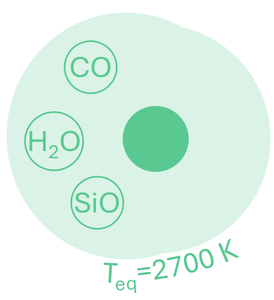
The first mid-IR emission spectrum of an ultra-hot Jupiter

K. Angelique Kahle[1], P. Mollière[1], L. Kreidberg[1], J. Bouwman[1], L. Acuna[1], M. Bergemann[1], B. Bitsch[2], L. Carone[3], D. Christie[1], K. Chubb[3,4], T. M. Evans-Soma[1,5], C. Gapp[1], C. Helling[3], T. Henning[1], P.-O. Lagage[6], M. Min[7], C. Mordasini[8], J. Polman[8], A. D. Schneider[9,10], N. Storm[1], R. Waters[7,11]

[1]Max Planck Institute for Astronomy, [2]University College Cork, [3]ÖAW Space Research Institute, [4]University of St Andrews, [5]University of Newcastle, [6]Université Paris Cité, [7]SRON Netherlands Institute for Space Research, [8]University of Bern, [9]KU Leuven, [10]Niels Bohr Institute, [11]Radboud University

Introduction: WASP-121 b



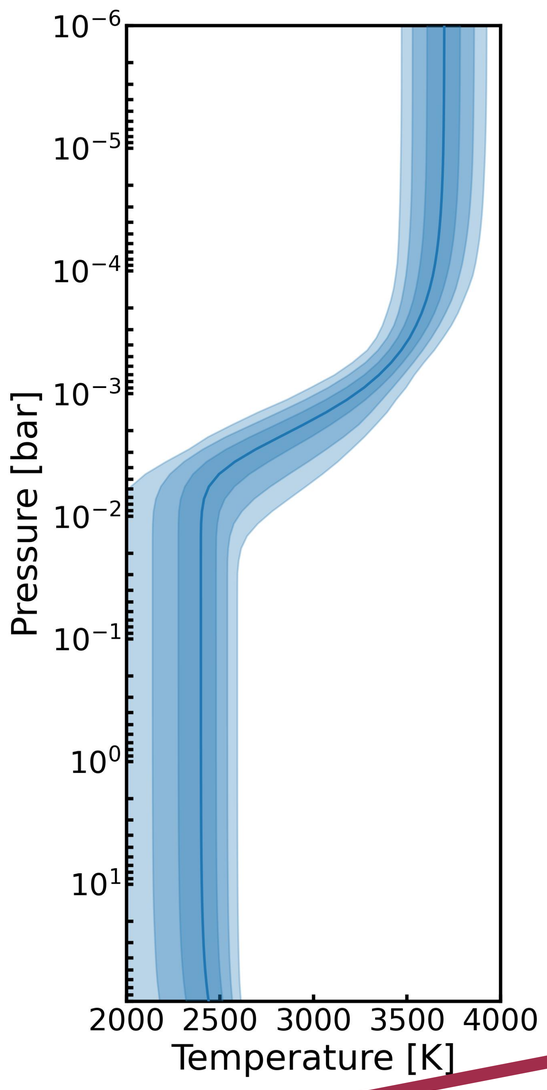
WASP-121 b is an **ultra-hot Jupiter** that orbits an F star. Such extreme dayside temperatures vaporize **refractory species**, giving us a unique opportunity to measure the refractory-to-volatile ratio. This provides an important benchmark for planet formation models.

