Hydrodynamic atmospheric escape in the benchmark ultra-hot Jupiter WASP-76 b

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Abstract. Hydrodynamic atmospheric escape driven by X-rays and extreme-UV irradiation is thought to be one of the key determining factors of the demographics in short-period exoplanets. In this context, ultra-hot Jupiters (UHJ) are the best targets to study hydrodynamic escape because they have detectable signals of exospheric metals in transmission spectroscopy. These signatures can only be observed by the Hubble Space Telescope (HST) in the ultraviolet. The UHJ WASP-76 b has been the subject of extensive studies since it was found due to its extreme conditions. We present the transmission spectrum of WASP-76b obtained with HST/STIS E230M. Our spectra cover a range of 2275-3119Å, which gives us access to resonant lines that trace hydrodynamic escape, as well as other lines of cloud-precursor species.

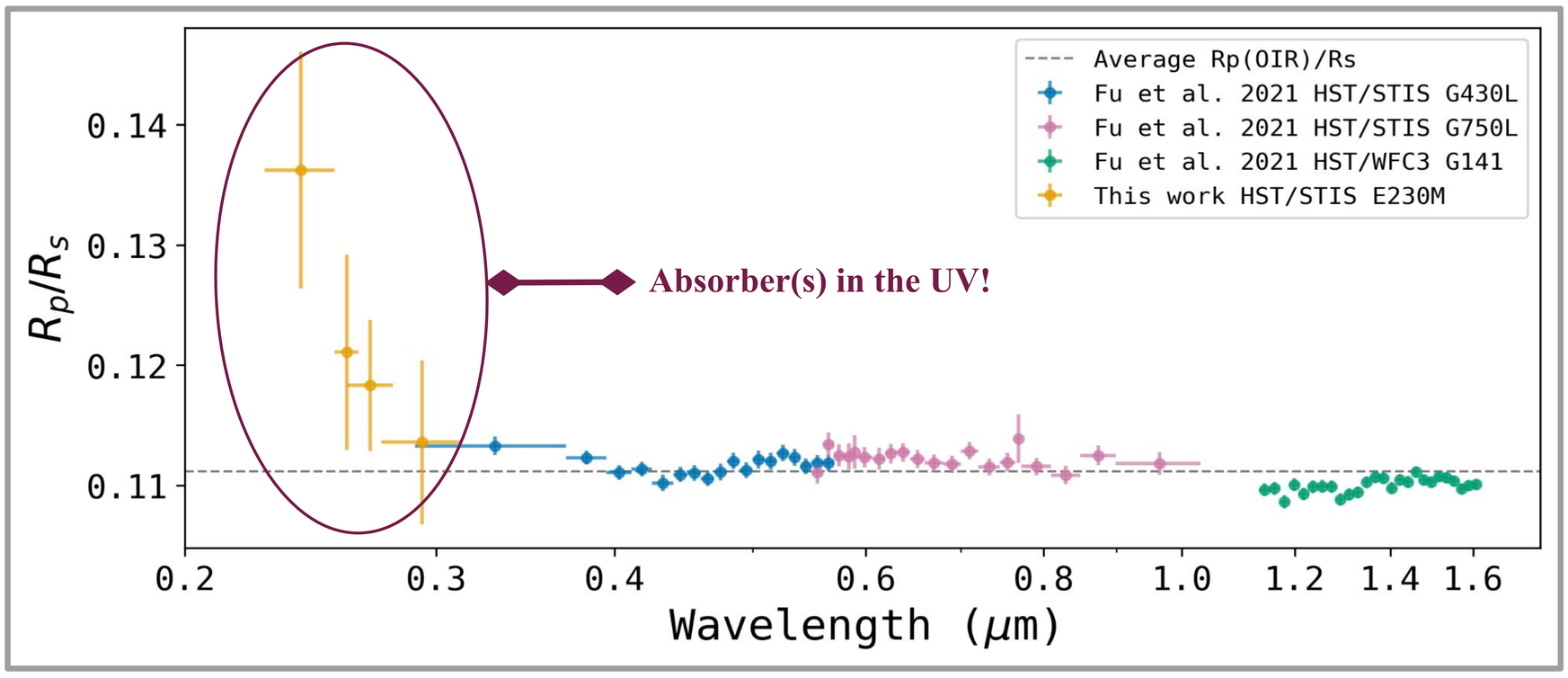

Figure 2. WASP-76b's preliminary transmission spectrum. The NUV values come from analysis of one visit using HST/STIS E230M (yellow). The optical and NIR values come from the analysis of [2] (blue, pink and green).

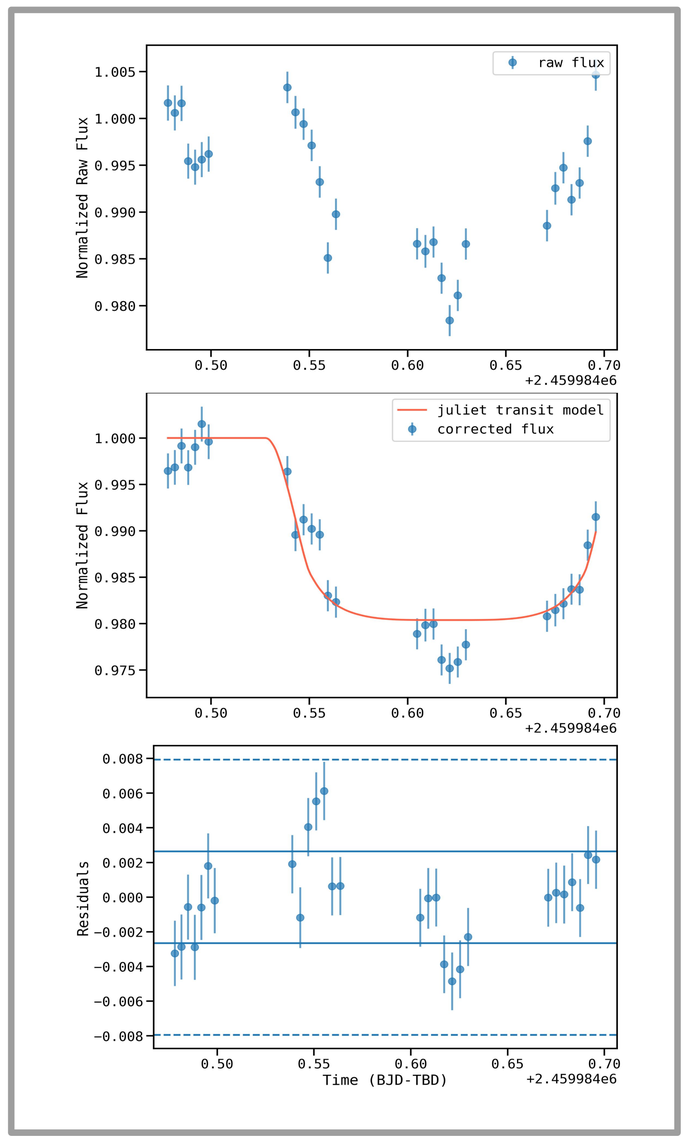

Figure 1. Raw and corrected transit light curve of WASP-76b.

