

# Surprising details leap out in sharp new James Webb Space Telescope images of Jupiter

August 22 2022, by Robert Sanders

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James Webb Space Telescope images of Jupiter display a stunning wealth of detail. A filter sensitive to auroral emission from ionized hydrogen (mapped into the red channel) reveals auroral ovals on the disk of the planet that extend to high altitudes above both the northern and southern poles. A different filter sensitive to high-altitude hazes (mapped into the green channel) highlights the polar hazes that swirl around the northern and southern poles, while a third filter highlights light reflected from the deeper main cloud (mapped in the blue channel). The Great Red Spot, the equatorial region and compact (including tiny) cloud regions appear white (or reddish-white) in this false-color image. Regions with little cloud cover appear as dark ribbons north of the equatorial region. Other dark regions here, both next to the Great Red Spot and in cyclonic features in the south hemisphere, are also dark-colored when observed in visible light. Credit: NASA, European Space Agency, Jupiter Early Release Science team. Image processing: Judy Schmidt

The latest images of Jupiter from the James Webb Space Telescope (JWST) are stunners.

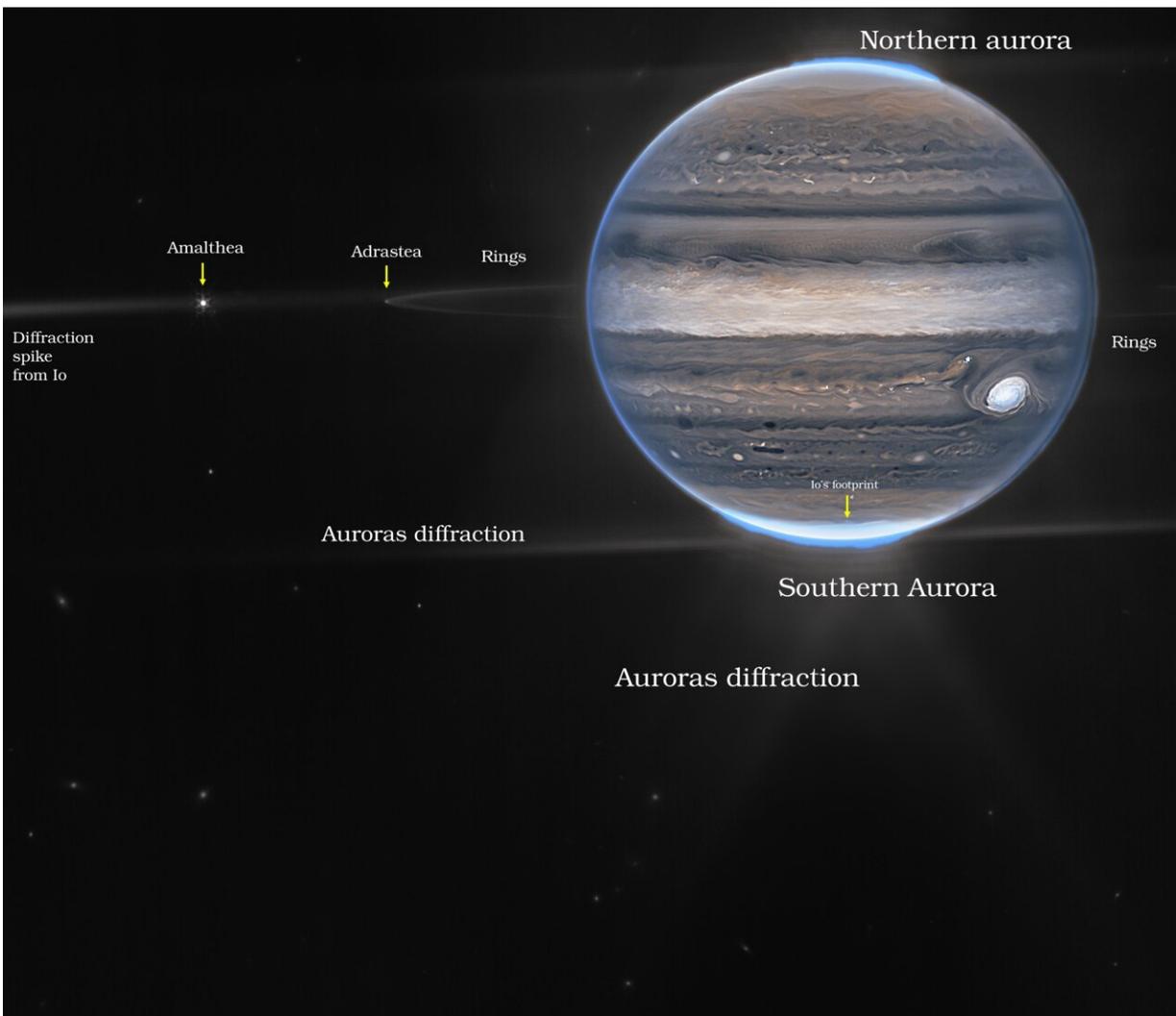
Captured on July 27, the [infrared images](#)—artificially colored to make specific features stand out—show fine filigree along the edges of the colored bands and around the Great Red Spot and also provide an unprecedented view of the auroras over the north and south poles.

