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WASP-12b and 4b: closing in on compositions of highly-irradiated exoplanet atmospheres

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Abstract

We present an analysis of the atmospheres of the exoplanets WASP-12b [2] and WASP-4b [4], using new data obtained from the WFC-3 instrument on the *Hubble Space Telescope*, in a previously sparsely-sampled wavelength range of 1.3 – 1.7 μm. The highly-irradiated atmospheres, located in the star-planet crossover regime for temperature, along with a possible high C/O ratio, make these intriguing candidates for studies of atmospheric composition and dynamics; we use a line-by-line radiative transfer model to fit the transmission spectrum in this wavelength range, and retrieve the atmospheric compositions and molecular abundances. We find that both planets exhibit some features more characteristic of atmospheres of late M-and L-dwarfs rather than of other exoplanets, and compare our results with theoretical predictions for such highly-irradiated hot-Jupiter atmospheres.

1. Introduction

3. Figures

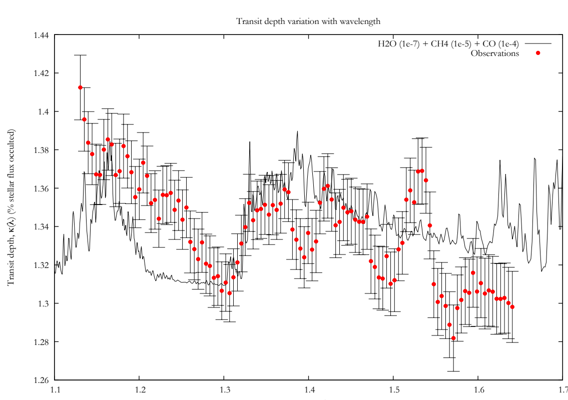

Figure 1: The best-fitting transmission spectrum using an $H_2O/CH_4/CO$ composition.

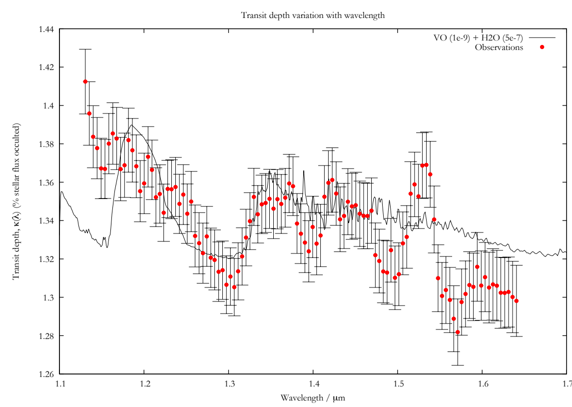

Figure 2: The best-fitting transmission spectrum using a VO/H_2O composition.

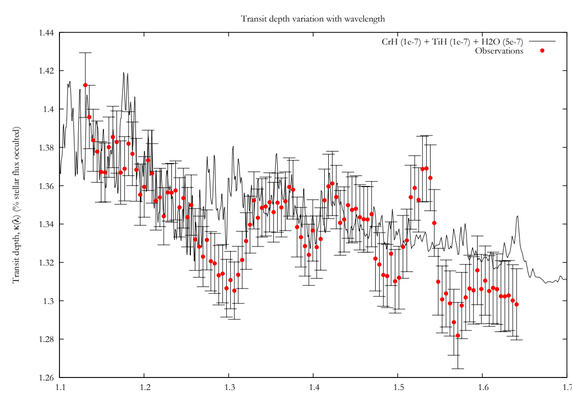

Figure 3: The best-fitting transmission spectrum using a $CrH/TiH/H_2O$ composition.

4. Tables

5. Equations

6. Summary and Conclusions

Presented here are transmission spectra for the hot exoplanets WASP-12b and WASP-4b. We find that for WASP-12b in particular, its to the new data using a standard chemical composition of predominantly hydrogen with molecular water and methane features are not particularly good; however better, or certainly equally good, fits are possible using either vanadium oxide and water, or combinations of metal hydrides (e.g. chromium and titanium) with some water. The preferred solution is a mixture of chromium hydride, titanium hydride and water, since this is the only combination able to additionally reproduce emission spectra for the dayside.

Metal oxides and hydrides are theorised to be present in low-mass stellar atmospheres, hence their presence also in the extreme atmospheres of the planets in this study may not be surprising. Their detection in these planet/star crossover regimes may imply a variety of different atmospheric characterisation scenarios, such as a possible low solar metallicity [1], or suppression of titanium oxide formation due to a high C/O ratio [3]. Further studies are required in order to resolve the degeneracy between these and other possible scenarios.

Acknowledgements

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References

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