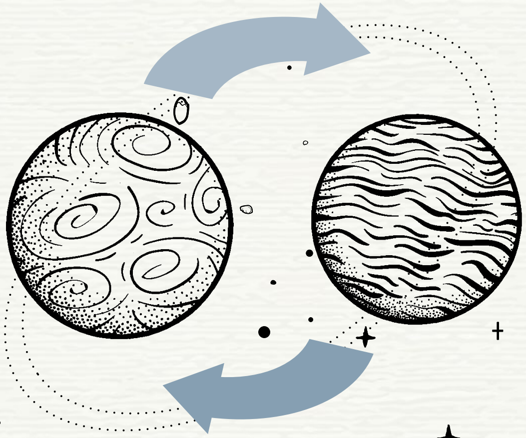
CAMK Annual Meeting 2024

Eclipsing Binaries as PLATO Benchmark Stars



Ganesh Pawar

2nd year PhD student, CAMK Toruń
Supervisor: Dr. hab. K.G. Hełminiak

PLATO!

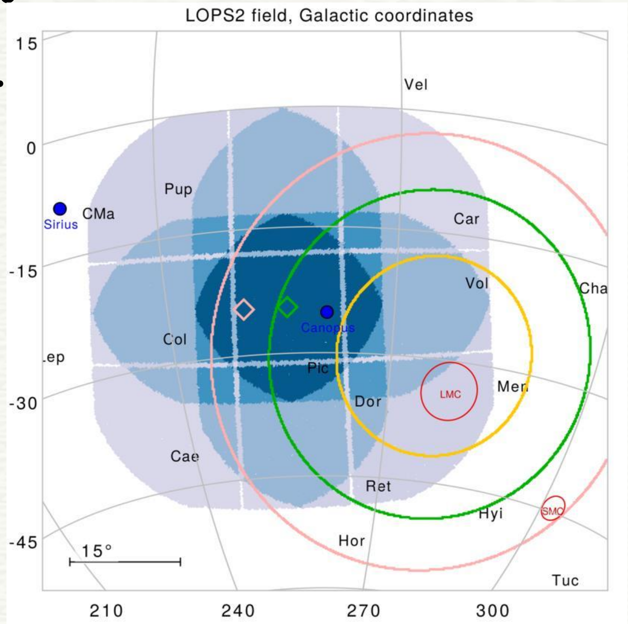
1. PLAnetary Transits and Oscillations of stars (PLATO) is ESA's third medium-class mission, to be launched in 2026.

2. Primary goal of the PLATO mission is to determine the accurate age of Planetary system (10% precision for bright solar-like stars).

3. Stars with high precise and accurate fundamental properties will be used as benchmark stars to calibrate stellar models and data analysis techniques.

