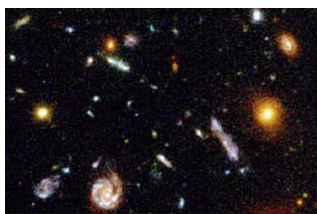


New clues about the origin of galaxies

## Hubble telescope captures glimpse of early universe

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Detail of a photograph taken by the Near Infrared Camera, in a 36-hour exposure of an area near the Big Dipper

Last week mankind made another important step forward in solving one of the greatest mysteries of nature: the origin and history of our universe. On October 8, scientists working with NASA released photographs taken by the Hubble Space Telescope which depict the most distant galaxies ever seen.

Using an instrument called the Near Infrared Camera, in a 36-hour exposure of a very small area near the Big Dipper, the scientists captured the clearest image ever taken of thousands of galaxies deep in outer space. Perhaps more importantly, the image also revealed the existence of 100 other objects that had never been seen before.

The light captured in this picture may be from an early period of the current form of our universe, when galaxies and stars first began to take shape. Further studies of these objects will undoubtedly contribute to the clarification of important and, as yet, unanswered questions about how the universe came into existence.

Astronomers involved in the study estimate that the new objects represent light which was emitted when the universe was approximately 5 percent of its current age. If one accepts the most widely held view that the universe is 13 billion years old (estimates range from 10 to 20 billion years), these objects are over 12 billion years old.

According to Alan Dressler of the Carnegie

Observatories in Pasadena, California, 'What we see may be the first stages of galaxy formation. But the objects are so faint that their true nature can only be explored with the advanced telescopes of the future.'

Roger Thompson of the University of Arizona, the principal scientist of the study, said, 'These are the deepest images of distant galaxies that have ever been obtained. We are seeing farther than ever before. We have not reached the edge [of the universe], but we have made a step into a new area.'

Some of the galaxies in the infrared image were first photographed in 1995 with a visible light camera known as the Hubble Deep Field. At that time, scientists were not certain what these formations were because they were obscured and appeared 'lumpy.' In the new infrared photos these 'lumpy' objects appear with the characteristic spiral shape of galaxies.

The understanding of galaxies, both their structure and evolution, is a critical component of present-day knowledge about the universe. The German philosopher Emanuel Kant first speculated on the existence of galaxies in 1755, when he said that the 'spiral nebulae' which were visible in space were made up of stars. At that time there were no means of confirming Kant's idea.

Some 170 years later, the astronomer Edwin Hubble (for whom the telescope is named) used photographic plates and the giant 100-inch telescope at Mount Wilson in California to prove that galaxies are made up of billions of stars. This discovery paved the way for the process of 'mapping' the universe, that is, establishing the locations and distances of the galaxies in relation to one another.

Over the course of many decades of mapping, it has

been established that galaxies exist in a hierarchical system of groups, clusters and superclusters, between which there are massive caverns of empty space. Until 1929 it was thought that while galaxies might undergo changes within themselves, they were essentially static relative to one another. With the aid of a spectroscope, a device which breaks down light into its constituent frequencies, Edwin Hubble confirmed that most galaxies were moving away from our own Milky Way as well as from each other at rates that were proportional to their distances.

The idea that the universe was expanding was new. Although Hubble was not aware of it, the conception of an expanding universe had been previously hinted at by Albert Einstein in 1916 as a byproduct of the general theory of relativity. The thought seemed so improbable to Einstein at the time that he considered it a mistake.

With solid evidence that the universe was stretching out, it was not very long before scientists began to consider what the expansion was like in its infancy. This is how the theory of the big bang emerged. (The term 'big bang' actually began as a derisive designation originated by the English physicist Fred Hoyle, who argued for a steady state theory of a universe that had always expanded, yet had no beginning.)

Over the past 60 years the big bang theory has, with the intersection of astronomy, physics and cosmology, undergone many modifications. However, what has become known as the standard big bang model is fairly well agreed upon. Its essential elements are that the universe began as a singularity, a tiny and very hot, very dense, high-energy unit. In this singularity everything was in the same space and the same time.

Suddenly, for reasons which remain unknown, in a tiny fraction of a second, the universe began its expansion. Evidence of this initial stage of the universe was first discovered in 1965 when physicists using a radio receiver built for communications satellite experiments detected what is known as the cosmic microwave background (CMB). The CMB is basically big bang radiation which is still present in the universe.

In 1992 further details of the CMB were revealed by the Cosmic Background Explorer (COBE) satellite sent up by NASA to explore this phenomenon. An all-sky map compiled by COBE showed that while the CMB was distributed uniformly throughout the cosmos, matter began to clump up into dense regions fairly early

in the process.

For all of the branches of science which are striving to reconstruct the evolution of the universe, the new and very distant objects photographed by the Hubble Space Telescope will provide crucial details of how the galaxies grew out of the generally homogenous but expanding cloud of the big bang.

It should be added that in speaking about 'the origins of the universe,' as astronomers and cosmologists habitually do, what is involved is not a beginning of the material world, but a starting point for the universe in its present form--atoms, molecules, planets, galaxies, etc.--all of which originated in the period since the big bang. What forms matter assumed before the big bang cannot be determined with present technical methods.

For further reading, see:

*The Whole Shebang: A state-of-the universe(s) report*, by Timothy Ferris, 1997, Touchstone Rockefeller Center 1230 Avenue of the Americas New York, NY 10020

For more information on the Hubble Space Telescope and the October 8 announcement access: <http://opposite.stsci.edu/pubinfo/pr/1998/32/index.html>



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