Investigating the atmosphere of the terrestrial exoplanet GJ1132b

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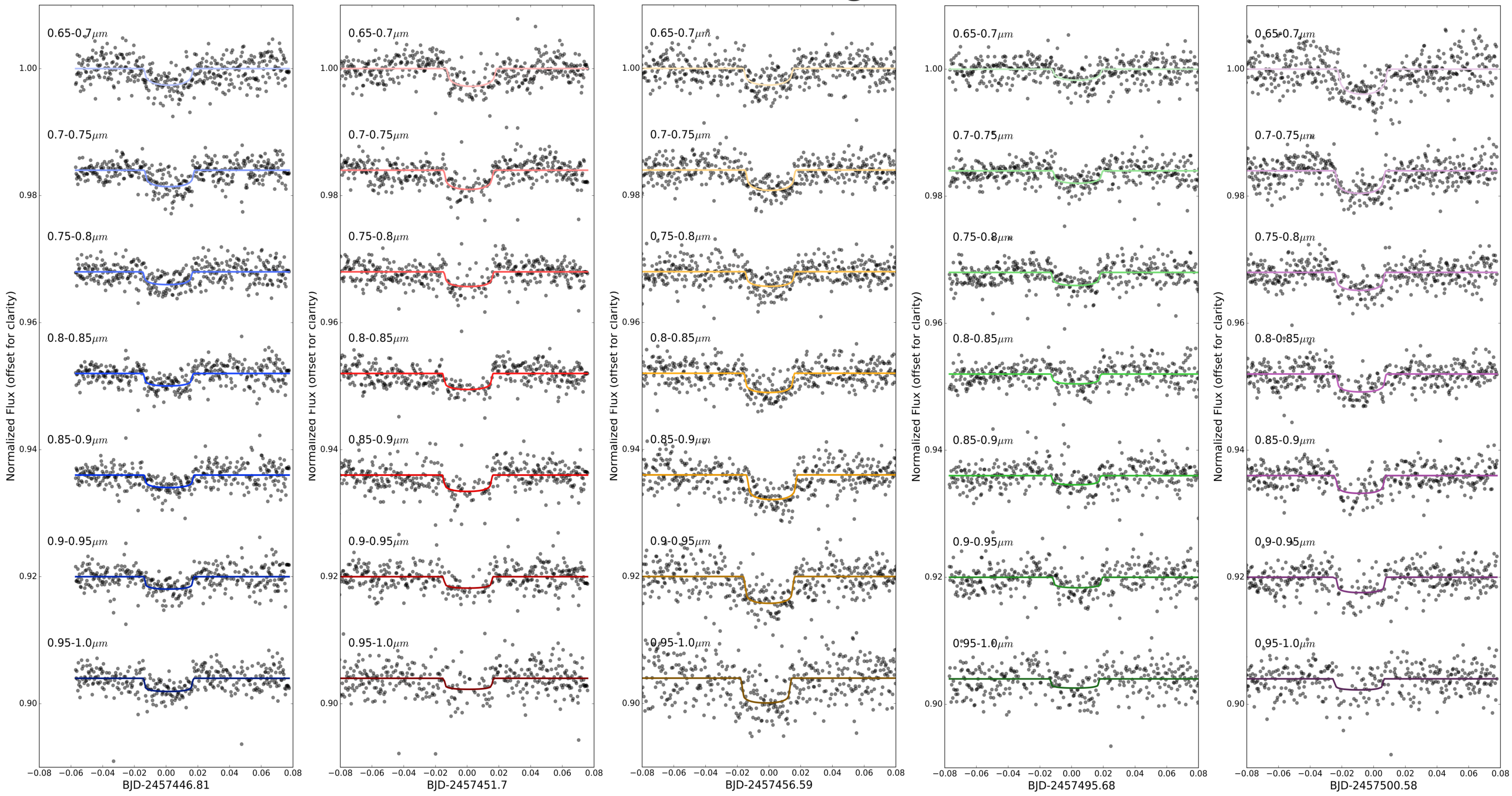
Abstract

GJ1132b is a recently discovered terrestrial exoplanet (1.2 $R_\oplus$, 1.6 $M_\oplus$) orbiting a 0.2 $R_\odot$ star 12 parsecs away (Berta-Thompson, et al. 2015). This planet provides an opportunity to investigate whether terrestrial exoplanets lose their primordial hydrogen-dominated atmospheres, as the Solar System terrestrial planets have, or if they instead maintain their hydrogen envelopes. We were awarded eight nights on the Magellan Clay Telescope with the LDSS3C multi-object spectrograph in order to observe transits of GJ1132b. We present here preliminary lightcurves from five nights when weather permitted observation, along with a preliminary transmission spectrum.

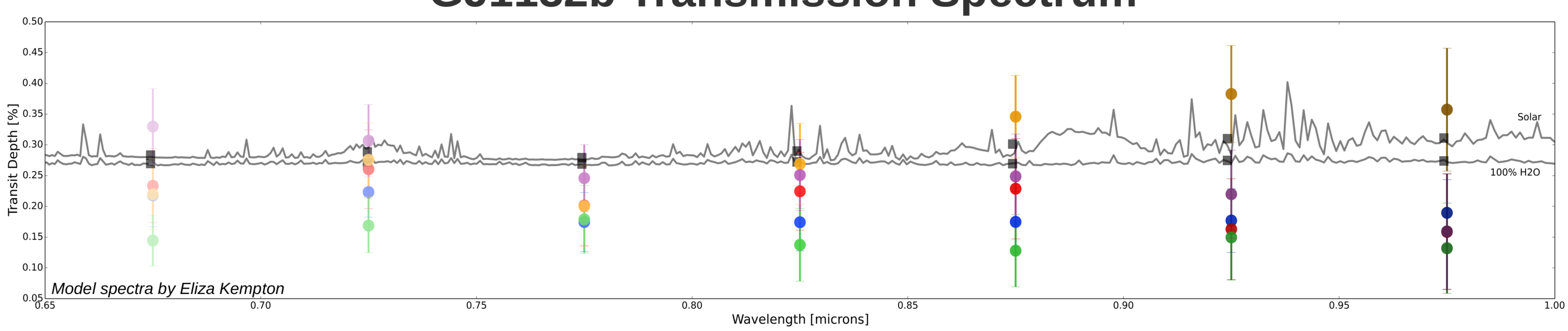
Data & Analysis

We extract our data from the raw LDSS3C images using our own pipeline (Berta-Thompson, et al., *in prep*). The usable comparison stars within the 6' LDSS3C field of view are all fainter and bluer than GJ1132. Here we present lightcurves derived from the flux of GJ1132 and a single comparison star, but we will combine the flux from up to 8 comparison stars in the final analysis. We developed an MCMC code that fits multi-wavelength lightcurves and corrects for instrument systematics simultaneously. Included in the code are the Python Limb Darkening Tool Kit (PyLDTk; Parviainen & Aigrain 2015, Huser, et al. 2013), Batman (Kreidberg 2015), and Emcee (Foreman-Mackey, et al. 2012).

GJ1132b Transit Lightcurves



GJ1132b Transmission Spectrum



Next Steps

1. Increase resolution to 0.01 μm bins to better correct for Earth's atmosphere and improve lightcurve precision
2. Combine comparison stars for each observation – more photons to correct for systematics and improve noise
3. Fit all five transit events simultaneously
4. Refine system parameters – fix transit midpoint across wavelengths for each transit
5. Perform detailed comparison to theoretical models
6. Bin data into larger wavelength bins to search for transit timing variations and exomoons

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