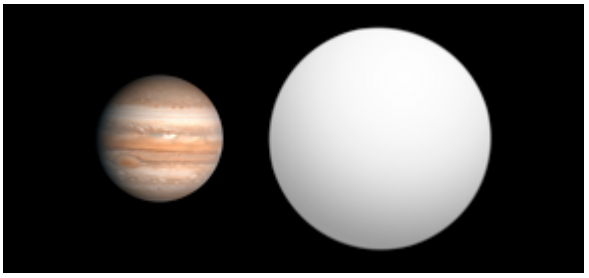
WASP-17b

WASP-17b, officially named **Ditsǒ̀**, is an exoplanet in the constellation Scorpius that is orbiting the star WASP-17. Its discovery was announced on 11 August 2009.[1] It is the first planet discovered to have a retrograde orbit, meaning it orbits in a direction counter to the rotation of its host star.[1] This discovery challenged traditional planetary formation theory.[4] In terms of diameter, WASP-17b is one of the largest exoplanets discovered and at half Jupiter's mass, this made it the most puffy planet known in 2010.[5] On 3 December 2013, scientists working with the Hubble Space Telescope reported detecting water in the exoplanet's atmosphere.[6][7]

WASP-17b's name was selected in the NameExoWorlds campaign by Costa Rica, during the 100th anniversary of the International Astronomical Union. Ditsǒ̀ is the name that the god Sibǒ̀ gave to the first Bribri people in Talamancan mythology.[8][9]

WASP-17b / Ditsǒ̀



Size comparison of Jupiter with Ditsǒ̀

Discovery[1]	
Discovered by	David R. Anderson *et al*
Discovery date	11 August 2009
Detection method	Transit (including secondary eclipse)
Orbital characteristics[2]	
Semi-major axis	0.051 51 ± 0.000 35 AU
Eccentricity	<0.020
Orbital period (sidereal)	3.735 4845 ± 0.000 0019 d
Inclination	$86.83^\circ\ ^{+0.68^\circ}_{-0.53^\circ}$
Argument of periastron	−70
Semi-amplitude	$56.0\ ^{+4.1}_{-4.0}$ m/s
Star	WASP-17
Physical characteristics[2]	
Mean radius	1.991 ± 0.081 R_J
Mass	0.512 ± 0.037 M_J
Mean density	$0.080\ ^{+0.013}_{-0.011}$ g/cm^3
Temperature	$1{,}550\ ^{+170}_{-200}$ K[3]

Discovery

A team of researchers led by David Anderson of Keele University in Staffordshire, England, discovered the gas giant, which is about 1,000 light-years (310 parsecs) from Earth, by observing it transiting its host star WASP-17. Such photometric observations also reveal the planet's size. The discovery was made with a telescope array at the South African Astronomical Observatory. Due to the involvement of the Wide Angle Search for Planets SuperWASP consortium of universities, the exoplanet, as the 17th found to date by this group, was given its present name.[10]

Astronomers at the Observatory of Geneva were then able to use characteristic redshifts and blueshifts in the host star's spectrum as its radial velocity varied over the course of the planet's orbit to measure the

planet's mass and obtain an indication of its orbital eccentricity.[1] Careful examination of the Doppler shifts during transits also allowed them to determine the direction of the planet's orbital motion relative to its parent star's rotation via the Rossiter–McLaughlin effect.[1]

Orbit

WASP-17b is thought to have a retrograde orbit (with a sky-projected inclination of the orbit normal against the stellar spin axis of about 149°,[11] not to be confused with the line-of-sight inclination of the orbit, given in the table, which is near 90° for all transiting planets), which would make it the first planet discovered to have such an orbital motion. It was found by measuring the Rossiter–McLaughlin effect of the planet on the star's Doppler signal as it transited, in which whichever of the star's hemispheres is turning toward or away from Earth will show a slight blueshift or redshift which is dampened by the transiting planet. Scientists are not yet sure why the planet orbits opposite to the star's rotation. Theories include a gravitational slingshot resulting from a near-collision with another planet, or the intervention of a smaller planet-like body working to gradually change WASP-17b's orbit by tilting it via the Kozai mechanism.[12] Spin-orbit angle measurement was updated in 2012 to $-148.7^{+7.7}_{-6.7}$°.[13]

