# IMPROVING TRANSIT PREDICTIONS OF KNOWN EXOPLANETS WITH TERMS

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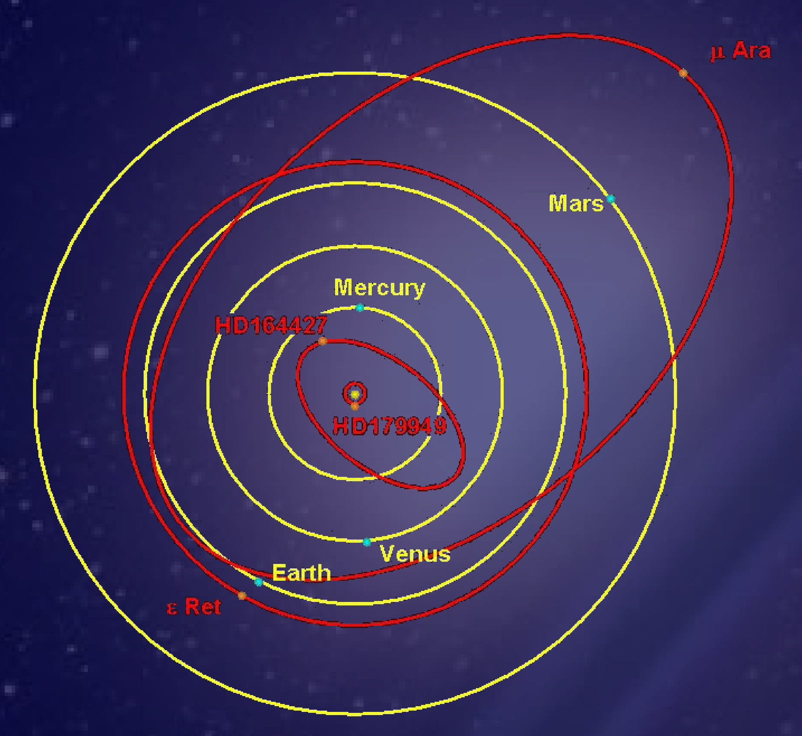
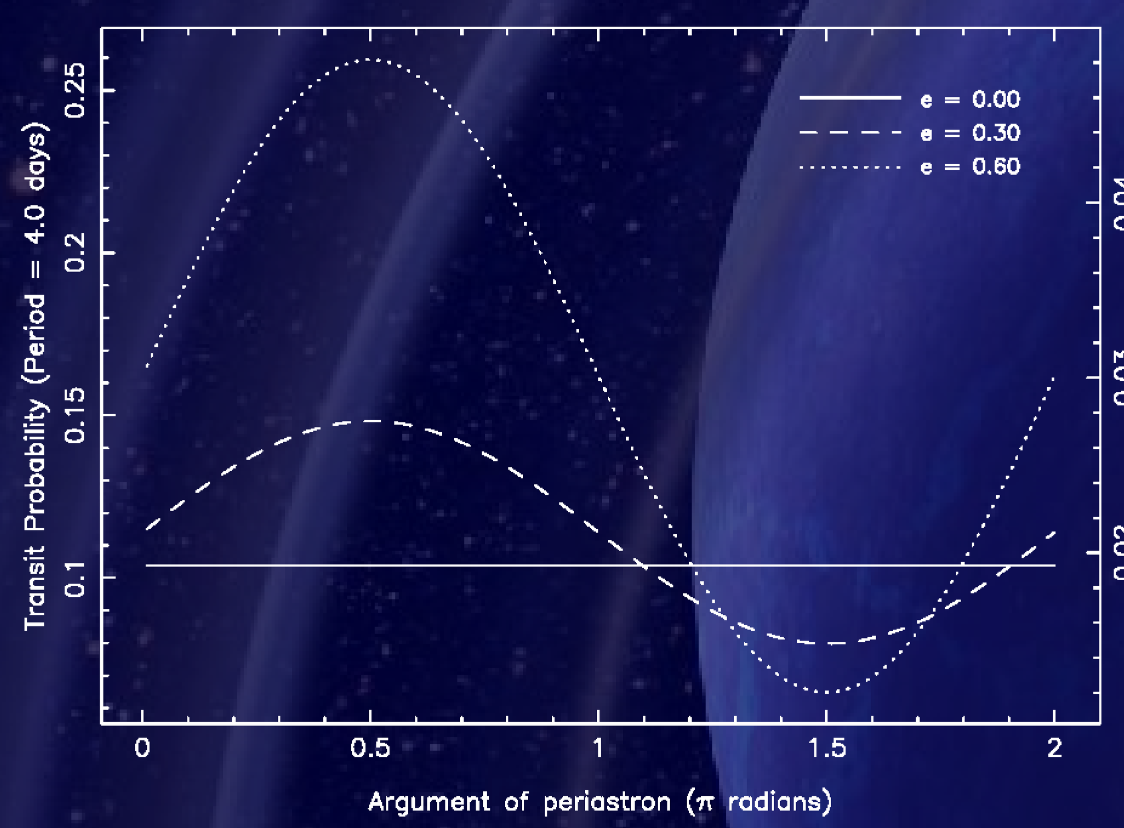
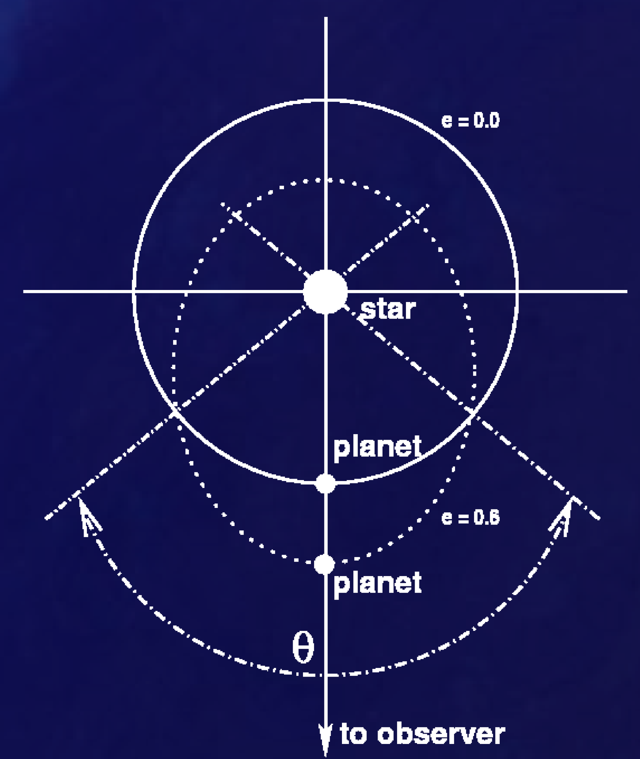



