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Astronomy

James Webb Space Telescope snaps its first exoplanet...

Alex Wilkins

THE James Webb Space Telescope (JWST) has captured its first direct images of an alien world – and as the telescope is performing better than expected, we are likely to see many more in the future.

Astronomers have taken such images of just 20 exoplanets, all from Earth-based telescopes. But because our planet's atmosphere blocks out large parts of the infrared part of the spectrum, it has been hard to detect features of these planets in any great detail.

"Being here on Earth really sets a sensitivity floor to what we're able to detect, and to this day, the lowest mass planet we've been able to detect is about two Jupiter masses," says Sasha Hinkley at the University of Exeter, UK.

Now, Hinkley and his colleagues have used JWST to directly image a so-called super-Jupiter exoplanet, HIP 65426 b, which is around seven Jupiter masses and orbits a star around 400 light years from Earth. The team captured it in a range of infrared wavelengths and at a precision that had previously been impossible (arxiv.org/abs/2208.14990).

While this didn't extend the range of direct observations to smaller worlds, it was chosen to test JWST's capabilities because it had previously been viewed by ground-based telescopes. Future work with the space observatory should allow us to go further, says Hinkley. "It's going to allow us to get down to planets that are analogues of ice giants in our own solar system. These might be things like Saturns, or possibly even Neptunes if we're lucky."

HIP 65426 b is relatively young and hot, meaning it is easier to image. The team found that JWST performed 10 times better than expected and was much more sensitive than previous telescopes.

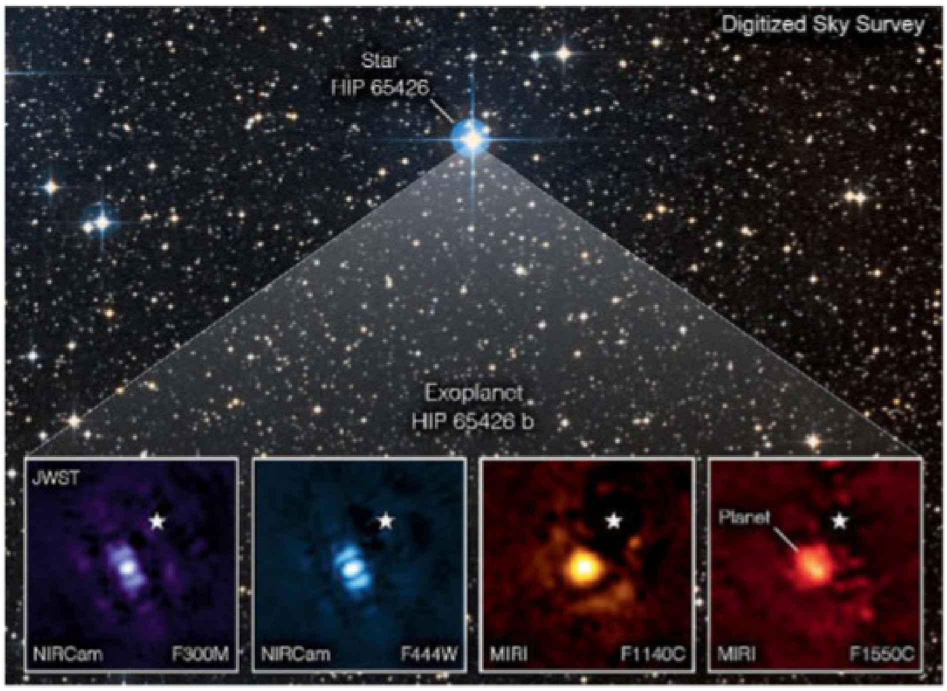
"We get just exquisite sensitivity with JWST, so we can see really faint objects, especially if they're a bit further from the star," says team member Beth Biller at the University of Edinburgh, UK.

Imaging HIP 65426 b is tricky because it orbits so close to its host star, which creates a high contrast in brightness. Hinkley and his team used a coronagraph to block out the star's light, allowing them to image the planet across a range of wavelengths. This distant world looks a little different depending on which of JWST's two infrared instruments, NIRCam and MIRI, were used because of the way these devices process the data, says Biller (see images, left).

Because JWST is in such demand to observe many different astronomical objects, it isn't actually the optimal exoplanet-imaging device, says Michael Merrifield at the University of Nottingham, UK. "But it's such a big leap forward on everything that, actually, I think it will probably take us into regimes we've never been to before."

That said, there are limits. Exoplanets are so far away from Earth and such difficult objects to image that even JWST can't capture high-resolution pictures that look like planets in our own solar system. ∎

Exoplanet HIP 65426 b as seen by the NIRCam and MIRI instruments



NASA/ESA/CSA, A CARTER (UCSC), ERS 1386 TEAM, A. PAGAN (STSCI)

...and sees strange sandy clouds on a brown dwarf

ASTRONOMERS have found direct evidence of clouds made from sand-like substances on a brown dwarf.

These large balls of gas, more massive than planets but without enough mass and pressure from gravity to start nuclear fusion like stars, glow mostly in the infrared range. To date, all our observations of these failed stars had been in a narrow wavelength of light, limiting our understanding of their chemical composition.

Now, Beth Biller at the University of Edinburgh, UK, and her colleagues have used the James Webb Space Telescope (JWST) to capture the signature of VHS 1256 b, a brown dwarf that is almost 20 times more massive than Jupiter and just under the threshold for nuclear fusion (arxiv.org/abs/2209.00620).

The telescope's ability to observe across a wide range of infrared means the team could capture much more detail from the brown dwarf's atmosphere, identifying molecules of water, methane and carbon dioxide; metals like sodium and potassium; and clouds made from silica-based particles, similar to sand. While astronomers had previously inferred the existence of silicate dust clouds in some brown dwarfs based on their colours, this is the first direct evidence of these clouds.

These silicates are probably molecules like enstatite and forsterite, which make up part of Earth's mantle. On VHS 1256 b, they instead take the form of tiny particulates floating through the atmosphere like smoke, says team member Sasha Hinkley at the University of Exeter, UK.

"If you put out your hand, you would feel sand, like when it is super windy at the beach"

"My mental picture is that, if you put out your hand, you would feel sand, like when it is super windy at the beach," says Mark Marley at the University of Arizona. "For us to see the feature in the spectrum means that at least some of the particles are small, sub-micron, so like very fine-grained dust, but some will be bigger, up to beach sand size." ∎
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