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OBSERVATIONS AND LIGHT CURVE SOLUTIONS OF THE ECLIPSING BINARIES KR Lyn, CSS J110212+244412, NSVS 4917488 AND NSVS 7336024

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SUMMARY: We present photometric observations in Sloan filters g', i' of the short-period eclipsing stars KR Lyn, CSS J110212+244412, NSVS 4917488 and NSVS 7336024. The light curve solutions revealed that all targets are overcontact binaries whose components are G and K stars. Their temperature differences do not exceed 300 K but they differ considerably in size and mass. NSVS 4917488 and NSVS 7336024 reveal total eclipses and their parameters can be considered as well-determined. We found that KR Lyn, NSVS 4917488 and NSVS 7336024 are of W-subtype while CSS J110212+244412 is A-subtype W UMa-type star.

Key words. binaries: close – binaries: eclipsing – Methods: data analysis – Stars: fundamental parameters – Stars: individual: KR Lyn, CSS J110212+244412, NSVS 4917488, NSVS 7336024

1. INTRODUCTION

The W UMa stars consist of two stars surrounded by a common convective envelope lying between the inner and outer critical Roche surfaces. As a result, the difference between the surface temperatures of their components usually is less than several hundred kelvins.

Binnendijk (1970) divided the W UMa binaries into two subclasses based on observational characteristics. The light curves of the A-type systems show deeper primary minimum due to the transit eclipse of the larger, more massive, hotter component. In the W-type systems the deeper primary minimum corresponds to the occultation eclipse of the smaller, hotter, less massive component. Moreover, the A-type systems are of earlier spectral type (from A to G) and have longer periods, higher luminosity, larger mass, smaller mass ratio and larger

Table 1. Parameters of the targets from the VSX database.

Target	RA	DEC	mag	ampl	P	type
KR Lyn	08 24 33.51	51 24 40.82	12.70	0.50	0.3465186	EW
CSS J1102+24	11 02 12.08	24 44 12.40	13.52	0.42	0.259016	EW
NSVS 4917488	10 41 04.56	38 54 14.80	11.60	0.53	0.351664	EW
NSVS 7336024	07 52 07.40	30 17 45.90	13.73	0.89	0.269553702	EW

degree of contact than the W-type systems (Van Hamme 1982, Smith 1984).

The mass ratio of the W UMa binaries is an important parameter for the W/A subclassification but it is very seldom available from spectral data due to their faintness (Rucinski 2002). Moreover, the rapid rotation of their components does not allow to obtain precise spectral mass ratio from measurement of their highly broadened and blended spectral lines (Bilir et al. 2005, Dall and Schmidtobreick 2005). That is why the W UMa binaries are poorly studied. It is supposed that their components are in a similar evolutionary state, near or just above the main sequence, but there is still not a satisfactory theory for their origin, structure, evolution and ultimate fate (Van Hamme 1982a,b, Li et al. 2007).

This paper presents photometric observations of the short-period W UMa-type systems KR Lyn, CSS J110212+244412 (further CSS J1102+24), NSVS 4917488 and NSVS 7336024. Table 1 presents information about their coordinates and variability from the VSX database (Clark 2014). The goal of our study was to determine their parameters by light curve solutions of our data. They could be useful for improvment of the empirical relations of short-period W UMa-type systems.

2. OBSERVATIONS

Our CCD photometric observations of targets in the Sloan g', i' bands were carried out with the 30-cm Ritchey Chretien Astrograph (located into the *IRIDA South* dome) using a CCD camera ATIK 4000M. Information about our observations is presented in Table 2 (for data see the Appendix).

Table 2. Journal of our photometric observations.

