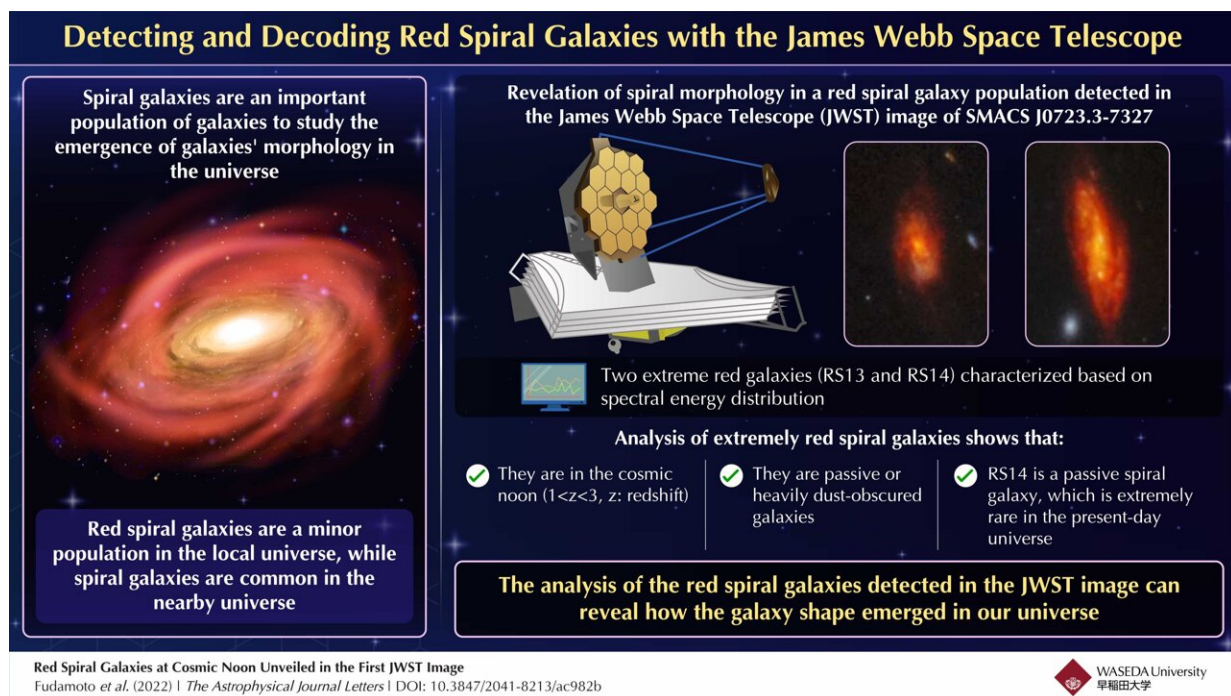


Discovering a rare red spiral galaxy population from the early universe with the James Webb Space Telescope

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Graphical abstract. Credit: Waseda University, Japan.

Spiral galaxies represent one of the most spectacular features in our universe. Among them, spiral galaxies in the distant universe contain significant information about their origin and evolution. However, we have had a limited understanding of these galaxies due to them being too

