Massive and multiphase gas outflow detected in the galaxy COSMOS-11142

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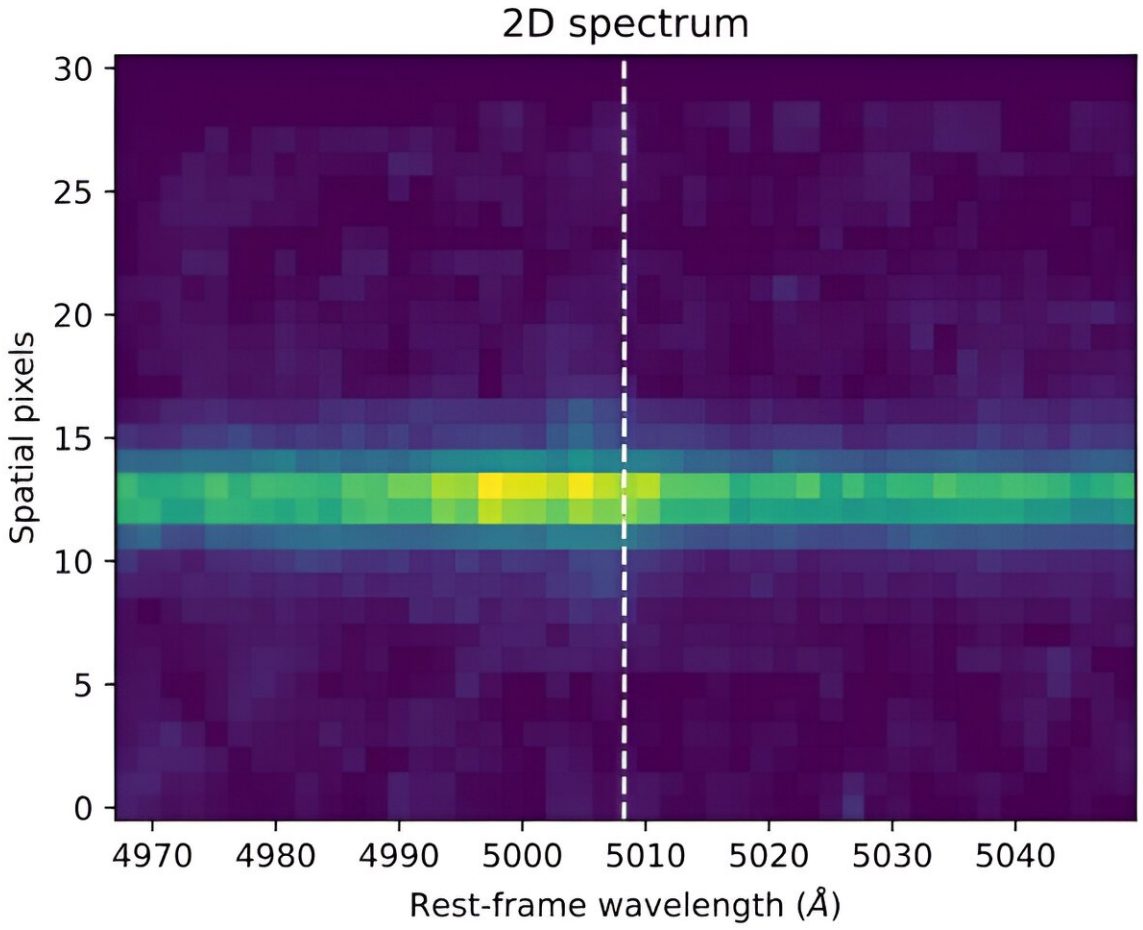

COSMOS-11142: Two-dimensional JWST/NIRSpec spectrum centered on the [O III]λ5008 emission line. Credit: Belli et al., 2023.

Using the James Webb Space Telescope (JWST), an international team of astronomers has performed deep spectroscopic observations of a galaxy known as COSMOS-1142. As a result, they detected massive and multiphase outflow of neutral and ionized gas in this galaxy. The finding was reported in a paper published August 10 on the pre-print server *arXiv*.

At a redshift of 2.445, COSMOS-11142 is a massive galaxy with a half-light radius of about 2,000 light years. Previous observations of COSMOS-11142 have found that it is in the "post-starburst" phase immediately following the rapid quenching of a star formation episode. The current star-formation rate of this galaxy is estimated to be between one and 10 solar masses per year.

A group of astronomers led by Sirio Belli of the University of Bologna in Italy, has recently observed COSMOS-11142 with JWST's Near Infrared Spectrograph (NIRSpec). The observations, aimed at investigating the properties of this galaxy, were conducted in December 2022 as part of the Blue Jay survey.

"We observed the galaxy COSMOS-11142 as part of the Blue Jay survey, a Cycle-1 JWST program that targeted about 150 galaxies uniformly distributed in redshift z (1.7 $_{*}$ (log $M_{*}/M_{\odot} > 9$)," the researchers wrote in the paper.

The observations found that COSMOS-11142 is compact, elongated and relatively dusty. The galaxy has a dynamical mass of about 70 billion solar masses and its metallicity is estimated to be at a level of approximately 0.16.

JWST imaging provided evidence of an outflow of neutral and ionized gas during the rapid quenching of COSMOS-11142's star formation. The mass outflow rates for the neutral and ionized gas outflow were

measured to be about 100 and one solar masses per year, respectively. The astronomers noted that the mass outflow rate of COSMOS-11142 is an order of magnitude larger than the typical values measured in local star-forming galaxies.

Moreover, the mass outflow rate in COSMOS-11142 turned out to be larger than the residual star-formation rate. This suggests that the gas ejection likely has a strong impact on the evolution of the investigated galaxy. The researchers assume that the observed outflow is driven by active galactic nucleus (AGN) feedback.

Based on the results, the authors of the paper concluded that the observed outflow likely plays a key role in the rapid quenching of COSMOS-11142. They added that the heating of the halo gas by radio-mode AGN feedback is likely required to maintain this galaxy quiescent.

"We confirm that the system is a post-starburst galaxy: it formed most of its stellar mass in a rapid and powerful starburst ~ 300 Myr before the observations, and then experienced a rapid quenching of the star formation rate by two orders of magnitude," the researchers concluded.

More information: Belli et al, Massive and Multiphase Gas Outflow in a Quenching Galaxy at z=2.445, *arXiv* (2023). DOI: 10.48550/arxiv.2308.05795