Two of a kind: parallel transmission spectra of a single transit

Dominique Petit dit de la Roche, Monika Lendl
Observatoire de Genève, Chemin Pegasi 51, 1290 Versoix, Switzerland
Dominique.Petit@unige.ch

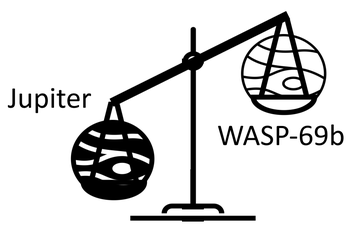
Abstract

Interpretation of ground-based transmission spectra is complicated by systematic uncertainties, especially at low to medium resolutions. Here we compare two ground-based medium-resolution transmission spectra (R~5000) of WASP-69 b taken independently during the same transit with different telescopes at different sites. The FORS2 data is part of the CHEWIE survey of transiting giant plants, while the second dataset is taken from the literature from Ouyang et al. (2023). We find a different slope and do not detect in our VLT/FORS dataset the potential TiO signature from SOAR/GHTS, emphasizing the need to understand instrumental and data analysis effects in transmission spectra.

WASP-69 b

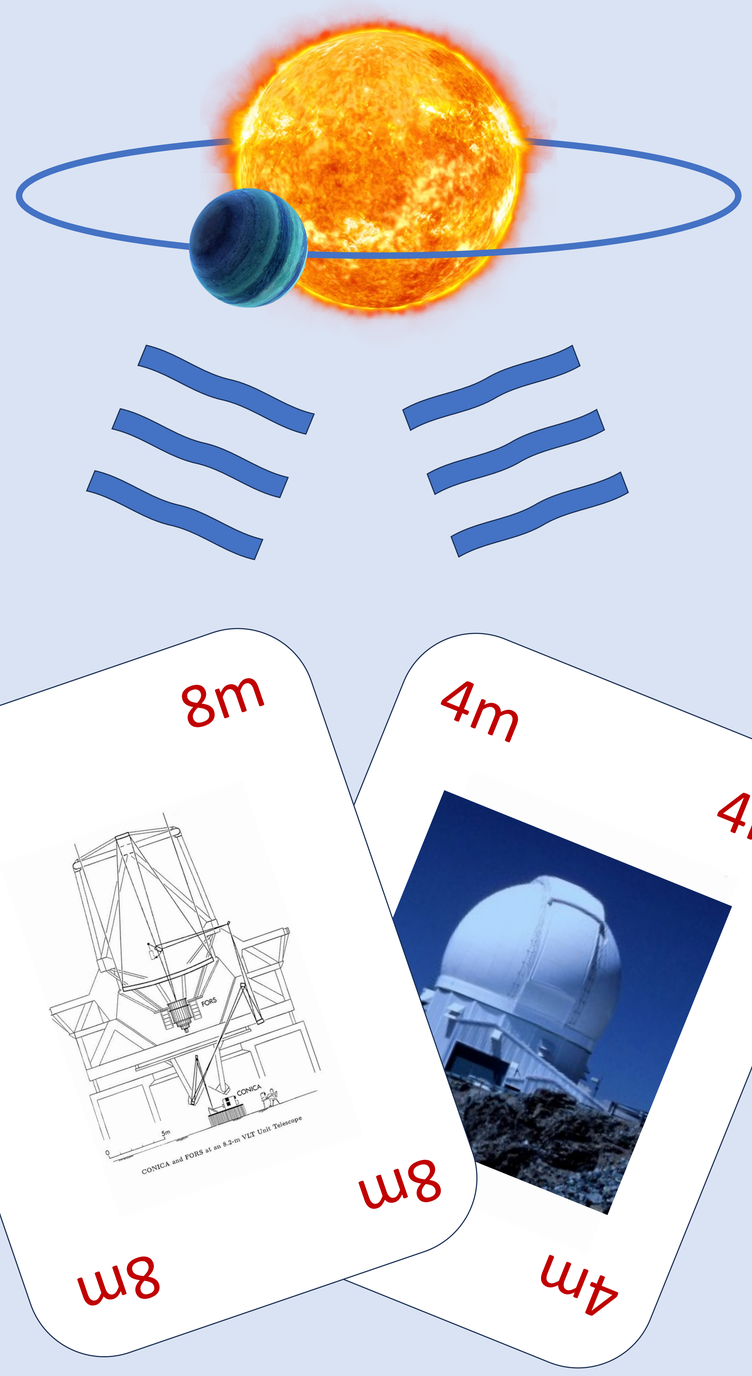
- $R_p = 1.057 \pm 0.047\ R_{Jup}$ [1]
- $M_p = 0.26 \pm 0.017\ M_{Jup}$
- $T_p = 963K$

WASP-69 b's short orbit (<0.05AU) and puffy atmosphere make it a good target for transmission spectroscopy. Previous observations have detected Na and an extended helium atmosphere with a possible evaporation tail [3-5]. They have also observed slopes in the spectrum that indicate the presence of aerosols [6-8]. Infrared observations have detected H2O, CO, CO_2 CH4, NH3 and C2H2 [9,10].