Star	Date	Exposure	Number	error
KR Lyn	2017 Jan 28	120,120	141, 141	0.004, 0.007
CSS J1102+24	2016 Apr 12	120,120	88, 88	0.006, 0.009
	2016 Apr 13	120,120	24, 18	0.009, 0.011
	2016 Apr 14	120,120	82, 80	0.006, 0.010
NSVS 4917488	2017 Feb 13	60, 90	74, 74	0.003, 0.004
	2017 Feb 14	60, 90	111, 111	0.003, 0.004
	2017 Feb 15	60, 90	56, 56	0.003, 0.004
	2017 Feb 17	60, 90	108, 108	0.003, 0.004
	2017 Apr 01	60, 90	25, 25	0.003, 0.004
NSVS 7336024	2016 Dec 19	120, 150	92, 92	0.007, 0.009
	2016 Dec 21	120, 150	35, 35	0.008, 0.011

The photometric data were reduced by AIP4WIN2.0 (Berry and Burnell 2005). An aperture ensemble photometry was performed with the software VPHOT using more than six standard stars (Table 3) in the observed field whose coordinates were taken from the catalogue UCAC4 (Zacharias et al. 2013) and their magnitudes from the catalogue APASS DR9.

To determine the times of minima we used the software MINIMA (Nelson 2007) that allowed us to apply different methods (Ghedini 1982): parabolic fit, digital tracing paper, bisectors of chords, Kwee and van Woerden (1956). The obtained times of minima (Table 4) lead to the following ephemerides:

$$HJD(MinI) = 2457782.34333(6) + 0.3465186 \times E \quad (1)$$

for KR Lyn,

$$HJD(MinI) = 2457491.41688(8) + 0.25901623(3) \times E \quad (2)$$

for CSS J1102+24,

$$HJD(MinI) = 2457802.37212(9) + 0.351664 \times E \quad (3)$$

for NSVS 4917488, and

$$HJD(MinI) = 2457742.47425(7) + 0.26953702 \times E \quad (4)$$

for NSVS 7336024.

3. LIGHT CURVE SOLUTIONS

We carried out the modeling of our data by the package PHOEBE (Prsa and Zwitter 2005). It is based on the Wilson–Devinney (WD) code (Wilson and Devinney 1971, Wilson 1979, 1993) but also provides a graphical user interface alongside other improvements, including updated filters as the Sloan ones used in our observations.

The observational data (Fig. 1) show that our targets are contact or overcontact systems and we modelled them using the corresponding modes "Overcontact binary not in thermal contact" of PHOEBE. We used the formal convention the deeper minimum to be the primary eclipse (phase 0.0). We determined in advance the mean temperatures T_m of the binaries (Table 5) by their infrared color indices $(J-K)$ from the 2MASS catalog and the calibration color-temperature of Tokunaga (2000).

Table 3. List of standard stars.

