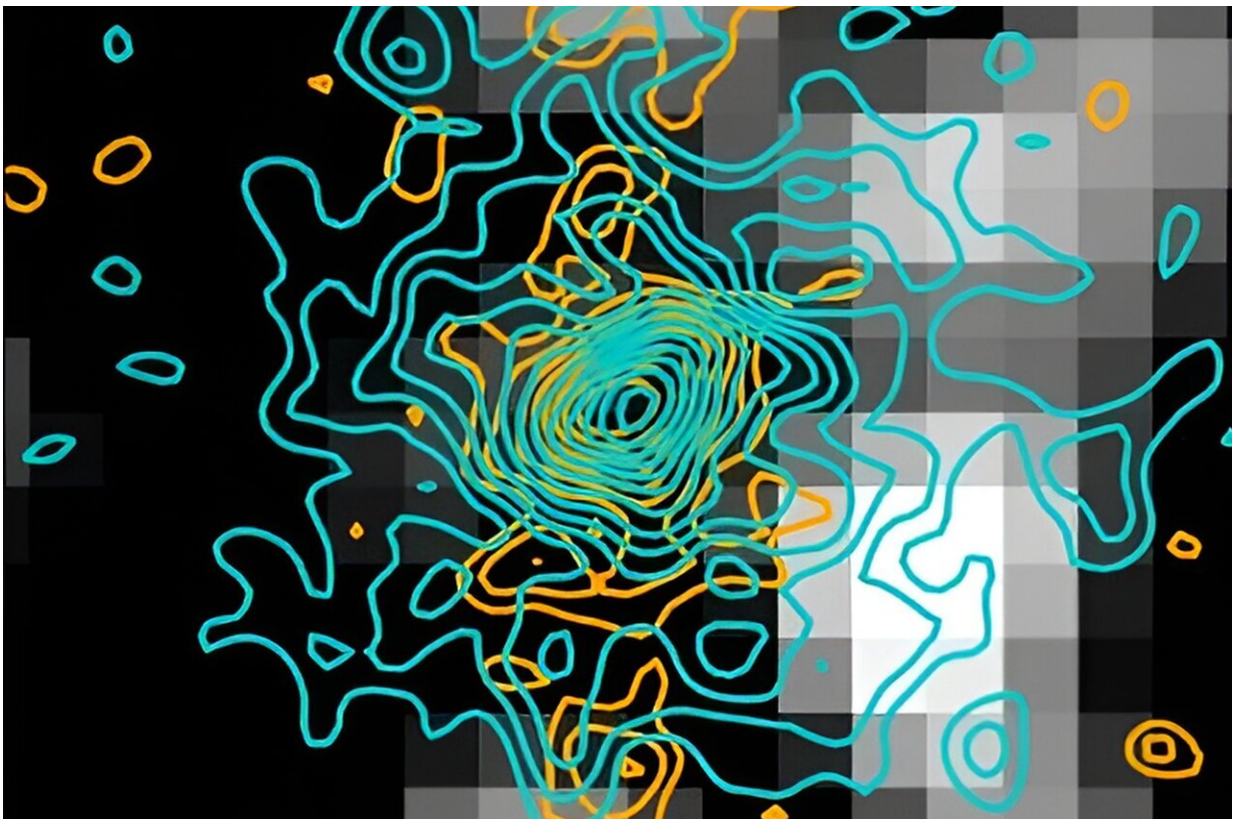


REBELS-25 is a dynamically cold disk galaxy, observations find

May 20 2024, by Tomasz Nowakowski



HST WFC3 F160W image of REBELS-25 from the COSMOS-DASH mosaic with the [CII] emission and dust continuum shown by the turquoise and orange contours, respectively. Credit: Rowland et al., 2024.

An international team of astronomers has observed a high-redshift massive star-forming galaxy known as REBELS-25. They found that REBELS-25 is a dynamically cold disk galaxy. This finding was presented in a [research paper](#) published May 9 on the pre-print server *arXiv*.

At a redshift of 7.31, which corresponds to a luminosity distance of about 236 billion [light years](#), REBELS-25 is an infrared luminous galaxy. It has a [stellar mass](#) of some 8 billion solar masses and its star-formation rate is estimated to be at a level of 199 solar masses per year.

Recently, a group of astronomers led by Lucie E. Rowland of the Leiden University in The Netherlands, decided to perform high-resolution and dust continuum observations of REBELS-25 in order to shed more light on its properties. For this purpose, they employed the Atacama Large Millimeter/submillimeter Array (ALMA) in Chile.

"In this paper, we have presented follow-up high-resolution (~ 710 pc) ALMA [CII] and dust ($\sim 150 \mu\text{m}$) continuum observations of REBELS-25; a massive star-forming galaxy at $z=7.31$, originally targeted as part of the ALMA Reionization Era Bright Emission Line Survey (REBELS) large program (LP)," the researchers wrote.

The observations found that REBELS-25 has a relatively low velocity dispersion of about 33 km/s and a high ratio of ordered-to-random motion—at a level of 11.0. These results indicate that REBELS-25 is a dynamically cold disk galaxy.

However, although REBELS-25 seems to be dynamically cold, the astronomers have observed some evidence of non-circular motions. These motions could be due to inflows or outflows, a minor merging

component, as well as due to a central bar or [spiral arms](#).

The observations also found that REBELS-25 has a total dynamical mass of about 120 billion solar masses. Based on this, the researchers estimated that the galaxy's gas mass is some 110 billion [solar masses](#), but this result is highly uncertain due to dust obscuration and requires further studies.

The authors of the paper underlined that their discovery makes REBELS-25 one of the most distant robustly confirmed cold disk galaxies observed to date. They added that finding such a very distant and very dynamically cold disk galaxy challenges current theoretical predictions and simulations. It also suggests that such galaxies could be more common in the [high-redshift](#) universe than previously thought.

"We therefore expect that future, high resolution studies of cold gas kinematics at high- z will reveal even more cold, massive disks. In particular, ongoing ALMA observations of other REBELS galaxies will enable robust kinematic modeling of additional rotating disk candidates at $z \sim 6-8$," the scientists conclude.

More information: Lucie E. Rowland et al, REBELS-25: Discovery of a dynamically cold disc galaxy at $z = 7.31$, *arXiv* (2024). [DOI: 10.48550/arxiv.2405.06025](#)

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