A large TESS sample of short-period ellipsoidal binary candidates

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Introduction

Short-period binaries show photometric signatures of ellipsoidal distortion, reflection, and Doppler beaming.

We used the BEER algorithm[1,2] to search through 9,000,000 TESS full-frame image lightcurves with $T < 13.5$ for targets showing signatures of this form.

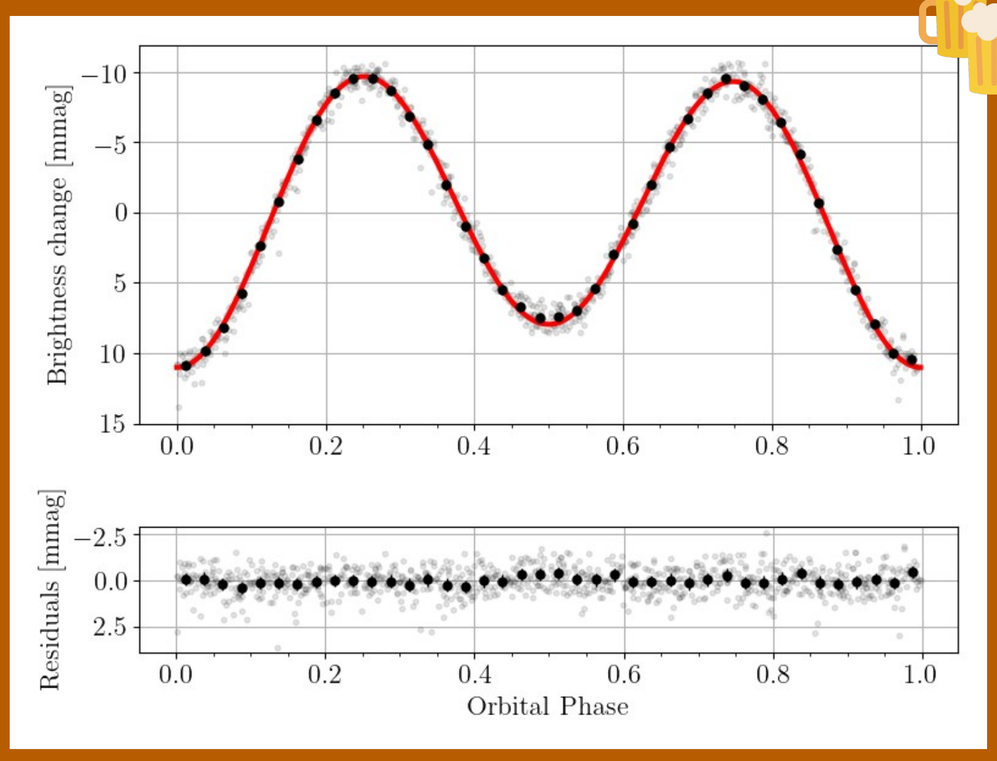

Figure 1: Phase-folded *TESS* lightcurve of an example ellipsoidal binary, TIC237532893, which shows ellipsoidal variation and reflection.

We selected the best 20,000 ellipsoidal binary candidates, including only main sequence targets with reliable mass and temperature measurements in the TIC.

Orbital Period Distribution

The completeness of our sample decreases with increasing orbital period. We can use a set of simulated lightcurves to estimate the underlying orbital period distribution. We find a pile-up of systems with periods of 8 hours (contact binaries), and a relatively uniform distribution between 1-3 days.

