The record for the farthest galaxy was just broken again, now just 250 million years after the Big Bang

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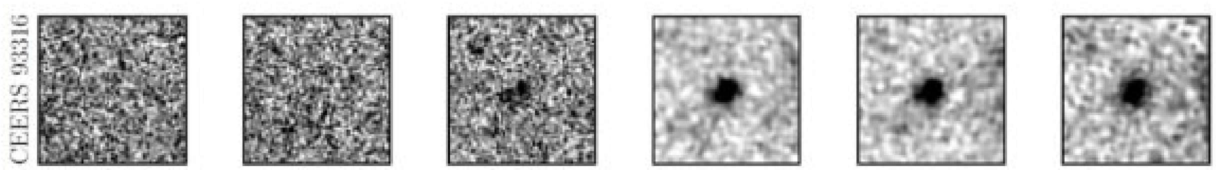

Postage stamp images of CEERS-93316 from their respective JWST NIRCam (Near Infrared Camera) filters (F115W, F150W, F200W, F277W, F356W, and F444W). Credit: Donnan et al. (2022)

In a recent study submitted to *Monthly Notices of the Royal Astronomical Society*, a collaborative research team has utilized the first set of data from the James Webb Space Telescope (JWST) discovering a galaxy candidate, CEERS-93316, that formed approximately 250 million years after the Big Bang, which also set a new redshift record of $z = 16.7$. This finding is extremely intriguing as it demonstrates the power of JWST, which only started sending back its first set of data a few weeks ago. CEERS stands for Cosmic Evolution Early Release Science Survey, and was specifically created for imaging with JWST.

"The past few weeks have been surreal, watching all the records that stood for a long time with Hubble be broken by JWST," says Dr.

Rebecca Bowler, who is an Ernest Rutherford Fellow at the University of Manchester, and a co-author on the study. "Finding a z = 16.7 galaxy candidate is an amazing feeling—it wasn't something we were expecting from the early data."

This new study references a dozen previous studies that have measured objects up to redshifts z ~ 10 using a mixture of ground-based observations and with the Hubble Space Telescope and Spitzer Space Telescope.

"It's amazing to have found such a distant galaxy candidate already with Webb given that this is just the first set of data," says Callum Donnan, a Ph.D. student at the University of Edinburgh, and lead author of the study. "It is important to note that to be certain of the redshift, the galaxy will need follow up observations using spectroscopy. This is why we refer to it as a galaxy candidate."

The study determined that CEERS-93316 can't be a low-mass star or unobstructed active galactic nucleus based on imaging data from NIRCam (Near Infrared Camera), which is JWST's primary imager. Since CEERS-93316 is could be only 250 million years old, one goal for cosmologists is to know what's happening in galaxies that young, and so soon after the Big Bang.

"After the Big Bang the Universe entered a period known as the dark ages, a time before any stars had been born," explains Dr. Bowler. "The observations of this galaxy push observations back to the time when we think the first galaxies ever to exist were being formed. Already we've found more galaxies in the very early Universe than computer simulations predicted, so there is clearly a lot of open questions about how and when the first stars and galaxies formed."

Given this incredible finding in just the first set of data from JWST, it's intriguing to think how much father back in the universe this record-shattering space telescope can see, and whether it can see the Big Bang itself.

"In principle JWST can detect galaxies at redshifts greater than 20, less than 200 million years after the Big Bang," explains Bowler. "These galaxies will likely be extremely hard to find, but the detection of CERRS 93316 gives us hope that they may exist. Watch this space!"

"The most distant phenomenon observed is the cosmic microwave background (CMB) which is the 'afterglow' of the Big Bang," explains Donnan. "The light from the CMB comes from approximately 400,000 years after the Big Bang and has been observed by various instruments over the years—most notably the Planck satellite which launched in 2009. Webb won't be able to see as far back as that, but it is able to probe the earliest stages of galaxy formation."

While Donnan and Bowler both stated there are no further observations planned for CEERS-93316, they are hopeful that there will be in the future.

Redshift is part of what's known as the Doppler effect, which astronomers use to measure distances in the universe. A frequent example to demonstrate the Doppler effect is the change in sound wave pitch as a loud object travels towards you then travels away from you, often by an ambulance or other first responder vehicle. The sound waves as the object travels towards you is known as blueshift, while the opposite is called redshift. This new study setting a new redshift record means scientists have measured the farthest object in the universe to date.

More information: C. T. Donnan et al, The evolution of the galaxy UV luminosity function at redshifts z ~ 8-15 from deep JWST and ground-based near-infrared imaging. arXiv:2207.12356v1 [astro-ph.GA], arxiv.org/abs/2207.12356

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