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First Results from the Transit Ephemeris Refinement and Monitoring Survey (TERMS)

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Abstract. Transiting planet discoveries have yielded a plethora of information towards understanding the structure and atmospheres of extra-solar planets. These discoveries have been restricted to the short-period or low-periastron distance regimes due to the bias inherent in the geometric transit probability. Through the refinement of planetary orbital parmaters, and hence reducing the size of transit windows, long-period planets become feasible targets for photometric follow-up. Here we describe the TERMS project which is monitoring these host stars at predicted transit times.

1. Introduction

Monitoring known radial velocity planets at predicted transit times presents an avenue through which to explore the mass-radius relationship of exoplanets into regions of period/periastron space beyond that which is currently encompassed (Kane 2007). This is particularly true for those planets in relatively eccentric orbits (Kane & von Braun 2008, 2009), as demonstrated by the variation in transit probability with the argument of periastron (see Figure 1, left). Here we describe techniques for refining ephemerides and performing follow-up observations (Kane et al. 2009). These methods are being employed by the Transit Ephemeris Refinement and Monitoring Survey (TERMS).

2. Transit Ephemerides

The transit window as described here is defined as a specific time period during which a complete transit (including ingress and egress) could occur for a specified planet. The size of a transit window depends upon the uncertainties in the fit parameters. They also deteriorate over time, motivating follow-up of the transit window as soon as possible after discovery. Figure 1 (right) shows the size of the first transit window (after the fit time of periastron passage, t_p) for a sample

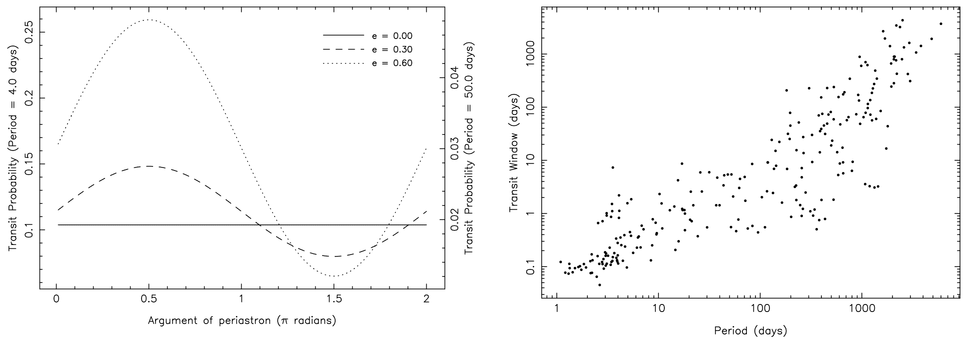

Figure 1. *Left:* Dependence of geometric transit probability on the argument of periastron for eccentricities of 0.0, 0.3, and 0.6, plotted for periods of 4.0 days (left axis) and 50.0 days (right axis). *Right:* Ephemeris calculations for a sample of 245 exoplanets, showing the dependence of transit window size on period.

of 245 exoplanets. The transit windows of the short-period planets tend to be significantly smaller than those of long-period planets since, at the time of discovery, many more orbits have been monitored to provide a robust estimate of the orbital period. Targets chosen for TERMS tend to be those which have small transit windows, medium-long periods, and a relatively high probability of transiting the host star.

3. TERMS Strategy

A considerable number of high transit probability targets are difficult to adequately monitor during their transit windows because the uncertainties in the predicted transit mid-points are too high (months or even years). The acquisition of just a handful of new radial velocity measurements at carefully optimised times can reduce the size of a transit window by an order of magnitude. This is described in more detail by Kane et al. (2009).

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. Note that the observations from this survey will lead to improved exoplanet orbital parameters and ephemerides even without an eventual transit detection for a particular planet. The results from this survey will provide a complementary dataset to the fainter magnitude range of the *Kepler* mission, which is expected to discover many transiting planets including those of intermediate to long-period.

References

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