Real data from the discovery paper for potential exoplanet KELT-1b

The host star (from analysis of its spectrum) is estimated to have a radius of R = 1.47 R_{sun} and a mass of M = 1.34 M_{sun}.

Here are the radial velocity (Doppler shift) measurements of the host star. The x-axis has units of days. The bottom panel shows the "observed minus computed" values; these are residuals of the model fit to the data. The fact that they're close to zero and have no systematic pattern is an indication that the fit is good.

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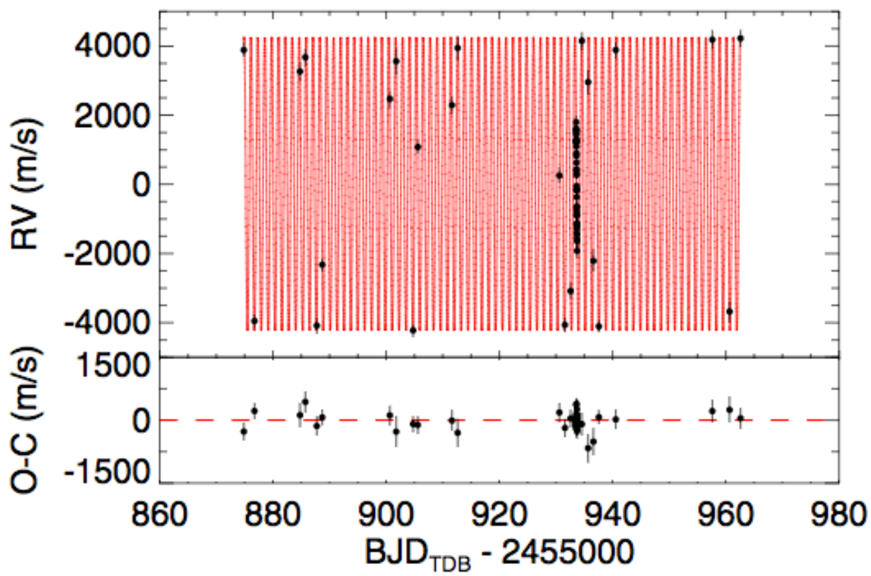

Figure 2. Top panel: the points with uncertainties show the measured RVs for KELT-1 as a function of time in BJD_{TDB}. The barycentric velocity of the system, as determined from the model fit shown in the solid line (see Section 5.2), has been subtracted from the data. Bottom panel: the residuals from the model fit.

(A color version of this figure is available in the online journal.)

The fit to the RV data provides a velocity semi-amplitude (what the textbook calls $v_A \sin i$) and the orbital period (1.22 days).

This "time series" plot can be folded on the derived period to produce the plot on the next page. It's the exact same data, but instead of time on the x-axis, the phase of the orbital period is on the x-axis. By convention, phase = 0.0 is when the exoplanet – host star – earth angle is 90 degrees, with the planet moving toward the Earth.

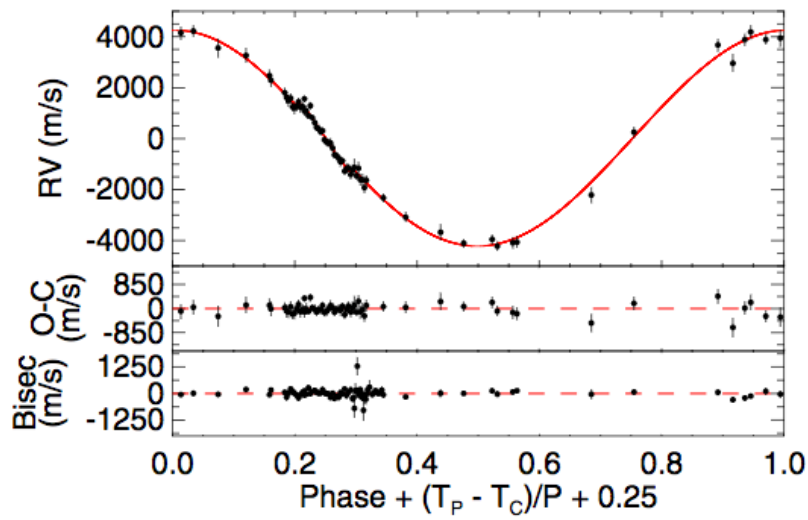

Figure 3. Points with uncertainties show the measured RVs for KELT-1 relative to the barycentric velocity of the system, phased to the best-fit period as determined from the model fit shown in the solid line (see Section 5.2). The phases are normally referenced to the time of periastron (T_P), but have been shifted such that a phase of 0.25 corresponds to the time of inferior conjunction T_C or transit. RV data near this phase show deviations from the Keplerian expectation due to the RM effect, which was included in the model. Middle panel: the residuals of the RV data from the model fit. Bottom panel: bisector spans as a function of phase.