Label	Star ID	RA	Dec	g'	i'
V	KR Lyn	08 24 33.51	51 24 40.82	13.130	12.52
Chk	UCAC4 707-047037	08 24 25.65	51 20 20.40	13.054	12.315
C1	UCAC4 708-048557	08 25 27.70	51 25 09.17	12.849	12.618
C2	UCAC4 708-048546	08 24 59.16	51 27 37.80	13.152	12.063
C3	UCAC4 708-048537	08 24 39.14	51 32 47.84	14.025	13.005
C4	UCAC4 708-048531	08 24 30.25	51 34 00.03	14.030	13.475
C5	UCAC4 708-048528	08 24 24.94	51 34 59.20	13.675	12.983
C6	UCAC4 708-048525	08 24 22.72	51 30 42.57	12.111	11.627
C7	UCAC4 708-048535	08 24 34.57	51 24 13.39	14.034	13.285
C8	UCAC4 707-047041	08 24 35.01	51 20 59.93	12.578	11.58
C9	UCAC4 707-047035	08 24 20.75	51 19 26.48	14.014	13.141
C10	UCAC4 707-047038	08 24 26.92	51 14 44.03	13.648	12.938
C11	UCAC4 707-047031	08 24 15.33	51 16 31.76	13.572	12.954
V	CSS J1102+24	11 02 12.08	24 44 12.40	13.829	13.057
Chk	UCAC4-803-018811	11 01 55.42	24 40 48.82	14.553	13.774
C1	UCAC4 574-046294	11 01 44.42	24 39 00.81	14.040	12.936
C2	UCAC4 573-048335	11 02 36.97	24 35 41.47	13.686	12.564
C3	UCAC4 574-046322	11 03 00.52	24 44 29.06	13.592	12.832
C4	UCAC4 574-046318	11 02 50.86	24 45 59.97	12.420	11.891
C5	UCAC4 574-046312	11 02 40.82	24 45 19.21	12.783	11.603
C6	UCAC4 575-046935	11 02 29.94	24 52 08.23	13.544	12.890
C7	UCAC4 575-046910	11 01 14.92	24 48 40.58	14.397	13.621
C8	UCAC4 575-046926	11 02 03.98	24 58 02.04	13.073	12.651
V	NSVS 4917488	10 41 04.56	38 54 14.80	11.720	11.09
Chk	UCAC4 645-048700	10 40 01.79	38 53 57.28	13.445	12.231
C1	UCAC4 646-049052	10 40 27.05	39 02 02.62	12.702	12.348
C2	UCAC4 645-048712	10 40 58.39	38 54 52.19	13.897	13.401
C3	UCAC4 645-048731	10 41 56.54	38 55 24.99	12.732	12.316
C4	UCAC4 645-048730	10 41 55.43	38 49 32.16	12.641	12.288
C5	UCAC4 644-047762	10 40 52.66	38 46 16.92	14.002	13.584
C6	UCAC4 645-048726	10 41 32.60	38 56 02.70	14.018	13.496
V	NSVS 7336024	07 52 07.40	30 17 45.90	13.970	12.93
Chk	UCAC4 602-042451	07 52 08.80	30 15 48.39	13.331	12.282
C1	UCAC4 601-043207	07 51 31.09	30 10 06.61	14.013	13.41
C2	UCAC4 601-043211	07 51 36.48	30 09 35.16	12.695	12.346
C3	UCAC4 602-042453	07 52 11.54	30 12 16.97	12.259	11.627
C4	UCAC4 602-042490	07 52 50.04	30 13 47.89	13.551	13.033
C5	UCAC4 602-042413	07 51 25.65	30 19 47.41	12.373	11.332
C6	UCAC4 602-042433	07 51 44.06	30 15 18.27	13.686	13.189
C7	UCAC4 603-043529	07 51 52.22	30 25 10.65	13.491	12.897
C8	UCAC4 602-042493	07 52 51.84	30 17 00.27	14.105	13.136
C9	UCAC4 602-042492	07 52 50.37	30 18 51.02	14.003	13.487
C10	UCAC4 602-042479	07 52 38.65	30 23 40.88	12.727	12.216
C11	UCAC4 602-042446	07 51 59.94	30 13 28.70	14.328	13.756
C12	UCAC4 601-043274	07 52 38.18	30 09 59.19	13.502	12.605
C13	UCAC4 601-043275	07 52 38.37	30 09 22.59	12.813	12.39

Table 4. Times of the observed light minima at Rozhen.

Target	Type of minima	Times of minima, HJD
KR Lyn	I	2457782.34333(6)
KR Lyn	II	2457782.51748(9)
CSS J1102+24	II	2457491.28614(7)
CSS J1102+24	I	2457491.41688(8)
CSS J1102+24	II	2457491.54436(6)
CSS J1102+24	II	2457492.32140(7)
CSS J1102+24	I	2457493.35845(9)
CSS J1102+24	I	2457493.48931(4)
NSVS 4917488	II	2457799.38297(6)
NSVS 4917488	I	2457802.37212(9)
NSVS 7336024	II	2457742.33944(7)
NSVS 7336024	I	2457742.47425(7)
NSVS 7336024	II	2457742.61105(6)
NSVS 7336024	I	2457744.36101(8)

The light curves of NSVS 4917488 and NSVS 7336024 (Fig. 1) reveal a flat primary minimum (occultation) that implies the W-subtype binaries, i.e. searching for solutions with $q > 1$. For the partially-eclipsed binaries KR Lyn and CSS J110212+244412 we had to vary mass ratio arbitrarily.

Table 5. Target temperatures.