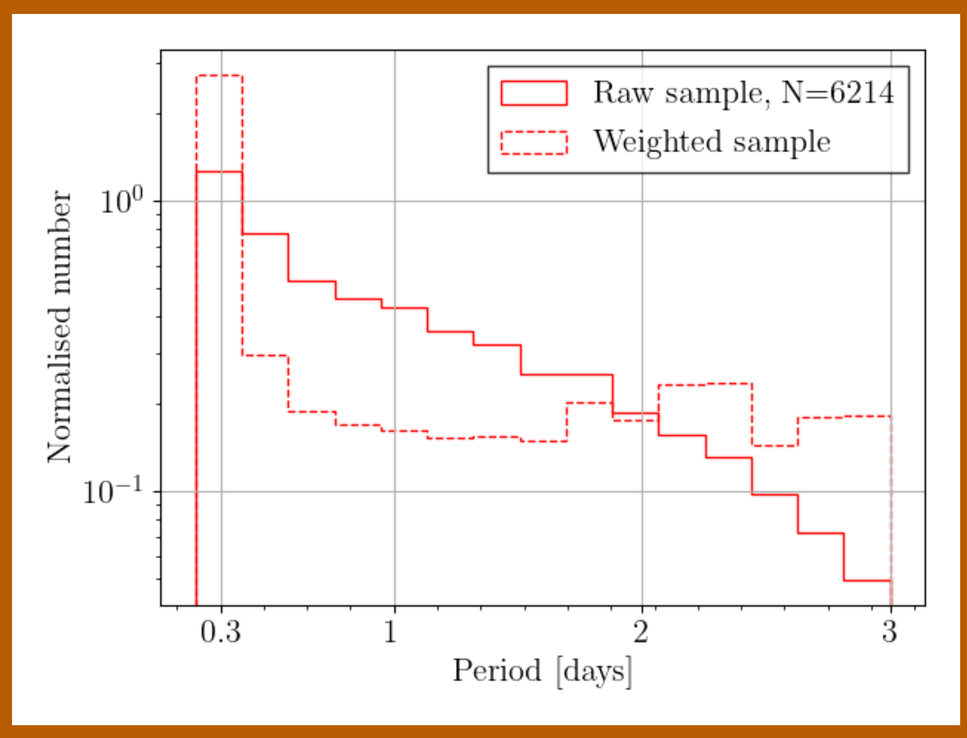

Figure 2: The period distribution of our sample of binaries is plotted with uniform weights (solid) and with weights that are inversely proportional to the detection probability, in order to reconstruct the underlying period distribution (dashed).

Primary Mass Distribution

The distribution of primary masses with orbital period follows a broken power law distribution, similar to that seen in other ellipsoidal binary samples, with a ‘clump’ of contact binaries at an orbital period of 8 hours.

