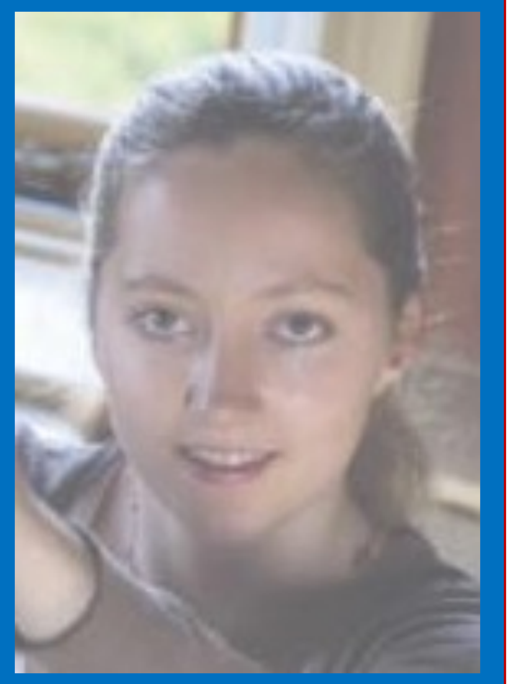
A first transmission spectrum of Wasp-15b with Gaussian Process modelling



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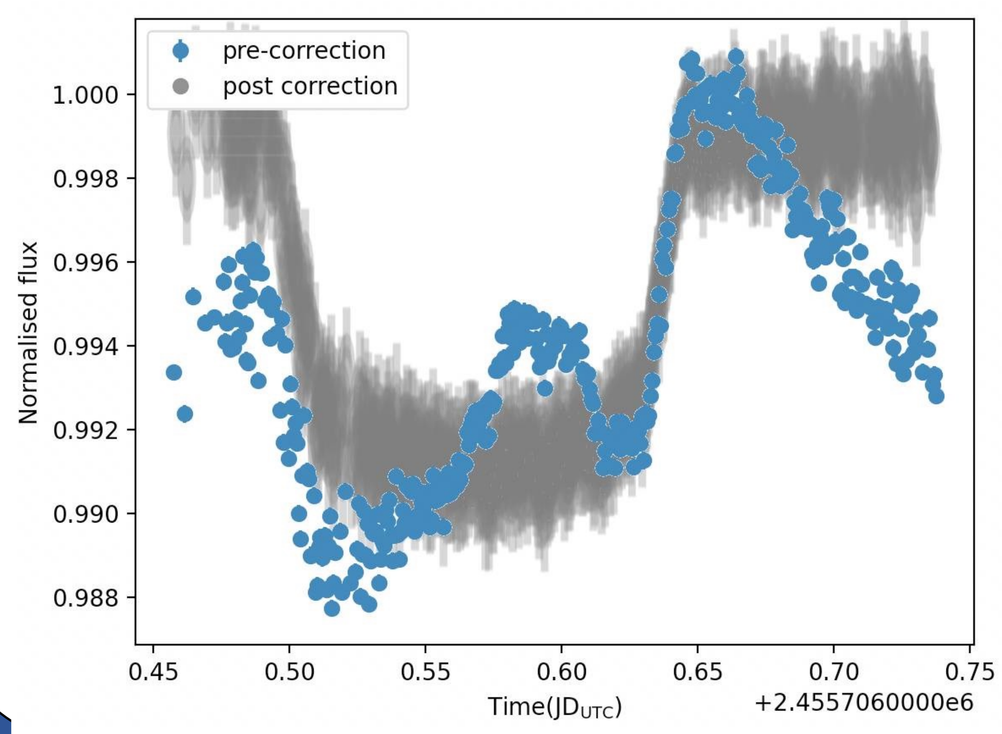
Abstract

Wasp-15 b is an inflated hot Jupiter orbiting a bright host star[1]. Its low density and consequent large atmospheric scale height make it an excellent candidate for atmospheric characterisation using transmission spectroscopy. In fact, it has previously been observed with the FORS2 spectrograph on the VLT, but large systematics have so far prevented this data from being used. Here, we show that Gaussian Process modelling can remove systematic noise features with amplitudes up to that of the transit signal, allowing us to achieve typical photometric precisions of 700-3000 ppm in 10nm wavelength bins centred at 920nm, around 1-3 times the photon noise. Our preliminary analysis indicates a featureless spectrum.



