SO_2, SILICATE CLOUDS, BUT NO CH_4 DETECTED IN A WARM NEPTUNE

By the **EXOMIRI TEAM**

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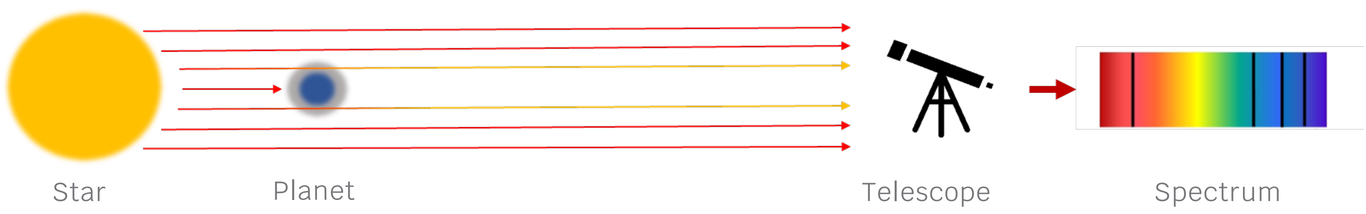
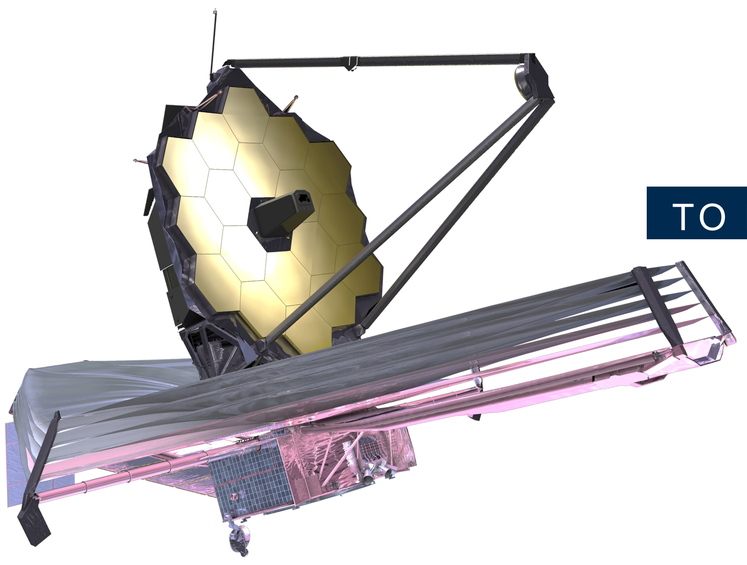
OBSERVING WITH THE JAMES WEBB SPACE TELESCOPE

The core of this research revolves around the mid-infrared atmospheric characterisation of the **puffy Neptune WASP-107b,** using the Low-Resolution Spectrometer (LRS) of the **Mid-Infrared Instrument** (MIRI) on board **James Webb Space Telescope** (JWST).

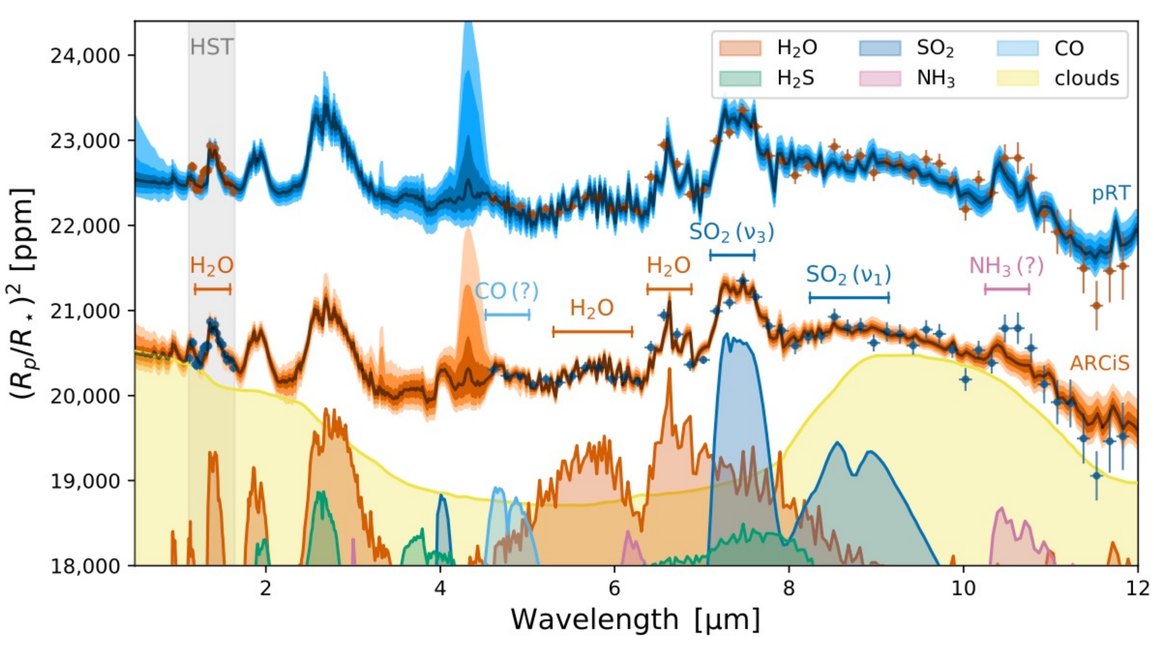
To detect molecules in close-in exoplanetary atmospheres, we use **transit spectroscopy:** molecules are likely to absorb stellar light at given wavelengths when the planet passes in front of its star. This work has been conducted as part of the **Cycle 1 MIRI GTO** (PID 1280, PI: P.O. Lagage).