Monitoring known radial velocity planets at predicted transit times, particularly those planets in relatively eccentric orbits, presents an avenue through which to explore the mass-radius relationship of exoplanets around bright host stars. Here we describe techniques for refining ephemerides and performing follow-up observations. These methods are used by the Transit Ephemeris Refinement and Monitoring Survey (TERMS).

## Transit Probabilities

Here we briefly show the combined effect of the eccentricity and the argument of periastron on the primary transit probability. This is described in detail by Kane & von Braun (2008) and Kane & von Braun (2009).



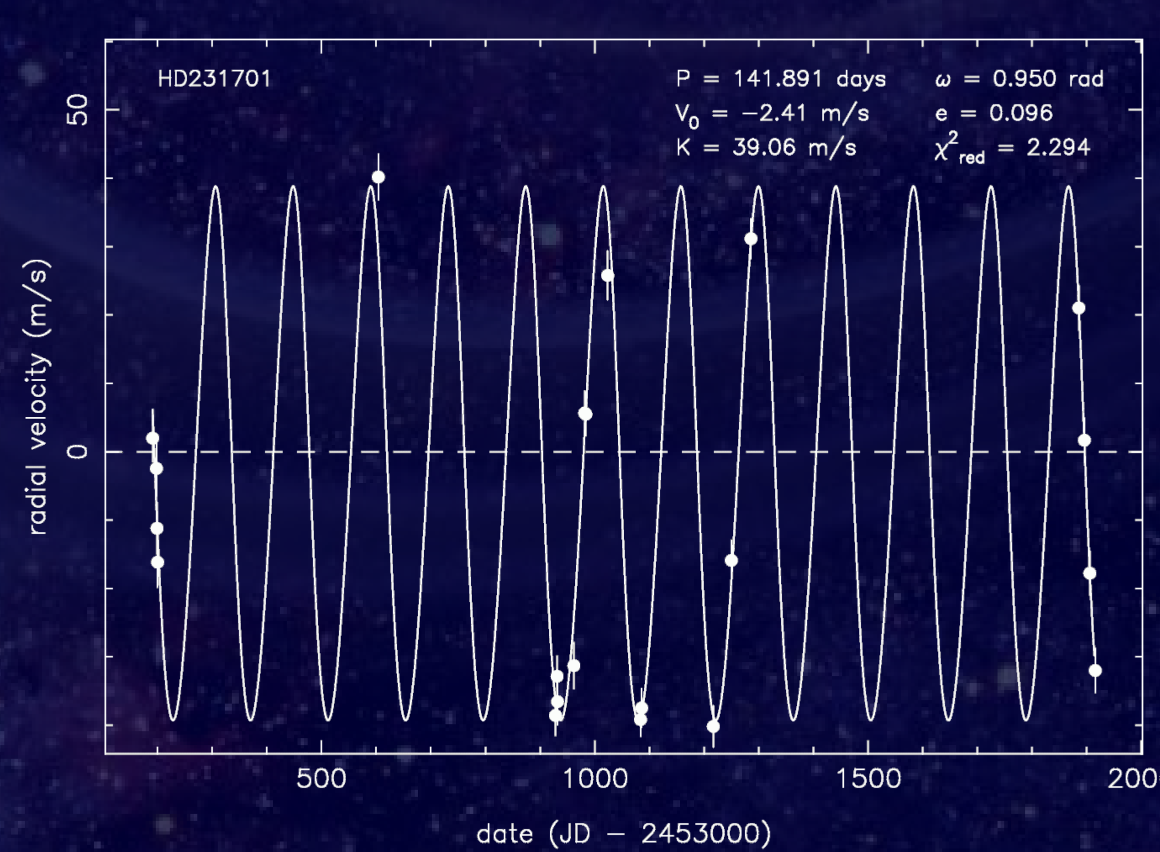




The above-left figure shows the effect upon the primary transit probability as we rotate the semi-major axis around the star for eccentricities of 0.0, 0.3, and 0.6. The angle θ in the above-right figure corresponds to the range of ω for which the elliptical probability is less than for a circular orbit (θ = 105° in this case). The eccentricity of long-period planets can raise their likelihood of transiting to a statistically viable number for detection.

## Refining the Ephemerides

The transit ephemeris for a particular planet can often be significantly improved with the addition of a handful of high-precision radial velocity data. For example, the planet orbiting the star HD 231701, discovered by Fischer et al (2007), has a current transit window of ~82 days based upon the discovery data.

The addition of four subsequent measurements (as shown in this figure) would improve both the precision of the period and time of periastron passage, resulting in a reduction of the transit window to 3.7 days - a factor of almost 25! Through selective observations at optimal times, we produce viable targets for photometric follow-up.

