

"Long before it's in the papers"

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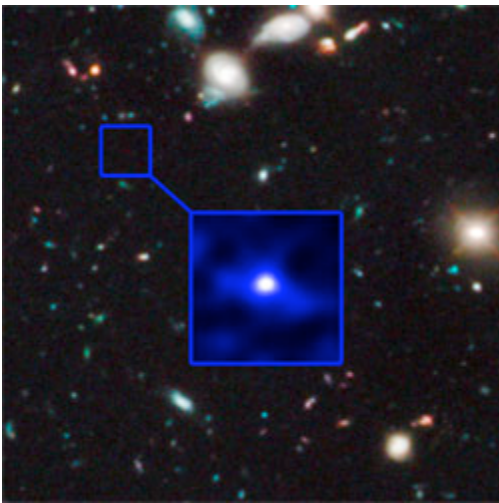
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## Hubble peers back to an age of fewer, newer galaxies

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Courtesy of UCSC  
and World Science staff

**Astronomers using the Hubble Space Telescope have peered so far across space that they have seen an age when galaxies were much fewer and further apart than today, a new report said.**

The scientists studying ultra-deep imaging data from the instrument found what they said may be the most distant galaxy ever seen, about 13.2 billion light-years away. A light-year is the distance light travels in a year. Because light takes time to travel, viewing things at such a distance means they are being seen as they looked just that many years ago.



A galaxy believed to have existed 480 million years after the Big Bang, shown in the blue box at upper left and enlarged in the blue box at lower right. (Credit: NASA, ESA, Garth Illingworth (University of California, Santa Cruz) and Rychard Bouwens (University of California, Santa Cruz and Leiden University) and the HUDF09 Team)

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**The study pushed the limits of Hubble's capabilities, astronomers said—extending its reach back to about 480 million years after the “Big Bang” event that gave birth to our universe. The universe then was just 4 percent of its current age.**

“We’re getting back very close to the first galaxies, which we think formed around 200 to 300 million years after the Big Bang,” said Garth Illingworth of the University of California, Santa Cruz, who led the study with fellow astronomer Rychard Bouwens, now at Leiden University in the Netherlands. The findings are to be published in the Jan. 27 issue of the research journal *Nature*.

Using infrared light data gathered by an instrument mounted on Hubble known as the Wide Field Planetary Camera 3, the astronomers said they saw dramatic changes in galaxies over a period from about 480 to 650 million years after the Big Bang. The rate of star birth in the universe increased by ten times during this 170 million-year period, Illingworth said.

“This is an astonishing increase in such a short period, just one percent of the current age of the universe,” he said.

There were also striking changes in the numbers of galaxies detected. “Our previous searches had found 47 galaxies at somewhat later times when the universe was about 650 million years old. However, we could only find one galaxy candidate just 170 million years earlier,” Illingworth said. “The universe was changing very quickly in a short amount of time.”

According to Bouwens, these findings are consistent with the “hierarchical” picture of galaxy formation. This is a model that proposes that galaxies grew and merged under the gravitational influence of an invisible substance known as dark matter, which is detectable only through its

gravitational effects.

“We see a very rapid build-up of galaxies around this time,” Illingworth said. “For the first time now, we can make realistic statements about how the galaxy population changed during this period and provide meaningful constraints for models of galaxy formation.”

Astronomers gauge the distance of an object from its redshift, a measure of how much the ongoing expansion of space has stretched the light. This stretch gives it a more reddish color. The newly detected galaxy has an estimated redshift of 10.3, which corresponds to an estimated time of 13.2 billion years ago.

“This result is on the edge of our capabilities, but we spent months doing tests to confirm it, so we now feel pretty confident,” Illingworth said.

The galaxy, a faint smudge of starlight in the Hubble images, is tiny compared to the massive galaxies seen in the local universe. Our own Milky Way, for example, is more than 100 times larger. The researchers also described three other galaxies with redshifts greater than 8.3.

The study involved a thorough search of data collected from deep imaging of the Hubble Ultra Deep Field, a small patch of sky about one-tenth the size of the Moon. During two four-day stretches in summer 2009 and summer 2010, Hubble focused on one tiny spot in the field for a total exposure of 87 hours with the infrared camera.

To go beyond redshift 10, astronomers will have to wait for Hubble’s successor, the James Webb Space Telescope, which NASA plans to launch later this decade. That telescope should also be able to perform the measurements needed to confirm the reported galaxy at redshift 10, the investigators said.