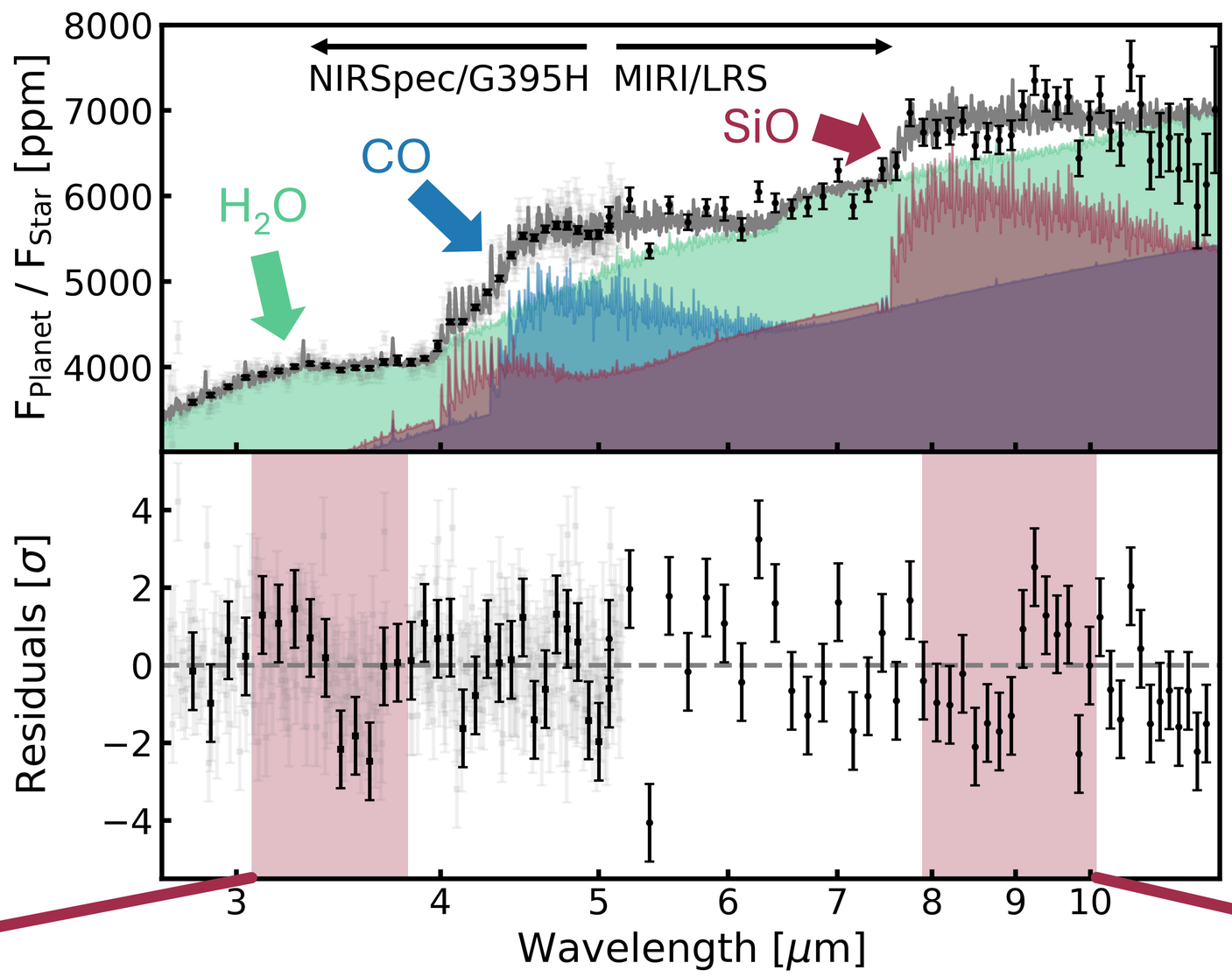
Observations with JWST MIRI/LRS

The refractory species **SiO** was detected with JWST NIRSpec/G395H on the planet's dayside (Evans-Soma et al. 2025) and terminator (Gapp et al. 2025). We analyze **one secondary eclipse** observed with **JWST MIRI/LRS**, which contains another strong SiO band at 8-10 µm.

These data will refine the SiO constraints – but what else will they reveal?

SiO is detected on the dayside of WASP-121 b - [Si/O] is under construction





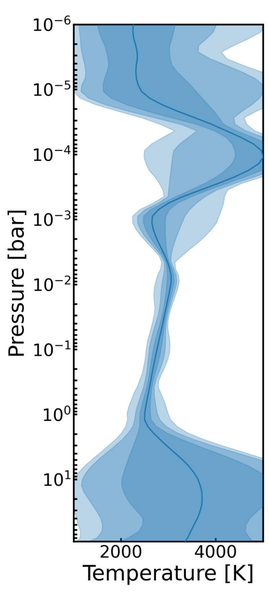
We model the spectrum using **petitRADTRANS** (Mollière et al. 2019) and **detect CO**, **H_2O**, and **SiO** signatures in the gas phase.

The displayed model shows a cloud-free atmosphere in chemical equilibrium. We use scaled solar abundances and a Guillot T-P profile.

While this model fits the data reasonably well, we see some mismatches at 3.5 µm and 9 µm. **We need to understand these deviations to measure the refractory-to-volatile ratio accurately!**

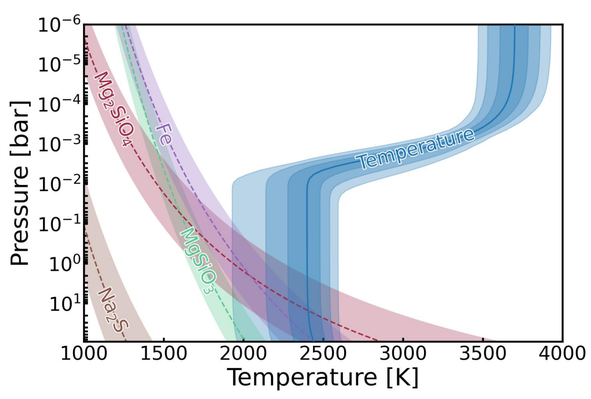
But what causes these residuals? Place your bets now!

Temperature profile?



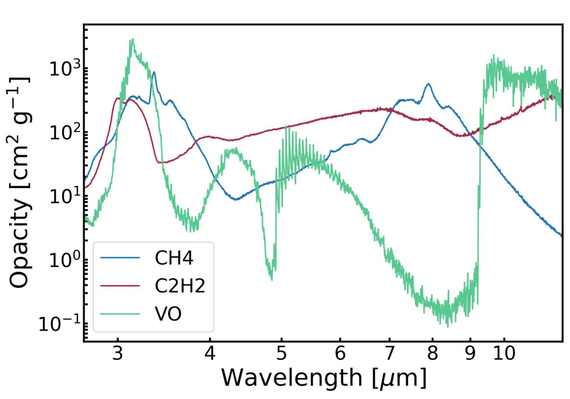
A Guillot T-P profile might be too simple for JWST data. A flexible profile fits the data better but requires some regularization.

Clouds on the dayside?



Silicate clouds could produce a feature around 9 µm. However, we **do not expect** any condensed species at WASP-121 b's dayside!

Different gas-phase species?



Our models could miss a relevant gas-phase emitter. If you have an obvious candidate in mind, please add it to the idea box!

Nothing, maybe it's just noise?

Of course, this is an option. More observations could clarify this.

Add your ideas:

- 3D effects
- [...]

Bets:

Bets:

Bets:

Bets:

References

- **Evans-Soma, et al. 2025**, *Nat. Astron.* 9, 845-861
- **Gapp, et al. 2025**, *AJ*, 169 341
- **Mollière, et al. 2019**, *A&A*, 627, A67

Contact me!

No time to chat?

My e-mail is:
kahle@mpia.de

Scan now, read later: