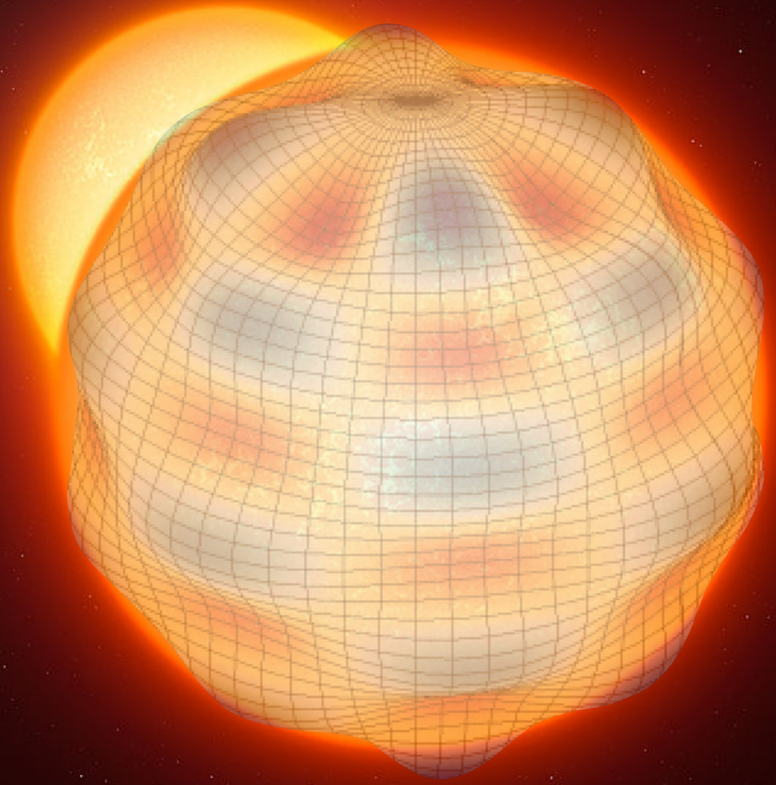
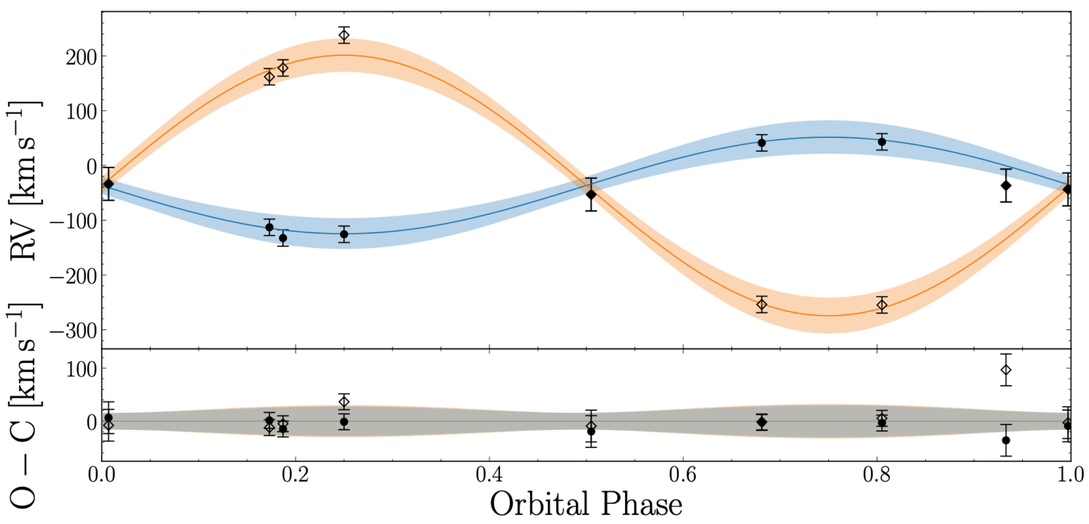


Asteroseismic study of eclipsing binaries

Amadeusz Miszuda

CAMK Annual Meeting

2025



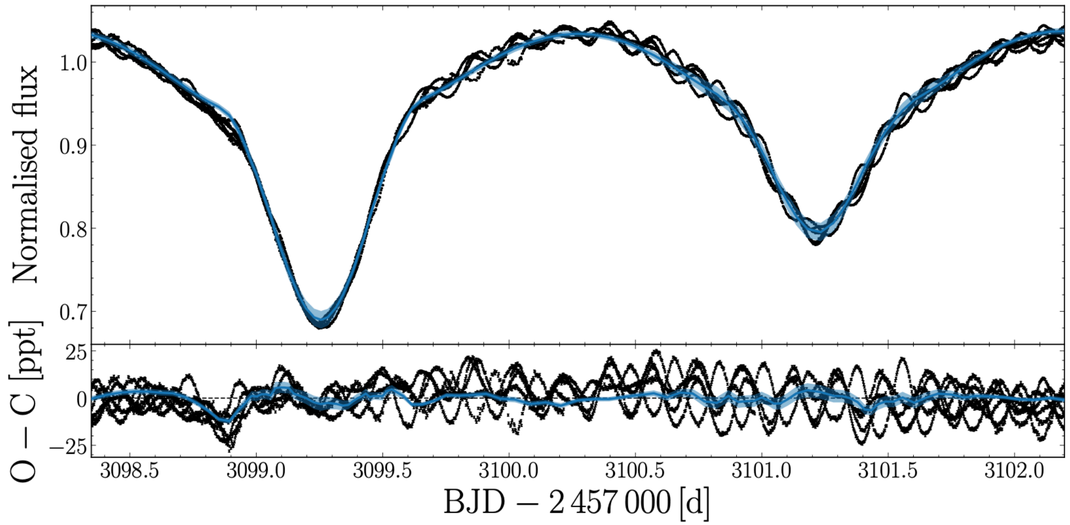


Table 5. Light curve parameters of V1216 Sco.

Parameter		Sector 12 Primary	Sector 12 Secondary	Sector 39 Primary	Sector 39 Secondary	Sector 66 Primary	Sector 66 Secondary	Median values Primary	Median values Secondary
$T_{0,TESS}$	[TBJD]	$1\,632.9490^{+0.0012}_{-0.0012}$		$2\,366.1024^{+0.0012}_{-0.0012}$		$3\,099.2569^{+0.0010}_{-0.0009}$		—	
$P_{\rm orb}$	[d]	$3.92063^{\dagger}$						$3.92063^{\dagger}$	
i	[deg]	$73.00^{+0.20}_{-0.18}$		$73.21^{+0.14}_{-0.15}$		$73.06^{+0.13}_{-0.14}$		$73.09^{+0.18}_{-0.18}$	
$q \equiv M_2/M_1$		$0.372^{\dagger}$						$0.372^{\dagger}$	
e		$0.0^{\dagger}$						$0.0^{\dagger}$	
L_3	[%]	$0.0^{\dagger}$						$0.0^{\dagger}$	
$T_{\rm eff}$	[K]	$22\,000^{\dagger}$	$17\,235^{+243}_{-255}$	$22\,000^{\dagger}$	$17\,637^{+242}_{-241}$	$22\,000^{\dagger}$	$17\,208^{+216}_{-219}$	$22\,000^{\dagger}$	$17\,336^{+341}_{-296}$
Ω		$3.585^{+0.070}_{-0.052}$	$2.592^{+0.003}_{-0.004}$	$3.587^{+0.043}_{-0.043}$	$2.582^{+0.002}_{-0.002}$	$3.570^{+0.032}_{-0.044}$	$2.596^{+0.002}_{-0.003}$	$3.579^{+0.048}_{-0.046}$	$2.591^{+0.005}_{-0.010}$
A		$1.0^{\dagger}$	$1.0^{\dagger}$					$1.0^{\dagger}$	$1.0^{\dagger}$
g		$1.0^{\dagger}$	$1.0^{\dagger}$					$1.0^{\dagger}$	$1.0^{\dagger}$
L_{TESS}		$7.885^{+0.146}_{-0.160}$	—	$7.731^{+0.131}_{-0.118}$	—	$8.166^{+0.127}_{-0.103}$	—	—	
$\sigma_{\ln f}$		$-5.219^{+0.082}_{-0.078}$		$-5.244^{+0.086}_{-0.083}$		$-5.450^{+0.085}_{-0.084}$		—	
x		$0.3247^{\dagger}$	$0.4077^{\dagger}$					$0.3247^{\dagger}$	$0.4077^{\dagger}$
y		$0.2129^{\dagger}$	$0.2778^{\dagger}$					$0.2129^{\dagger}$	$0.2778^{\dagger}$
$x_{\rm bol}$		$0.758^{\dagger}$	$0.704^{\dagger}$					$0.758^{\dagger}$	$0.704^{\dagger}$
$y_{\rm bol}$		$0.112^{\dagger}$	$0.068^{\dagger}$					$0.112^{\dagger}$	$0.068^{\dagger}$

Notes. The listed parameter values represent the mode of the posterior distributions, with uncertainties provided as the 16$^{\rm th}$ and 84$^{\rm th}$ percentiles, corresponding to the 1σ credible intervals. The bolometric LD coefficients, $x_{\rm bol}$ and $y_{\rm bol}$, are from van Hamme (1993), while x and y, the *TESS* LD coefficients were taken from Claret (2017).
† Fixed value for all sectors

Table 6. Absolute parameters of V1216 Sco.

Parameter		Primary	Secondary
Mass	[$M_\odot$]	$11.720^{+1.210}_{-1.130}$	$4.344^{+0.657}_{-0.637}$
Radius	[$R_\odot$]	$8.426^{+0.139}_{-0.105}$	$8.058^{+0.024}_{-0.017}$
$\log L/L_\odot$		$4.174^{+0.080}_{-0.080}$	$3.970^{+0.130}_{-0.130}$

Notes. The listed parameter values represent the mode of the posterior distributions, with uncertainties provided as the 16$^{\rm th}$ and 84$^{\rm th}$ percentiles, corresponding to the 1σ credible intervals.

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Eclipsing binary systems with β Cephei components

V1216 Sco

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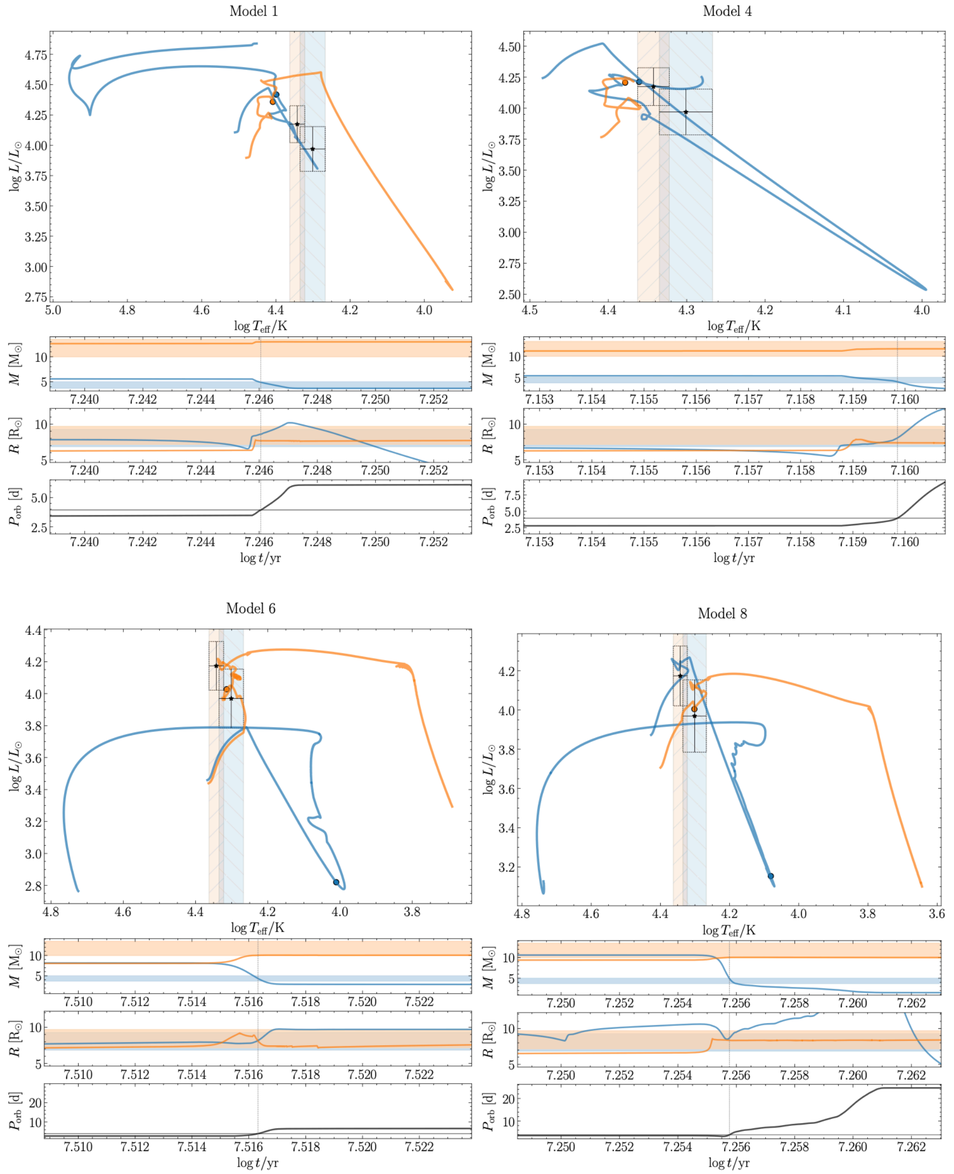
ABSTRACT