One wide-field image presents a unique lineup of the planet, its faint rings and two of Jupiter's smaller satellites—Amalthea and Adrastea—against a background of galaxies.

"We've never seen Jupiter like this. It's all quite incredible," said planetary astronomer Imke de Pater, professor emerita of the University of California, Berkeley, who led the scientific observations of the planet with Thierry Fouchet, a professor at the Paris Observatory. "We hadn't

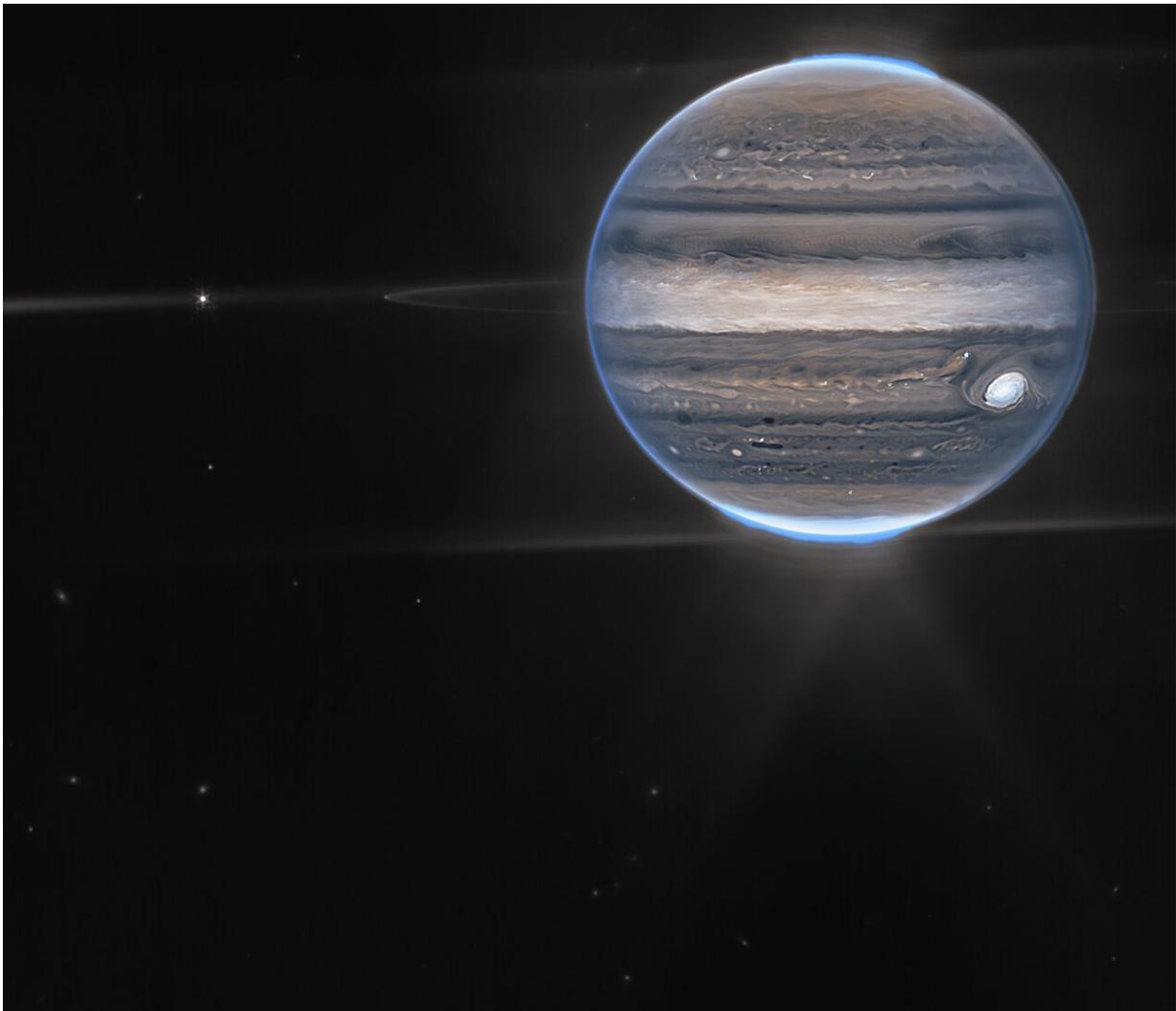
really expected it to be this good, to be honest. It's really remarkable that we can see details on Jupiter together with its rings, tiny satellites and even galaxies in one image."

