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Chromospherically active stars in the OGLE-II database: Paper 2. Another 25 new variables

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Abstract: Another 25 new chromospherically active stars are presented, which were found in the OGLE-II database:
OGLE-II BUL_SC4_463586, OGLE-II BUL_SC4_649863, OGLE-II BUL_SC4_661351,
OGLE-II BUL_SC4_636297, OGLE-II BUL_SC39_97323, OGLE-II BUL_SC39_68727,
OGLE-II BUL_SC39_111735, OGLE-II BUL_SC1_462536, OGLE-II BUL_SC1_451975,
OGLE-II BUL_SC1_451926, OGLE-II BUL_SC1_463762, OGLE-II BUL_SC1_452586,
OGLE-II BUL_SC1_628838, OGLE-II BUL_SC1_655399, OGLE-II BUL_SC1_652986,
OGLE-II BUL_SC1_629202, OGLE-II BUL_SC1_608452, OGLE-II BUL_SC45_102713,
OGLE-II BUL_SC45_78178, OGLE-II BUL_SC45_101976, OGLE-II BUL_SC45_101872,
OGLE-II BUL_SC45_101465, OGLE-II BUL_SC45_268912, OGLE-II BUL_SC45_268843,
OGLE-II BUL_SC2_745969

The new chromospherically active stars presented in this paper have been found during a programme of optical identification of X-ray sources from Chandra X-ray observatory (http://cxc.harvard.edu/) in the DIA OGLE-II candidate variable stars catalog (Wozniak et al., 2002). For further details of the programme see Bernhard, 2009.
The OGLE-II 1.3 m Warsaw University Telescope is situated at Las Campanas Observatory in Chile, an I filter is used in combination with a SITe 2048×2049 thin chip (Szymański, 2005, Udalski et. al, 1997) . The OGLE-II data are available at http://ogledb.astrouw.edu.pl/~ogle/photdb/ .

The criteria for including a star in this list of chromospherically active stars including an analysis of the OGLE-II data with Period 04 (Lenz and Breger 2005) were:

i) the X-ray identification: Because of the crowded OGLE fields only those objects from the DIA OGLE-II candidate variable list were chosen, which had a maximum distance of 2 arcseconds to a X-ray source from the Chandra X-ray catalog. Therefore it is very likely that the X-ray identifications of the variables stars given in this paper are correct and types of variables like Cepheids or semiregular variables can be ruled out because of their low X-ray emission (see the more detailed discussion in Bernhard&Lloyd, 2008).

ii) an investigation of the respectively star fields using ALADIN (http://aladin.u-strasbg.fr/aladin.gml) to check, if there are nearby open star clusters or known young stellar objects to rule out young stellar objects (T Tauri stars), which usually can be found in associations.

iii) period, amplitude and shape of the light curve are consistent with the definition of RS CVn and BY Dra stars in the GCVS (http://www.sai.msu.su/groups/cluster/gcvs/gcvs/iii/vartype.txt , for a detailed description and sample light curves of the various types of chromospherically active stars see Berdyugina, 2005). Due to the shapes of the light curves other types of chromospherically active and X-ray emitting objects like W UMa variables and Algol stars can be ruled out.

iiii) appropriate 2MASS J-K (Skrutskie et al. 2006, Table 8 in Gonzalez-Solares et al. 2008) colour index if available. A possible interstellar reddening of the 2MASS J-K values has to be considered near the Galactic plane (Sumi, 2004).

Further information like proper motions (Sumi et al., 2003) and the relation of the maximum amplitude vs. periods of main sequence stars given in Messina et al., 2003 were also used for the classification of the objects.

The resulting list of variables contains with a very high likelihood chromospherically active stars of the types RS CVn or BY Dra, which exhibit spectral types of F-K (these are mostly RS CVn systems, and a small number of FK Comae stars) and K-M (BY Dra variables).

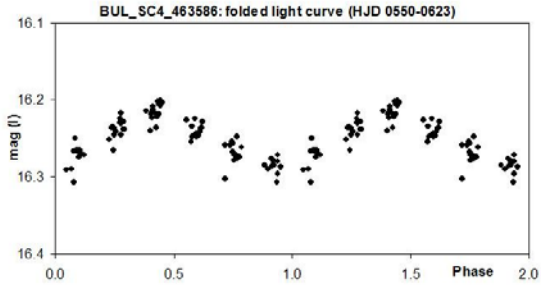
The light variability of RS CVn and BY Dra variables is caused by axial rotation of a star with a variable degree of nonuniformity of the surface brightness (spots). Some of these variables are also eclipsing systems. Secular variations of the light curves, which are typical for many RS CVn and BY Dra variables (see the detailed light curves below) can be explained by the existence of a long-period stellar activity cycle similar to the 11-year solar activity cycle, during which the number and total area of spots on the star's surface vary.

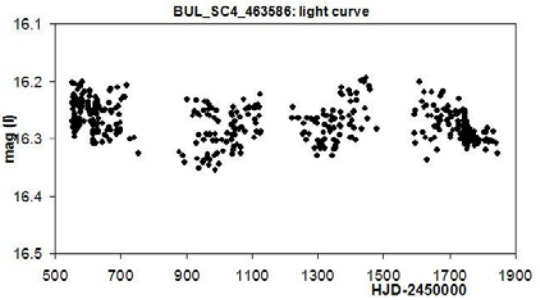
Table 1: Positions, identifications and photometric data for the new chromospherically active stars, Figures in brackets denote errors (sigma) in units of the last decimal, the epochs are given as HJD-2450000. The ranges are derived from the time span of the OGLE observations, due to secular variations (activity cycles) the full ranges could be somewhat larger.

