HD 86226c: a hot sub-Neptune with a surprisingly featureless transmission spectrum

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SPACE and HD 86226c

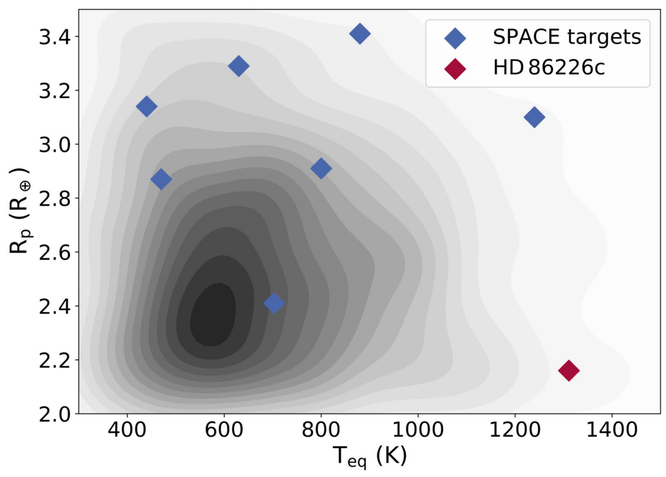


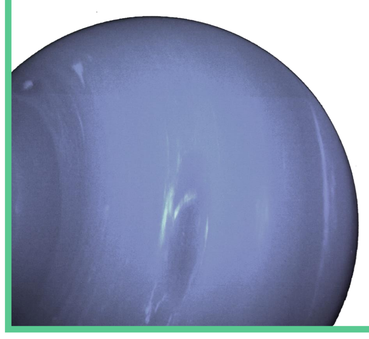
Fig. 1: SPACE targets displayed on sub-Neptune density distribution.

The **S**ub-neptune **P**lanetary **A**tmosphere **C**haracterization **E**xperiment (SPACE) is an HST Multi-Cycle Treasury Program.

For **8 sub-Neptunes** in a physically motivated **R_p-T_{eq}** grid, SPACE measures:

- WFC3 transmission spectra
- STIS UV stellar spectra

It is designed to reveal how atmospheres of sub-Neptune are shaped by **metal enrichment, disequilibrium chemistry**, and **aerosols**.



HD 86226c:

- T_{eq} = 1300 K
- R_p = 2.2 $R_\oplus$
- ρ = 3.9 g/cm^3
- Period = 3.98 d
- Transit Duration = 2.45 h
- G-type host star

Data and Reduction

The **NIR transmission** data**:**

- Instrument: HST / WFC3
- 7 / 9 transits observed
- 4 HST orbits per transit

The data reduction:

- **PACMAN** pipeline for flux extraction and light curve fit
- Flux correction by decorrelation of the spectrum position on the detector
- Free parameters :

