Hubble’s Deep View of the Universe

Red galaxies, blue galaxies: old galaxies, new galaxies. Astronomers have never before had a picture like this.

Last month, the Hubble Space Telescope stared at a tiny patch of sky near the handle of the Big Dipper for 10 consecutive days, generating a high-resolution image that reaches deeper into the heavens than any previous one. A composite of several hundred 15-minute to 40-minute exposures recorded from ultraviolet, blue, red, and infrared emissions, the Hubble picture shows a bewildering array of galaxies.

Like a swath cut through several layers of an archaeological dig, the combined image is thought to include galaxies of all ages. Astronomers believe that the most distant galaxies in this image were recorded as they looked when the universe was only about a billion years old, a mere 10 to 20 percent of its current age.

Known as the Hubble Deep Field, the image contains about 1,500 galaxies, many of them only one four-billionth as bright as the dimmest light the human eye can see and fainter than any existing telescope on Earth can detect. More than just a pretty picture, the Deep Field will help astronomers tackle some of the most fundamental mysteries of the cosmos, including the birth and evolution of galaxies, says Robert E. Williams, director of the Space Telescope Science Institute in Baltimore.

Viewing the image is “like looking down a long tube and seeing all the galaxies along the line of sight,” says Mark Dickinson of the Space Telescope Science Institute. “They’re all stacked up against one another... and the challenge now is to disentangle them.”

Williams, Dickinson, and their colleagues unveiled a poster-sized version of this month at a meeting of the American Astronomical Society in San Antonio. They plan to release the data to the astronomical community after only 2 weeks instead of the usual 1 year.

In doing so, says Stanislav G. Djorgovski of the California Institute of Technology in Pasadena, “Williams has invested in science venture capitalism. This will truly stimulate a vast amount of follow-up studies.”

A priority, Djorgovski adds, will be to determine distances from Earth for as many of the galaxies as possible. The expansion of the universe provides the means. That expansion causes distant galaxies to move away from each other faster than nearby galaxies. Thus, by measuring velocity, astronomers can learn how far from Earth a galaxy lies.

Because so many of the galaxies in the Deep Field are extremely faint, Williams estimates that even the world’s largest telescope, the 10-meter W.M. Keck atop Hawaii’s Mauna Kea, can measure the velocity of only about 100 of them. That’s why Hubble’s color information becomes so important, Dickinson notes.

For instance, very distant galaxies tend to vanish in the ultraviolet, even if they show up clearly at longer, redder wavelengths. That’s because hydrogen gas readily absorbs ultraviolet light, and the most distant galaxies have the largest amount of hydrogen gas between them and Earth.

With the help of this effect, known as ultraviolet dropout, Dickinson hopes to determine whether a number of bizarre, stringlike galaxies, also noted in another Hubble image, are truly distant (SN: 7/29/95, p. 69). If so, these filaments may represent the building blocks of the more familiar spiral and elliptical galaxies of today’s universe.

Color information may also indicate whether many of the Deep Field galaxies are as compact as they appear or are merely the brightest parts of large, diffuse galaxies, Dickinson adds.