
JWST Reveals Exoplanet Weather and Atmosphere Bias

Description

The James Webb Space Telescope (JWST) has created a near-daily weather report for WASP-94A b, a planet situated 690 light-years from Earth. This finding is significant because it reveals the complex and dynamic atmosphere of a distant celestial body.

WASP-94A b is a tidally locked gas giant with a mass slightly less than half that of Jupiter but a diameter over 70% larger. Its surface temperature surpasses 1,500 Kelvin due to its unique orbit, where one side experiences constant daylight, while the opposite remains in perpetual darkness. This arrangement results in a stark temperature difference: the evening side is about 450 Kelvin warmer than the morning side, leading to distinct atmospheric behaviour akin to two differing planets.

Observations show that the morning atmosphere is thick with clouds composed of vaporized magnesium silicate, resembling sand, while the evening side is clear. This variability arises from equatorial super-rotation, where strong winds at the dividing line lift the magnesium silicate from the night side, allowing it to condense and later evaporate before reaching the evening limb.

The research team aimed to investigate whether the atmospheres of such exoplanets are static or dynamic. Findings indicate that WASP-94A b's weather is in constant motion, resembling a sandstorm circulating between hemispheres.

An important implication of this research is the identification of a methodological bias in older exoplanet studies. Previous assessments, which averaged light from entire planets, inaccurately suggested WASP-94A b had an oxygen content 100 times greater than that of the Sun. When examined using limb-resolved methods, the actual enrichment was found to be three to five times solar levels.

This correction is crucial for understanding planetary formation and could lead to reevaluations of many other hot Jupiters' composition estimates. The research team emphasises the need for improved techniques to address these biases in observational data.

The JWST team has extended their work to eight additional hot Jupiters, discovering similar atmospheric patterns. This advancement highlights JWST's capability to produce detailed spectral data, contrasting with previous instruments that provided only averages.

Looking ahead, Mukherjee's team intends to apply this observational technique to a broader range of planets, including one with a highly eccentric orbit that could display unusual weather patterns. For now, WASP-94A b serves as an exemplar of how a single exoplanet might reveal intricate atmospheric phenomena when scrutinised closely.



Vocabulary List:

1. **atmosphere** //ˈætməsfɪr// (noun): the layer of gases around a planet
2. **equatorial** //,ekwəˈtɔːriəl// (adjective): near a planet's middle, around the equator
3. **condense** //kənˈdɛns// (verb): change from gas to liquid or solid
4. **limb** //lɪm// (noun): the outer edge of a round body
5. **bias** //ˈbaɪəs// (noun): an unfair preference or wrong opinion
6. **spectral** //ˈspektrəl// (adjective): relating to a range of light or colors

Comprehension Questions

Multiple Choice

1. What is the primary function of the James Webb Space Telescope (JWST) regarding WASP-94A b?
Option: To measure its distance from Earth
Option: To create a near-daily weather report
Option: To determine its age
Option: To analyze its surface composition
2. What is the mass of WASP-94A b compared to Jupiter?
Option: Slightly more than half that of Jupiter
Option: Slightly less than half that of Jupiter
Option: Equal to Jupiter's mass
Option: Twice that of Jupiter
3. What is the surface temperature of WASP-94A b?
Option: About 1,000 Kelvin
Option: Over 1,500 Kelvin
Option: Less than 500 Kelvin
Option: Around 2,000 Kelvin
4. What atmospheric feature is prevalent on the morning side of WASP-94A b?
Option: Vaporized magnesium silicate clouds
Option: Clear skies
Option: Ice formations



Option: Acid rain

5. What did previous studies inaccurately suggest about WASP-94A b's oxygen content?

Option: It had no oxygen

Option: It had an oxygen content 10 times that of the Sun

Option: It had an oxygen content 100 times greater than that of the Sun

Option: It had an oxygen content equal to that of the Sun

6. How many additional hot Jupiters has the JWST team extended their work to?

Option: Five

Option: Six

Option: Eight

Option: Ten

True-False

7. WASP-94A b is a tidally locked gas giant.

8. The evening side of WASP-94A b is 450 Kelvin warmer than the morning side.

9. Limb-resolved methods revealed that WASP-94A b's oxygen content is lower than previously thought.

10. The research team aims to apply the observational technique only to WASP-94A b.

11. The JWST has replaced older instruments entirely with its capabilities.

12. WASP-94A b exhibits similar atmospheric patterns to other hot Jupiters studied by JWST.

Gap-Fill

13. WASP-94A b is located _____ light-years from Earth.

14. The surface temperature of WASP-94A b surpasses _____ Kelvin.

15. The evening side of WASP-94A b is subjected to _____ daylight.

16. Observation shows that the morning atmosphere is thick with _____ composed of



vaporized magnesium silicate.

17. The research team emphasized the need for improved techniques to address biases in

_____ data.

18. The JWST team intends to apply this technique to a _____ range of planets.

Answer

Multiple Choice: 1. To create a near-daily weather report 2. Slightly less than half that of Jupiter 3. Over 1,500 Kelvin 4. Vaporized magnesium silicate clouds 5. It had an oxygen content 100 times greater than that of the Sun 6. Eight

True-False: 7. True 8. False 9. True 10. False 11. False 12. True

Gap-Fill: 13. 690 14. 1,500 15. constant 16. clouds 17. observational 18. broader

CATEGORY

1. Sci/Tech - LEVEL6

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1. C2
2. esl news
3. exoplanets
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Date Created

2026/05/23

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