PHOTOMETRY OF YOUNG STARS WITH WASP

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ABSTRACT

We present observations of nearly 2000 T-Tauri, FU Ori, Young Stellar Objects & Pre-MS stars with WASP, specifically in the context of a planet search. Detection techniques included phase-folding and a search for long-duration eclipse events. We confirm the variable nature of many of these objects and discuss a handful of interesting exoplanet & Eclipsing Binary candidates.

METHODS

WASP (Pollacco, 2006) has observed 30 million+ stars with precision of ~1% hr^{-1}. 3000 of these are classed as of T-Tauri, FU Ori, YSO & PMS stars (eg Torres et al, 2006), of which 1900 have >28 days of high-quality photometry. This work, the firs t of its kind, entails a detailed study of the majority of these objects.

VARIABILITY

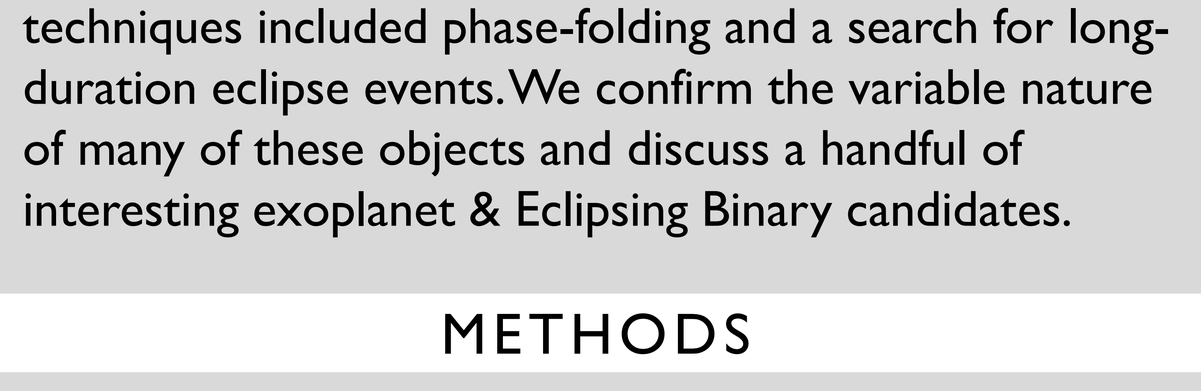


Figure 1: The highest-amplitude long-P variable (115d) from the WASP archive. Fitted line is the phase-folded lightcurve.

Variability, a property of many young stars, was searched for using a Lomb-Scargle method. 69% of stars showed variability, with many showing quasi-periodic changes. Interestingly, 43 showed variability of longer than 30 days (eg Fig. 1).

To aid the detection of planets & EBs, the binned phase-folded variability was subtracted from the lightcurve, significantly decreasing the RMS at other periods.

PLANET & ECLIPSING BINARY SEARCH

No transiting planets and a handful of eclipsing binaries are known to orbit young stars. Such objects are important as young EBs allow stellar evolution models to be constrained while young hot Jupiters could directly allow observations of planet formation & tidal evolution.

Three good candidates are presented here (Fig. 2). ***A*** is one of the brightest and longest-period EBs yet found around a PMS star (Stassun, 2014). Objects ***B*** & ***C*** are much shorter-period, shallower, and lack a secondary eclipse. Such objects could be