  T_0, R_p, $v_{forward}$, $v_{reverse}$

  c, v, r_1, r_2, $scale_{up\text{-}down}$

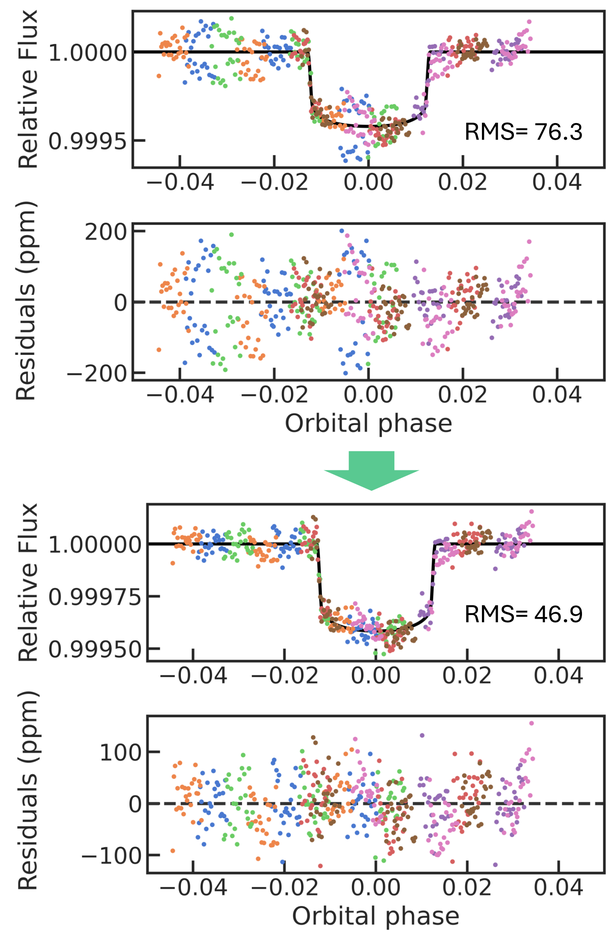


Fig. 2: spatial decorrelation improves the light curve precision significantly

Light curves and flat spectrum

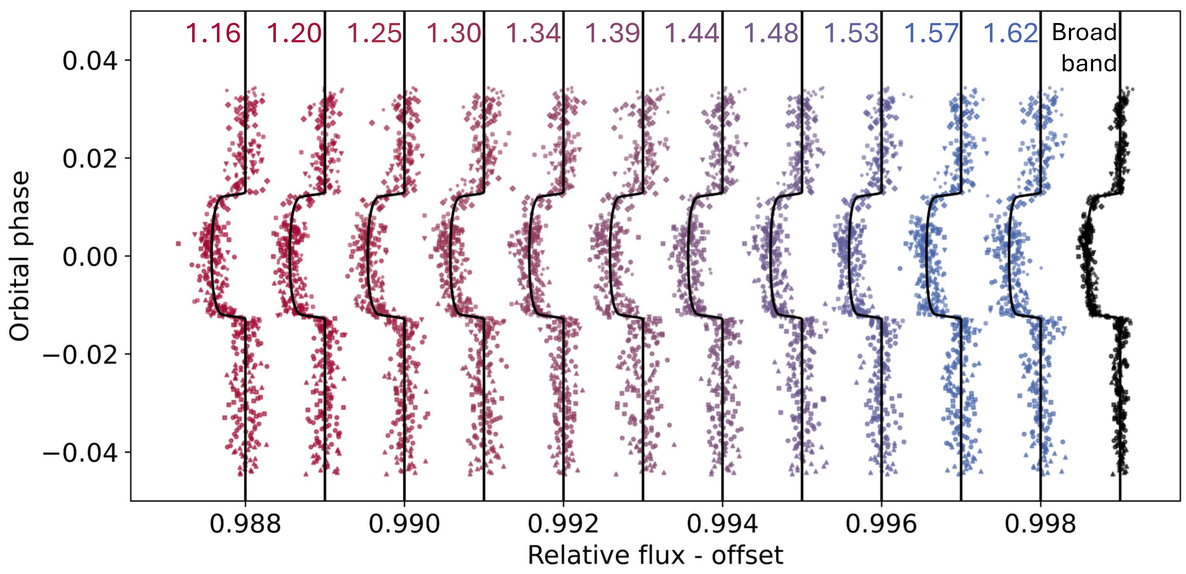


Fig 3: Spectroscopic and broad band light curves.