Gaussian Process regression models systematic, correlated noise by fitting a distribution of possible noise functions[2]. The uncorrected white light curve of WASP-15b shows correlated noise with an amplitude of the order of the transit depth which are reduced to the order of the photon noise after the model is subtracted.

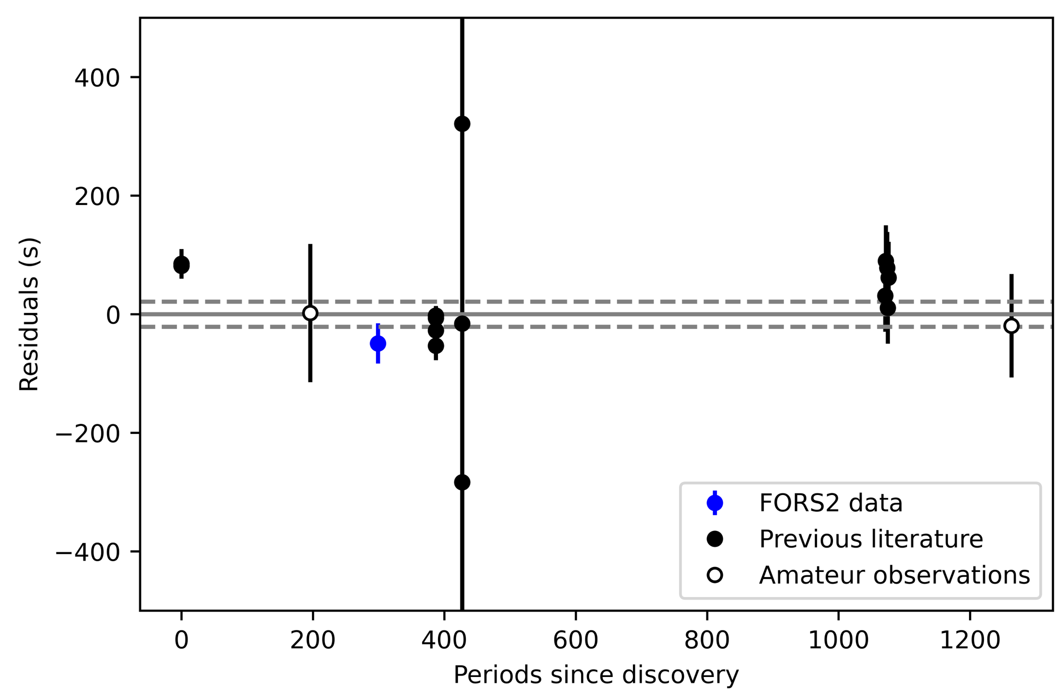
Fig 1. The white light curve before (blue) and after (gray) GP correction.