No.	OGLE II	RA (2000)	Dec	X-Ray id	Range(OGLE)	Epoch(Min)	Per.(d)
26	BUL_SC4_463586	17 54 51.21	-29 52 50.9	CXO J175451.2-295251	16.20-16.33	0688.51(6)	6.013(1)
27	BUL_SC4_649863	17 54 58.53	-29 51 50.1	CXO J175458.5-295150	16.37-16.58	0575.6(3)	38.8(1)
28	BUL_SC4_661351	17 55 01.89	-29 49 57.4	CXO J175501.9-294957	15.98-16.16	0582.8(3)	34.73(2)
29	BUL_SC4_636297	17 55 04.88	-29 55 25.1	CXO J175504.8-295525	15.77-15.90	0629.59(1)	1.21880(2)
30	BUL_SC39_97323	17 55 08.35	-29 47 35.7	CXO J175508.3-294736	13.91-14.10	0628.6(5)	63.3(2)
31	BUL_SC39_68727	17 55 08.67	-29 54 18.5	CXO J175508.6-295419	16.19-16.33	0561.8(3)	37.6(2)
32	BUL_SC39_111735	17 55 14.74	-29 42 35.2	CXO J175514.7-294236	12.73-12.79	0577.82(7)	7.86(1)
33	BUL_SC1_462536	18 02 41.80	-29 55 10.2	CXO J180241.8-295510	12.88-13.20	0896.7(2)	21.74(1)
34	BUL_SC1_451975	18 02 45.27	-30 01 08.5	CXO J180245.2-300108	13.75-13.85	0989.7(1)	14.22(1)
35	BUL_SC1_451926	18 02 45.39	-29 57 55.3	CXO J180245.4-295755	12.08-12.16	0657.7(4)	46.61(5)
36	BUL_SC1_463762	18 02 48.45	-29 55 31.3	CXO J180248.4-295531	17.20-17.42	0568.7(1)	12.892(5)
37	BUL_SC1_452586	18 02 48.63	-29 58 34.8	CXO J180248.6-295835	15.65-15.92	0623.8(3)	39.45(6)
38	BUL_SC1_628838	18 02 51.81	-29 59 58.6	CXO J180251.8-295958	15.21-15.43	0936.8(1)	15.64(1)
39	BUL_SC1_655399	18 02 54.48	-29 51 18.5	CXO J180254.4-295118	17.09-17.32	0988.68(3)	3.7766(4)
40	BUL_SC1_652986	18 02 55.96	-29 52 23.6	CXO J180255.9-295224	15.93-16.08	1252.8(2)	25.59(2)
41	BUL_SC1_629202	18 03 00.62	-29 59 46.6	CXO J180300.6-295946	16.00-16.08	1610.90(9)	9.240(2)
42	BUL_SC1_608452	18 03 01.81	-30 07 56.2	CXO J180301.8-300755	15.80-15.90	1672.8(1)	12.341(4)
43	BUL_SC45_102713	18 03 04.31	-29 54 35.8	CXO J180304.3-295435	16.50-16.61	1256.9(2)	19.35(5)
44	BUL_SC45_78178	18 03 11.85	-30 04 58.9	CXO J180311.8-300459	14.64-14.72	1749.56(8)	8.906(7)
45	BUL_SC45_101976	18 03 14.16	-29 55 25.7	CXO J180314.1-295525	15.77-15.91	1755.7(2)	21.59(4)
46	BUL_SC45_101872	18 03 15.00	-29 56 25.2	CXO J180315.0-295625	15.78-16.03	1773.6(3)	30.45(1)
47	BUL_SC45_101465	18 03 18.49	-29 57 39.7	CXO J180318.5-295739	14.88-15.00	1775.6(4)	48.9(1)
48	BUL_SC45_268912	18 03 25.71	-29 55 15.5	CXO J180325.7-295515	16.42-16.60	1626.87(3)	3.7015(4)
49	BUL_SC45_268843	18 03 30.90	-29 55 33.2	CXO J180330.9-295533	16.72-16.92	1754.7(2)	19.851(6)
50	BUL_SC2_745969	18 04 55.55	-28 38 31.6	CXO J180455.5-283831	14.95-15.01	1700.59(5)	5.190(4)

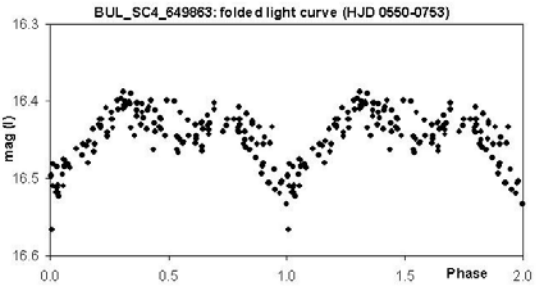
Folded light curves (with the period given above), light curves and comments:
Some of the following stars showed a clear variation of the shape of the light curves.
Therefore the folded light curves are given for a distinct time period of time (described in figure as HJD 245 ....-....).