4. Detached Eclipsing Binary Stars (DEBs) are the key targets.

Target Selection

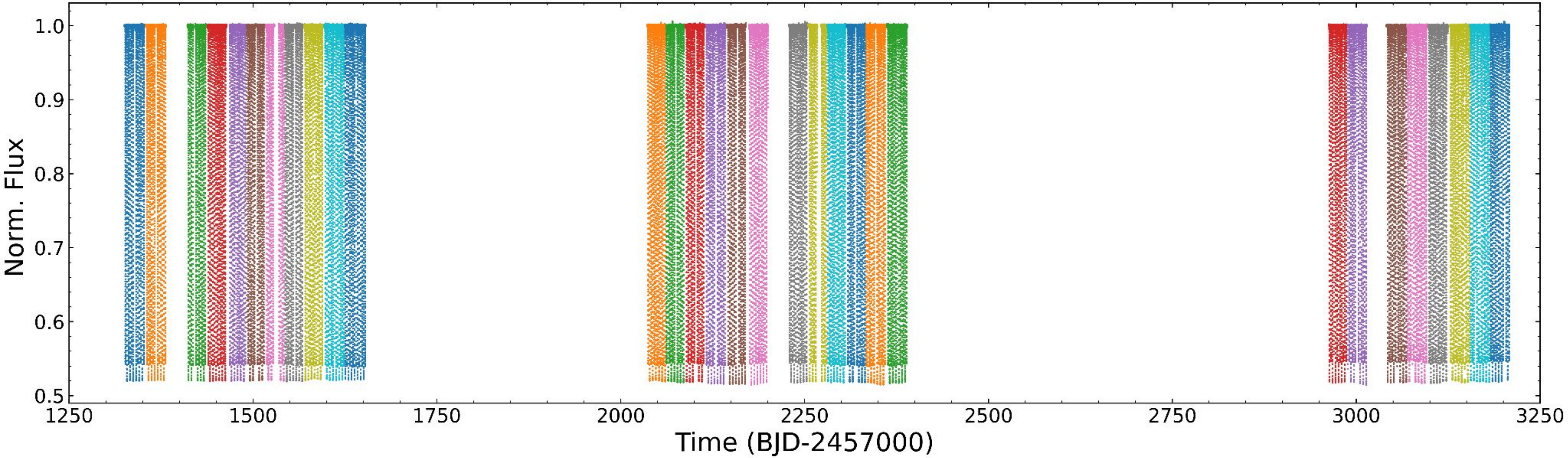


PLATO Field of View of LOPS2 (credit: PLATO SWT)

1. We have found ~**70** DEB systems with $<1\%$ precision in masses from the CRÉME project (Comprehensive Research with Échelles on the Most interesting Eclipsing binaries) with the **criteria** of period $>$ **4d** and multiple TESS observations.
2. These targets are well scattered in the sky.
3. We have ~20 systems in LOPS2 field.

UX Men

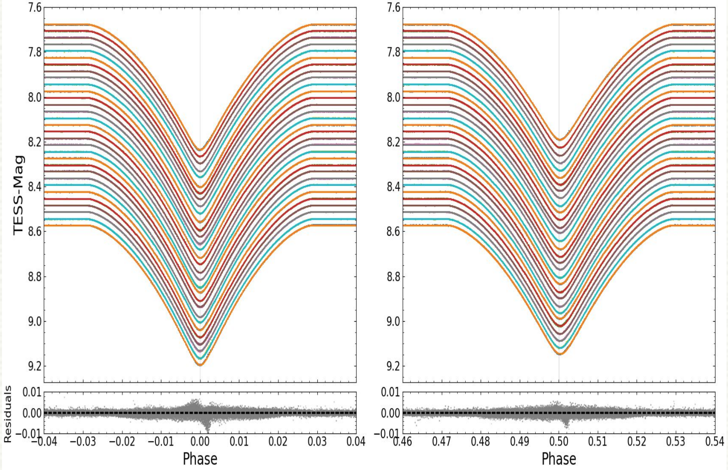
1. UX Men lies in TESS's continuous viewing zone i.e. sector 1-69.
2. The light curves are reduced using customised codes to subtract all the background scattering.