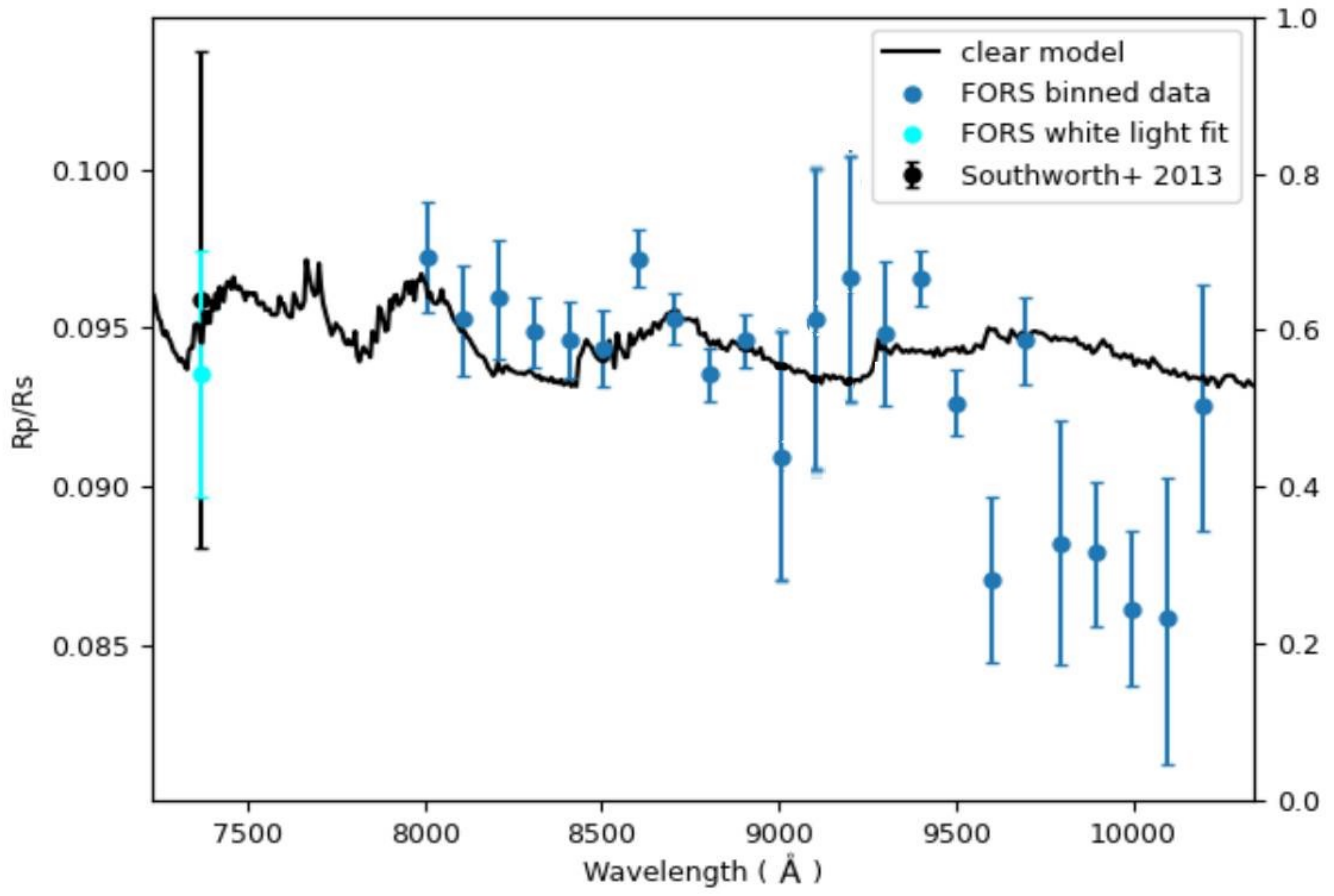
We used our and previous data to calculate a new and more precise ephemeris for the planet:

$$T_0(BJD_{TDB}) = 3.7520982(6) \cdot N + 2454584.6985(3)$$

Tension between the first observations and our ephemeris and data and the distribution of the data points could indicate transit timing variations, but further observations are required to confirm this.

Fig 2. Residuals of observations compared to the new epehemeris [1,3-6].





Correlated noise is reduced to the amplitude of the photon noise, although residuals of 2-3x that amplitude remain at the extreme wavelength ends. The decrease in flux at the red end also contributes to the large errorbars there. The scatter at 9000 Å coincides with a major water absorption band and is probably the result of tellurics. This is reflected in the errorbars.

The transmission spectrum shows no features and is consistent with both clear and cloudy atmospheres [7].

Fig 3. The transmission spectrum (blue) at a resolution of 100 Å. The white light radius (cyan) is consistent with previous measurement (black).

References

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