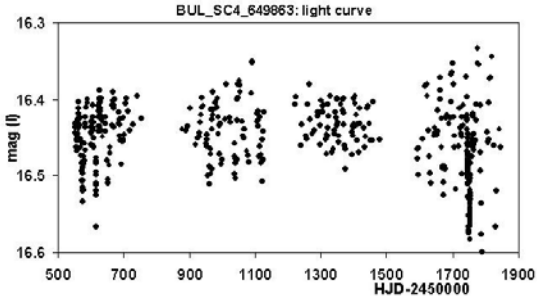
No. 26 OGLE-II BUL_SC4_463586
period: 6.013(1) d
pmRA -3.59 mas/yr pmDEC 6.70 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



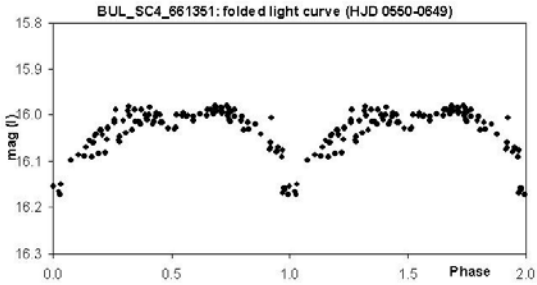


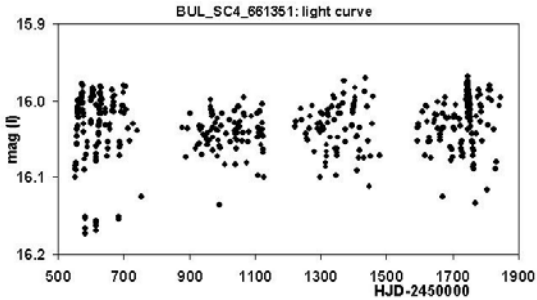
No. 27 OGLE-II BUL_SC4_649863
period: 38.8(1) d
pmRA -5.90 mas/yr pmDEC -17.11 mas/yr (Sumi et al., 2004)
likely a RS CVn variable



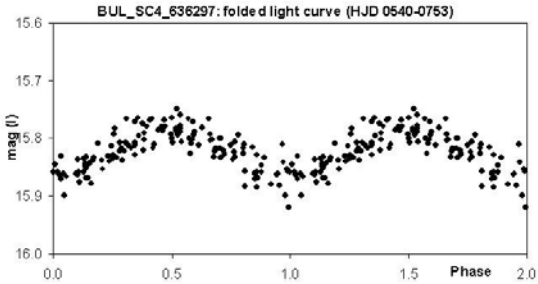


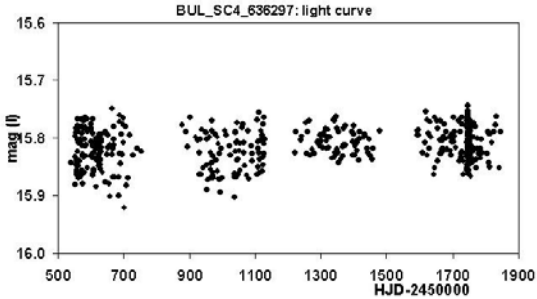
No. 28 OGLE-II BUL_SC4_661351
period: 34.73(2) d
pmRA -0.30 mas/yr pmDEC -5.34 mas/yr (Sumi et al., 2004)
likely an eclipsing RS CVn variable



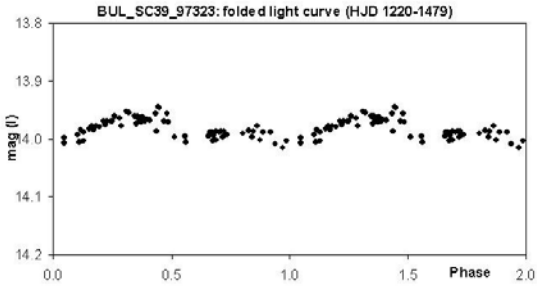


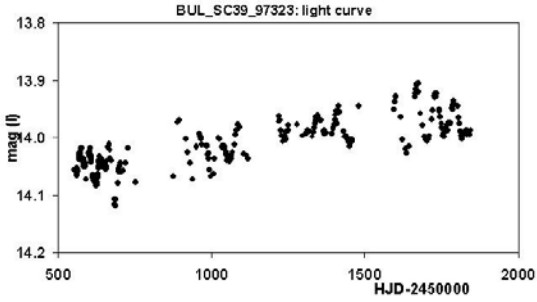
No. 29 OGLE-II BUL_SC4_636297
period: 1.21880(2) d
pmRA 2.98 mas/yr pmDEC 2.41 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