Target	KR Lyn	CSS J1102+24	NSVS 4917488	NSVS 7336024
T_m	5830	5338	5700	5010

The procedure of the light curve solutions consists of several steps. First, we adopted the primary temperature $T_1 = T_{\rm m}$ and searched for the best fit varying: the secondary temperature T_2; mass ratio q; orbital inclination i (in the range 60–90° corresponding to the eclipse depths); potential Ω. We adopted the coefficients of gravity brightening 0.32 and reflection effect 0.5 appropriate for late stars (Table 5). The limb-darkening coefficients were chosen according to the tables of Van Hamme (1993).

In order to reproduce the O'Connell effect we used cool spots and varied their parameters (longitude λ, latitude β, angular size α and temperature factor κ).

After reaching the best solution (corresponding to the minimum of χ^2) we adjusted the stellar

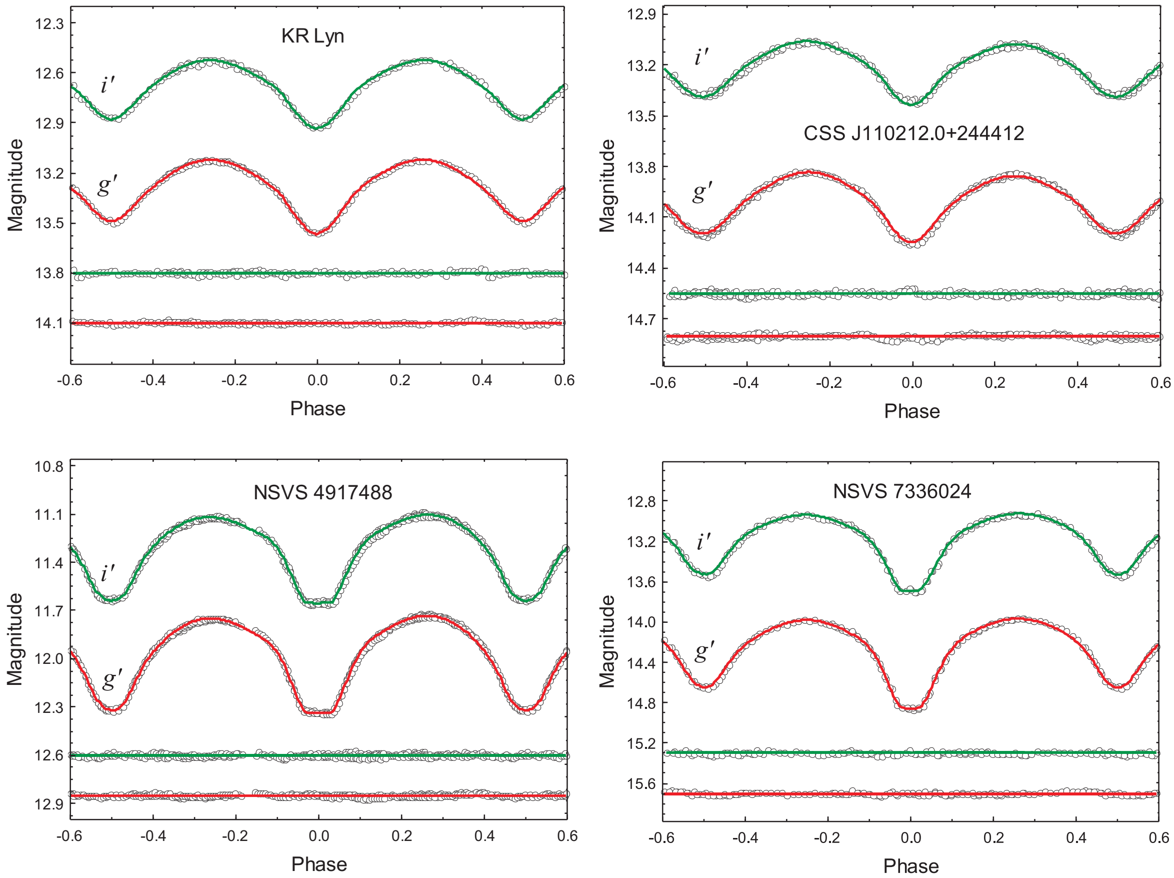

Fig. 1. *Top: the folded light curves of the targets and their fits; Bottom: the corresponding residuals (shifted vertically by a different amount to save space). The observational data are accessible in the form of tables (whose samples A1-A4 are shown in the Appendix) at* $http://www.irida-observatory.org/Observations/irida-14-SerAJ.zip$.