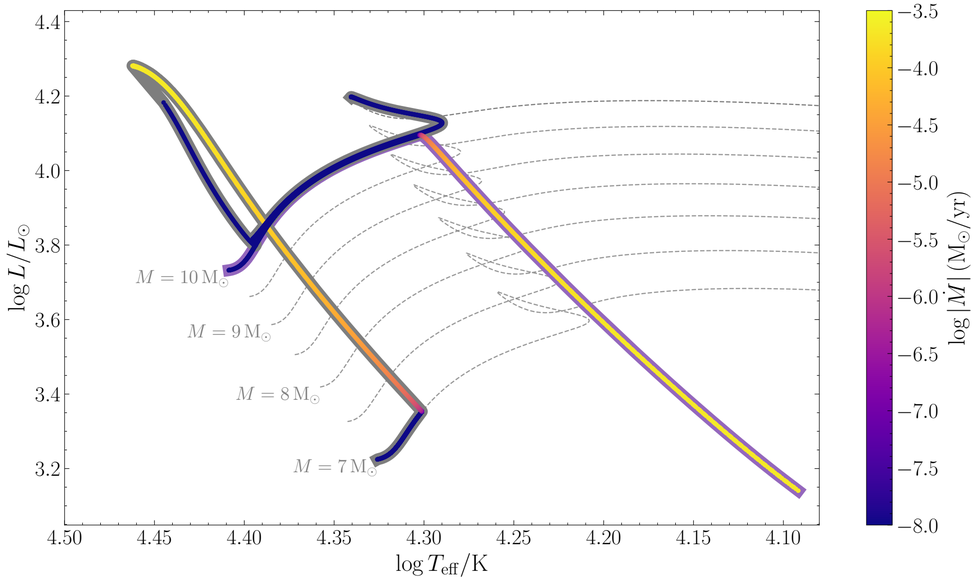
We present a detailed analysis of the high-mass binary system V1216 Sco, an eclipsing Algol-type binary hosting a β Cep pulsator, with an orbital period of 3.92 days. This system was analysed using *TESS* photometry and high-resolution spectroscopy from SALT HRS to investigate its orbital parameters, stellar properties, and evolutionary history. The *TESS* light curve, comprising over 12 000 data points, revealed 5 independent pulsation frequencies within the β Cep range of 5 to 7 d^{-1}.
Spectroscopic analysis provided radial velocities and disentangled atmospheric parameters, enabling precise orbital and evolutionary modelling. The system features a primary star of 11.72 $M_\odot$ and a secondary of 4.34 $M_\odot$, the latter with a radius near its Roche lobe, indicating recent or ongoing mass transfer. Evolutionary modelling with MESA-BINARY suggests that V1216 Sco went through case A mass transfer scenario, where mass transfer began while the donor was still on the main sequence. The system's evolutionary models indicate an age of 15–30 Myr, highlighting the significant impact of binary interactions on stellar evolution.
This study underscores the value of combined observational and theoretical approaches to understanding complex systems like V1216 Sco, emphasizing the role of mass transfer in shaping binary star evolution.

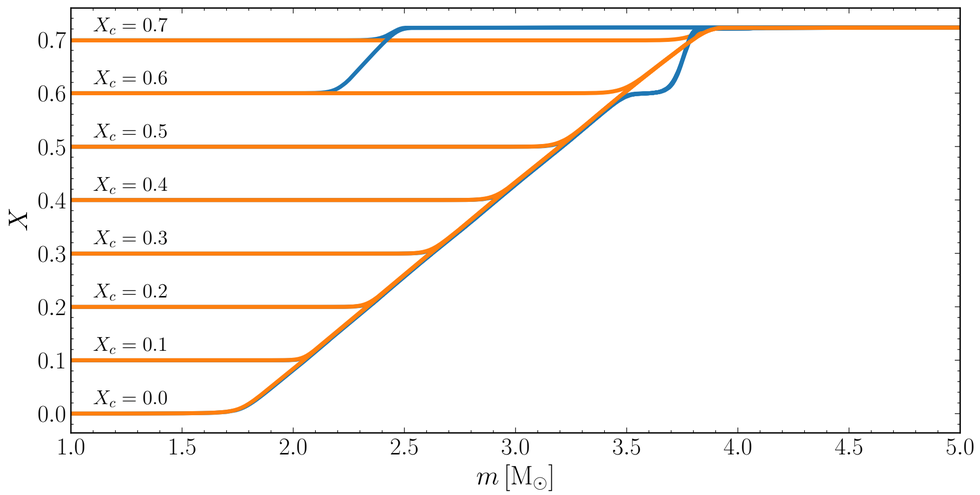
Key words. Stars: binaries: close – Stars: evolution – Asteroseismology