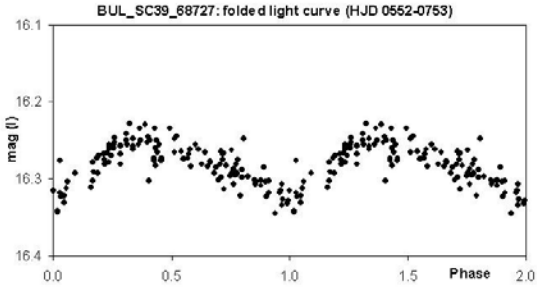


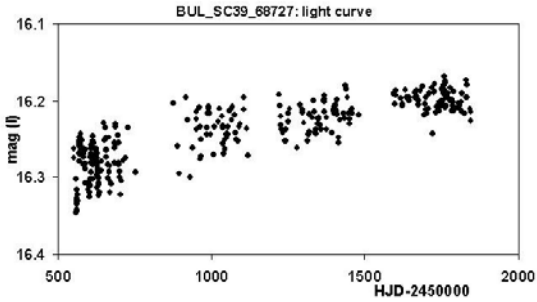
No. 30 OGLE-II BUL_SC39_97323
period: 63.3(2) d
2MASS J-K: 0.801
likely a RS CVn variable



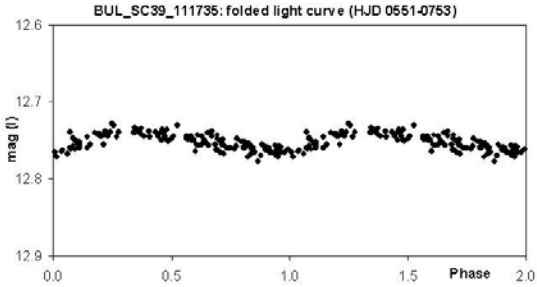


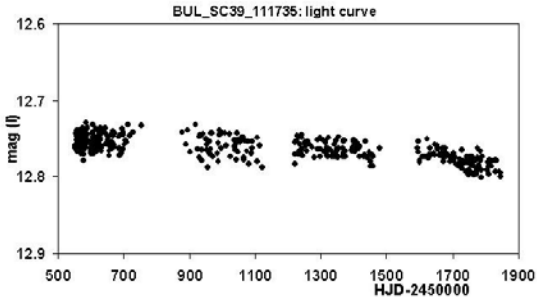
No. 31 OGLE-II BUL_SC39_68727
period: 37.6(2) d
pmRA 5.25 mas/yr pmDEC 7.22 mas/yr (Sumi et al., 2004)
likely a RS CVn variable



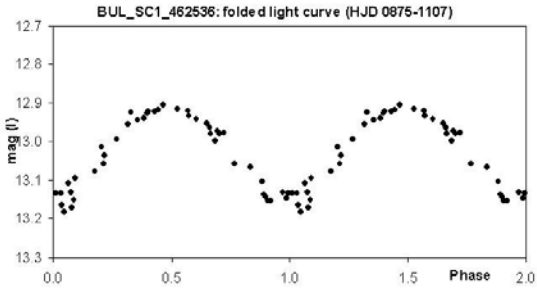


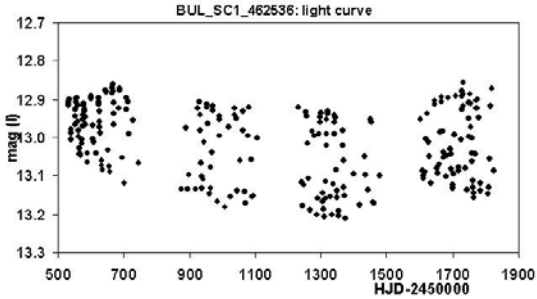
No. 32 OGLE-II BUL_SC39_111735
period: 7.86(1) d
2MASS J-K: 0.840
pmRA -13.52 mas/yr pmDEC -25.09 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



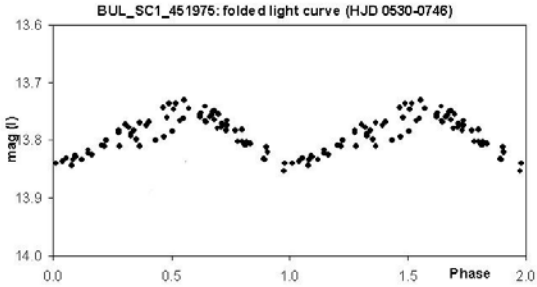


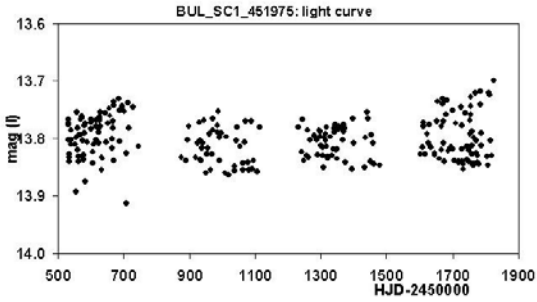
No. 33 OGLE-II BUL_SC1_462536
period: 21.74(1) d
2MASS J-K: 0.903
pmRA -0.44 mas/yr pmDEC -0.62 mas/yr (Sumi et al., 2004)
likely a RS CVn variable