temperatures T_1 and T_2 around the value T_m by the formulae (Kjurkchieva and Vasileva 2015)

$$T_1^f = T_{\rm m} + \frac{c\Delta T}{c+1}; \quad T_2^f = T_1^f - \Delta T \qquad (5)$$

where the quantities $c = L_2/L_1$ (the luminosity ratio) and $\Delta T = T_m - T_2$ are determined from the PHOEBE solution.

PHOEBE gives a possibility to calculate all values (polar, point, side, and back) of the relative radius $r_i = R_i/a$ of each component (R_i is linear radius and a is orbital separation). Moreover, one can determine the luminosity ratio $c = L_2/L_1 = l_2/l_1$ from the PHOEBE output parameter $M_{\rm bol}^2 - M_{\rm bol}^1$.

The formal PHOEBE errors of the fitted parameters were unreasonably small. That is why we estimated the parameter errors manually based on the following rule (Dimitrov et al. 2017). The error of parameter b corresponded to that deviation Δb from its final value b^f for which the mean residuals increase by $3\bar{\sigma}$ ($\bar{\sigma}$ is the mean photometric error of the target).

In order to take into account the effect of possible correlation between the mass ratio and orbital inclination we carried out the q-search analysis. For this aim we fixed the component temperatures and radii as well as the spot parameters and calculated the normalized χ^2 for a two-dimensional grid along i and q. Fig. 2 illustrates the result from this q-search procedure for KR Lyn.

Table 6 contains the final values of the fitted stellar parameters and their uncertainties: inclination i; mass ratio q; potential Ω; secondary temperature T_2.

Table 7 exhibits the calculated parameters: stellar temperatures $T_{1,2}^f$; relative stellar radii $r_{1,2}$ (back values); fillout factor f; luminosity ratio L_2/L_1. Their errors are determined from the uncertainties of fitted parameters used for their calculation.

Table 6. Fitted parameters of the best light curve solutions.

Star	i	q	T_2	Ω
KR Lyn	66.4±0.2	1.996±0.005	5557±15	5.184±0.03
CSS J1102+24	69.7±0.2	0.305±0.004	5119±20	2.442±0.003
NSVS 4917488	83.9±0.2	3.807±0.003	5574±10	7.523±0.01
NSVS 7336024	82.75±0.1	2.878±0.005	4783±25	6.420±0.02

Table 7. Calculated parameters.

Star	T_1^f	T_2^f	r_1	r_2	f	L_2/L_1
KR Lyn	6019±5	5746±10	0.329±0.004	0.449±0.004	0.104	0.445
CSS J1102+24	5507±5	5288±15	0.497±0.002	0.293±0.002	0.187	0.295
NSVS 4917488	5798±2	5672±8	0.284±0.003	0.512±0.002	0.232	0.286
NSVS 7336024	5183±6	4956±19	0.295±0.002	0.478±0.002	0.057	0.311

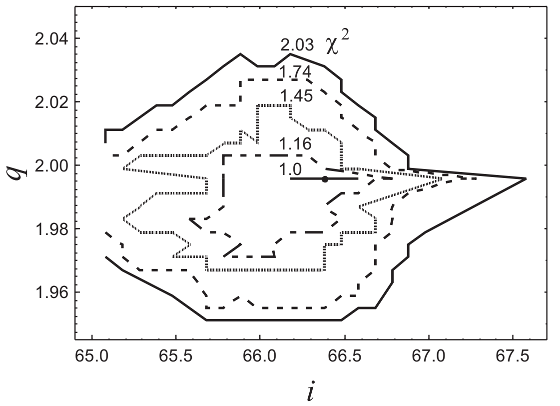

Fig. 2. *Illustration of the q-search method for KR Lyn.*

Table 8 reveals the spot parameters reproducing the light curve distortions. Due to the correlation between spot parameters we present parameters of the equatorial spots which have minimum radii.

