A helium exosphere was recently detected around the exoplanet WASP-107b, a low-density, warm Neptune (Spake et al. 2018), based on absorption features from metastable helium at 10833 Å (predicted by Seager & Sasselov 2000; Oklopčić & Hirata 2018). The helium feature provides a new probe of atmospheric escape that is advantageous in several ways: (1) it is observable with near-infrared facilities (in contrast to other signposts of atmospheric escape that appear in the ultraviolet) and (2) it is minimally affected by interstellar absorption, thus opening the door to studying atmospheric escape in a greater number of systems.

Inspired by the WASP-107b detection, we searched archival HST observations of another evaporating exoplanet, WASP-12b, for signs of a helium exosphere. WASP-12b is a promising candidate for this search: it is one of the hottest known hot Jupiters ($T_{\rm eq}$ = 2500 K; Hebb et al. 2009). At this level of intense irradiation, theory predicts a high rate of escaping atoms and molecules from the planet's atmosphere, and indeed, transit observations in the ultraviolet have revealed a patchy cloud of escaping material (Nichols et al. 2015).

For this Note, we reanalyzed three transits of WASP-12b observed with the Hubble Space Telescope/Wide Field Camera 3 G102 grism (originally published in Kreidberg et al. 2015). In our analysis, we used the same methodology as Kreidberg et al. (2015), except with different spectral binning to include a narrow band (70 Å, the spectrograph's native resolution) centered on the He feature, with two wider bands at adjacent wavelengths. The transmission spectrum (shown in Figure 1) is consistent with that reported in Kreidberg et al. (2015) and shows no evidence for variability between epochs. Surprisingly, there is no significant increase in transit depth at 10833 Å.

To estimate the expected absorption signal of WASP-12b at 10833 Å, we used the theoretical model described in Oklopčić & Hirata (2018). In this 1D model, we assumed the thermosphere of the planet is composed of atomic hydrogen and helium in 9:1 number ratio. For the thermospheric density and velocity profiles we adopted the isothermal Parker wind model, assuming the gas temperature of $T = 10^4$ K and the total atmospheric mass loss rate of $4 \times 10^{11}$ g s$^{-1}$ (based on the results of hydrodynamic simulations of atmospheric escape in WASP-12b by Salz et al. 2016). We used the solar irradiance spectrum as the input spectrum. We considered two cases: one that includes all the evaporating gas predicted from the Parker wind model (Model A), and the other that only includes gas within the planet's Roche radius (Model B), to account for the possibility of dissipation of gas as it escapes the planet's gravitational influence.

Model A predicts an equivalent width for the helium feature of 0.056 Å, which is ruled out by the observed spectrum at 5.2$\sigma$ confidence (see Figure 1). By contrast, Model B predicts a smaller equivalent width (0.003Å) that is consistent with the data, suggesting rapid dissipation of the gas cloud. In addition, another possible explanation for the absence of a large helium feature is that WASP-12 may be faint in the EUV. The star has an unusually low activity level, which has been attributed to a shroud of material accreted from the evaporating planet (Haswell 2017). If the EUV flux is lower than that of the Sun, the population of helium in the metastable state will be relatively depleted, shrinking the amplitude of the 10833Å feature.

In conclusion, we find that WASP-12b has no evidence for a helium exosphere, but the significance of the result is dependent on the assumed geometry of the evaporating gas cloud as well as the input stellar spectrum. Both of these factors should be considered in the design of future searches for helium exospheres.

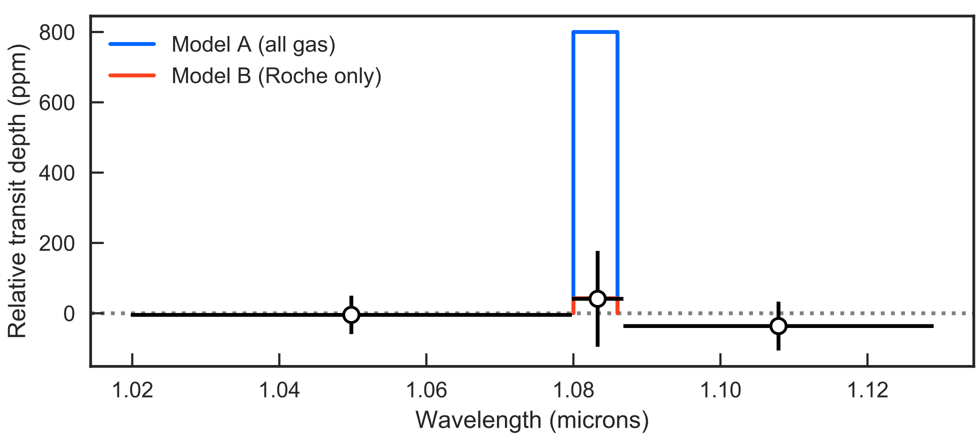


**Figure 1.** Transmission spectrum of WASP-12b, compared to model predictions for the strength of the 10833Å helium feature.

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