ECLIPSING BINARY & PLANET CANDIDATES

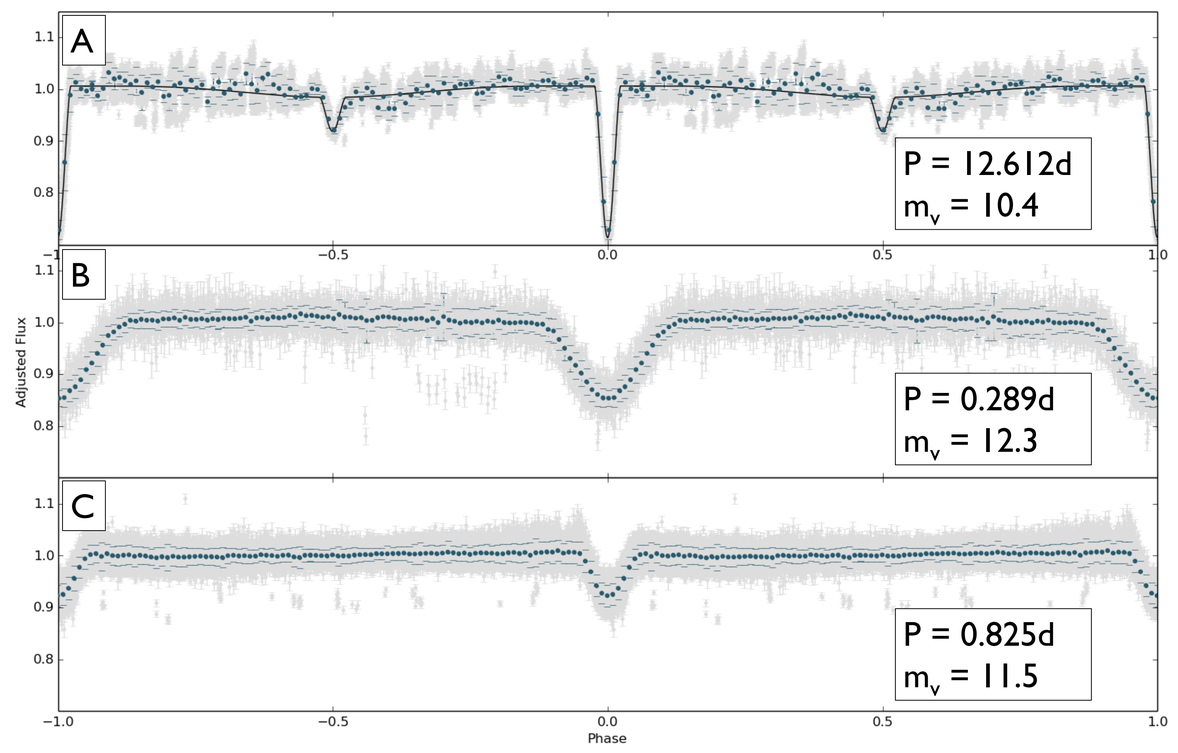


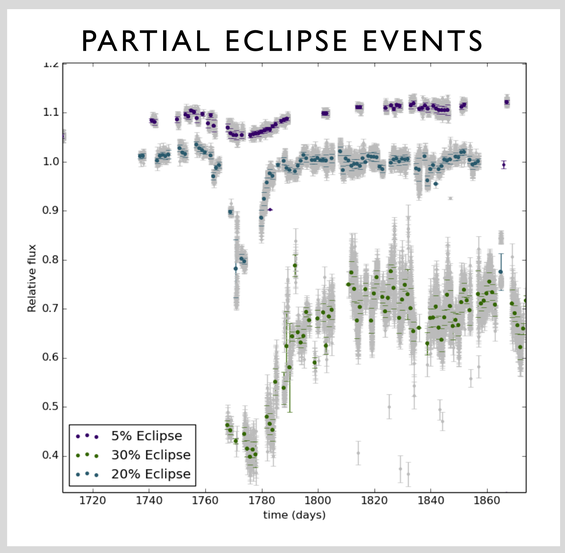
Figure 2: Phase-folded detection lightcurves. They orbit PMS (A & C) and T-Tauri's (B) respectively. A is fitted using JKTEBOP

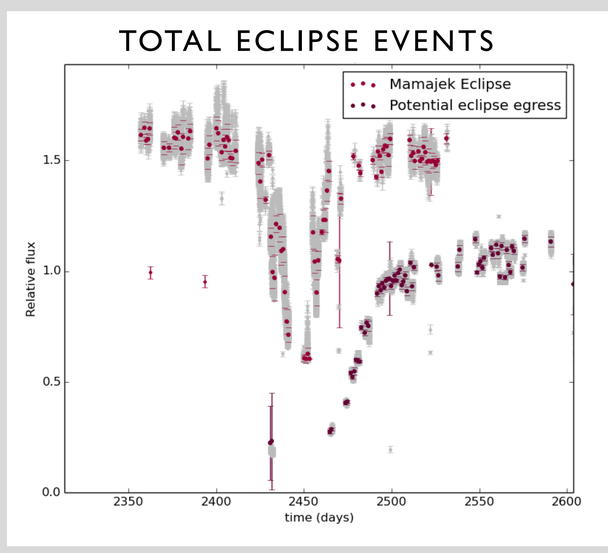
anything from bloated young planets or brown dwarfs to low-mass stars. RV follow-up is planned to determine their nature.

We also improved the ephemeris for 15 known young EBs.

ECLIPSE EVENTS

Long-duration eclipse events around young stars have been interpreted as the transit of planetary ring systems in which exo-moons are forming (Mamajek, 2012). This project has uncovered four additional candidate events (Figs 3 & 4). Again, follow-up is required to eliminate stellar variability or a binary companion as potential sources of the dimming.





Figures 3 & 4: Long-duration eclipse events from 30d long & 8% deep (upper left) to >50d & 70% deep (lower right). The previously-discovered planetary disc (Mamajek, 2011) is shown in red (upper right).

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