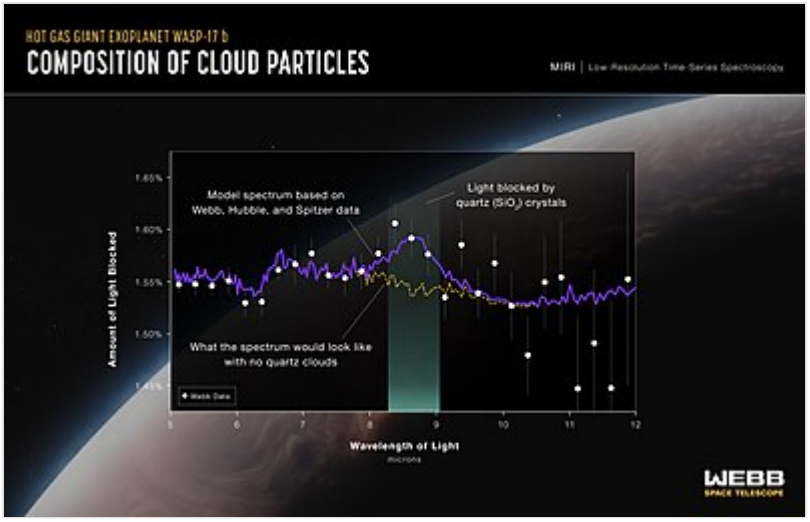
Physical properties

WASP-17b has a radius between 1.5 and 2 times that of Jupiter and about half the mass.[1] Thus its mean density is between 0.08 and 0.19 g/cm^3,[1] compared with Jupiter's 1.326 g/cm^3[14] and Earth's 5.515 g/cm^3 (the density of water is 1 g/cm^3). The unusually low density is thought to be a consequence of a combination of the planet's orbital eccentricity and its proximity to its parent star (less than one seventh of the distance between Mercury and the Sun), leading to tidal flexing and heating of its interior.[1] The same mechanism is behind the intense volcanic activity of Jupiter's moon Io. WASP-39b has a similarly low estimated density.

Exoplanetary sodium in the atmosphere of the WASP-17 has been detected in 2018,[3] but was not confirmed by 2021. Instead, the spectral signatures of water, aluminium oxide (AlO) and titanium hydride (TiH) were detected.[15] The water signature was confirmed in 2022, together with carbon dioxide absorption.[16] In 2023, evidence of clouds made of quartz was detected on the planet by the James Webb Space Telescope.[17][18]

Comparison of "hot Jupiter" exoplanets (artist concept)

From top left to lower right: WASP-12b, WASP-6b, WASP-31b, WASP-39b, HD 189733 b, HAT-P-12b, WASP-17b, WASP-19b, HAT-P-1b and HD 209458 b



This is a transmission spectrum of the hot gas giant exoplanet WASP-17 b captured by Webb's Mid-Infrared Instrument (MIRI) on 12–13 March 2023. It reveals the first evidence for quartz (crystalline silica, SiO2) in the clouds of an exoplanet.[19]

See also

- HAT-P-7b, another exoplanet announced to have a retrograde orbit the day after the WASP-17b announcement
- TrES-4b, another large exoplanet with a low density
- List of exoplanet extremes

References

1. Anderson, D. R.; et al. (2010). "WASP-17b: An Ultra-Low Density Planet in a Probable Retrograde Orbit". *The Astrophysical Journal*. **709** (1): 159–167. arXiv:0908.1553 (https://arxiv.org/abs/0908.1553). Bibcode:2010ApJ...709..159A (https://ui.adsabs.harvard.edu/abs/20

10ApJ...709..159A). doi:10.1088/0004-637X/709/1/159 (https://doi.org/10.1088%2F0004-637X%2F709%2F1%2F159). S2CID 53628741 (https://api.semanticscholar.org/CorpusID:53628741).