SAGE Activity

WASP-69 is an active K star, which means activity from spots and plages can introduce false trends and signatures into the planet transmission spectrum [11]. We do simultaneous retrievals with the planet atmosphere and the **S**tellar **A**ctivity **G**rid for **E**xoplanets (**SAGE**) code. We find **31±15% spot coverage** and **19±8% plage coverage**. This is more precise and consistent with the activity only fits done to the SOAR data and to another transit the year before [2,6,8].



VLT/FORS2

- Paranal
- 8m telescope
- 512– 845 nm (RI grism)
- 229 spectra
- 15s exposure time
- 33 bins
- 15 nm resolution

Three transits were observed with VLT/FORS2 in July and August of 2017, covering a full wavelength range of 330 – 1100 nm. These observations were part of the CHEWIE programme.

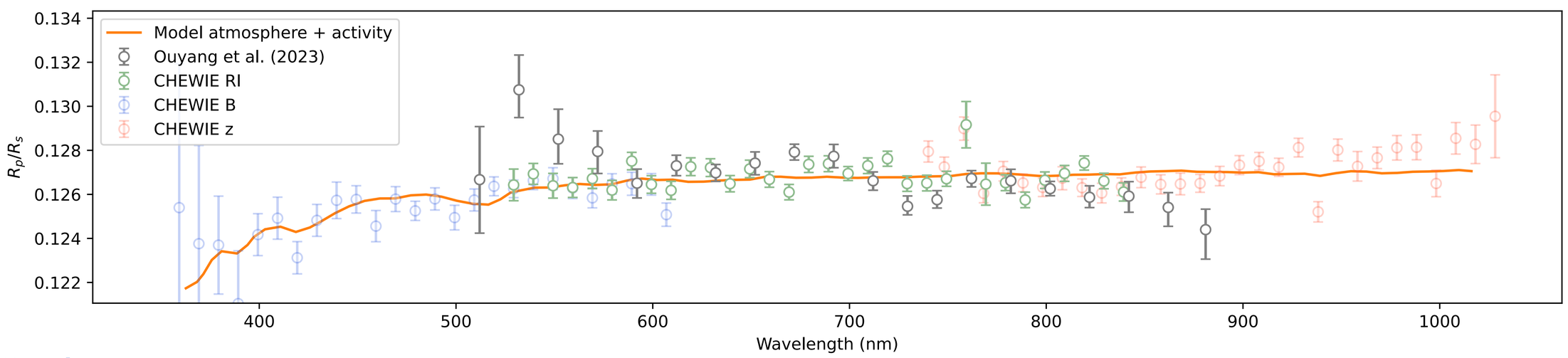
SOAR/GHTS [2]

- Páchon (800km south of VLT)
- 4m telescope
- 500 – 905 nm
- 290 spectra
- 30-50s exposure time
- 20 bins
- 20 nm resolution

Two transits were observed with SOAR/GHTS in July of 2017 in the same mode.

CHEWIE

The **C**louds, **H**azes and **E**lements vie**W**ed **I**n **E**xoplanets (**CHEWIE**) survey covers 11 hot, close-in planets and aims to characterize their atmosphere in order to determine the impact of temperature on the planet atmospheric properties. WASP-69 b will be compared specifically to WASP-94Ab, a planet with similar size and mass and orbital period, but with a significantly higher temperature.



Results

While the spectra are generally in good agreement in the middle of the wavelength range, we do not retrieve the slope that is seen in the Ouyang et al. (2023) results, emphasizing the need for understanding instrumental and data analysis effects. Instead, extending the wavelength range with additional transmission spectra taken less than a month later, our data show strong signs of plage contamination. We also find that the bumps seen in both spectra are not entirely consistent, indicating some kind of correlated noise rather than spectral features. Our retrievals **do not detect TiO** and find a **flat planetary contribution** and constraints on the Na and K abundances: $\mathbf{\log(Na) = -6.8 \pm 2.1}$ **and** $\mathbf{\log(K) < -3.8}$ (3σ).

References

1. Anderson et al., 2014, MNRAS, 445, 1114
2. Ouyang et al., 2023, MNRAS, 521, 5860
3. Casasayas-Barris et al., 2017, A&A, 608, A135
4. Nortman et al., 2018, Science, 362, 6421
5. Vissapragada et al., 2020, ApJ, 159, 6, 278
6. Murgas et al. , 2020, A&A, 641, A158
7. Khalafinejad et al., 2021, A&A, 656, A142
4. Estrela et al., 2021, ApJ, 162, 3, 91
5. Guilluy et al. 2022, A&A, 665, A104
6. Schlawin et al. 2024, AAS, 56, 2
3. Rackham et al. , 2018, ApJ, 853, 2, 122

We acknowledge support of the Swiss National Science Foundation under grant number PCEFP2_194576. This work has been carried out within the framework of the NCCR PlanetS supported by the Swiss National Science Foundation under grant and 51NF40_205606