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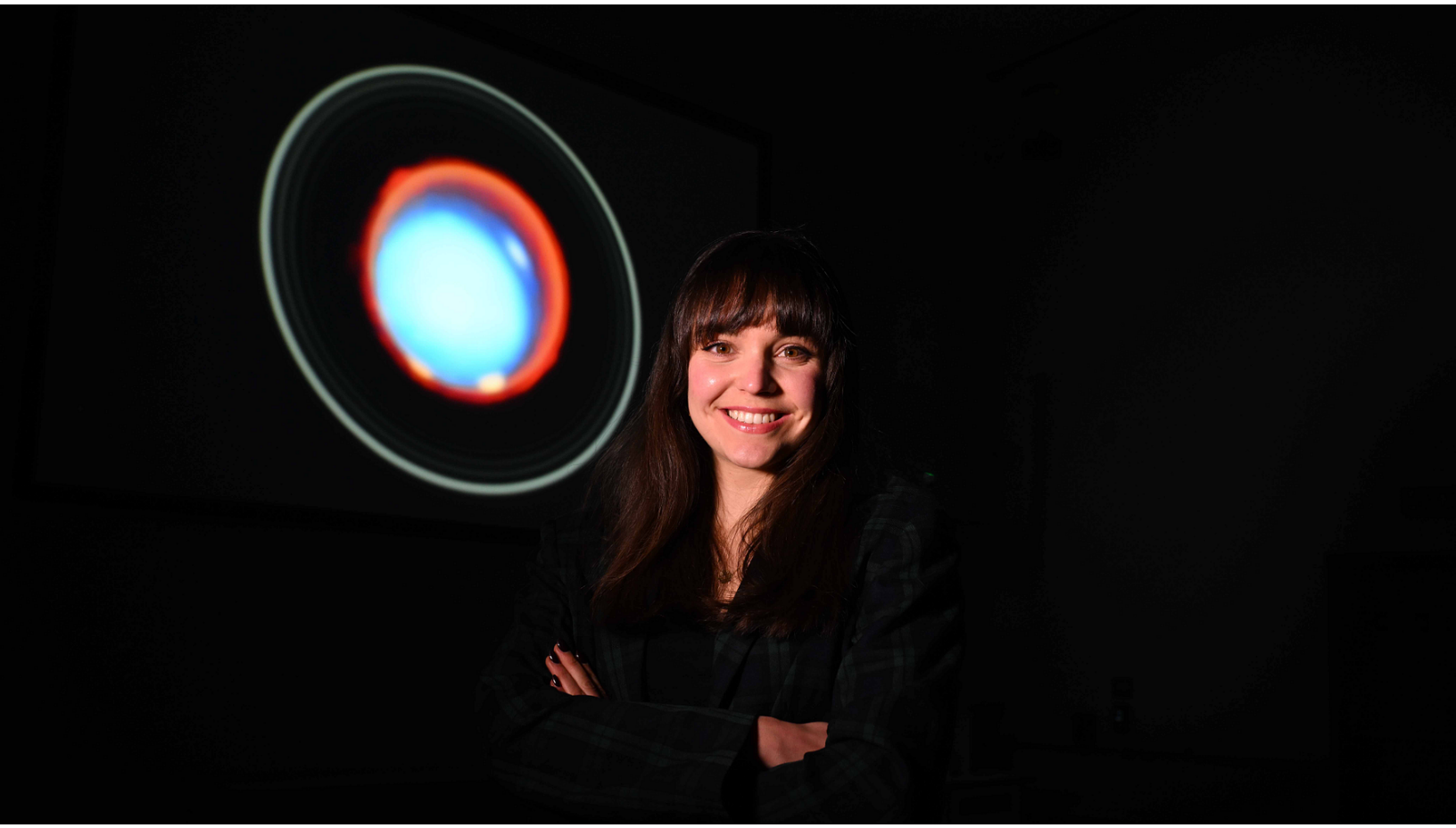


PhD student Paola Tiranti of Northumbria University

Feb 19, 2026 14:06 GMT

PhD student maps mysterious upper atmosphere of Uranus for the first time

A Northumbria University PhD student has led an international team of astronomers in creating the first-ever three-dimensional map of Uranus's upper atmosphere, revealing how the ice giant's unusual magnetic field shapes spectacular auroras high above the planet's clouds.

Using the James Webb Space Telescope, led by NASA with its partners, ESA (European Space Agency) and CSA (Canadian Space Agency), Paola Tiranti and her colleagues observed Uranus for nearly a full rotation, detecting the faint

glow from molecules up to 5,000 kilometres above the cloud tops.

The observations provide the most detailed picture yet of where the planet's auroras form and how energy moves through its atmosphere.

