Galaxy found at record-breaking distance

Seven primitive and distant galaxies observed in Hubble image.

Ron Cowen

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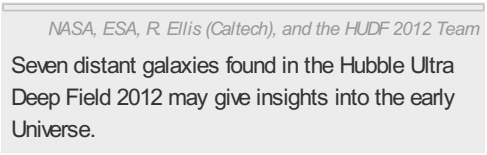
Seven distant galaxies — so remote that the light now recorded from them left the bodies less than 600 million years after the Big Bang — have been revealed by the deepest infrared images of the Universe ever recorded. And one of the galaxies, previously thought to be remote, has now been tentatively pegged at 13.29 billion light years (4.1 billion parsecs) away from Earth, which would make it the most distant object yet discovered[1].



NASA, ESA, R. Ellis (Caltech), and the HUDF 2012 Team

Seven distant galaxies found in the Hubble Ultra Deep Field 2012 may give insights into the early Universe.

This is the first reliable sample of such distant galaxies to be identified using images taken by the Hubble Space Telescope's Wide Field Camera 3. The images, recorded by Richard Ellis, an astronomer at the California Institute of Technology in Pasadena, and his colleagues, also constitute the first sample large enough to confirm the standard theory that astronomers should see a smooth decline in the number of galaxies the further back in time they peer, to when the cosmos was just 450 million old, less than 4% of its current age.

The abundance of the galaxies also suggests that an early galaxy population contained enough stars to reionize hydrogen atoms (strip them of their single electrons) — a key benchmark in the Universe's evolution — after they had cooled down from the Big Bang.

Ellis and his colleagues presented the findings at a NASA phone briefing on 12 December. The study is also forthcoming in *Astrophysical Journal Letters.*

"This study represents the deepest archaeological dig of the Universe so far," says Avi Loeb, a theoretical astrophysicist at Harvard University in Cambridge, Massachusetts. It is also the most comprehensive, he adds.

Ellis and his colleagues trained the Hubble camera on a tiny patch of sky known as the Hubble Ultra Deep Field. Because the remote galaxies appear so faint, researchers cannot directly gauge distances by measuring the objects' redshift — the amount by which the expansion of the Universe has shifted the ultraviolet light they radiate to longer, infrared wavelengths. Instead, astronomers estimate the distance by viewing the galaxies through several infrared filters.

Hubble's limits

Combined with earlier studies of the Hubble Deep Field, the new observations, recorded in August and September, generated images that were twice as deep (exposed for twice as long) as any the camera had previously recorded. They also included images taken with an extra filter that allowed the team to rule out with more certainty the possibility that some of the galaxies are spurious foreground objects.

"There is no doubt that these new data will help us all get the best sample of galaxies yet at redshift 8–10, from about 450 million years to 600 million years after the Big Bang," says Garth Illingworth, an astrophysicist at the University of California (UC), Santa Cruz, and a member of a rival team of researchers who have also used the Hubble infrared camera to find distant galaxies.

Illingworth and Rychard Bouwens, an astronomer at UC Santa Cruz, and their collaborators had previously identified one of the galaxies examined by Ellis's team as having a redshift of 10, corresponding to a time when the Universe was about 482 million years old. But the latest data suggest that the galaxy may in fact have a redshift of 11.9, putting it at a record-breaking distance of 13.29 billion light years (4.1 billion parsecs) away — the very limit of what the Hubble camera can detect.

The researchers on both teams warn, however, that there is also a possibility that it lies much closer to Earth, as this find was completely unexpected. "It defies all expectations," says Bouwens.

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Corrections

Corrected: The distance to the newly recorded farthest galaxy from Earth was incorrectly stated as 4.1 parsecs in an earlier version of this story. The story has now been updated with the correct distance of 4.1 billion parsecs.

References

1. Ellis, R. S. *et al*. *Preprint at* http://arxiv.org/abs/1211.6804 (2012).