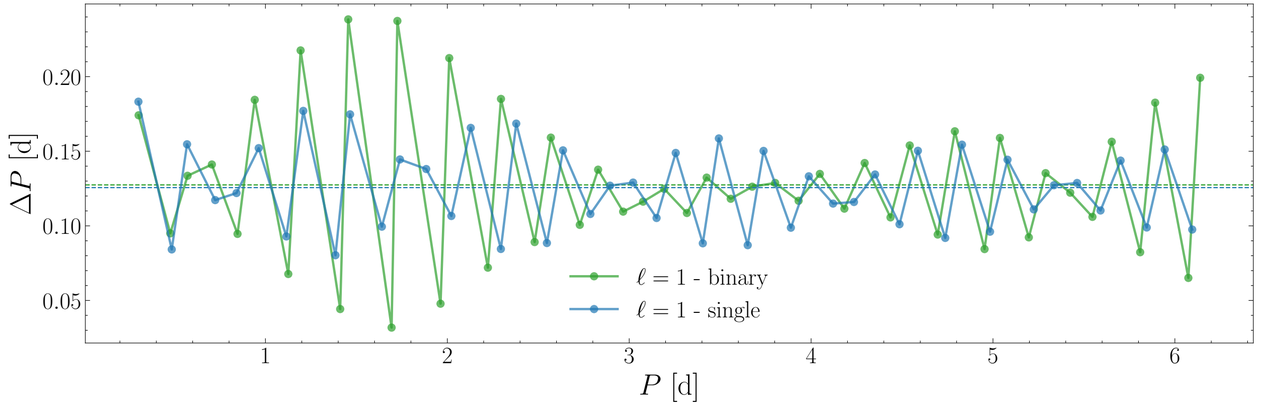


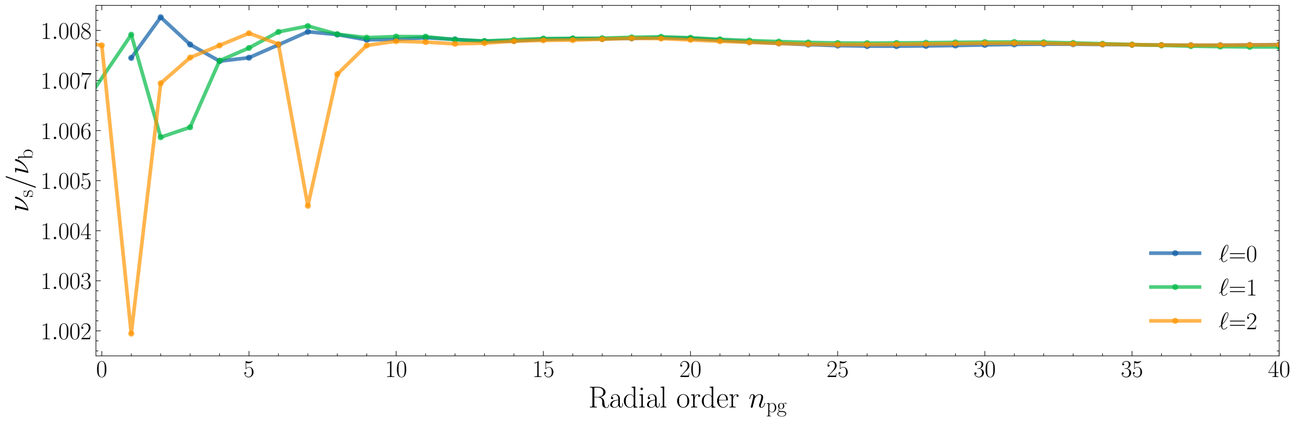
MISZUDA A., EZE C., KAHRAMAN ALICAVUS F., JONSTON C., HANDLER G.,
SUBMITTED TO A&A