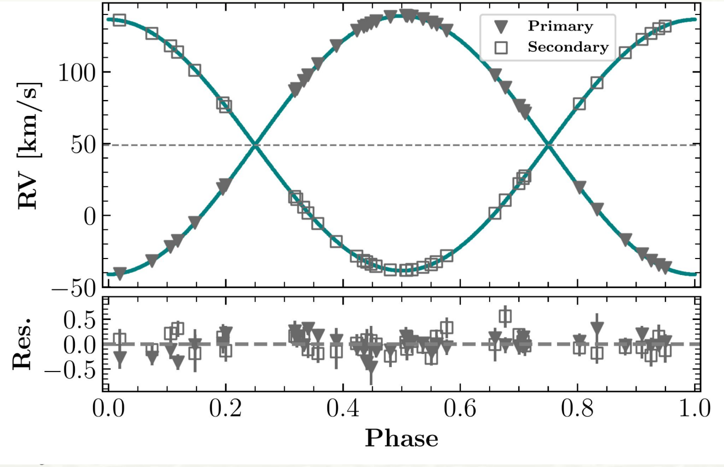


UX Men

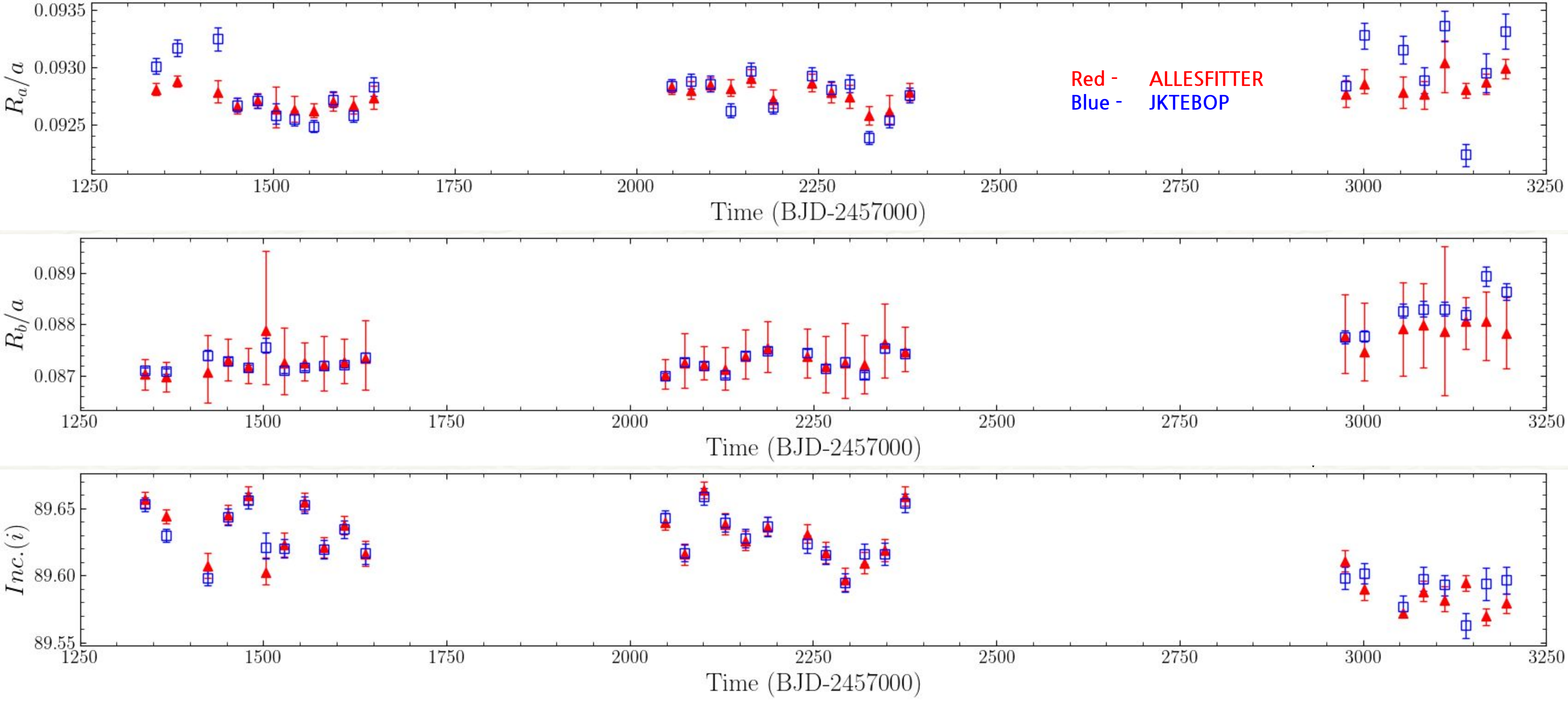
1. Lightcurve models are generated by using two different codes:
   1. **ALLESFITTER** (Günther & Daylan, 2019) and 2. **JKTEBOP** (Southworth 2013).
   (~2000 hrs of computational time)

