

X22a The Onset of Star Formation 250 Million Years After the Big Bang

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We present spectroscopic observations of MACS1149-JD1, a gravitationally lensed galaxy observed when the Universe was less than four per cent of its present age. Using the Atacama Large Millimeter/submillimeter Array (ALMA), we detect an emission line of doubly ionized oxygen, [OIII] $88 \mu\text{m}$, at a redshift of 9.1096 ± 0.0006 . This precisely determined redshift indicates that the red rest-frame optical colour observed with the Spitzer Space Telescope arises from a dominant stellar component that formed about 250 million years after the Big Bang, corresponding to a redshift of about 15. Our results indicate that it may be possible to detect such early episodes of star formation in similar galaxies with future telescopes.