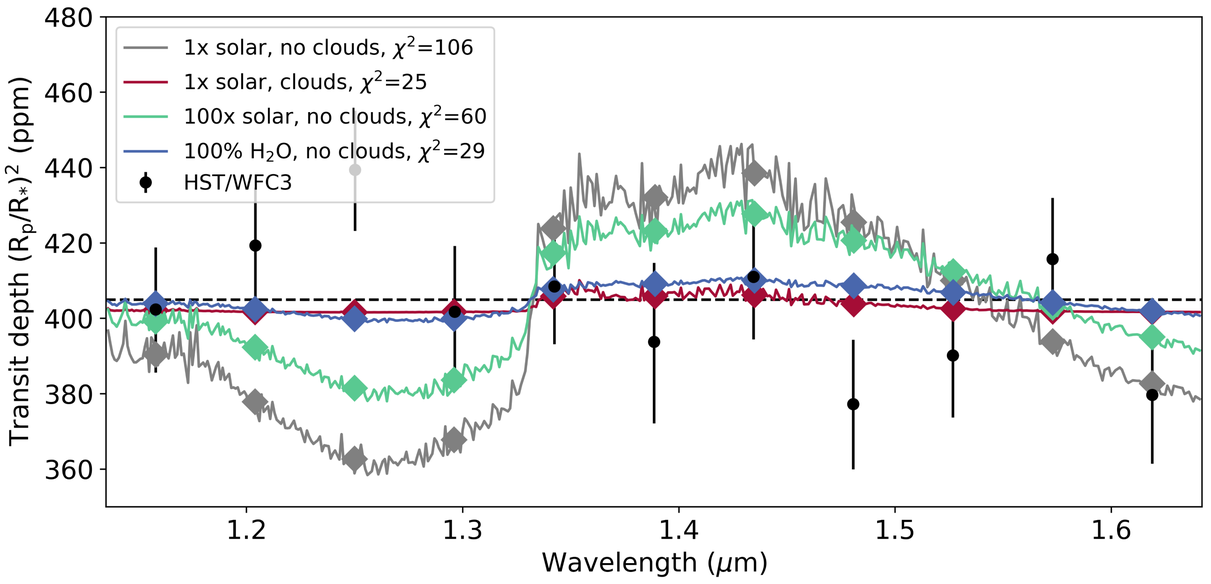


Fig 4: Spectrum of HD 86226c and atmosphere forward models

We binned the signal in 11 spectral bins with average RMS of 110 ppm. The spectrum was compared to forward models from the radiative transfer code **petitRADTRANS**. Based on the observed spectrum, **a cloud-free solar composition atmosphere is ruled out**. It is consistent with a cloud layer above 10^{-3} bar, or a cloud-free atmosphere with [M/H] well above 100. A complete water atmosphere is also consistent.

Conclusions

The NIR transmission spectrum of hot sub-Neptune HD 86226c does not show spectral features.

- HD 86226c **does not follow the trend of Neptune-sized objects**, which show an increasing feature size for equilibrium temperatures over 700 K.
- High temperatures on this planet disfavor the formation of hazes. **Silicate clouds are an alternate possibility**.
- The missing features can also be explained by a **possible high metallicity** of the planet.

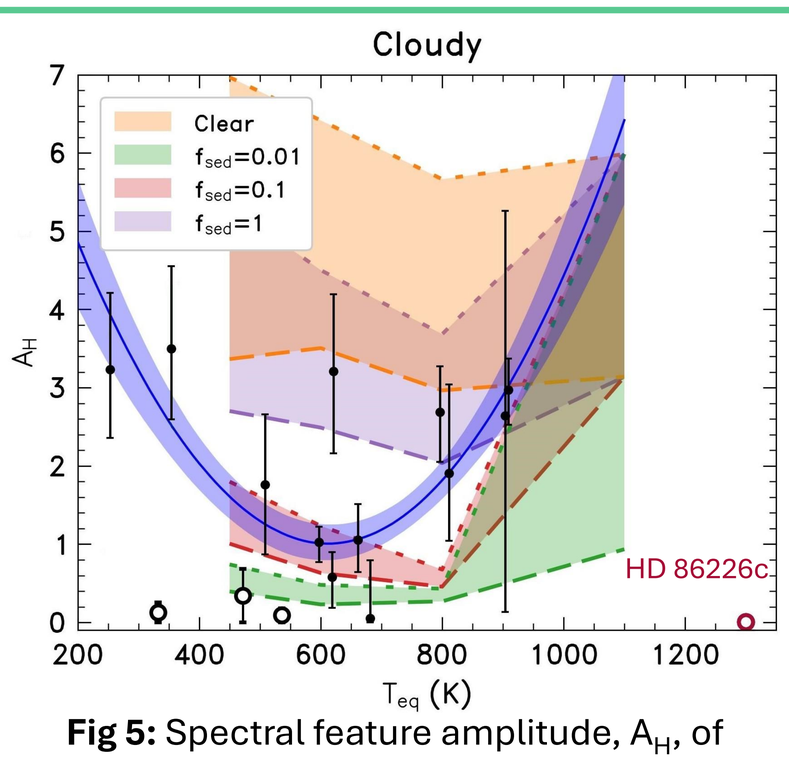


Fig 5: Spectral feature amplitude, A_H, of the (sub-) Neptune sample analyzed by Brande et al. (2024) and of HD 86226c.

References / Contact

References:

- **Zieba & Kreidberg 2022**, JOSS, 7, 4838
- **Mollière, et al. 2019**, A&A, 627, A67
- **Brande, et al. 2024,** ApJ, 961, L23

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