2. RV models are made using V2FIT code (Konacki et. al. 2010).

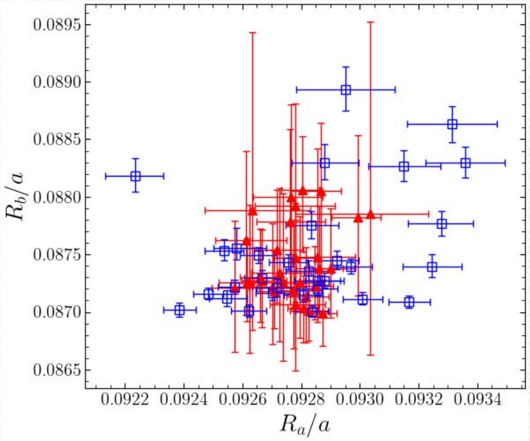


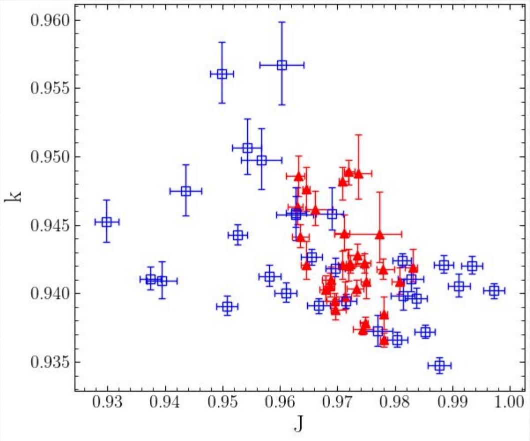


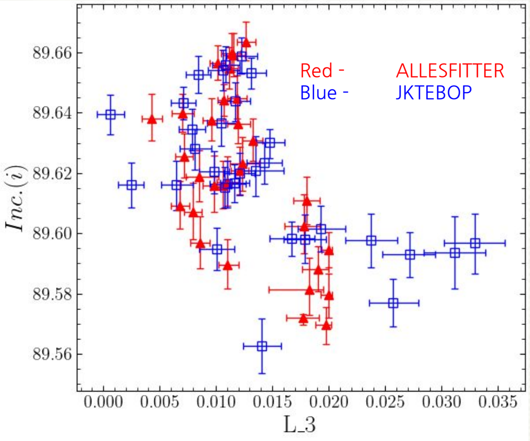
Parameters Over Sectors



Correlation

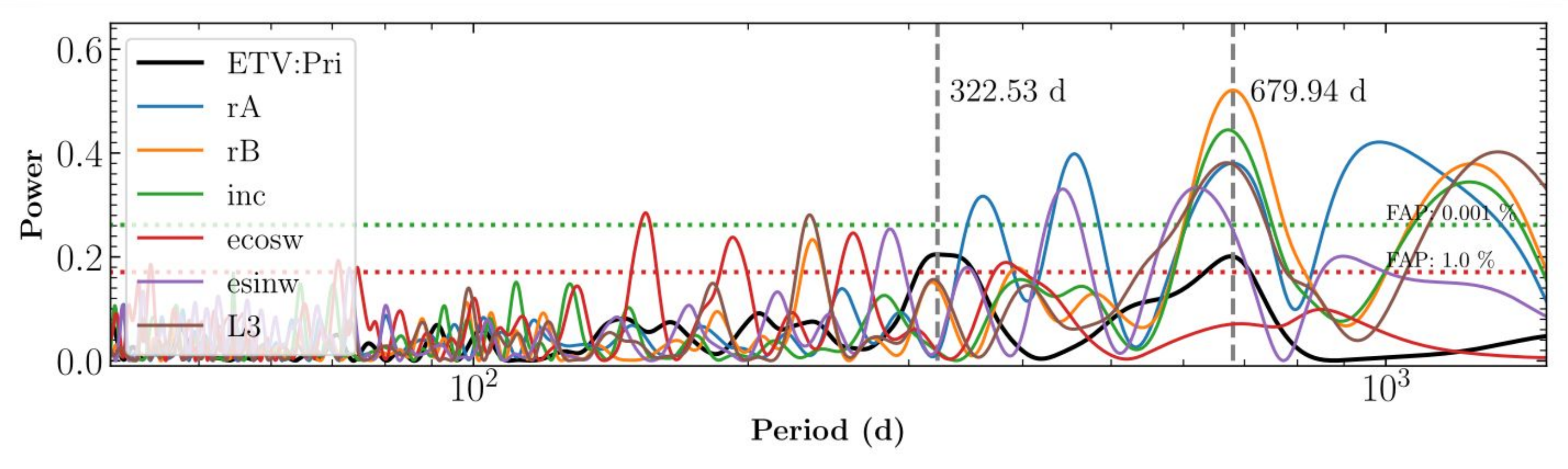






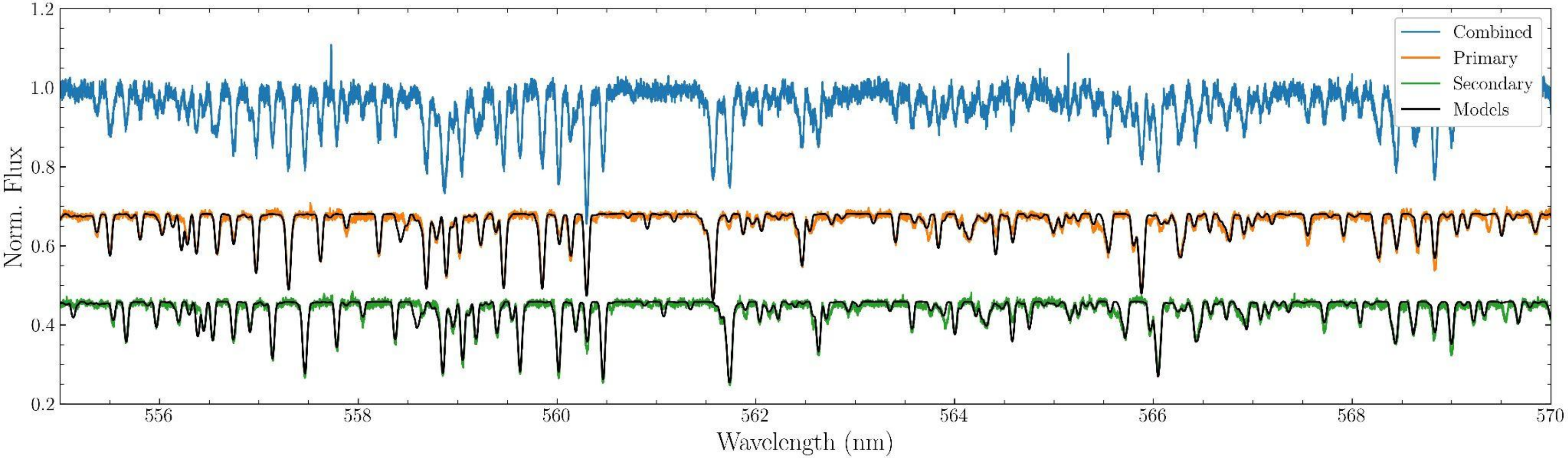
Parameters	R_a/a	R_b/a	i (°)	k	J	L_3	$(R_a+R_b)/a$	e cos ω	e sin ω	M_a ($M_\odot$)	M_b ($M_\odot$)
	0.092746	0.087309	89.6287	0.9414	0.9722	0.0208	0.1801	0.0198	0.0202	1.23	1.195
+1σ	0.000092	0.000583	0.007785	0.001047	0.001192	0.008153	0.000081	0.002137	0.007855	0.00149	0.00167
-1σ	0.00008	0.000487	0.00734	0.000866	0.001277	0.008918	0.000076	0.002331	0.008529	0.00149	0.00167

Stellar Activity



Atmospheric parameters

Disentangling the spectrum of each component.



Parameters	$T_{eff,A}$ (K)	$T_{eff,B}$ (K)	$logg_A$	$logg_B$	$v\mathrm{Sini}_A$ (km/s)	$v\mathrm{Sini}_B$ (km/s)	$[M/H]_A$ (dex)	$[M/H]_B$ (dex)	LD_A	LD_B
	6284	6185	4.27	4.31	16.24	14.99	0.00	0.00	0.59	0.45
+/-1σ	204	65	-	-	1.43	0.92	0.06	0.05	-	-

Side Projects

Software Development

Welcome to DEBRaVE's documentation! View page source

Welcome to DEBRaVE's documentation!

