The most distant galaxy ever discovered holds amazing secrets

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Instruments like the James Webb Space Telescope (JWST) are allowing scientists to look further back in the history of the universe than ever before, exploring incredibly distant objects like galaxies that formed in the first few hundred million years of the universe. Recently, astronomers conducted an intensive observation campaign of the galaxy JADES-GS-z14-0, the most distant known galaxy, and discovered something even more astonishing: Signs of oxygen.

This galaxy is so far away from Earth that it took 13.4 billion years for its light to reach us, meaning we are seeing an image of JADES-GS-z14-0 300 million years after the Big Bang. For such a young galaxy in the early stages of the universe, scientists expected to find plenty of hydrogen and helium, as these are elements present in early galaxies. However, using the ground-based Atacama Large Millimeter Array (ALMA) telescope, they also detected oxygen – an element that would not have appeared until the galaxy was much older.

Sander Schouws, a researcher at the Leiden Observatory, said:

> Observations show that this galaxy formed very quickly and also matured much more quickly than originally predicted.

Ever since James Webb began observing early galaxies, scientists have begun to suspect that their models of the early universe may be wrong, or at least incomplete. It seems that the early universe was much more vibrant and brighter than predicted, with galaxies forming and growing faster than expected, and scientists are still not sure why.

The results are surprising because they provide a new perspective on the earliest stages of galaxy evolution. Evidence that a galaxy was already mature in the early universe raises questions about when and how galaxies form.

The oxygen was detected using a technique called spectroscopy, in which light from distant objects is split into different wavelengths to determine which wavelengths have been absorbed. By looking for these absorption lines, scientists can learn what the distant object is made of. In this case, two independent teams found signs of oxygen in the galaxy while analyzing data from ALMA, a 66-dish radio telescope array operating in Chile.

The ALMA findings also helped confirm the enormous distance from Earth to JADES-GS-z14-0. Although the galaxy was originally discovered by the James Webb Space Telescope, ALMA helped confirm and precisely measure its enormous distance. This shows how well the combination of ALMA and JWST can reveal the formation and evolution of early galaxies.

The research will be published in a paper in the journal Astronomy & Astrophysics and another in The Astrophysical Journal.