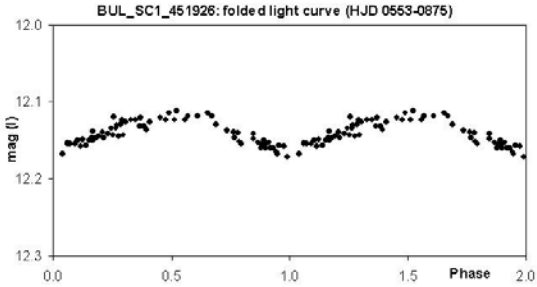


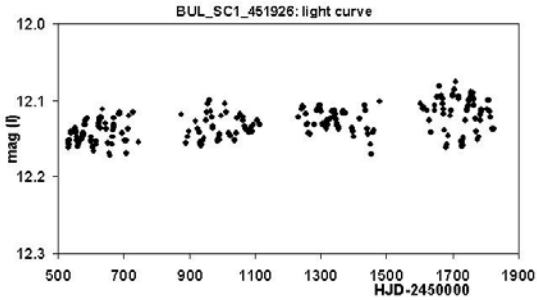
No. 34 OGLE-II BUL_SC1_451975
period: 14.22(1) d
2MASS J-K: 0.887
pmRA 4.80 mas/yr pmDEC 5.34 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



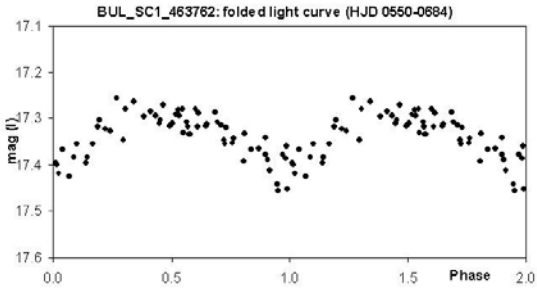


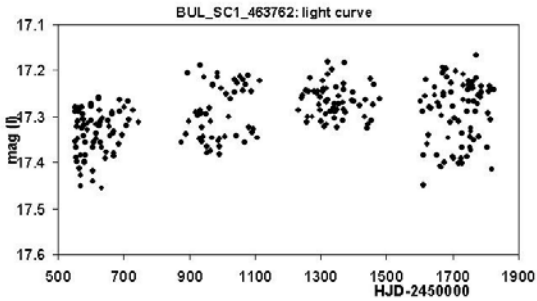
No. 35 OGLE-II BUL_SC1_451926
period: 46.61(5) d
2MASS J-K: 0.748
likely a RS CVn variable



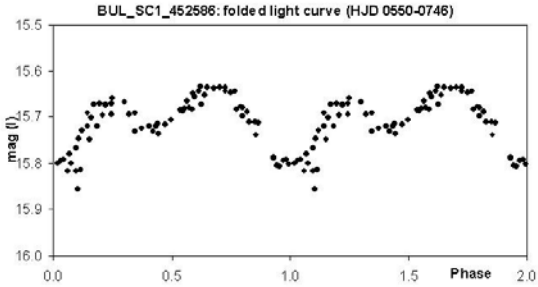


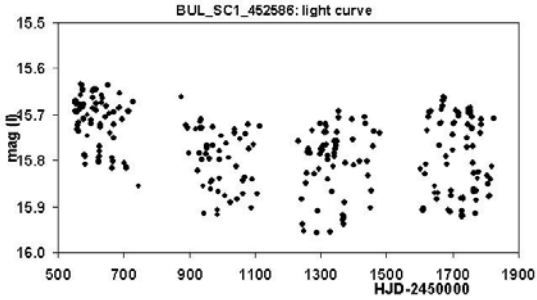
No. 36 OGLE-II BUL_SC1_463762
period: 12.892(5) d
OGLE variable: OGLE BWC V173, type MISC (Szymanski et al., 1996)
pmRA -9.09 mas/yr pmDEC 3.17 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



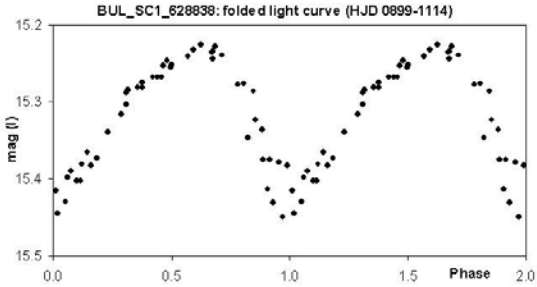


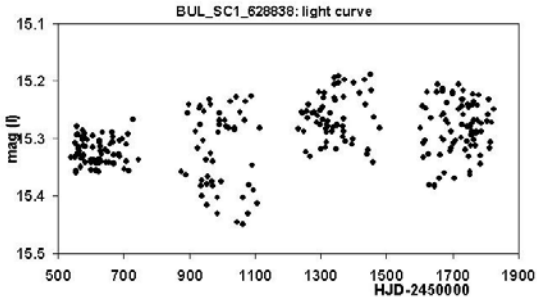
No. 37 OGLE-II BUL_SC1_452586
period: 39.45(6) d
OGLE variable: OGLE BWC V34, type: MISC, (Szymanski et al., 1996)
pmRA -2.36 mas/yr pmDEC -1.72 mas/yr (Sumi et al., 2004)
likely a RS CVn variable



