

"Long before it's in the papers"



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“Earliest galaxy” offers surprises

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Courtesy of University of Massachusetts Amherst
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Astronomers say they have identified the most distant galaxy ever detected, in a survey not even designed to find one like it.

Because light takes time to travel, the galaxy is therefore being seen as it was earlier in the history of the universe than any other, they add.

Although other Hubble-based observations have identified many other candidates for early-universe galaxies, including some that may be even further, this one is the farthest and earliest whose distance can be confirmed with follow-up observations from the Keck I telescope, one of the largest on earth, the astronomers said.

University of Massachusetts Amherst astronomer Mauro Giavalisco and colleagues identified the body as part of a major survey of the early universe conducted using NASA’s Hubble Space Telescope.

The surprise finding of a young galaxy from a survey that was not designed to find such bright early galaxies suggests that the infant universe may harbor a larger number of intense star-forming galaxies than astronomers believed possible, said the researchers, reporting their work in research journal *Nature*.

This means some theories may need revision.

“We expected to find a lot more small objects with this survey,” said Giavalisco. In the same way that throwing a brick through a window should produce a huge number of small shards and very few large pieces, he adds, theory predicts there should be many small galaxies “but just a few large ones. And our survey was not really designed to find these early galaxies with such a high rate of star formation. However, on the first try we see this very active object. So we’re not sure if we’re really, really lucky or if our predictive models are slightly off.”

The high luminosity, powered by star formation activity, of this new galaxy “raise a tantalizing question about whether we’ve got the theory of galaxy formation correct in its fundamental ideas,” the astronomer added.

The researchers used two special cameras on Hubble as part of the largest investigation of the distant universe ever made with the space telescope.

To identify the galaxy from among myriads of other, closer faint galaxies that obscure deep images of the sky, they used a technique called the “Lyman-break selection” developed by Giavalisco and others in the 1990s. It exploits the apparent colors of galaxies as a crude distance indica-

tor. “Colors encode a lot of physical processes at work in them,” he points out, “such as whether they form stars or not and how much dust is in them, because dust dims stellar light and makes their colors redder.”

But the technique yields only crude distance estimates, so astronomers need to accurately determine the distance to pre-selected remote galaxies. To do that, the scientists needed very sensitive spectroscopic, or light-analyzing telescopes to detect a specific feature in the light emitted by hydrogen known as the Lyman-alpha emission line. The team used the Keck 10-meter telescope in Hawaii, a very powerful spectroscopic instrument.

Results yielded a “redshift parameter,” that is an indicator of distance, of 7.51, by far the most distant galaxy ever recorded. At that time the universe was an estimated 700 million years old, compared to 13.8 billion years today. The universe is believed to have been 8.5 times smaller than today, 600 times more dense and expanding 8.5 times faster.

The astronomers said the findings could yield new clues to an early process called re-ionization. In it, a fog dropped away from the universe and it went from being distribution of cold, electrically neutral gas with no light sources, to being visible across large distances.