Note that positive velocities are red-shifts and negative velocities are blue-shifts. Given the definition of phase 0.0 given at the bottom of the previous page, **does it makes sense that this phased radial velocity curve has its *maximum* at phase 0?**

Talk to the person sitting next to you and try to convince them that this is right.

At what phase does the transit occur? (You might consult Fig. 12.5 in the textbook.)

Here are the several transit light curves (note that the top one was taken by us, with the telescope on the roof):

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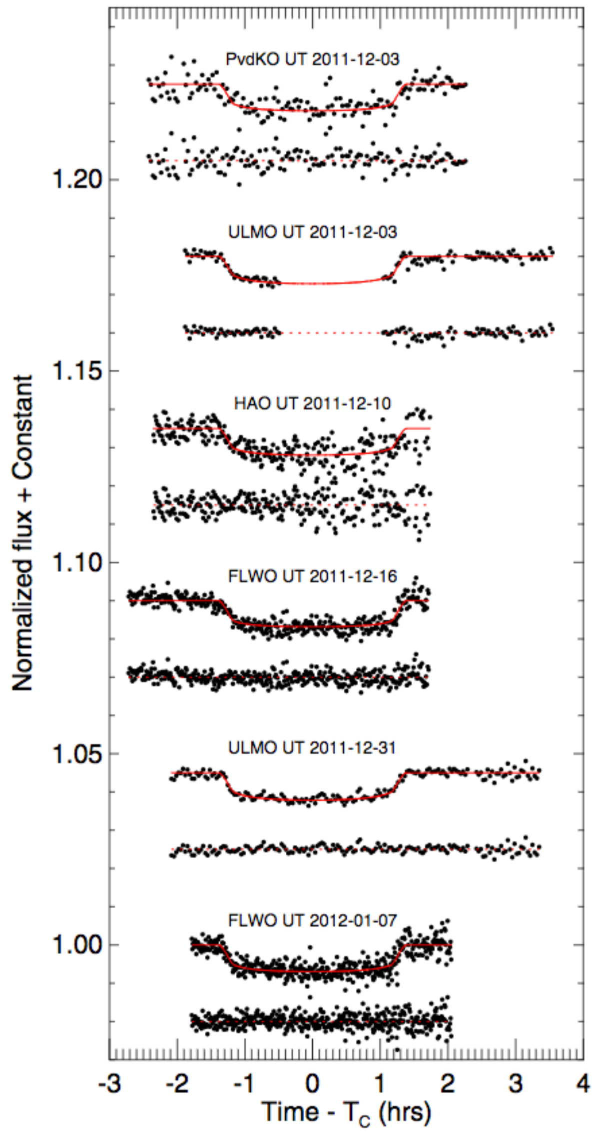

Figure 5. Points show the relative flux as a function of time from transit (T_C) for the six sets of follow-up observations of transits we analyze here. The data sets are labeled and summarized in Table 2. The data are normalized by the fitted out-of-transit flux, and a linear trend with air mass has been removed (see Section 5.2). In addition, an arbitrary offset has been applied to each light curve for clarity. For each observation, we plot the data above and the residuals below. In all cases, the solid lines show the model fit from the analysis in Section 5.2.

Measure/estimate the transit depth (use a ruler), and measure the velocity semi-amplitude from the plot on the previous page and answer the questions on the next page.

What is the transit depth (a unitless ratio that the textbook calls delta-F/F)?

What is the radius of KELT1b in meters and in Jupiter radii?

What is the mass of KELT1b?

Is KELT1b a planet, a brown dwarf, or a star?

What is the density of KELT1b?