Infrared Camera Goes the Distance

Viewing the world through rose-colored glasses has its advantages. Using its infrared camera, the Hubble Space Telescope has peered deeper into space and farther back in time than ever before, finding several galaxies that may be the most distant known in the cosmos.

Astronomers estimate that some of the galaxies are so distant that the light they emitted more than 12 billion years ago has only now reached Earth. If the universe is 13 billion years old—estimates vary—then the images reveal what these starlit bodies looked like just 700,000 years after the Big Bang.

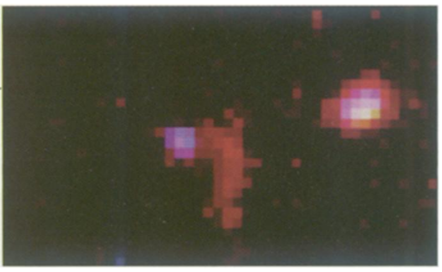
The faint objects are among 300 or so imaged earlier this year when Hubble revisited the scene of a previous triumph, a patch of sky near the handle of the Big Dipper. For 10 days in late 1995, the telescope's visible-light camera stared at the region, dubbed the Hubble Deep Field, and revealed some 1,500 galaxies (SN: 1/20/96, p. 36). Last January, Hubble reexamined about one-sixth of the field in the near-infrared.

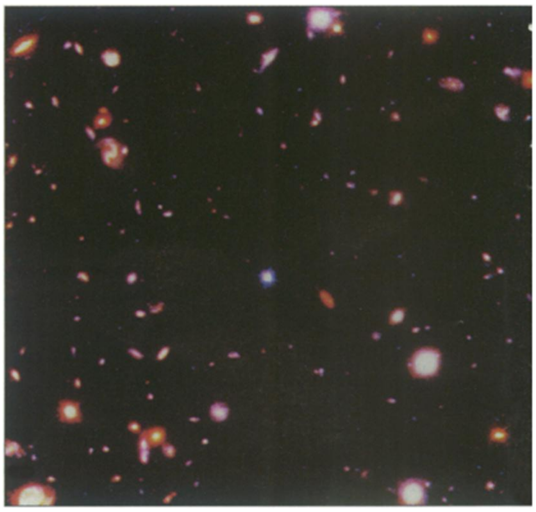
About 100 of the galaxies found in the near-infrared had not been seen in visible light. Most are not believed to lie very far away but were hidden by dust, which absorbs visible light and reradiates it in the infrared. About 10 of the faint objects, however, may reside at the edge of the observable universe, says Rodger I. Thompson of the University of Arizona in Tucson. He and a colleague, Lisa J. Storrie-Lombardi of the Carnegie Observatories in Pasadena, Calif., presented the images this week at a briefing in Washington, D.C.

To estimate the distances of the galaxies, Thompson's team relied on a key property of hydrogen: This most common of elements readily absorbs ultraviolet light. The more distant the galaxy, the more hydrogen lies between it and Earth, and the more its ultraviolet emission is dimmed. The expansion of the universe slightly complicates the story—it shifts the absorption toward longer wavelengths by an amount that increases with the galaxy's distance. For a galaxy some 12 billion light-years from Earth, the absorption shifts from the ultraviolet into visible light.

The team found several galaxies that appeared about equally bright at near-infrared wavelengths of 1.1 and 1.6 micrometers but didn't show up in the visible-light images. "We can't absolutely claim that these are the most distant objects [known] in the universe," says Thompson, but they "are very good candidates."

He emphasizes that these galaxies are so dim that measuring their distances may require Hubble's successor, the Next Generation Space Telescope, which is not scheduled for launch until 2007.


Thompson/NASA



Above: This galaxy (center object) may be one of the most distant known. Right: False-color, infrared image shows over 300 galaxies.

Finding galaxies that existed so soon after the Big Bang puts a bigger burden on theories that seek to explain galaxy formation. "It's entirely plausible that we are pushing back the frontier even farther," says James D. Lowenthal of the University of Massachusetts in Amherst.

The new images also solve a puzzle. Each bluish knot of light in the visible-light pictures had appeared to be a separate, compact galaxy about halfway to the edge of the universe. But there were far too many of these objects to square with the relatively small population of such bodies in the nearby cosmos. The infrared images reveal that many of these are in fact star-forming regions within much larger, older galaxies. —*R. Cowen*

RNA folding process reveals a new twist

The way RNA strands fold into their three-dimensional structures might not be as straightforward as researchers think, according to a new study.

Ignacio Tinoco Jr. and Ming Wu of the University of California, Berkeley have found that RNA molecules rearrange their internal structures as they fold into their final shape. The finding adds another layer of complexity to the already difficult problem of predicting how a strand of RNA will fold.

Scientists commonly believe that RNA folds in a stepwise process directed by interactions between the four bases, or molecular units, that constitute it: Guanine usually bonds with cytosine, and adenine with uracil.

When an RNA strand folds upon itself, base pairs near each other link up to create loops, twists, and kinks, features known as RNA's secondary structure. The strand then bends into its final three-dimensional shape, or tertiary structure, by simply forming bonds between bases left unpaired after the initial folding.

Tinoco and Wu examined a fragment of a ribozyme, a length of RNA that catalyzes biochemical reactions (SN: 7/22/95, p. 53). They determined the structure of the fragment, obtained from a microorganism called *Tetrahymena thermophila,* in solutions with and without magnesium ions, which normally stabilize the ribozyme's three-dimensional structure.

"By leaving out magnesium, you're just looking at the secondary structure," Tinoco explains. "When you add magnesium, [the RNA] goes into its tertiary folding."

The researchers found that, contrary to current belief, the transition between the secondary and tertiary structures involves rearrangement of some base-pair bonds, not just bonding by the unmatched bases. As the RNA folds into its tertiary structure, six of the original 19 base pairs break, and six new ones form.

"People thought that the base pairs were so stable that the tertiary structure wouldn't disrupt them," says Tinoco. "We've found that this is not always true." He and Wu report their findings in the Sept. 29 PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES.

"Understanding RNA structure is key to understanding RNA function," says Scott K. Silverman of the University of Colorado at Boulder. Researchers use computers to help predict secondary structure from the base sequence, then make informed guesses about tertiary structure from those results. The new finding shows that "you might have to worry about what the tertiary structure looks like before you can draw the secondary structure correctly." —*C. Wu*