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Light from farthest galaxy yet discovered breaks through cosmic fog

A galaxy seen as it was when the Universe was just 700 million years old may have been surrounded by fog left over from the 'cosmic dark ages'.

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An artist's impresison of z8_GND_5296, the farthest galaxy yet discovered.

Researchers have observed a galaxy just 700 million years after the Big Bang and now some 30 billion light years (9 billion parsecs) from Earth, the farthest yet seen.

The galaxy, z8_GND_5296, is the closest yet observed to the cosmic 'dark ages' — a period when space was filled with neutral hydrogen gas. This epoch lasted for a few hundred million years after the Big Bang, until the first stars and galaxies began to emit light. As they shuddered to life, this fog dissipated as it was gradually ionized, but when that process started and how long it took is unclear.

One way to find out is to spot galaxies from many different cosmic eras and "figure out what the neutral fraction of gas is at each", says Steven Finkelstein, an astrophysicist at the University of Texas in Austin and a co-author of the z8_GND_5296 findings, published today in *Nature*[1].

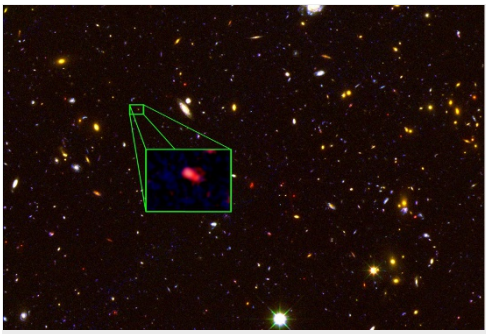
Light from z8_GND_5296 has a redshift — a measure of how much the light is stretched as it travels through the expanding Universe — of a record-breaking 7.51. About 100 galaxies seem to have a redshift of 7 or more, indicating they formed within 770 million years of the Big Bang. But only a handful of these have had their distances confirmed via the redshift of their spectra, which is nearly always done using a spectral line called Lyman-α. Light of this wavelength is usually the brightest emitted by hydrogen atoms, and it can be absorbed or scattered by any hydrogen atoms it strikes.

Era of light

There are relatively few galaxies at such eras that detectably emit Lyman-α lines, which Finkelstein says may be an indication of neutral gas surrounding the galaxies at redshifts of about 7 or more. "The difficulty we've been having [detecting the line], and the

increasing difficulty as we move farther away, could be us entering this era of reionization," he says.

If that is the case, how did the light from z8_GND_5296 break through the fog? One possibility is that it ionized its immediate surroundings, says Finkelstein, creating a way for photons to escape the fog. Indeed, its colour and brightness suggest that it is forming stars at the furious rate of 330 solar masses per year. That is about 30 times higher than expected, the researchers say, and suggests that active stellar nurseries may be more common than thought in the early Universe.



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Light from z8_GND_529 has a record-breaking redshift and appears to be red in this image from the Hubble Space Telescope.

Finding other galaxies at similar distances will be tough, however, because their Lyman-α lines have been shifted to infrared wavelengths similar to those produced by molecules in Earth's atmosphere. Finkelstein hopes to spot perhaps 20 more using the spectrograph — on the Keck I telescope at the W. M. Keck Observatory in Hawaii — that turned up z8_GND_5296.

But future telescopes should do much better, including the James Webb Space Telescope, which is planned to launch in 2018. "There is a bright future for studies of the first galaxies in the Universe," writes Dominik Riechers, an astronomer at Cornell University in Ithaca, New York, in a commentary accompanying the research[2].

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References

1. Finkelstein, S. L. *et al*. *Nature* **502**, 524–527 (2013).
2. Riechers, D. A. *Nature* **502**, 459–460 (2013).