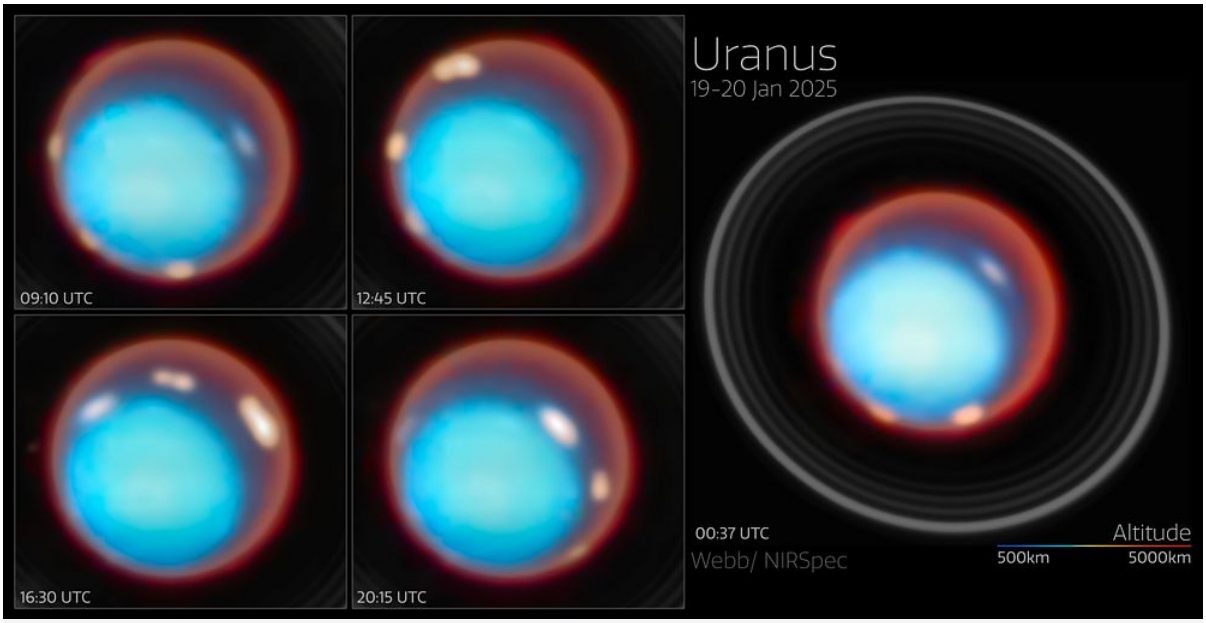
The study, published today in *Geophysical Research Letters*, also confirms that Uranus's upper atmosphere has continued to cool over the past thirty years – a trend that has been surprising scientists for over three decades.

Auroras occur when energetic particles become trapped in a planet's magnetic field and strike the upper atmosphere, releasing energy that creates a signature glow.

Using Webb's Near-Infrared Spectrograph, the team mapped out the temperature and density of ions in Uranus's ionosphere, a region where the atmosphere becomes ionised and interacts strongly with the planet's magnetic field.

The measurements revealed that temperatures peak between 3,000 and 4,000 kilometres above the cloud tops, whilst ion densities reach their maximum around 1,000 kilometres.

Speaking about the findings, lead author Paola Tiranti said: “This is the first time we've been able to see Uranus's upper atmosphere in three dimensions. With Webb's sensitivity, we can trace how energy moves upward through the planet's atmosphere and even see the influence of its lopsided magnetic field.”



Uranus' auroras captured during a full rotation of the planet.

Uranus's magnetosphere is one of the strangest in the Solar System. Unlike Earth, where the magnetic field is relatively aligned with the planet's rotation axis, Uranus's magnetic field is tilted by nearly 60 degrees and offset from the planet's centre. This means its auroras sweep across the surface in complex ways.

The Webb observations detected two bright auroral bands near Uranus's magnetic poles, together with a distinct depletion in emission and ion density between them – a feature likely linked to how magnetic field lines guide charged particles through the atmosphere. Similar darkened regions have been seen at Jupiter, where magnetic field geometry controls particle flow.

Webb's data also confirmed that Uranus's upper atmosphere is still cooling, extending a trend that began in the early 1990s. The team measured an average temperature of around 426 kelvins (about 150 degrees Celsius), lower than values recorded by ground-based telescopes or previous spacecraft observations.

Understanding why Uranus is cooling, despite being so far from the Sun, could provide crucial insights into how ice giant planets regulate their atmospheric temperature.

Paola Tiranti said: “By revealing Uranus's vertical structure in such detail, Webb is helping us understand the energy balance of the ice giants. This is a

crucial step towards characterising giant planets beyond our Solar System."

PhD student Paola Tiranti of Northumbria University

The study is based on data from JWST General Observer programme 5073, led by Dr Henrik Melin of Northumbria University, which used the telescope's Integral Field Unit on 19 January 2025 to observe Uranus for 15 hours.

Planetary scientists from Northumbria University's Solar and Space Physics peak of research excellence have been involved in a number of research projects using data from Webb, specifically exploring the upper atmospheres of our solar system's giant gas planets – Jupiter, Saturn, Uranus and Neptune.

- Deep space telescope captures Neptune's auroras for the first time
- Unveiling Jupiter's upper atmosphere
- Uranus aurora discovery promises new riches from James Webb Space Telescope
- Telescope to provide insight into Solar System light shows
- Telescope reveals unexpected activity above Jupiter's Great Red Spot

The James Webb Space Telescope is the world's premier space science observatory. Webb is solving mysteries in our solar system, looking beyond to distant worlds around other stars, and probing the mysterious structures and origins of our universe and our place in it. Webb is an international program led by NASA with its partners, ESA (European Space Agency) and CSA (Canadian Space Agency).

The paper *JWST Discovers the Vertical Structure of Uranus' Ionosphere* was published in *Geophysical Research Letters* on Thursday 19th February at 09:00 ET/14:00 GMT.

Image/video credit: ESA/Webb, NASA, CSA, STScI, P. Tiranti, H. Melin, M. Zamani (ESA/Webb)

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