THE ASTEROSEISMIC IMPRINTS OF MASS TRANSFER

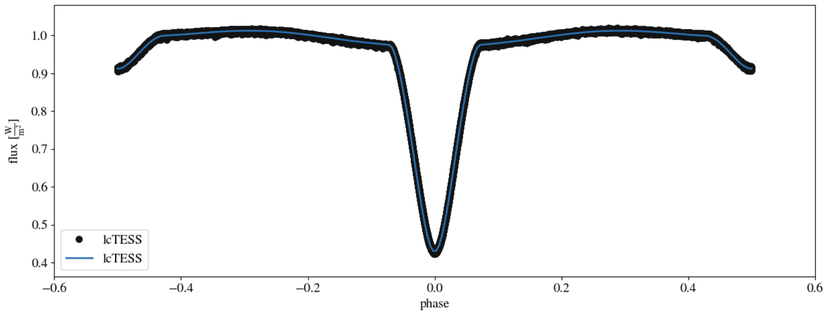


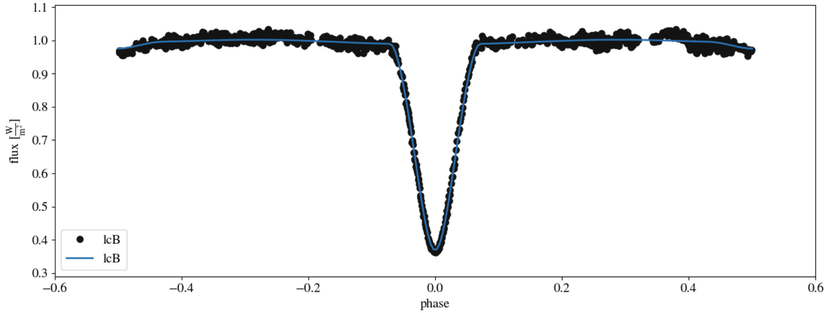


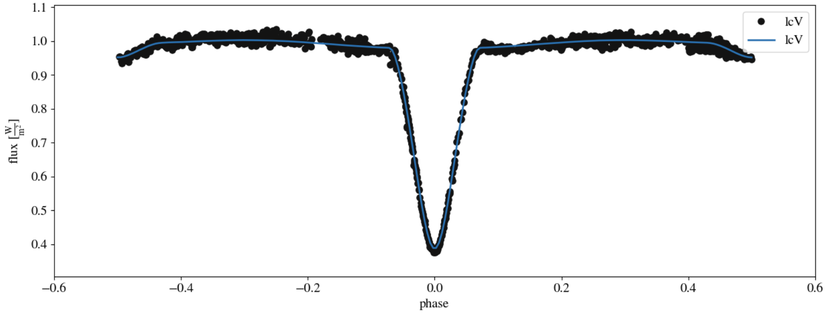


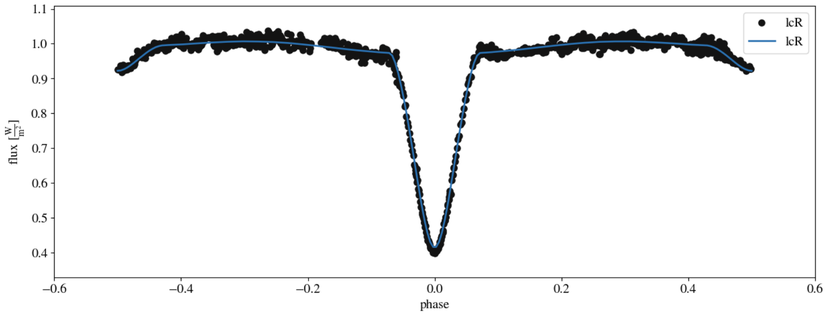


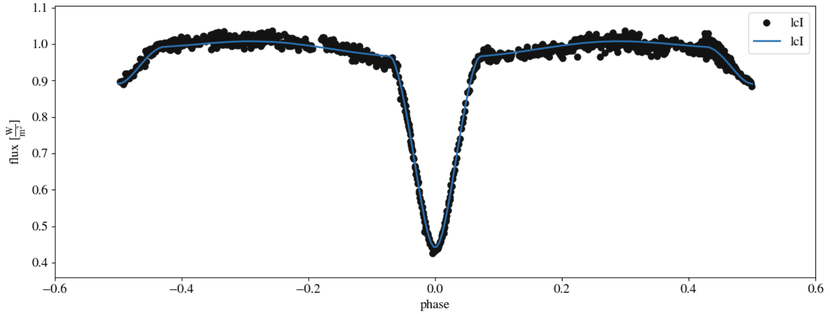
MISZUDA A., GUO Z., R. H. TOWNSEND, IN PREPARATION

