UNIVERSITY OF LEICESTER

Exploring the Atmospheres of Uranus and Neptune with JWST

• JWST has opened a new window for exploring Uranus and Neptune, providing unprecedented new data for the Ice Giants. • Infrared spectral maps from NIRSpec and MIRI reveal the weather, dynamics, chemistry, and clouds in 3D. • Learn how to use JWST, alongside ground-based observatories, to explore the origins and climate of other worlds	**Level**	PhD
	First Supervisor	Prof Leigh Fletcher leigh.fletcher@leicester.ac.uk
	Second Supervisor	Prof Jonathan Nichols
	Application Closing Date	See web page
	PhD Start date	21st September 2026

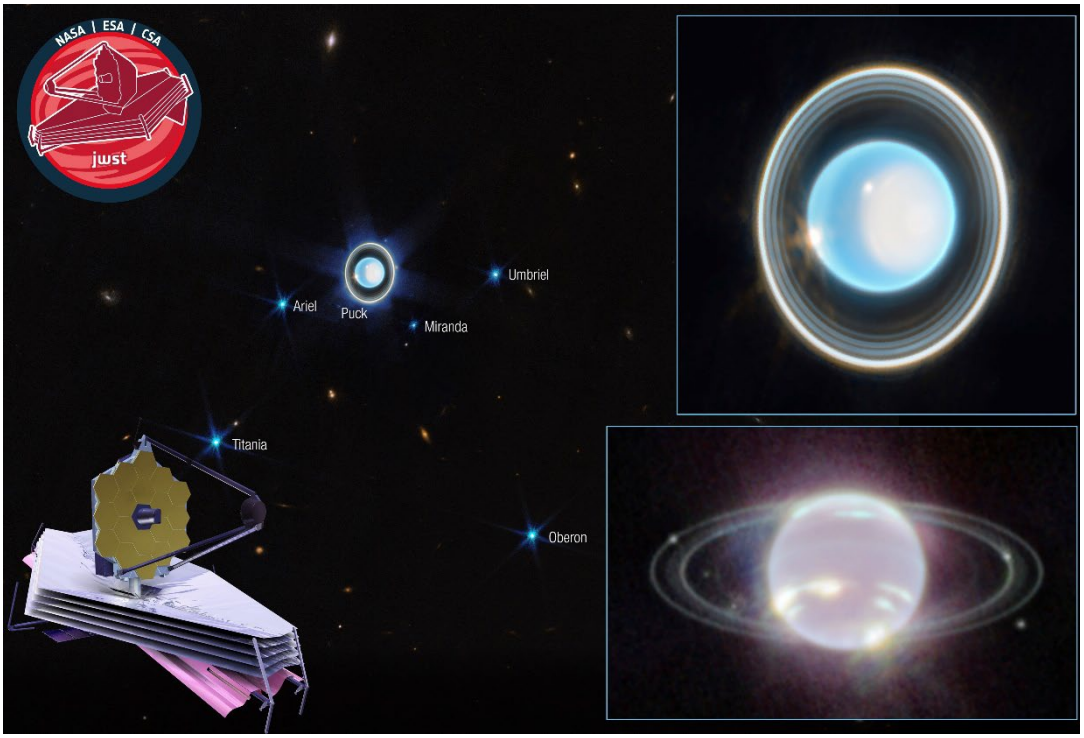
Details:

In the four years since launch, JWST has delivered astonishing new discoveries via infrared observations of the near and far universe. Leicester planetary scientists have been leading the exploration of the four giant planets, using infrared spectroscopy to explore the atmospheres, ionospheres, rings, and satellites of these enormous worlds, revealing wavelengths that have been too cold and too faint for any previous observatories.

The planetary atmospheres team is seeking a new student to explore the riches of the JWST Ice Giant dataset, to pave the way for future missions to Uranus and Neptune. JWST's key advance is the use of integral field spectroscopy, which acquires hundreds of spectra simultaneously across a small field of view, producing maps of both worlds from 1.6 µm (reflected sunlight with the NIRSpec instrument) to 28 µm (thermal emission with the MIRI instrument). Infrared spectroscopy will be modelled to understand the temperatures, winds, gaseous composition, and aerosols from the turbulent clouds to the upper atmosphere, providing insights onto the origins, climate, dynamics, and seasonal chemistry shaping these enigmatic worlds.

Global maps were acquired in 2023; a full Uranus rotation was observed in 2025; and both Ice Giants will be observed over a full month in 2026 – these datasets therefore allow the first investigation of temporal changes, particularly as Uranus approaches summer solstice in 2030 (when the north pole points directly at the Sun). Data reduction tools have been developed in Python, and spectral inversion will use an optimal-estimation retrieval algorithm (NEMESIS). The PhD student will have access to world-leading infrared data, coupled with mature and well-developed analysis tools, enabling new discoveries at the cutting edge of planetary science.

This is a computationally intensive project making use of Leicester's high-performance computing facility, so familiarity with Python is desirable, and prior knowledge of atmospheric physics, astronomical observing, or planetary science would be welcome. There will be opportunities to become involved in ground-based observing (Hawaiian and Chilean observatories). With Leicester's current involvement in Juno, JWST, JUICE, and future involvement in missions to the Ice Giants, this PhD project offers the potential for exciting opportunities in planetary science.



The Uranus and Neptune systems as seen by JWST/NIRCam (Credit: NASA, ESA, CSA, STScI; Image Processing: Joseph DePasquale). Uranus and its classical satellites are shown on the left against a background of galaxies; Uranus and Neptune are shown on the right replete with reflective rings and clouds. NIRSpec and MIRI will be used to provide full spectroscopy of the Uranus and Neptune atmospheres.

Further Reading:

- JWST: New Infrared Eye on the Solar System: https://www.europlanet-society.org/europlanet-magazine/issue-3/jwst-solar-system/
- Fletcher et al. (2023), Saturn's Atmosphere in Northern Summer Revealed by JWST/MIRI: https://doi.org/10.1029/2023JE007924
- Melin et al. (2025), Discovery of H3+ and infrared aurorae at Neptune with JWST: doi: https://doi.org/10.1038/s41550-025-02507-9
- Harkett et al. (2024), The Thermal Structure and Composition of Jupiter's Great Red Spot From JWST/MIRI: doi: https://doi.org/10.1029/2024JE008415
- G. L. Villanueva & S. N. Milam (2023), A new era in solar system astronomy with JWST, doi: https://doi.org/10.1038/s41467-023-43313-z

Further information on how to apply and funding can be found here