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James Webb Space Telescope discovers its first exoplanet

- One of the main objectives of contemporary astronomy is the search for exoplanets, which provide a better understanding of how planetary systems form.
- For the first time since its launch in 2021, the James Webb Space Telescope has enabled the discovery of a new exoplanet; it is located in the debris disk of a young star.
- It is the lightest planet observed by direct imagery, and represents an important stage in the imaging of less and less massive planets that are more comparable to the Earth.

The James Webb Space Telescope (JWST) has made it possible to better characterize known exoplanets since it was commissioned in 2022. Thanks to research[1] led by a CNRS researcher[2] at the *Observatoire de Paris-PSL* associated with the *Université Grenoble Alpes*, the telescope recently captured the direct image of a previously unknown exoplanet. This discovery, which is published on June 25 2025 in the journal *Nature*, is a first for the telescope, and was achieved using a French-produced coronagraph installed on the JWST's MIRI instrument.

Exoplanets are key targets in observational astronomy, as they help better understand how planetary systems form, including our own. While thousands have been detected indirectly, obtaining images of exoplanets represents a genuine challenge[3]. They are less bright, and seen from the Earth are located very near their star; their signal, which is drowned out by that of the star, does not stand out enough to be visible. To overcome this problem, the CNRS developed, in collaboration with the CEA, a telescopic attachment for the JWST's MIRI instrument–a coronagraph. It can reproduce the effect observed during an eclipse: masking the star makes it easier to observe the objects surrounding it, without them being hidden by its light. It is this technique that allowed the team led by a CNRS researcher to discover a new exoplanet, the first by the JWST. It is located within a disk of rocky debris and dusts.

Rings in Debris Disks

Scientists have focused on the most promising targets of observation: a few millions years old systems that can be seen "pole-on", which allows for seeing the disks "from above". The recently formed planets in these disks are still hot, which makes them brighter than their older counterparts. Low-mass planets are in principle easier to detect in the mid-infrared thermal range, for which the JWST has provided a unique window of observation. Among the disks seen from the front, two drew

special attention from researchers, with previous observations revealing concentric ring-like structures within them.

The scientists had until now suspected that these structures resulted from gravitational interaction between unidentified planets and planetesimals[4]. One of the two systems, named TWA 7, has three distinct rings, one of which is especially narrow, and surrounded by two empty areas with almost no matter. The image obtained by the JWST revealed a source within the heart of this narrow ring. After eliminating the possibility of a potential observation bias[5], the scientists concluded that it was most probably an exoplanet. Detailed simulations have indeed confirmed the formation of a thin ring and a "hole" at the exact planet's position, which perfectly corresponds to the observations made with the JWST.

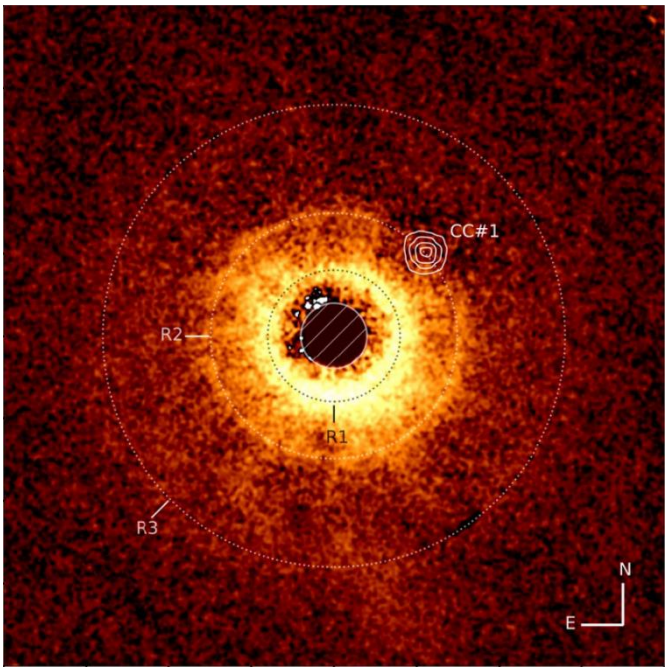

Image of the disk around the star TWA 7 recorded using ESO's Very Large Telescope's SPHERE instrument. The image captured with JWST's MIRI instrument is overlayed. We can clearly see the empty area around TWA 7 B in the R2 ring (CC #1).

What Prospects for the Future Discovery of Exoplanets?

Named TWA 7 b, this new exoplanet is ten times lighter than those previously captured in images! Its mass is comparable to Saturn's, which is approximately 30% that of Jupiter, the Solar System's most massive planet. This result marks a new step in the research and direct imaging of increasingly light exoplanets. The JWST has the potential to go even further in the future. The scientists thus hope to capture images of planets with just 10% of Jupiter's mass. This discovery paves the way to direct imagery of terrestrial exoplanets. They will be prime targets for the future generations of space-based and ground-based telescopes, some of which will use more advanced coronagraphs. The most promising systems are already being identified for these future observations.

Notes

1 – This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (COBREX; grant agreement n°885593).

2 – From the LIRA, *Laboratoire d'instrumentation et de recherche en astrophysique (CNRS/Observatoire de Paris/Sorbonne Université/université Paris Cité)*, *the Institut de planétologie et d'astrophysique de Grenoble (CNRS/Université Grenoble Alpes)*, the *Laboratoire d'étude de l'Univers et des phénomènes extrêmes (CNRS/Obs. de Paris/Sorbonne Université)*, the *Centre de recherche astrophysique de Lyon (CNRS/ENS de Lyon/Université Claude Bernard)*, the *Département d'informatique de l'École normale supérieure (CNRS/Inria/ENS-PSL)* and the *Observatoire de la Côte d'Azur (CNRS/OCA)*.

3 – Unlike a coronograph, the two most common methods of detection do not provide a direct image of the exoplanet, but rather its effect. Transit photometry uses a small drop of luminosity from the star when its planet is in front of it (seen from Earth). Radial velocity measures a star's speed variations under its planet's gravitational influence to deduct the existence of said planet.

4 – Rocky celestial bodies a few kilometers wide; they are the bricks for planet formation within developing star systems or in debris disks. Through collisions, they produce the dust observed within said disks.

5 – The source could have been a galaxy in the background.

Bibliography

Evidence for a sub-jovian planet in the young TWA7 disk, A.-M. Lagrange, C. Wilkinson, M. Mâlin, A. Boccaletti, C. Perrot, L. Matrà, F. Combes, D. Rouan, H. Beust, A. Chomez, B. Charnay, S. Mazevet, O. Flasseur, J. Olofsson, A. Bayo, Q. Kral, G. Chauvin, P. Thebault, P. Rubini, J. Milli, F. Kiefer, A. Carter, K, Crotts, A. Radcliffe, J. Mazoyer, T. Bodrito, S. Stasevic, P. Delorme, M. Langlois, June 25 2025, *Nature*, https://doi.org/10.1038/s41586-025-09150-4

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