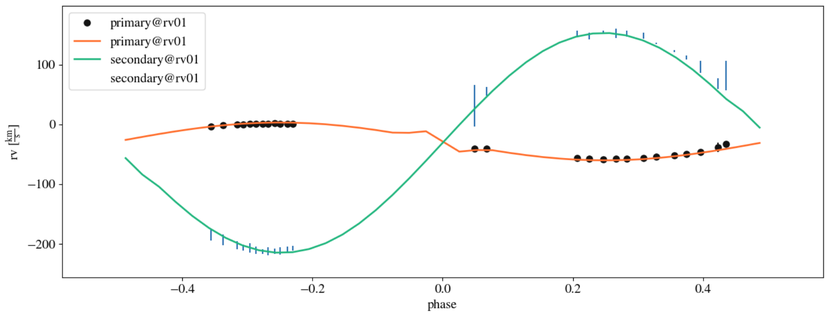


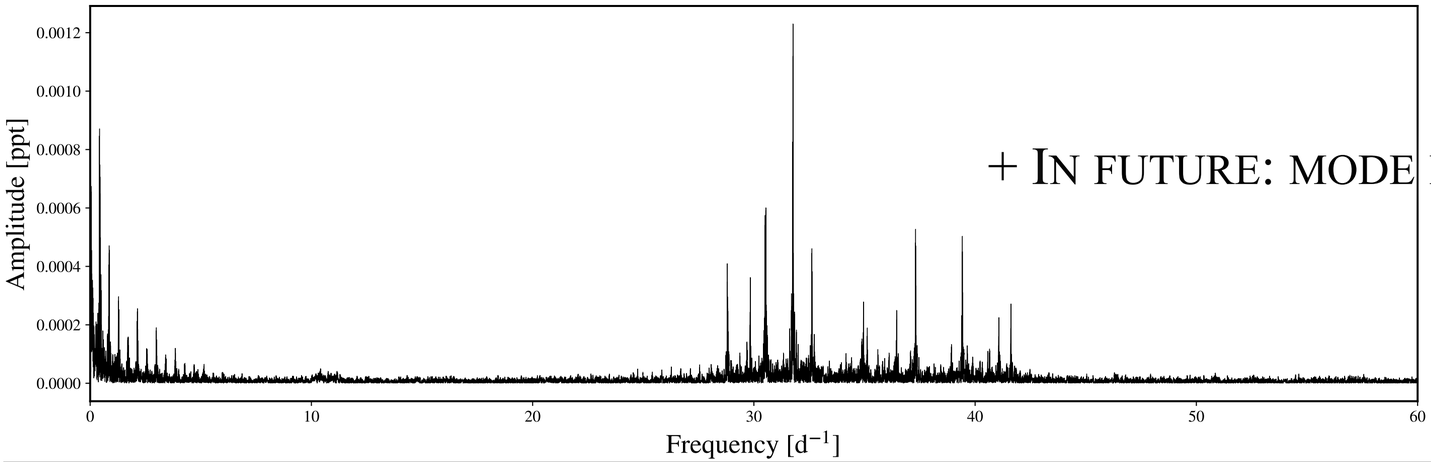












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