy filaments, flat walls, and large bubbles of nearly empty space.

In the opening video we are introduced to the Sloan Digital Sky Survey, one of several surveys that have been mapping millions of galaxies and other objects. In the video, we take fly-through of the Universe as revealed by Sloan. We start from our vantage point at Earth, and then we visit galaxies, clusters, filaments, and places nearly devoid of galaxies. The survey is done in slices, and the completely blank areas are slices yet to be mapped. As we go farther out in into space we are also seeing farther back in time, almost to the edge of our observable Universe. This edge is depicted as a sphere centered on Earth. In the last few frames of the video, we see light from a time before galaxies formed, the cosmic microwave background. One thing that the video makes clear: the Universe of long ago is not identical to the Universe we live in now. There have been noticeable changes to its mean properties over its lifetime.

In this chapter we will see how the gravitational attraction of dark matter gave rise to galaxies, galaxy clusters, and the largest structures of the Universe. Combining powerful telescopic surveys and massive computer simulations based on the laws of physics, astronomers have created a detailed picture of the known Universe.

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