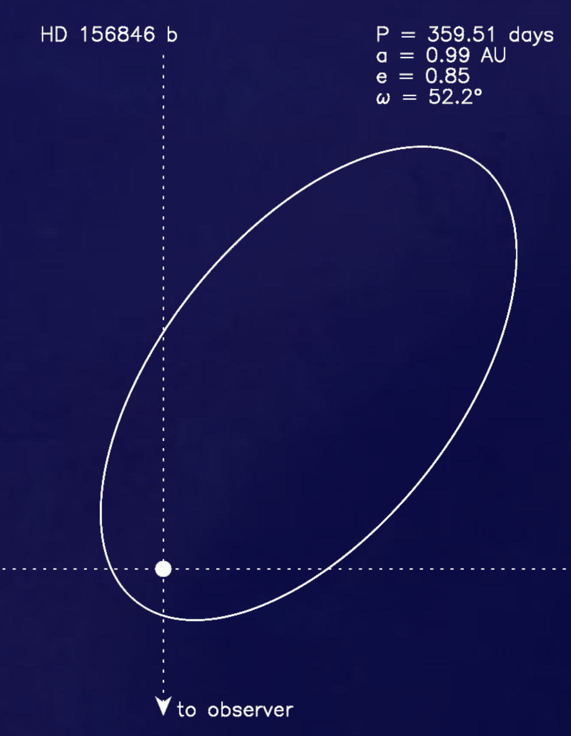


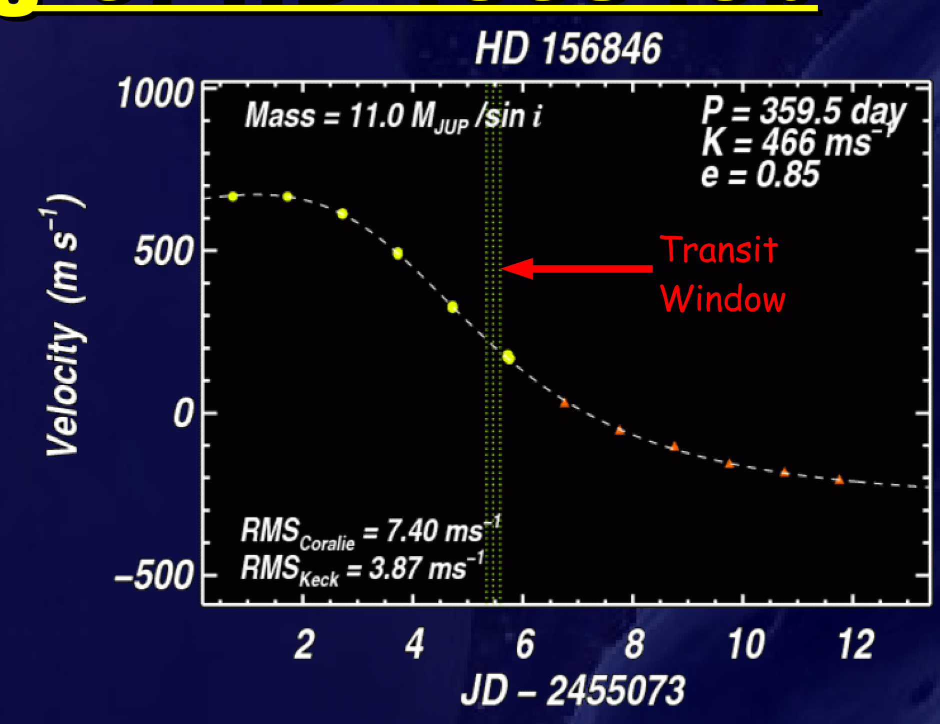

## TERMS Telescopes

Due to the wide range of stars monitored, both in sky location and brightness, TERMS collaborates with a variety of existing groups to take advantage of transit window opportunities. Telescopes used include:

- CTIO 0.9m
- CTIO 1.0m (pictured - top)
- LCO 1.0m
- Keck/HIRES (pictured - bottom)
- APT 0.8m (Fairborn Observatory)
- UCO/Lick 3.0m
- Hobby-Eberly Telescope
- Peter van de Kamp Observatory 0.6m