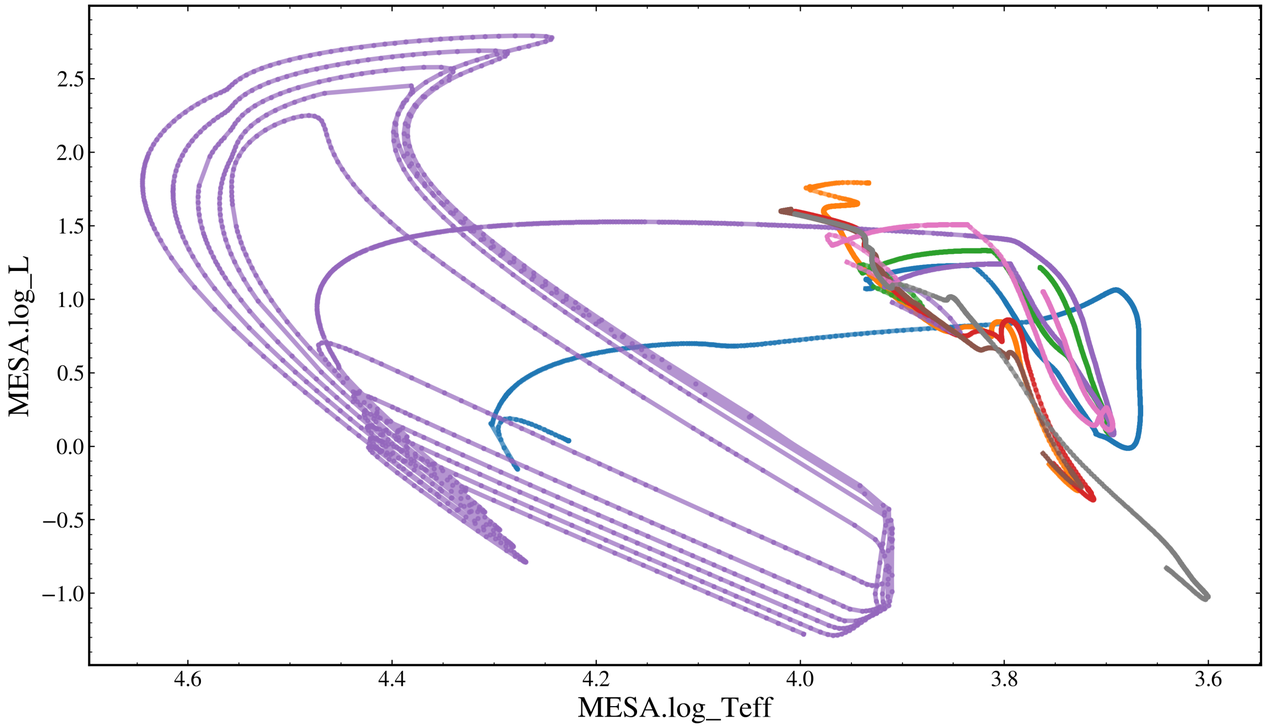
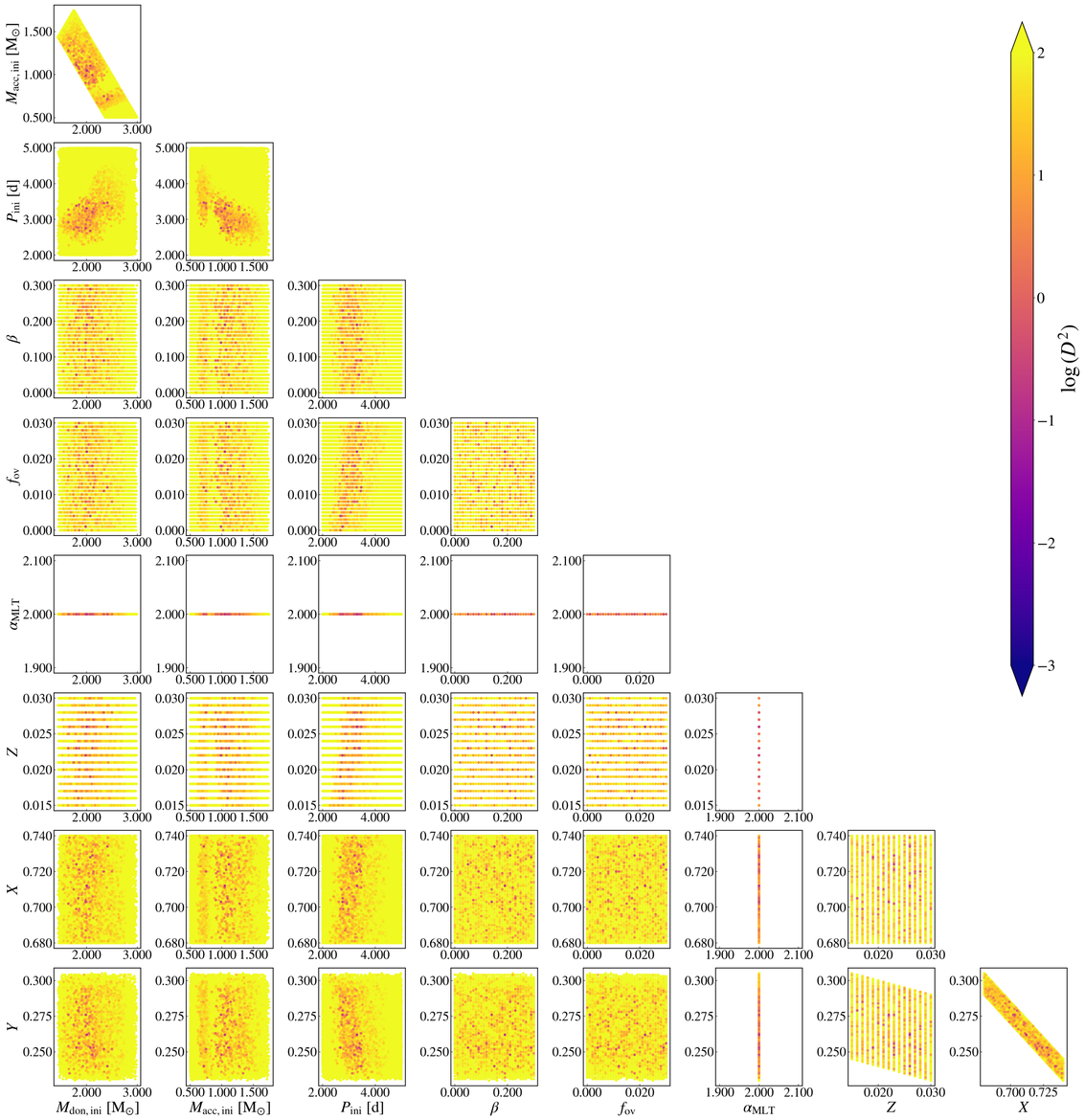
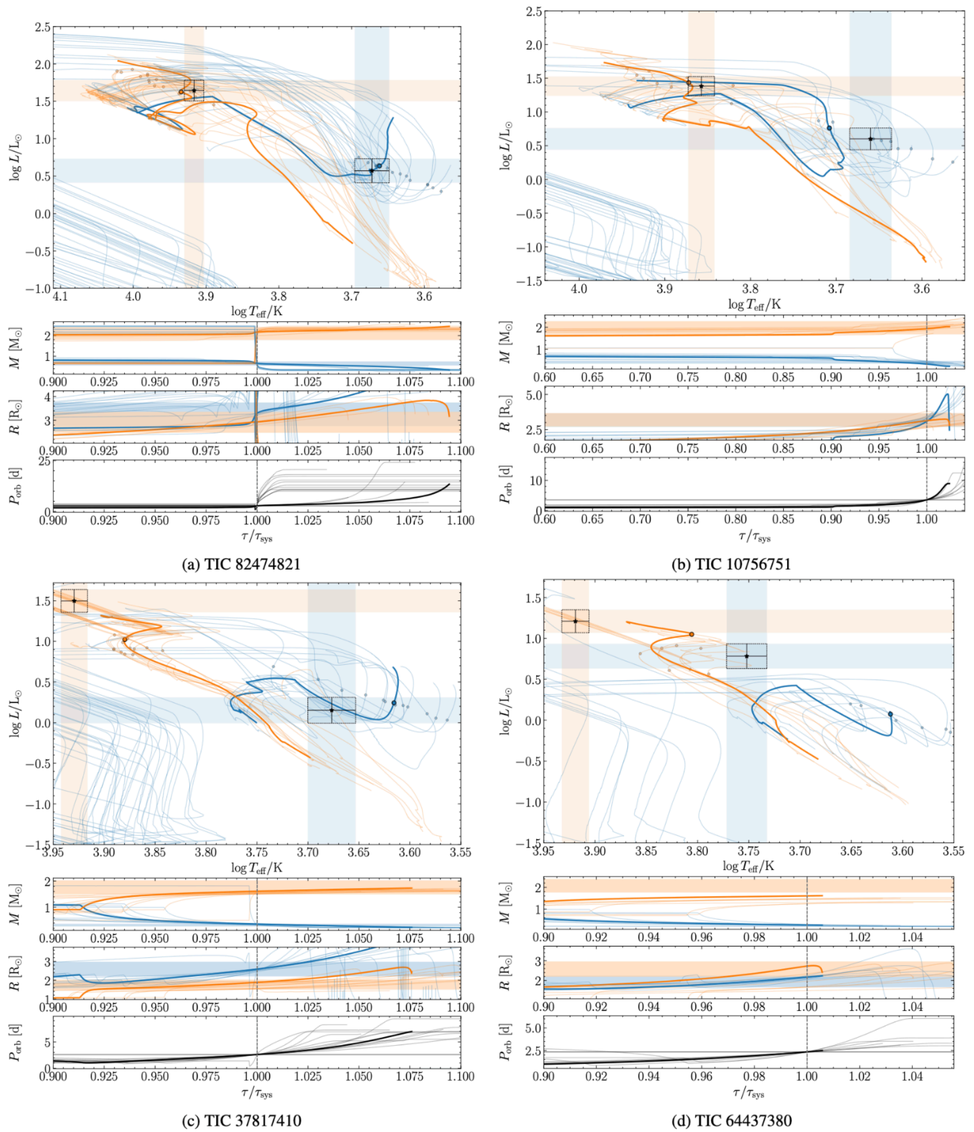