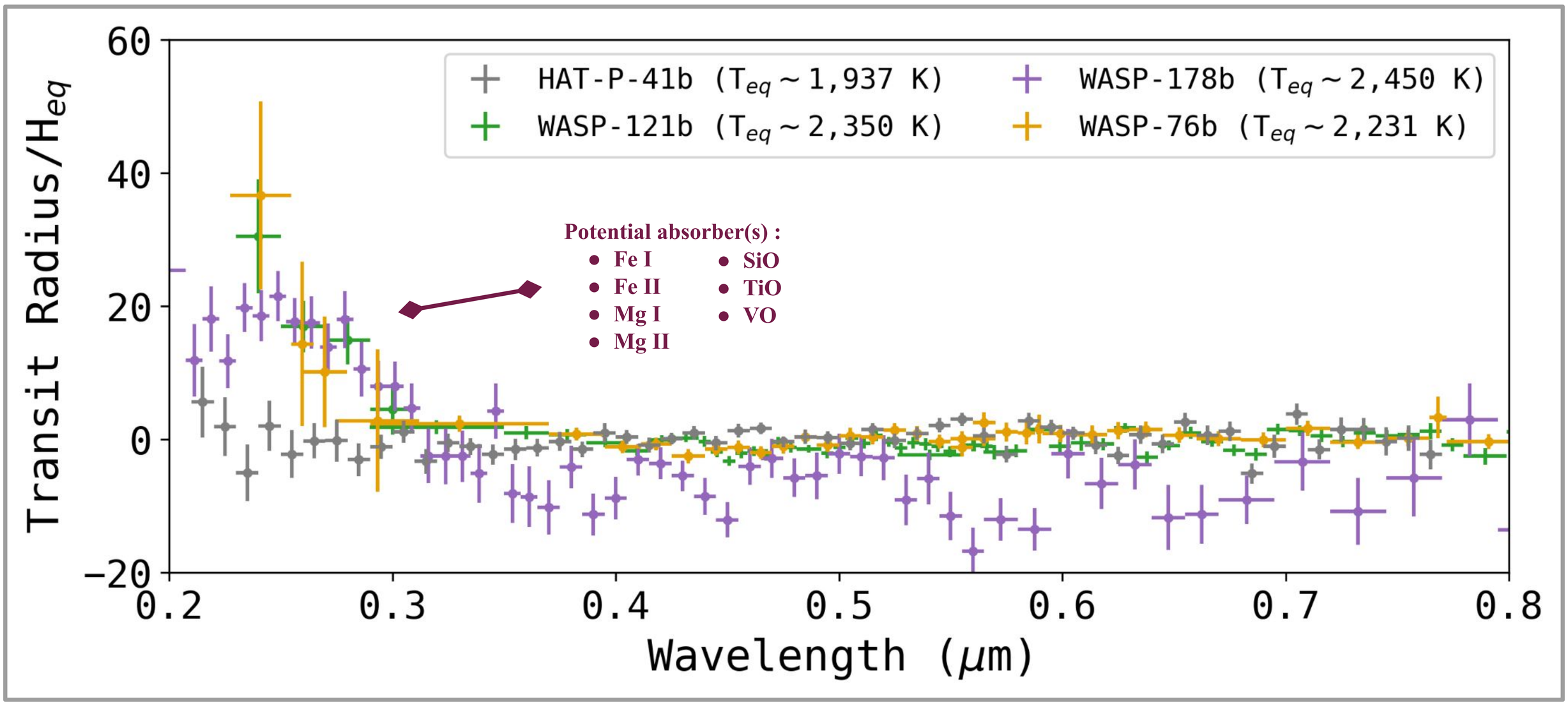

Figure 3. Comparison of four UHJs NUV-Optical transmission spectra. HST/STIS E230M transmission spectrum of WASP-76b compared to the UV and optical spectra [2] of similar giant planets WASP-178b [3] , WASP-121b [1,4] and HAT-P-41b [5] , normalized by each planet's equilibrium temperature scale height. This plot follows the format of Fig. 2 in [3].

Takeaways:

- WASP-76b's transmission spectrum in the UV looks very similar to WASP-121b's and WASP-178b's.
- Species such as Mg II, Fe II and SiO are important opacity sources in these UHJ.
- Potential absorbers in the atmosphere of WASP-76b include Fe I, Fe II, Mg I, Mg II, SiO, TiO, and VO.
- WASP-76b's absorption in the UV is comparable to, or greater than, WASP-121b's, which shows the largest UV absorption depth.
- This planet provides an opportunity to gain deeper insights into the condensation process in exoplanetary atmospheres.

References

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