The synthetic curves corresponding to the parameters of our light curve solutions are shown in Fig. 1 as continuous lines while Fig. 3 exhibits the 3D configurations.

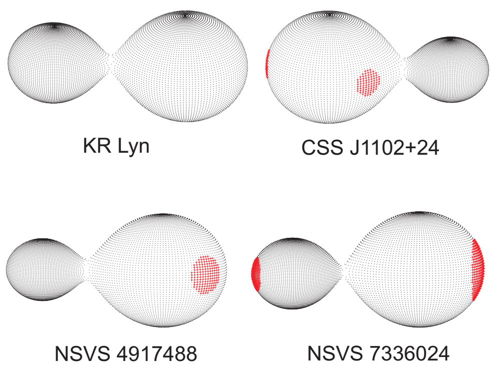

Fig. 3. *3D configurations of the targets.*

Table 8. Spot parameters.

Star (component)	λ [°]	α [°]	κ
CSS J1102+24 (1)	313±1	13±1	0.84±0.01
(1)	178±1	16±1	0.87±0.01
NSVS 4917488 (1)	139±1	18±1	0.84±0.01
NSVS 7336024 (1)	161±1	29±1	0.87±0.01
(2)	178±1	24±1	0.84±0.01

4. RESULTS AND CONCLUSIONS

The main results from our study of the W UMa-type binaries KR Lyn, CSS J1102+24, NSVS 4917488, and NSVS 7336024 are as follows.

(1) We determined initial epochs for all targets and improved the period of CSS J1102+24.

(2) All targets are overcontact binaries with the fillout factor in the range 0.06–0.23. Hence, their mass ratios should be considered with confidence (Terrell and Wilson 2005).

(3) KR Lyn and CSS J1102+24 undergo partial eclipses while NSVS 4917488 and NSVS 7336024 reveal total eclipses. Hence, the parameters of the last two targets could be considered as well-determined.

(4) The components of all targets are G or K stars whose temperature differences do not exceed 300 K.

(5) The components of all targets differ considerably in size and mass (Tables 6–7).

(6) The light distortions of CSS J1102+24, NSVS 4917488 and NSVS 7336024 were reproduced by one/two cool spot(s) with angular radii 13–29°. The photospheric activity is an expected characteristic for these cool stars.

(7) The light curve solutions revealed that NSVS 4917488, NSVS 7336024 and KR Lyn are of W-subtype while CSS J1102+24 is of A-subtype.

This investigation added four new members to the family of short-period binaries with determined parameters which may be used for improving their empirical relations.

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REFERENCES

Berry, R. and Burnell, J.: 2005, The Handbook of Astronomical Image Processing 2nd ed., Willmann-Bell, Richmond, VA.
Bilir, S., Karatas, Y., Demircan, O. and Eker, Z.: 2005, *Mon. Not. R. Astron. Soc.*, **357**, 497.
Binnendijk, L.: 1970, *Vistas in Astronomy*, **12**, 217.
Dall, T. H. and Schmidtobreick, L.: 2005, *Astron. Astrophys.*, **429**, 625.
Dimitrov, D., Kjurkchieva, D. and Iliev, I.: 2017, *Mon. Not. R. Astron. Soc.*, **469**, 2089.
Ghedini, S.: 1982, Software for Photometric Astronomy, Willmann-Bell, Richmond, VA.
Kjurkchieva, D. and Vasileva, D.: 2015, *Publ. Astron. Soc. Aust.*, **32**, 23.
Kjurkchieva, D., Popov, V., Vasileva, D. and Petrov, N.: 2016, *Serb. Astron. J.*, **192**, 21.
Kwee, K. K. and van Woerden, H.: 1956, *Bull.Astron. Inst. Neth.*, **9**, 252.
Li, L., Zhang, F., Han, Z. and Jiang, D.: 2007, *Astrophys. J.*, **662**, 596.
Nelson, R.: 2007, https://www.variablestarssouth.org/software-by-bob-nelson/
Prsa, A. and Zwitter, T.: 2005, *Astrophys. J. Suppl. Ser.*, **628**, 426.
Rucinski, S. M.: 2002, *Publ. Astron. Soc. Pac.*, **114**, 1124.
Smith, R. C.: 1984, *Quarterly Journal of the Royal Astronomical Society*, **25**, 405.
Terrell, D. and Wilson, R.: 2005, *Astrophys. Space Sci.*, **296**, 221.
Tokunaga, A. T.: 2000, Allen's Astrophysical Quantities, Springer, New York.
Van Hamme, W.: 1982a, *Astron. Astrophys.*, **105**, 389.
Van Hamme, W.: 1982b, *Astron. Astrophys.*, **116**, 27.
Van Hamme, W.: 1993, *Astron. J.*, **106**, 2096.
Wilson, R. E. and Devinney, E. J.: 1971, *Astrophys. J.*, **166**, 605.
Wilson, R.: 1979, *Astrophys. J.*, **234**, 1054.
Wilson, R.: 1993, *ASP Conference Series*, **38**, 91.
Zacharias, N. et al.: 2013, *Astron. J.*, **145**, 44.