Contents:

- DEBRaVE Functions
  - FStarSpectra
  - Spectra
  - main()
  - readSpectraFITS()

Detached Eclipsing Binaries Radial Velocities Extractor a python package to extract RVs from the composite spectrums.

Indices and tables

- Index
- Module Index
- Search Page

It is based on TODCOR algorithm.

Next

Built with Sphinx using a theme provided by Read the Docs.

Eclipse Timing of EBs

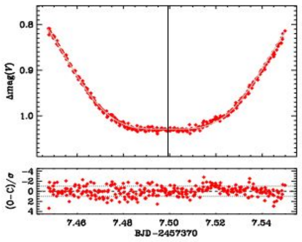


Figure 2. Eclipse fitting of the Solaris observations of HD 60637 (primary eclipse) using our eclipse fitting code.

Table 3. Linear ephemeris from fits to timing measurements.

Target	P_C	T_0^{Cp} (−2457000 BJD)	rms (s)
SU Ind	0.9863 ± 0.0114	213.1 ± 5.5	91
CPD-52 10 541	1.0161 ± 0.0104	241.8 ± 4.8	64
BK Ind	1.1125 ± 0.0130	248.1 ± 5.4	88
HD 60 637	1.4462 ± 0.0167	377.5 ± 2.7	43
V889 Ara	1.0533 ± 0.0111	223.4 ± 3.9	49
TYC 8504-1018-1	1.9335 ± 0.0312	289.5 ± 4.61	106
GSC 08814–01026	0.7024 ± 0.0008	231.7 ± 1.1	40

5.2 Calculating variations

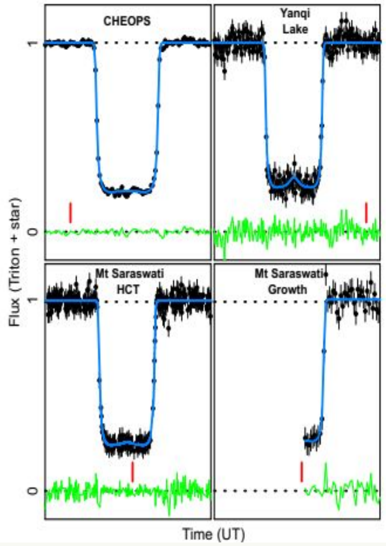
For the ETV plots, we first calculated the reference parameters from a linear fit to cycle-number versus T_0^P. This gave us the reference primary epoch ($T_0^{Cp}(0)$) and an estimate of the reference period (P_C), as listed in Table 3. The corresponding secondary epoch ($T_0^{Cs}(0)$)

doi:10.1093/mnras/stad3117

Moharana et. al. 2023

Stellar Occultation by Triton

A&A proofs: manuscript no. T



Sicardy et. al. under revision in A&AL

CONFERENCE/ WORKSHOPS:

- Conference on "Science Highlights from SALT",CAMK, Warsaw, 1-3 June, 2023
- Code Astro Workshop 2023, CEIRA, Northwestern University, Chicago, 10-14 July, 2023
- XLI Meeting of the Polish Astronomical Society, Toruń, 11-15 Sept, 2023
- Scientist's ABC, workshop by Dr. hab. Edyta Zawisza
- From Research Ideas to Winning Grant Proposals: A Workshop by Prof. Valentina Lepri and Dr. Katarzyna Rusinek-Abarca

Courses:

- The Universe in X-rays, Telescopes, Observations and Theory by Prof. Dr. hab. Agata Różańska
- Understanding probability by Dr. hab Mariusz Bialecki
- Introduction to Machine Learning with Python by Dr. Piotr Klejment
- Scientist's ABC, lecture by Prof. Stanisław Lasocki

Posters Presentation:

- PLATO Stellar Science Conference 2023, Italy, 26-30 June, 2023
- XLI Meeting of the Polish Astronomical Society, Toruń, 11-15 Sept, 2023

THANKS!

Do you have any questions?

gpawar@ncac.torun.pl

https://www.ncac.torun.pl/~gpawar

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