De Pater, Fouchet and their team released the images today (Aug. 22) as part of the telescope's Early Release Science program.



This false color composite image of Jupiter was obtained with the NIRCcam instrument on board the James Webb Space Telescope on July 27, 2022. The wide-field color scheme differs from the color composite because this imaging

mode used different exposure times and only two filters, mapped in orange and cyan colors. The image shows Jupiter's rings and some of its small satellites together with background galaxies. Amalthea (~250 x 150 km across) and tiny Adrastea (~20 km across) are visible in this image. The diffraction pattern created by the bright auroras, as well as the moon Io (just off to the left, not visible in the image), form a complex background of scattered light around Jupiter. Credit: NASA, European Space Agency, Jupiter Early Release Science team. Image processing: Ricardo Hueso [UPV/EHU] and Judy Schmidt



This false color composite image of Jupiter was obtained with James Webb

Space Telescope's NIRCam instrument on July 27, 2022. A combination of short and long exposures in F212N (mapped to an orange color) and F335M (mapped to cyan) show Jupiter's rings and some of its small satellites together with background galaxies. Amalthea (~250 x 150 km across) and tiny Adrastea (~20 km across) are visible in this image. The diffraction pattern created by the bright auroras, as well as the moon Io (just off to the left, not visible in the image), form a complex background of scattered light around Jupiter. Credit: NASA, European Space Agency, Jupiter Early Release Science team. Image processing: Ricardo Hueso [UPV/EHU] and Judy Schmidt

In addition to the enormous storm referred to as the Great Red Spot, numerous storm systems—seen as small pallid ovals—are also visible, as are tiny bright plumes of cloud particles. The transition between organized zonal flows and the chaotic vortex patterns at [higher latitudes](#) is also clearly visible.

"Although we have seen many of these features on Jupiter before, JWST's [infrared wavelengths](#) give us a new perspective," said de Pater. "JWST's combination of images and spectra at near- and mid-infrared wavelengths will allow us to study the interplay of dynamics, chemistry and temperature structure in and above the Great Red Spot and the auroral regions."

## **Amalthea and Adrastea**

JWST's Near Infrared Camera (NIRCam) also captured a wide-field view of Jupiter revealing its rings and two of its moons.

"This image illustrates the sensitivity and dynamic range of JWST's NIRCam instrument," Fouchet said. "It reveals the bright waves, swirls and vortices in Jupiter's atmosphere and simultaneously captures the dark ring system, 1 million times fainter than the planet, as well as the

moons Amalthea and Adrastea, which are roughly 200 and 20 kilometers across, respectively. This one image sums up the science of our Jupiter system program, which studies the dynamics and chemistry of Jupiter itself, its rings and its satellite system."

The JWST images were processed with the help of citizen scientist Judy Schmidt of Modesto, California, who has worked with Hubble Space Telescope and other telescope images for the past 10 years, and Ricardo Hueso, who studies [planetary atmospheres](#) at the University of the Basque Country in Spain. Hueso is one of several coinvestigators on the Early Release Science (ERS) program, and is leading the NIRCam observations of Jupiter's atmosphere.

Schmidt's love of astronomy images has led her to process images of nebulae, [globular clusters](#), stellar nurseries and more spectacular cosmic objects.

"Something about it just stuck with me, and I can't stop. I could spend hours and hours every day," she said. Her goal, she added, is to "... try to get it to look natural, even if it's not anything close to what your eye can see."

Spectroscopic observations of Jupiter's auroras are scheduled for later this year, while detailed spectroscopic observations of Jupiter's Great Red Spot were taken on July 27 in the near-infrared and August 14-15 at mid-infrared wavelengths. The Great Red Spot observations are a joint project between the Early Release Science (ERS) team—with de Pater and Fouchet as co-principal investigators—and a program of Solar System observations developed by Heidi Hammel of the Association of Universities for Research in Astronomy (AURA), with the Jupiter observations led by Leigh Fletcher, a professor at the University of Leicester in England.

Other UC Berkeley members of the ERS team for Jupiter observations are research astronomer Mike Wong and postdoctoral fellow Ned Molter.

Provided by University of California - Berkeley

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