2. Bonomo, A. S.; Desidera, S.; et al. (June 2017). "The GAPS Programme with HARPS-N at TNG. XIV. Investigating giant planet migration history via improved eccentricity and mass determination for 231 transiting planets". *Astronomy & Astrophysics*. **602**: A107. arXiv:1704.00373 (https://arxiv.org/abs/1704.00373). Bibcode:2017A&A...602A.107B (https://ui.adsabs.harvard.edu/abs/2017A&A...602A.107B). doi:10.1051/0004-6361/201629882 (https://doi.org/10.1051%2F0004-6361%2F201629882). S2CID 118923163 (https://api.semanticscholar.org/CorpusID:118923163).
3. Khalafinejad, Sara; Salz, Michael; et al. (October 2018). "The atmosphere of WASP-17b: Optical high-resolution transmission spectroscopy" (https://doi.org/10.1051%2F0004-6361%2F201732029). *Astronomy & Astrophysics*. **618**: A98. arXiv:1807.10621 (https://arxiv.org/abs/1807.10621). Bibcode:2018A&A...618A..98K (https://ui.adsabs.harvard.edu/abs/2018A&A...618A..98K). doi:10.1051/0004-6361/201732029 (https://doi.org/10.1051%2F0004-6361%2F201732029). S2CID 119007114 (https://api.semanticscholar.org/CorpusID:119007114).
4. "A planet going the wrong way" (http://www.physorg.com/news/2011-06-planet-wrong.html), Phys Org. June 7, 2011. Accessed June 10, 2011
5. Kaufman, Rachel (17 August 2009). " "Backward" Planet Has Density of Foam Coffee Cups" (https://web.archive.org/web/20090820034615/http://news.nationalgeographic.com/news/2009/08/090817-new-planet-orbits-backward.html). *National Geographic*. National Geographic Society. Archived from the original (http://news.nationalgeographic.com/news/2009/08/090817-new-planet-orbits-backward.html) on August 20, 2009. Retrieved 6 February 2011.
6. "Hubble Traces Subtle Signals of Water on Hazy Worlds" (http://www.nasa.gov/content/goddard/hubble-traces-subtle-signals-of-water-on-hazy-worlds/). *NASA*. 3 December 2013. Retrieved 4 December 2013.
7. Mandell, Avi M.; Haynes, Korey; Sinukoff, Evan; Madhusudhan, Nikku; Burrows, Adam; Deming, Drake (3 December 2013). "Exoplanet Transit Spectroscopy Using WFC3: WASP-12 b, WASP-17 b, and WASP-19 b". *Astrophysical Journal*. **779** (2): 128. arXiv:1310.2949 (https://arxiv.org/abs/1310.2949). Bibcode:2013ApJ...779..128M (https://ui.adsabs.harvard.edu/abs/2013ApJ...779..128M). doi:10.1088/0004-637X/779/2/128 (https://doi.org/10.1088%2F0004-637X%2F779%2F2%2F128). S2CID 52997396 (https://api.semanticscholar.org/CorpusID:52997396).
8. "Approved names" (http://www.nameexoworlds.iau.org/final-results). *NameExoworlds*. Retrieved 2020-01-02.
9. "100 000s of People from 112 Countries Select Names for Exoplanet Systems In Celebration of IAU's 100th Anniversary" (https://www.iau.org/news/pressreleases/detail/iau1912/). *International Astronomical Union*. Retrieved 2020-01-02.
10. Rincon, Paul (August 13, 2009). "New planet displays exotic orbit" (http://news.bbc.co.uk/2/hi/science/nature/8197683.stm). *BBC News*. Retrieved 2009-08-13.
11. Amaury H.M.J. Triaud et al. *Spin-orbit angle measurements for six southern transiting planets*. Accepted for publication in A&A 2010. arXiv preprint (https://arxiv.org/abs/1008.2353)
12. Grossman, Lisa (August 13, 2009). "Planet found orbiting its star backwards" (https://www.newscientist.com/article/dn17603-planet-found-orbiting-its-star-backwards-for-first-time.html?full=true). *New Scientist*. Retrieved 2009-08-13.