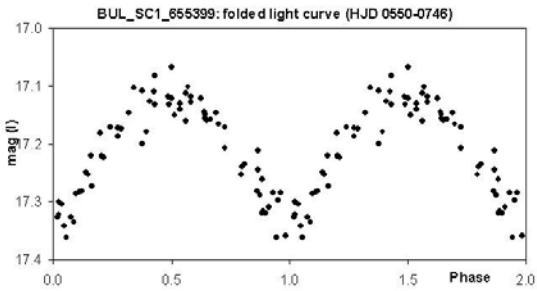


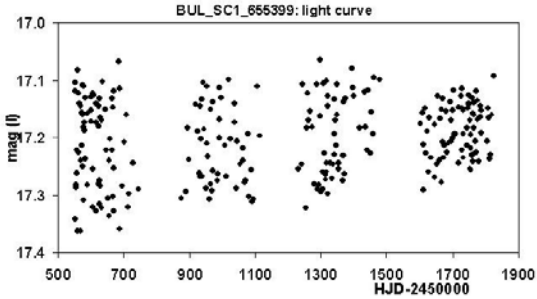
No. 38 OGLE-II BUL_SC1_628838
period: 15.64(1) d
2MASS J-K: 1.01
pmRA -0.11 mas/yr pmDEC 1.10 mas/yr (Sumi et. al, 2003)
it is not possible to decide whether the star is BY Dra or RS CVn



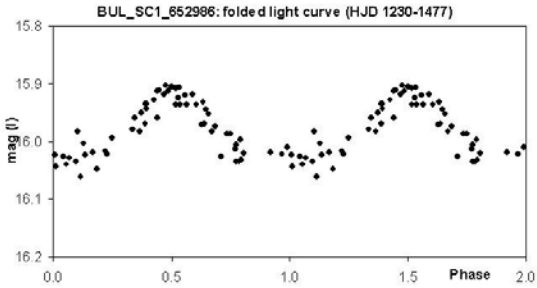


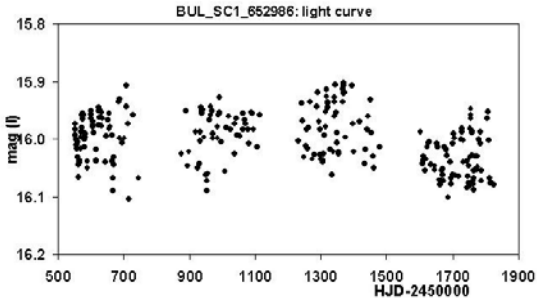
No. 39 OGLE-II BUL_SC1_655399
period 3.7766(4) d
pmRA 4.17 mas/yr pmDEC -0.10 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



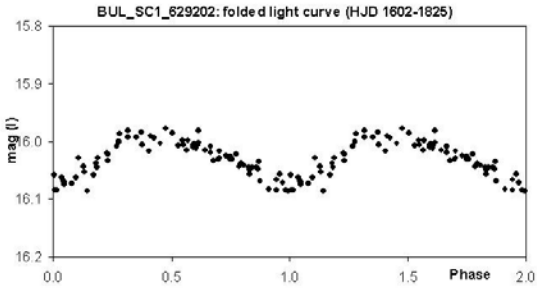


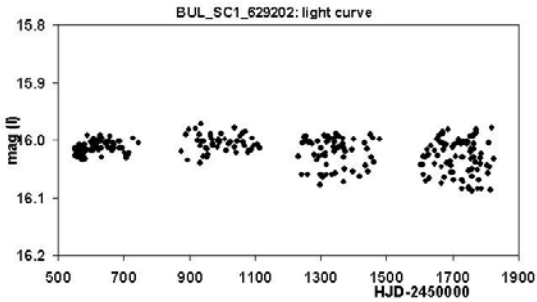
No. 40 OGLE-II BUL_SC1_652986
period: 25.59(2) d
pmRA -3.66 mas/yr pmDEC -1.56 mas/yr (Sumi et. al, 2003)
likely a RS CVn variable



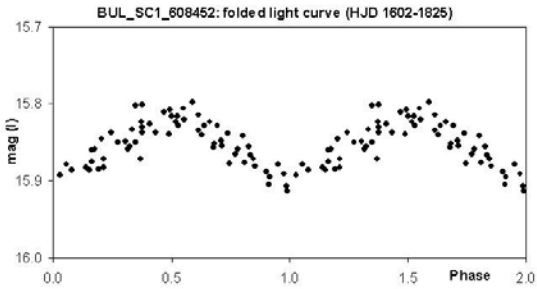


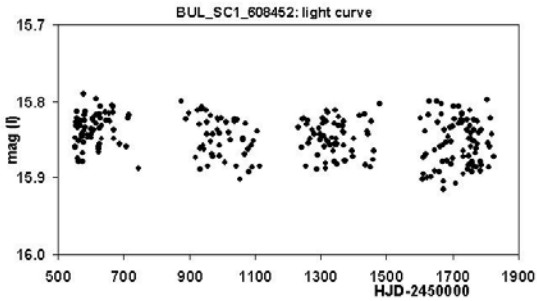
No. 41 OGLE-II BUL_SC1_629202
period: 9.240(2) d
pmRA 2.41 mas/yr pmDEC 6.32 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