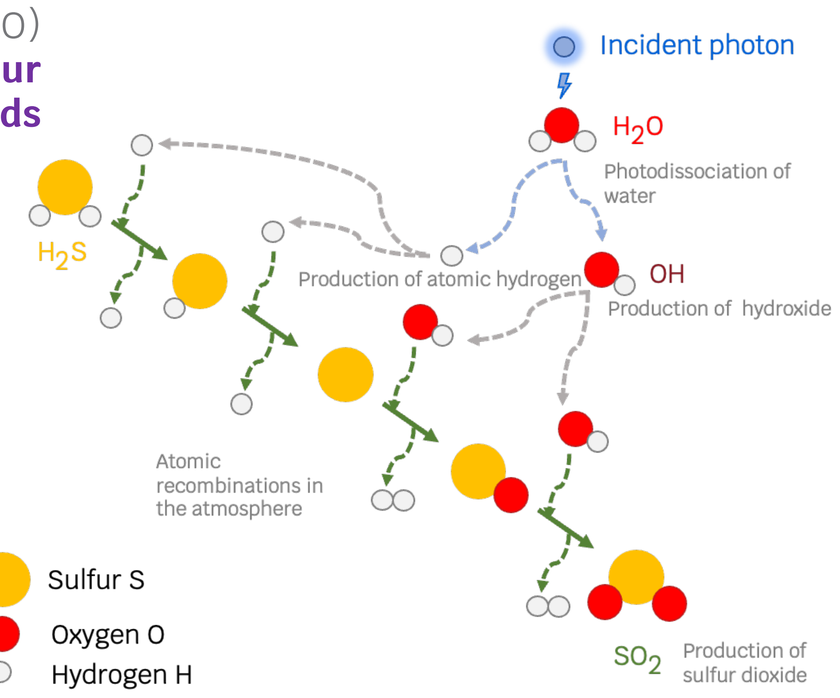
TO DETECT UNEXPECTED MOLECULES

By observing this super-Neptune, we confirmed the detection of **water vapour** (H_2O) and unexpectedly found **sulphur dioxide** (SO_2) and **silicate clouds** in its atmosphere [1].



HST/STIS - JWST/MIRI transmission spectra of WASP-107b with key contributions

Photochemical process of SO_2 production



Atmospheric modelling of WASP-107b demonstrated that SO_2 is produced through **photochemistry**, thus extending the range of exoplanet temperatures with detected SO_2 from ~1,200 K [2] down to ~740 K.

IN AN IRRADIATED LOW-DENSITY SUPER-NEPTUNE'S ATMOSPHERE

Previous models had not predicted the presence of SO_2 in such a cool/warm planet.

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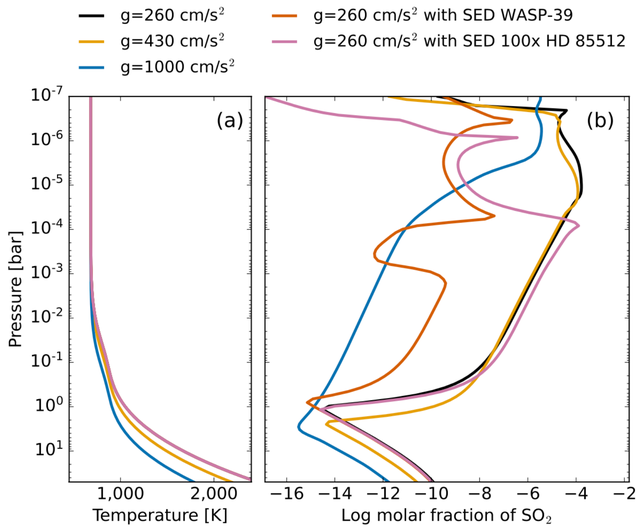
For such a fluffy planet, as long as the UV irradiation and FUV/NUV ratio remain moderate and the gravity is low, **disequilibrium processes** lead to detectable SO_2 levels even at the low equilibrium temperature of WASP-107b.



Impact of gravity and UV irradiation on predicted SO_2 molar fraction

Our models also predict a **super-solar metallicity** and a **high intrinsic temperature**, leading to a non-detection of methane (CH_4) in the mid-infrared range.

REFERENCES

[1] Dyrek, Min, Decin+, 2024, Nature 625 51–54
[2] Rustamkulov+, 2022, Nature 614 659–663