## Monitoring of HD 156846b

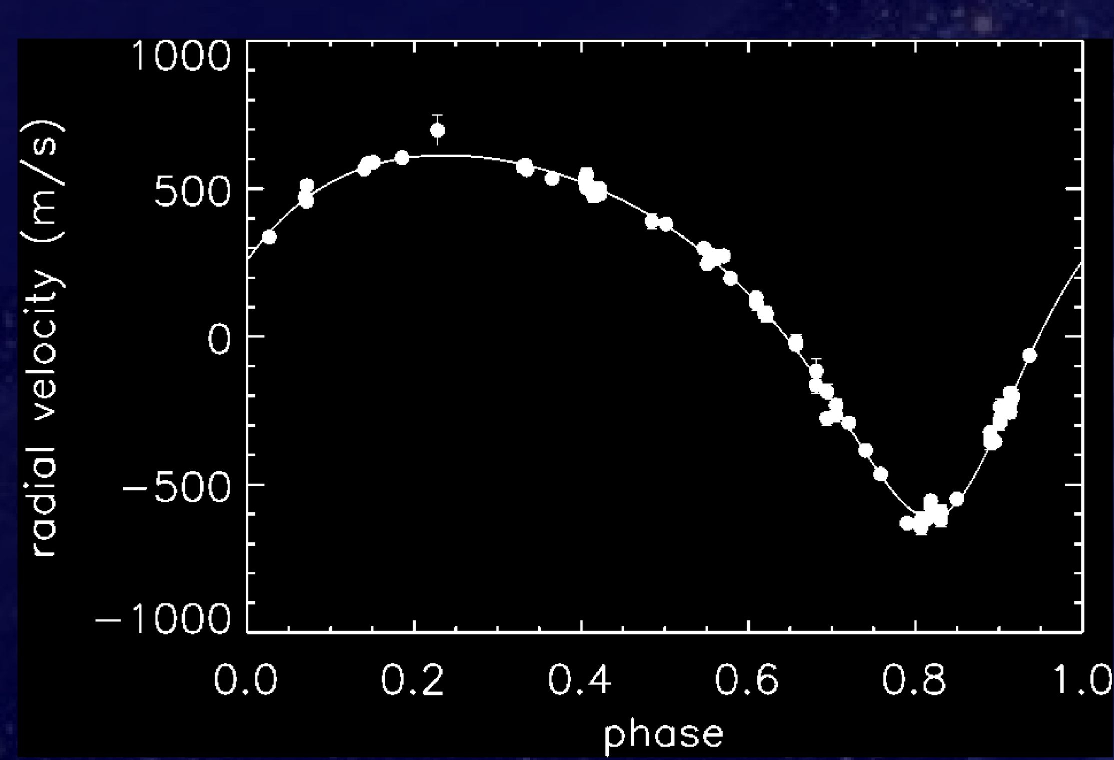



An example TERMS target is the host star HD 156846 (Kane et al. 2011) whose planet is in a 359 day period, highly eccentric orbit (shown above). New Keck data combined with the CORALIE discovery data (Tamuz et al. 2008) produced an uncertainty in the transit mid-point of only 20 minutes!

Next predicted transit mid-point:
JD 2455797.59 2011/08/24 02:12 UT

## No Transit for HD 114762b




The planet HD 114762b was recently analysed using TERMS data which creates a RV baseline of 19 years (Lick) and a photometric baseline of 23 years (APT). The revised data and Keplerian orbital solution are shown in this figure. The RV and photometric data rule out additional companions in the system and also rule out transits > 1 millimag.

## References

- Fischer, D.A., et al., 2007, ApJ, 669, 1336
- Kane, S.R., von Braun, K., 2008, ApJ, 689, 492
- Kane, S.R., von Braun, K., 2009, PASP, 121, 1096
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- Tamuz et al., et al., 2008, A&A, 480, L33