MISZUDA A., KOŁACZEK-SZYMAŃSKI P. A., HEŁMINIAK K., POSIŁEK N., RÓŻAŃSKI T., WORK IN PROGRESS

OSCILLATING ECLIPSING ALGOLS CANDIDATES

Mod. #	Initial parameters P_{ini} [d]	$M_{don,ini}$ [$M_\odot$]	$M_{acc,ini}$ [$M_\odot$]	Z	f_{ov}	α_{MLT}	β	Final parameters M_{acc} [$M_\odot$]	R_{acc} [$R_\odot$]	$\log T_{eff}^{acc}$	M_{don} [$M_\odot$]	R_{don} [$R_\odot$]	$\log T_{eff}^{don}$	$\log \tau_{sys}$ [yr]	MT Case
TIC 82474821															
1	1.36039	2.061	0.958	0.028	0.022	1.3	0.13	2.169	2.931	3.934	0.66	3.289	3.662	9.19	A
2	2.97347	2.099	0.629	0.030	0.027	1.5	0.02	2.041	2.878	3.99	0.651	3.29	3.69	8.96	B
3	1.33773	2.148	0.964	0.017	0.014	0.5	0.19	2.162	2.964	3.914	0.661	3.284	3.577	9.18	A
4	1.26583	1.552	1.140	0.025	0.023	0.8	0.03	1.995	2.947	3.889	0.66	3.288	3.588	9.47	A
5	2.69152	2.204	0.709	0.010	0.018	1.1	0.11	2.055	2.863	3.979	0.687	3.348	3.663	8.91	B
6	3.79526	2.465	0.620	0.028	0.011	1.0	0.21	2.041	3.04	4.001	0.662	3.311	3.633	8.7	B
7	2.39379	2.481	0.715	0.014	0.015	1.0	0.26	2.089	2.781	3.978	0.62	3.23	3.667	8.78	B
8	3.10770	2.152	0.657	0.014	0.010	0.7	0.06	2.028	2.839	3.958	0.689	3.349	3.596	8.93	B
9	1.30167	1.922	0.933	0.018	0.027	1.5	0.02	2.199	2.812	3.937	0.62	3.214	3.678	9.33	A
10	3.17406	2.312	0.663	0.013	0.008	0.9	0.16	2.032	3.036	3.968	0.679	3.335	3.625	8.83	B
11	3.45509	2.293	0.630	0.022	0.002	0.8	0.15	2.006	3.058	3.98	0.67	3.321	3.596	8.78	B
12	2.51167	2.427	0.694	0.026	0.015	0.9	0.24	2.065	3.119	3.98	0.619	3.231	3.644	8.75	B
13	2.66580	2.437	0.717	0.017	0.011	1.1	0.17	2.176	2.726	4.016	0.676	3.327	3.651	8.78	B
14	2.94571	2.456	0.638	0.027	0.015	1.1	0.16	2.174	2.697	4.022	0.623	3.239	3.665	8.73	B
15	1.43394	1.986	0.837	0.023	0.027	1.2	0.03	2.171	3.136	3.921	0.6	3.184	3.666	9.28	A
16	2.55736	2.303	0.662	0.024	0.009	0.9	0.22	1.987	2.719	3.971	0.6	3.196	3.62	8.8	B
TIC 10756751															
1	1.23834	1.773	0.574	0.023	0.025	1.6	0.05	1.93	3.13	3.872	0.334	3.061	3.708	9.49	A
2	1.27960	1.980	0.674	0.014	0.027	1.7	0.03	2.185	3.093	3.918	0.411	3.279	3.721	9.37	A
3	1.26999	1.839	0.766	0.013	0.025	0.9	0.06	2.053	3.387	3.874	0.458	3.397	3.636	9.44	A
4	1.23910	2.060	0.813	0.012	0.023	1.6	0.09	2.24	2.884	3.944	0.483	3.457	3.704	9.28	A
5	1.53421	1.918	0.599	0.029	0.023	0.8	0.03	2.051	2.695	3.933	0.412	3.28	3.647	9.27	A
6	1.59119	1.898	0.566	0.025	0.028	0.6	0.05	1.983	2.65	3.925	0.396	3.239	3.657	9.33	A
7	1.29047	1.645	0.633	0.027	0.016	0.8	0.00	1.9	2.644	3.892	0.369	3.16	3.588	9.46	A
8	1.29674	1.066	1.044	0.025	0.024	0.8	0.00	1.668	2.757	3.822	0.433	3.334	3.564	9.91	A
9	1.20346	1.775	0.661	0.019	0.012	1.1	0.04	2.015	2.608	3.909	0.356	3.123	3.628	9.42	A
10	1.24970	1.655	0.747	0.028	0.028	0.9	0.08	1.856	3.795	3.82	0.437	3.345	3.612	9.54	A
TIC 37817410															
1	1.47500	1.093	0.911	0.025	0.006	1.4	0.03	1.613	1.878	3.88	0.363	2.587	3.616	9.84	B
2	1.26929	1.835	0.531	0.023	0.027	1.5	0.29	1.594	1.916	3.89	0.327	2.505	3.734	9.51	A
3	1.25630	1.106	0.899	0.024	0.009	1.2	0.06	1.588	1.788	3.882	0.367	2.597	3.602	9.83	B
4	1.41540	1.827	0.503	0.020	0.011	0.5	0.27	1.578	1.573	3.872	0.35	2.567	3.583	9.11	B
5	1.43283	1.102	0.848	0.017	0.002	0.7	0.02	1.569	1.706	3.875	0.36	2.579	3.563	9.89	B
6	1.23132	1.621	0.555	0.026	0.028	1.4	0.20	1.562	1.925	3.877	0.353	2.567	3.69	9.6	A
7	1.39078	1.096	0.830	0.012	0.007	1.2	0.04	1.551	1.567	3.89	0.339	2.527	3.624	9.89	A
8	1.94405	1.057	0.798	0.012	0.014	1.8	0.00	1.543	1.55	3.89	0.306	2.442	3.667	9.95	A
9	1.23281	1.137	0.842	0.014	0.019	1.3	0.12	1.527	1.528	3.88	0.353	2.564	3.626	9.86	B
10	1.29737	1.120	0.830	0.026	0.005	0.9	0.12	1.516	1.718	3.871	0.335	2.517	3.574	9.8	B
11	2.51667	1.000	0.905	0.016	0.011	1.6	0.07	1.507	1.904	3.843	0.346	2.544	3.643	10.05	A
12	1.21457	1.639	0.610	0.023	0.019	0.8	0.29	1.507	1.846	3.858	0.367	2.598	3.607	9.57	A
13	1.37117	1.115	0.747	0.027	0.005	1.4	0.02	1.505	1.549	3.883	0.336	2.522	3.614	9.79	B
TIC 64437380															
1	1.30566	1.024	0.916	0.019	0.013	1.1	0.08	1.608	2.729	3.806	0.263	2.167	3.612	10.01	A
2	1.26533	0.979	0.871	0.020	0.019	0.5	0.15	1.457	2.334	3.797	0.28	2.214	3.531	10.1	A
3	1.32244	0.989	0.830	0.029	0.011	0.7	0.10	1.466	2.178	3.82	0.275	2.199	3.553	10.0	B
4	2.35677	0.981	0.866	0.014	0.020	1.3	0.14	1.484	1.962	3.835	0.255	2.142	3.641	10.11	B
5	1.31652	0.993	0.706	0.012	0.014	0.8	0.06	1.427	1.651	3.856	0.218	2.034	3.606	10.09	B
6	1.70143	1.046	0.725	0.022	0.005	1.6	0.28	1.303	1.485	3.828	0.237	2.089	3.651	9.95	B
TIC 126945917															
1	1.28362	1.092	0.823	0.024	0.003	0.6	0.09	1.534	2.001	3.845	0.304	1.57	3.551	9.88	B
2	1.38418	1.022	0.728	0.023	0.019	1.6	0.21	1.329	1.488	3.836	0.256	1.481	3.647	9.98	B
3	1.31652	0.993	0.706	0.012	0.014	0.8	0.06	1.337	1.427	3.839	0.316	1.59	3.596	10.06	B
4	2.62958	0.970	0.720	0.016	0.004	1.4	0.30	1.235	1.426	3.805	0.229	1.425	3.662	10.11	B
5	1.39068	1.041	0.555	0.030	0.009	1.7	0.12	1.264	1.387	3.834	0.231	1.43	3.653	9.89	B
6	1.27810	1.081	0.665	0.011	0.021	1.7	0.23	1.293	1.359	3.835	0.26	1.488	3.675	9.92	B
7	1.31712	1.131	0.562	0.018	0.010	1.5	0.24	1.178	1.229	3.795	0.317	1.592	3.639	9.83	B
8	1.56653	1.048	0.525	0.024	0.020	1.6	0.25	1.077	1.104	3.782	0.309	1.579	3.639	9.91	B



(a) TIC 82474821 (b) TIC 10756751

(c) TIC 37817410 (d) TIC 64437380

PAWAR T., **MISZUDA A.**, HEŁMINIAK K. G., MARCADON F., MOHARANA A., PAWAR G., KONACKI M., WORK IN PROGRESS

Summary

Papers:

- „Eclipsing binary systems with β Cephei components I. V1216 Sco”, **Miszuda A.**, Eze C., Kahraman Alicavus F., Jonston C., Handler G., submitted to A&A
- „The asteroseismic imprints of mass transfer, β Cep Case”, **Miszuda A.**, Guo Z., R. H. Townsend, in preparation
- „Eclipsing binary systems with δ Scuti components III. XX Cep”, **Miszuda A.**, Kołaczek-Szymański P. A., Hełminiak K., Posiłek N., Różański T., work in progress
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