



Precision timing of eclipsing binaries from TESS full frame images

Dr. Frédéric MARCADON

Annual meeting - January 23rd 2025

CAMK - Warsaw

Publications

THE ASTROPHYSICAL JOURNAL, 976:242 (22pp), 2024 December 1
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OPENACCESS

https://doi.org/10.3847/1538-4357/ad8571



Precision Timing of Eclipsing Binaries from TESS Full Frame Images: Method and Performance

Frédéric Marcadon i and Andrej Prša

Monthly Notices

Solaris photometric survey: Search for circumbinary companions using eclipse timing variations

A. Moharana⁰,¹* K. G. Hełminiak⁰,¹ F. Marcadon,² T. Pawar,¹ G. Pawar⁰,¹ P. Garczyński,³ J. Perła,⁴ S. K. Kozłowski,⁵ P. Sybilski,⁶ M. Ratajczak⁷ and M. Konacki⁸

Monthly Notices

ROYAL ASTRONOMICAL SOCIETY MNRAS 499, 3019–3033 (2020) Advance Access publication 2020 October 2

doi:10.1093/mnras/staa3040

Analysis of eclipsing binaries in multiple stellar systems: the case of V1200 Centauri

F. Marcadon,^{1*} K. G. Hełminiak⁰,¹ J. P. Marques,² R. Pawłaszek,¹ P. Sybilski,¹ S. K. Kozłowski,¹ M. Ratajczak⁰³ and M. Konacki¹

fmarcadon@camk.edu.pl

• Eclipsing binaries (EBs): fundamental calibrators.

- Ensemble asteroseismology, model parameters.
- Distance determinations of Local Group galaxies.
- Architecture and dynamics of multiple systems.
- $\bullet ~{\sim}20\%$ of EBs are members of multiple systems.
- Goal: detect **compact hierarchical triples** (CHTs) and substellar circumbinary companions.
 - Eclipse timing variations (ETVs) caused by the light-traveltime effect (LTTE).
- TESS full frame images (FFIs) contain hundreds of thousands of EBs.

Targets and data

- $\bullet \sim 100$ targets identified in the Villanova TESS EB catalog.
 - Continuous viewing zones (long-duration obs.).
 - Target pixel files (TPFs) in 2-min short cadence (SC).
 - FFIs collected every 30 min, 10 min, and 200 s.
- FFI light curves (LCs) extracted using the eleanor package (Feinstein et al. 2019).



fmarcadon@camk.edu.pl

Method and analysis

- Bayesian approach for the derivation of the times of minima.
- Eclipse profile described using the **phenomenological** model of Mikulášek (2015):
 - Reference time of eclipse, orbital period.
 - Eclipse depth, eclipse width, kurtosis, etc.
 - Observed-minus-calculated (O C) time difference.



fmarcadon@camk.edu.pl

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Results and conclusions

- Identification of 10 EBs with a possible tertiary companion (occurrence rate of 10%).
- TIC 229771234: overcontact EB with an orbital period of 0.821 d.
 - New CHT system (*P*_{out} = 359.8 d).
 - Minimum tertiary mass of $0.600^{+0.063}_{-0.056} M_{\odot}$.



fmarcadon@camk.edu.pl

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Future prospects



 Locations in the P_{in} - P_{out} plane of 222 CHTs detected by Kepler.

- Detection limits: amplitudes A_{dyn} and A_{ltte} greater than \sim 50 s (blue lines).
- Deficit of CHTs with $P_{in} \lesssim 0.7 \, \mathrm{d}$ and $P_{out} \lesssim 200 \, \mathrm{d}$ (yellow area).

(Borkovits et al. 2016)

- Search for **ultra-compact hierarchical triples** (UCHTs) in TESS photometric data.
 - \Rightarrow Investigate the formation mechanisms of close binaries.