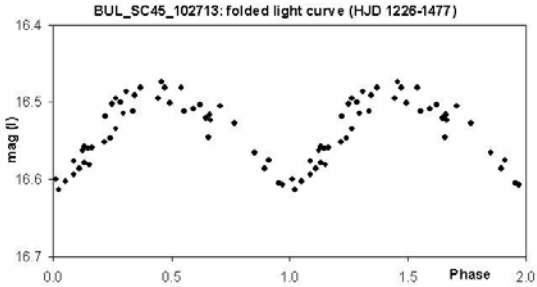


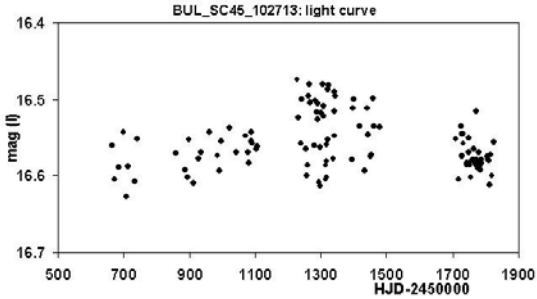
No. 42 OGLE-II BUL_SC1_608452
period: 12.341(4) d
pmRA 1.70 mas/yr pmDEC 4.75 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



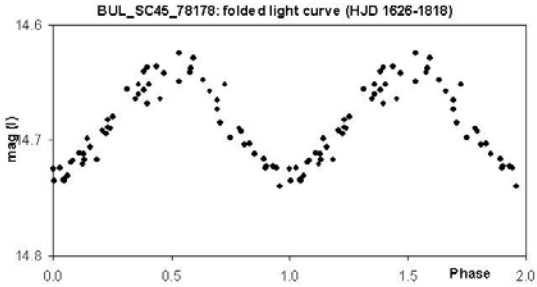


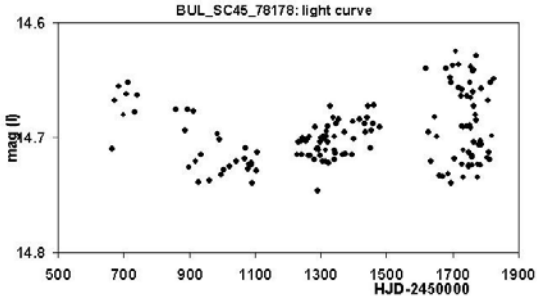
No. 43 OGLE-II BUL_SC45_102713
period: 19.35(5) d
pmRA -6.00 mas/yr pmDEC 5.41 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



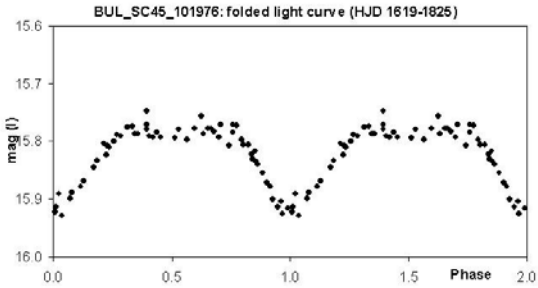


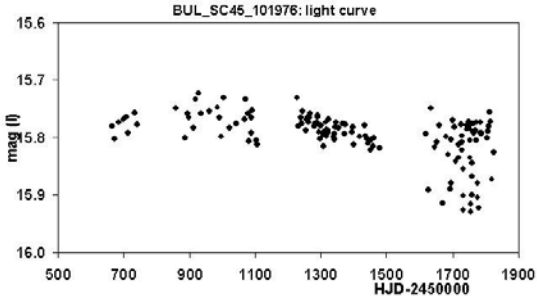
No. 44 OGLE-II BUL_SC45_78178
period: 8.906(7) d
pmRA 5.09 mas/yr pmDEC 1.58 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



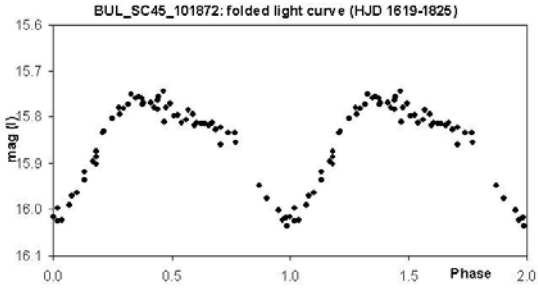


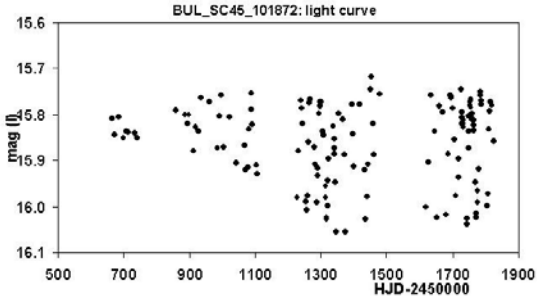
No. 45 OGLE-II BUL_SC45_101976
period: 21.59 (4) d
OGLE variable: OGLE BWC V49 (Szymanski et. al, 1996)
pmRA 0.21 mas/yr pmDEC 3.75 mas/yr (Sumi et al., 2004)
Likely a RS CVn variable



