UNIVERSITÉ DE GENÈVE

PRESS RELEASE

Geneva | 16 April 2025

The most distant twin of the Milky Way ever observed

An international team led by UNIGE has discovered a massive, Milky Way-like spiral galaxy that formed just 1 billion years after the Big Bang, revealing an unexpectedly mature structure in the early Universe.

An international team led by the University of Geneva (UNIGE) has discovered the most distant spiral galaxy candidate known to date. This ultra-massive system existed just 1 billion years after the Big Bang and already shows a remarkably mature structure, with a central old bulge, a large star-forming disk, and well-defined spiral arms. The discovery was made using data from the James Webb Space Telescope (JWST) and offers important insights into how galaxies can form and evolve so rapidly in the early Universe. The study is published in *Astronomy & Astrophysics*.

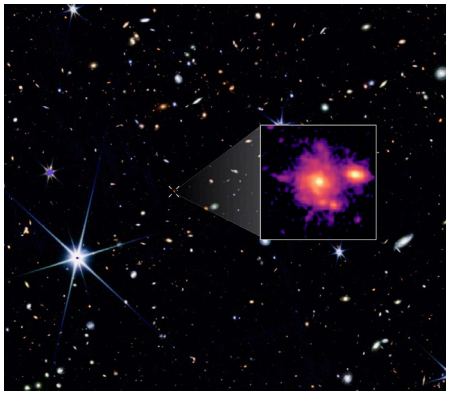
Large spiral galaxies like the Milky Way are expected to take several billion years to form. During the first billion years of cosmic history, galaxies are thought to be small, chaotic, and irregular in shape. However, the JWST is beginning to reveal a very different picture. Its deep infrared imaging is uncovering surprisingly massive and well-structured galaxies at much earlier times than previously expected – prompting astronomers to reassess how and when galaxies take shape in the early Universe.

A Milky Way Twin in the Early Universe

Among these new findings is Zhúlóng, the most distant spiral galaxy candidate identified to date, seen at a redshift of 5.2 – just 1 billion years after the Big Bang. Despite this early epoch, the galaxy exhibits a surprisingly mature structure: a central old bulge, a large star-forming disk, and spiral arms – features typically seen in nearby galaxies.

"We named this galaxy Zhúlóng, meaning 'Torch Dragon' in Chinese mythology. In the myth, Zhúlóng is a powerful red solar dragon that creates day and night by opening and closing its eyes, symbolizing light and cosmic time," says Dr. Mengyuan Xiao, a postdoctoral researcher at the Department of Astronomy of the UNIGE Faculty of Science and lead author of the study. "What makes Zhúlóng stand out is just how much it resembles the Milky Way in shape, size and stellar mass," she adds.

Its disk spans over 60,000 light-years, comparable to our own galaxy, and contains more than 100 billion solar masses in stars. This makes it one of the most compelling Milky Way analogues ever found at such an early time, raising new questions about how massive, well-ordered spiral galaxies could form so soon after the Big Bang.



The image of Zhúlóng, the most distant spiral galaxy discovered to date, shows its remarkably well-defined spiral arms, a central old bulge, and a large star-forming disk, resembling the structure of the Milky Way. Image taken by the James Webb Space Telescope.

High resolution pictures

A serendipitous discovery

Zhúlóng was discovered in deep imaging from JWST's PANORAMIC survey (GO-2514), a wide-area extragalactic program led by Christina Williams (NOIRLab) and Pascal Oesch (UNIGE). PANORAMIC exploits JWST's unique "pure parallel" mode – an efficient strategy to collect high-quality images while JWST's main instrument is taking data on another target. "This allows JWST to map large areas of the sky, which is essential for discovering massive galaxies, as they are incredibly rare," says Dr. Christina Williams, an assistant astronomer at NOIRLab and principal investigator of the PANORAMIC program. "This discovery highlights the potential of pure parallel programs for uncovering rare, distant objects that stress-test galaxy formation models."

Rewriting the Story

Spiral structures were previously thought to take billions of years to develop, and massive galaxies were not expected to exist until much later in the universe, because they typically form after smaller galaxies merged together over time. "This discovery shows how JWST is fundamentally changing our view of the early Universe," says Pascal Oesch, an associate professor in the Department of Astronomy at the UNIGE Faculty of Science and co-principal investigator of the PANORAMIC program.

Future JWST and Atacama Large Millimeter Array (ALMA) observations will help confirm its properties and reveal more about its formation history. As new wide-area JWST surveys continue, astronomers expect to find more such galaxies – offering fresh insights into the complex processes shaping galaxies in the early Universe.

contact

Mengyuan Xiao
Postdoctoral researcher
Department of Astronomy
Faculty of Science
UNIGE
+41 22 379 22 34
Mengyuan.Xiao@unige.ch

Pascal Oesch
Associate Professor
Department of Astronomy
Faculty of Science
UNIGE
+41 22 379 24 66
Pascal.Oesch@unige.ch

DOI: 10.1051/0004-6361/202453487

UNIVERSITÉ DE GENÈVE
Communication Department
24 rue du Général-Dufour
CH-1211 Geneva 4

Tel. +41 22 379 77 17

media@unige.ch
www.unige.ch