

Padua, 11 November 2022

TOO MUCH DUST AT THE EDGE OF COSMIC DAWN, WEBB SAYS

The launch of the James Webb Space Telescope (JWST), the most sophisticated space telescope ever made and launched into space on December 25 2021, is pushing the reach of the human eye far beyond any previous limit. Immediately after the public release of the first data set, in July 2022, a wealth of papers reported the existence of previously unknown sources. These were simply invisible to any other telescope, including the Hubble Space Telescope, JWST's older brother. Such objects are thought to be extremely distant galaxies, and their distance causes the photons to shift toward longer wavelengths (Doppler effect). Exquisitely sensitive instruments with near- and mid-Infrared capabilities are thus required to catch such elusive and faint sources.

By observing the emission of cosmic sources in different portions of the electromagnetic spectrum, JWST has identified several tens of these galaxies. However, spectroscopic information is now required to confirm that we are really looking at sources sitting at the dawn of the cosmic time. The earliest multiwavelength analyses indicate that these primordial galaxies are basically very young, blue and star-forming systems. They are so distant that their light has travelled up to 13 Gyrs to reach our planet Earth.

While the actual nature of these sources is highly debated across the scientific community, a team of astrophysicists has recently uncovered an even more peculiar sample of dark sources, that appear to be redder and more obscured than expected by cosmological models of galaxy formation and evolution. The results have been presented in a letter entitled “JWST unveils heavily obscured (active and passive) sources up to $z\sim 13$ ”, published in the Monthly Notices of the Royal Astronomical Society.



Giulia Rodighiero

these large amounts of dust in galaxies that are so young (ages of a few hundreds megayears).”

These sources have been selected via the so-called “dropout” technique, meaning that they are visible in the NIRCAM instrument at roughly 4.5 micron, but they disappear at wavelengths shorter than 2 micron. Dr. **Laura Bisigello** (University of Padua and INAF associate), co-author of the paper, explains that “the results of our photometric analysis are based on the most recent calibrations of the NIRCAM instrument. However, it is now essential to obtain confirmation with spectroscopic data from telescopes such as the Atacama Large Millimeter Array (ALMA), and the JWST itself, to confirm the identification and distance of these dusty giants.”

“Looking at the deepest early images of JWST in the SMACS0723 field - says **Giulia Rodighiero**, associate professor at the University of Padua and associate at the Istituto Nazionale di Astrofisica (INAF), first author of the paper, - we have uncovered a mixed population of sources sitting at different cosmic epochs, many of which present an unexpected amount of interstellar dust that obscures them and might explain their particularly red colors. The process of dust buildup by stars takes time, and we were very surprised to find



Laura Bisigello

About the results of the new paper, Dr. Laura Sommovigo and Prof. Andrea Ferrara, external collaborators working at the Scuola Normale Superiore (Pisa), comment that “JWST proved for the first time that super-early massive galaxies might already contain astonishing amounts of dust. The origin of this dust constitutes a theoretical challenge for theoretical models. At the same time it represents a key question to understand the physical properties of these primordial systems.”

Dr. Andrea Grazian (INAF - Padua), co-author, adds that “this is a very exciting time for extragalactic studies, and the discovery space of Webb has just started.”

The sources have been baptized by the team with the ancient Cimbrian names of the Asiago districts (see in particular the more distant dusty candidate source, Pennar, in the figure).

Link: <https://academic.oup.com/mnrasl/article-lookup/doi/10.1093/mnrasl/slac115>

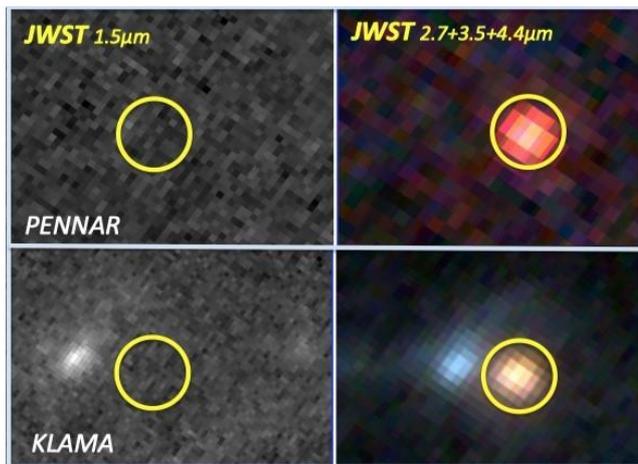


Image 1

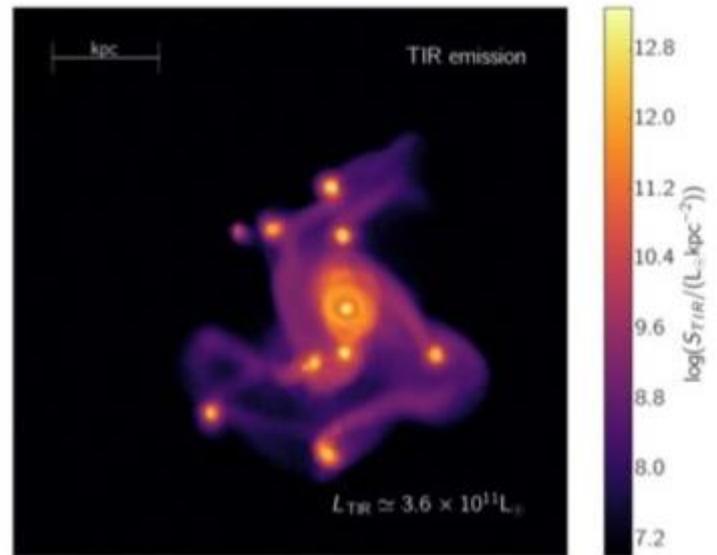


Image 2

IMAGES:

Image 1: Example of two candidates distant dusty galaxies that are invisible at short wavelengths, but they clearly appear as red objects at longer wavelengths in the NIRCAM/JWST filters.

Credits: Rodighiero, NASA/STSCI.

Image 2: Morphology of a primordial dusty galaxy as predicted by the SERRA simulations.

Credits: Behrens et al. 2018, MNRAS, 477, 552.