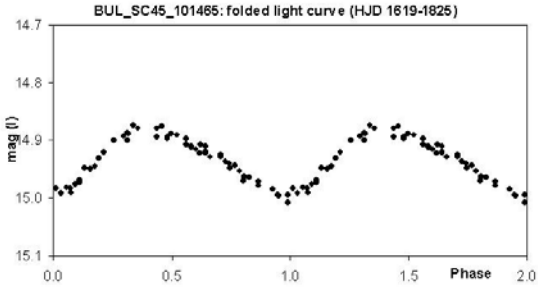


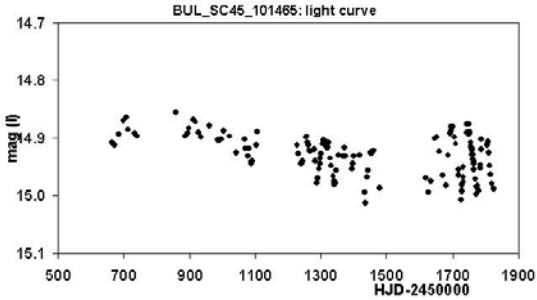
No. 46 OGLE-II BUL_SC45_101872
period: 30.45(1) d
pmRA -3.12 mas/yr pmDEC -1.37 mas/yr (Sumi et al., 2004)
likely a RS CVn variable



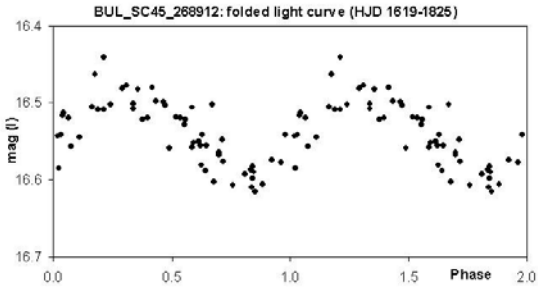


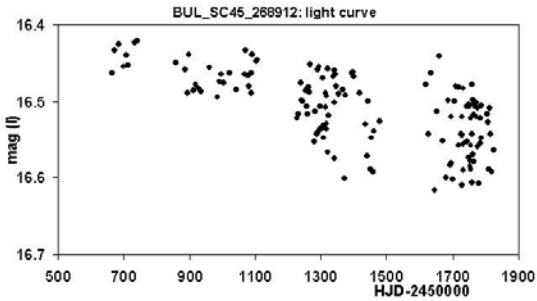
No. 47 OGLE-II BUL_SC45_101465
period: 48.9(1) d
2MASS J-K: 0.932
pmRA 0.52 mas/yr pmDEC 6.11 mas/yr mag (Sumi et al., 2004)
likely a RS CVn variable



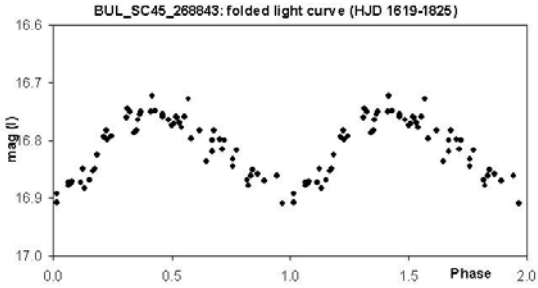


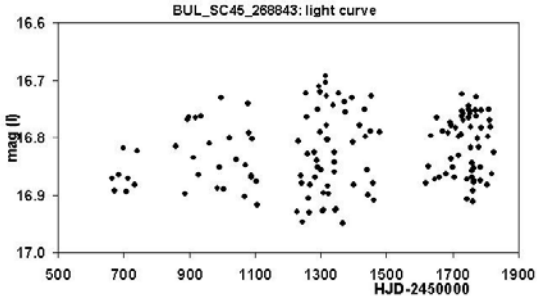
No. 48 OGLE-II BUL_SC45_268912
period: 3.7015(4) d
pmRA 3.33 mas/yr pmDEC 5.90 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn



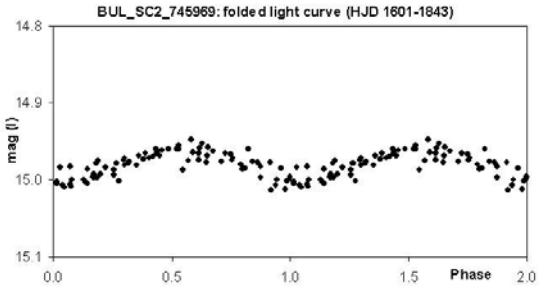


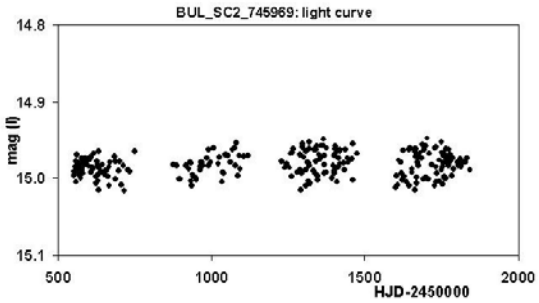
No. 49 OGLE-II BUL_SC45_268843
period: 19.851(6) d
pmRA 2.04 mas/yr, pmDEC -0.81 mas/yr (Sumi et al., 2004)
OGLE variable: OGLE BWC V113: type MISC (Szymanski et al., 1996)
it is not possible to decide whether the star is BY Dra or RS CVn





No. 50 OGLE-II BUL_SC2_745969
period: 5.190(4) d
pmRA -6.21 mas/yr, pmDEC -19.25 mas/yr (Sumi et al., 2004)
it is not possible to decide whether the star is BY Dra or RS CVn





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