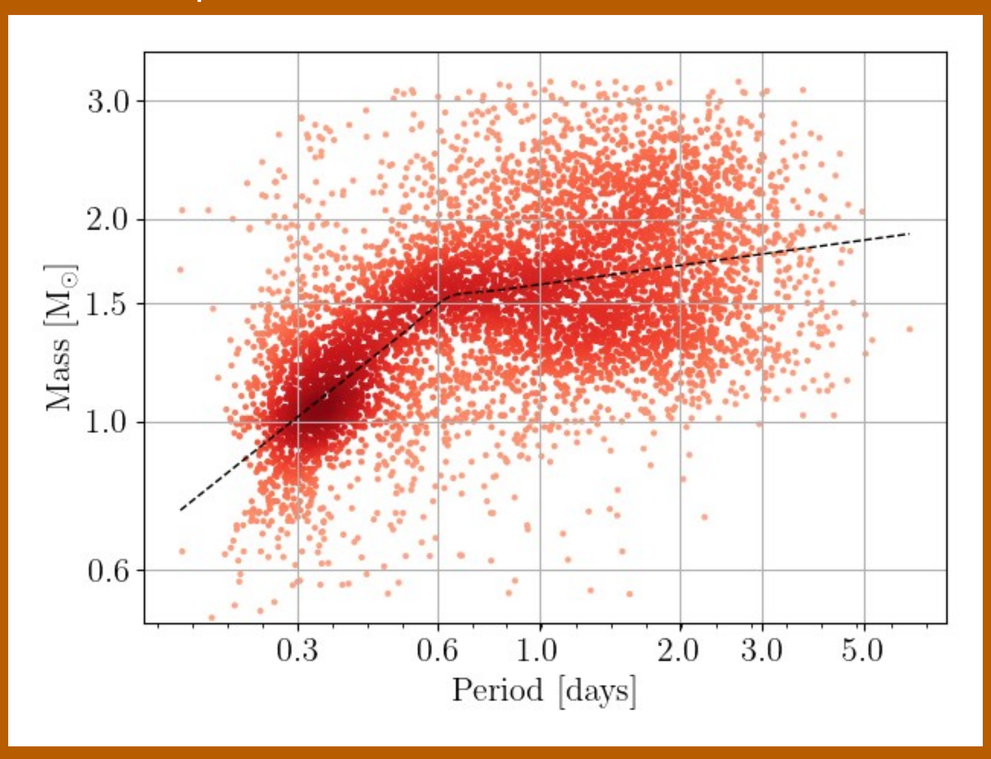

Figure 3: The distribution of primary mass as a function of orbital period, plotted with a best-fit broken power law.

Mass-Ratio Distribution

We estimate the mass-ratio distribution based on the ellipsoidal amplitudes. The distribution is affected by a number of selection effects, including the larger amplitude from high mass-ratio binaries, the Malmquist bias, selection against eclipsing binaries, and the unreliable estimation of mass ratio from contact binaries at short orbital periods.

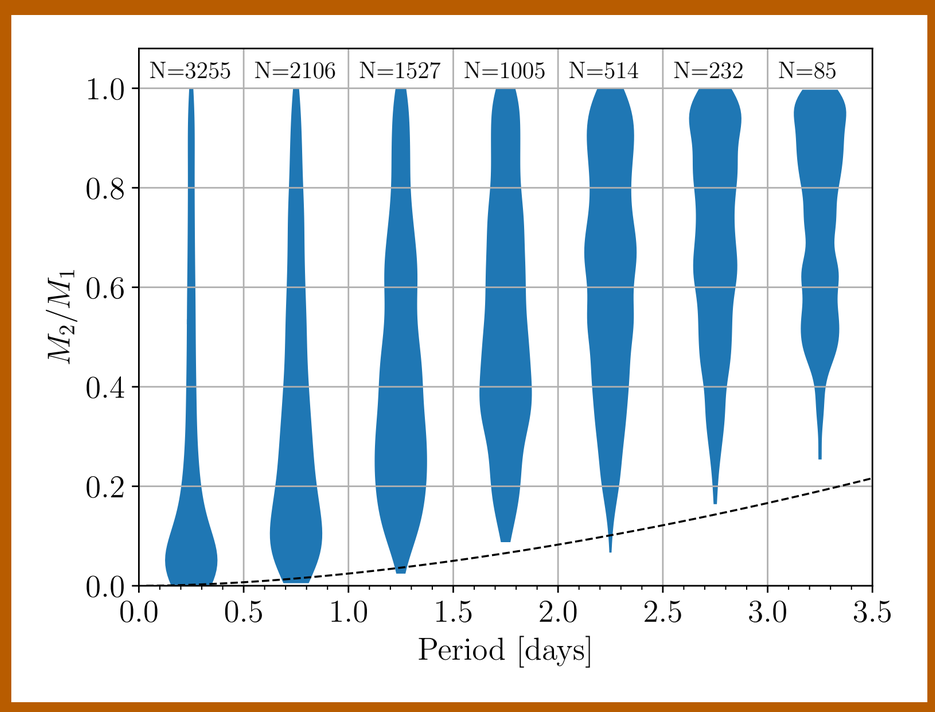

Figure 4: Violin plots of the estimated mass-ratios in our sample, separated into period bins.

References: Faigler et al (2011), MNRAS, 415, 3921
Gomel et al (2021), MNRAS, 501, 2822