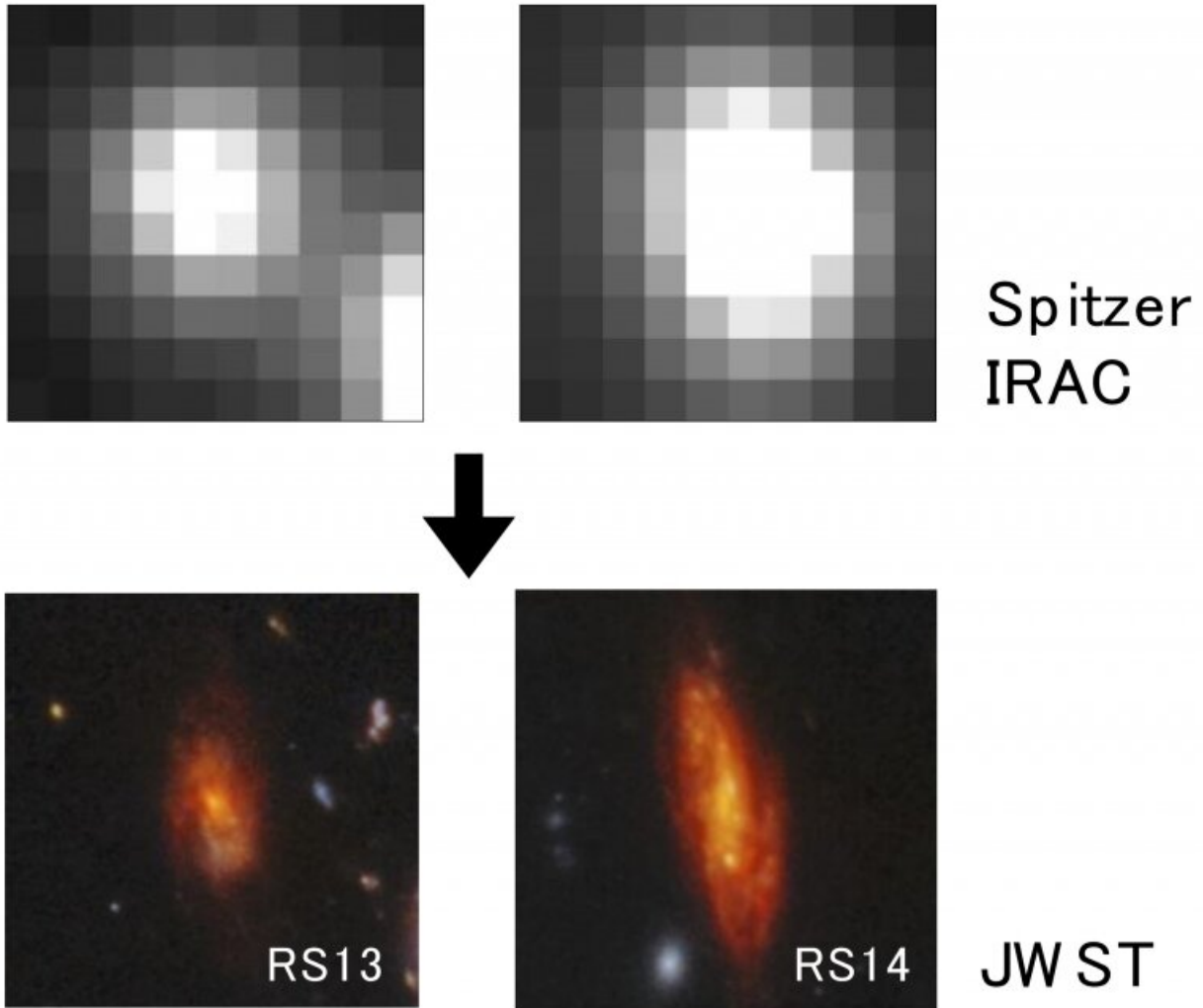
distant to study in detail.

"While these galaxies were already detected among the previous observations using NASA's Hubble Space Telescope and Spitzer Space Telescope, their limited spatial resolution and/or sensitivity did not allow us to study their detailed shapes and properties," explains Junior Researcher Yoshinobu Fudamoto from Waseda University in Japan, who has been researching galaxies' evolution.

Now, NASA's James Webb Space Telescope (JWST) has taken things to the next level. In its very first imaging of the galaxy cluster, SMACS J0723.3-7327, JWST has managed to capture infrared images of a population of red spiral galaxies at an unprecedented resolution, revealing their morphology in detail!

Against this backdrop, in a recent article published in *The Astrophysical Journal Letters*, a team of researchers comprising Junior Researcher Yoshinobu Fudamoto, Prof. Akio K. Inoue, and Dr. Yuma Sugahara from Waseda University, Japan, has revealed surprising insights into these red spiral galaxies.

Among the several red spiral galaxies detected, the researchers focused on the two most extremely red galaxies, RS13 and RS14. Using [spectral energy distribution](#) (SED) analysis, the researchers measured the distribution of energy over wide wavelength range for these galaxies. The SED analysis revealed that these red spiral galaxies belong to the [early universe](#) from a period known as the "cosmic noon" (8-10 billion years ago), which followed the Big Bang and the "cosmic dawn."



As a remarkable improvement over previous IRAC image (top), JWST's unprecedented spatial resolution and high IR sensitivity reveals the morphological details of the red spiral galaxies (below) RS13 and RS14. This facilitates a detailed analysis revealing hitherto unknown features of red spiral galaxies belonging to the early universe. Credit: Yoshinobu Fudamoto from Waseda University, Japan.

Remarkably, these are among the farthest known spiral galaxies till date.

Rare, red spiral galaxies account for only 2% of the galaxies in the local

universe. This discovery of red spiral galaxies in the early universe, from the JWST observation covering only an insignificant fraction of space, suggests that such spiral galaxies existed in large numbers in the early universe.

The researchers further discovered that one of the red spiral galaxies, RS14, is a "passive" (not forming stars) spiral galaxy, contrary to the intuitive expectation that galaxies in the early universe would be actively forming stars. This detection of a passive spiral galaxy in the JWST's limited field of view is particularly surprising, since it suggests that such passive spiral galaxies could also exist in large numbers in the early universe.

Overall, the findings of this study significantly enhances our knowledge about red spiral galaxies, and the universe as a whole. "Our study showed for the first time that passive spiral galaxies could be abundant in the early universe. While this paper is a [pilot study](#) about spiral galaxies in the early universe, confirming and expanding upon this study would largely influence our understanding of the formation and evolution of galactic morphologies," concludes Fudamoto.

More information: Yoshinobu Fudamoto et al, Red Spiral Galaxies at Cosmic Noon Unveiled in the First JWST Image, *The Astrophysical Journal Letters* (2022). [DOI: 10.3847/2041-8213/ac982b](https://doi.org/10.3847/2041-8213/ac982b)

Provided by Waseda University

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