13. Albrecht, Simon; Winn, Joshua N.; Johnson, John A.; Howard, Andrew W.; Marcy, Geoffrey W.; Butler, R. Paul; Arriagada, Pamela; Crane, Jeffrey D.; Shectman, Stephen A.; Thompson, Ian B.; Hirano, Teruyuki; Bakos, Gaspar; Hartman, Joel D. (2012), "Obliquities of Hot Jupiter Host Stars: Evidence for Tidal Interactions and Primordial Misalignments", *The Astrophysical Journal*, **757** (1): 18, arXiv:1206.6105 (https://arxiv.org/abs/1206.6105), Bibcode:2012ApJ...757...18A (https://ui.adsabs.harvard.edu/abs/2012ApJ...757...18A), doi:10.1088/0004-637X/757/1/18 (https://doi.org/10.1088%2F0004-637X%2F757%2F1%2F18), S2CID 17174530 (https://api.semanticscholar.org/CorpusID:17174530)
14. "Jupiter Fact Sheet" (http://nssdc.gsfc.nasa.gov/planetary/factsheet/jupiterfact.html). Retrieved 2009-08-13.
15. Saba, Arianna; Tsiaras, Angelos; Morvan, Mario; Thompson, Alexandra; Changeat, Quentin; Edwards, Billy; Jolly, Andrew; Waldmann, Ingo; Tinetti, Giovanna (2022), "The Transmission Spectrum of WASP-17 b from the Optical to the Near-infrared Wavelengths: Combining STIS, WFC3, and IRAC Data Sets", *The Astronomical Journal*, **164** (1): 2, arXiv:2108.13721 (https://arxiv.org/abs/2108.13721), Bibcode:2022AJ....164....2S (https://ui.adsabs.harvard.edu/abs/2022AJ....164....2S), doi:10.3847/1538-3881/ac6c01 (https://doi.org/10.3847%2F1538-3881%2Fac6c01), S2CID 237363318 (https://api.semanticscholar.org/CorpusID:237363318)
16. Alderson, L.; Wakeford, H. R.; MacDonald, R. J.; Lewis, N. K.; May, E. M.; Grant, D.; Sing, D. K.; Stevenson, K. B.; Fowler, J.; Goyal, J.; Batalha, N. E.; Kataria, T. (2022), "A comprehensive analysis of WASP-17b's transmission spectrum from space-based observations", *Monthly Notices of the Royal Astronomical Society*, **512** (3): 4185–4209, arXiv:2203.02434 (https://arxiv.org/abs/2203.02434), doi:10.1093/mnras/stac661 (https://doi.org/10.1093%2Fmnras%2Fstac661)
17. Grant, David; Lewis, Nikole K.; et al. (October 2023). "WST-TST DREAMS: Quartz Clouds in the Atmosphere of WASP-17b" (https://doi.org/10.3847%2F2041-8213%2Facfc3b). *The Astrophysical Journal Letters*. **956** (2): L29. arXiv:2310.08637 (https://arxiv.org/abs/2310.08637). Bibcode:2023ApJ...956L..32G (https://ui.adsabs.harvard.edu/abs/2023ApJ...956L..32G). doi:10.3847/2041-8213/acfc3b (https://doi.org/10.3847%2F2041-8213%2Facfc3b).
18. "NASA's Webb Detects Tiny Quartz Crystals in Clouds of Hot Gas Giant" (https://webbtelescope.org/contents/news-releases/2023/news-2023-140). *webbtelescope.org*. STScI. 16 October 2023. Retrieved 16 October 2023.
19. "Composition of cloud particles - hot gas giant exoplanet WASP-17b" (https://esawebb.org/images/WASP17b/). October 20, 2023.

External links

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- Alexander, Amir. Scientists Detect "Wrong-Way" Planet. [1] (http://www.planetary.org/news/2009/0812_Scientists_Detect_WrongWay_Planet.html) Archived (https://web.archive.org/web/20090816085545/http://www.planetary.org/news/2009/0812_Scientists_Detect_WrongWay_Planet.html) 2009-08-16 at the Wayback Machine The Planetary Society, August 12, 2009. Accessed August 14, 2009.