APPENDIX

Table A1. Photometric data for KR Lyn.

JD	*g'*	error *g'*
2457782.21397178	13.227	0.004
2457782.21711172	13.200	0.003
2457782.22028165	13.197	0.003
...	...	...
JD	*i'*	error *i'*
2457782.21555175	12.612	0.006
2457782.21870168	12.599	0.006
2457782.22186162	12.580	0.006
...	...	...

* The complete table is available at http://saj.math.rs/196/TableA1.dat.

Table A2. Photometric data for CSS J110212+244412.

JD	*g'*	error *g'*
2457491.26939790	14.124	0.006
2457491.27257768	14.143	0.006
2457491.27573747	14.170	0.006
...	...	...
JD	*i'*	error *i'*
2457491.27098779	13.315	0.009
2457491.27416758	13.351	0.010
2457491.27730736	13.361	0.010
...	...	...

* The complete table is available at http://saj.math.rs/196/TableA2.dat.

Table A3. Photometric data for NSVS 4917488.

JD	*g'*	error *g'*
2457798.22995132	11.734	0.003
2457798.23209133	11.741	0.003
2457798.23426133	11.737	0.003
...	...	...
JD	*i'*	error *i'*
2457798.23103133	11.110	0.004
2457798.23316133	11.093	0.004
2457798.23533133	11.108	0.004
...	...	...

* The complete table is available at http://saj.math.rs/196/TableA3.dat.

Table A4. Photometric data for NSVS 7336024.

JD	*g'*	error *g'*
2457742.31829715	14.253	0.007
2457742.32187731	14.332	0.007
2457742.32547747	14.422	0.007
...	...	...
JD	*i'*	error *i'*
2457742.32005723	13.211	0.010
2457742.32367739	13.302	0.010
2457742.32731756	13.355	0.011
...	...	...

* The complete table is available at http://saj.math.rs/196/TableA4.dat.

ПОСМАТРАЊА И РЕШЕЊА ЗА КРИВЕ СЈАЈА ЕКЛИПСНО ДВОЈНИХ СИСТЕМА KR Lyn, CSS J110212+244412, NSVS 4917488 И NSVS 7336024

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Стручни чланак

У раду представљамо фотометријска посматрања краткопериодичних еклипсно двојних звезда KR Lyn, CSS J110212+244412, NSVS 4917488 и NSVS 7336024, спроведена коришћењем Слоунових филтера g', i'. Криве сјаја показују да су све посматране звезде контактни двојни системи у којима су компоненте спектралних класа G и K. Разлика у температурама компоненти не прелази 300, али се саме компоненте битно разликују по величини и маси. NSVS 4917488 и NSVS 7336024 показују потпуна помрачења и њихове параметре можемо сматрати поуздано одређеним. Пронађено је да су системи KR Lyn, NSVS 4917488 и NSVS 7336024 W-подтипа, док је CSS J110212+244412 A-подтип звезда типа W UMa.