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Chromospherically active stars in the ROTSE-1 database: Paper 5. Variables 101 - 125

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Abstract: Another 25 new chromospherically active stars are presented, which were found in the ROTSE-1 database:
GSC 03297-01671, GSC 00664-00136, GSC 02881-00392, GSC 04743-00662, GSC 02388-00772, GSC 00102-01239, GSC 00105-02553, GSC 01337-00535, GSC 00746-00366, GSC 02459-00865, GSC 00182-02245, GSC 00184-02077, GSC 01377-01142, GSC 06020-00653, GSC 05464-01135, GSC 01961-01360, GSC 03010-01373, GSC 00856-01223, GSC 00278-00814, GSC 00915-01391, GSC 04427-01555, GSC 04436-01377, GSC 04223-00399, GSC 01063-00973, GSC 01062-01972
For one of these stars (GSC 00278-00814), further observations were made using a Flatfield Camera 576/2.0 with a CCD camera OES-LcCCD12 and IR-cutting filter in Velden, Germany.

During a programme of optical identification of X-ray sources from the ROSAT All-Sky Bright Source Catalogue (1RXS) (Voges et al., 1999) in the ROTSE1 database (http://skydot.lanl.gov/ , Wozniak et al. 2004) another 25 new chromospherically active stars have been found. For further details of the programme see Schirmer et al. (2009).

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

i) the X-ray identification: Only those variable NSVS objects were chosen, which were within the error ellipse of the ROSAT All-Sky Bright Source Catalogue. 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) and B-V (Høg et al. 2000) colour indices if available.

Further information like the ratios of X-ray to optical flux f_X / f_opt (Voges et al., 1999), proper motions 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.

The ROTSE-I telescope was operated without any filters so the quantum efficiency of the used CCD camera AP-10 camera makes the effective band most comparable to the Johnson R band (range in Table 1). The ranges are derived from the time span of the NSVS observations, due to secular variations (activity cycles) the full ranges could be somewhat larger. The epochs are given for the minima as HJD-2450000, ASAS-3 data (http://www.astrouw.edu.pl/asas/?page=main) are used for the period analysis and the following figures when available (Pojmanski, 2002). Figures in brackets denote errors (sigma) in units of the last decimal.

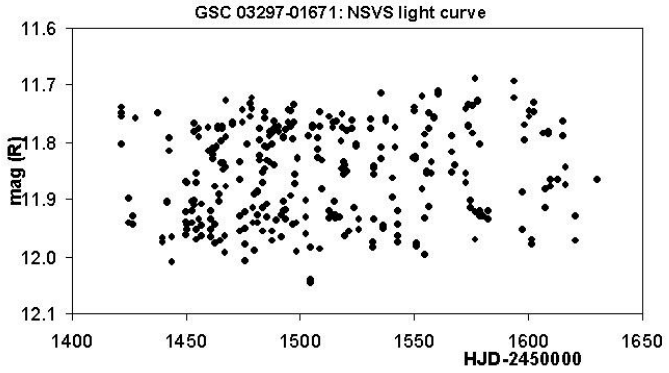
Table 1: Positions, identifications and photometric data for the new chromospherically active stars

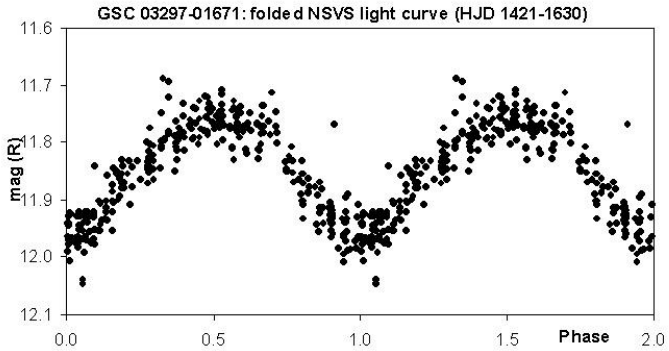
No.	GSC	RA (2000)	Dec	1RXS	Range(NSVS)	Epoch(Min)	Per.(d)	NSVS ID
101	03297-01671	02 53 57.78	+46 09 27.4	J025357.3+460947	11.75-11.97	1426.822(6)	0.67760(3)	4067338
102	00664-00136	03 51 39.60	+14 47 48.2	J035139.0+144753	11.78-12.00	1517.882(6)	0.66929(2)	9386318
103	02881-00392	04 00 05.80	+39 41 37.0	J040005.4+394133	11.65-11.90	1603.75(5)	5.595(2)	4195255
104	04743-00662	04 39 39.17	-05 01 50.8	J043938.9-050202	10.95-11.37	1874.68(1)	1.7836(1)	12253340
105	02388-00772	05 03 29.64	+31 09 41.8	J050328.9+310955	11.60-12.05	1453.8(1)	17.01(2)	6848896
106	00102-01239	05 06 39.98	+02 08 25.2	J050639.5+020828	10.96-11.14	4489.71(2)	1.9814(1)	12307864
107	00105-02553	05 29 29.50	+03 18 20.6	J052929.6+031838	12.20-12.40	1521.72(2)	2.175(1)	12341801
108	01337-00535	06 39 57.11	+20 00 16.8	J063957.4+200008	11.55-11.80	2657.6(1)	18.14(3)	9791679
109	00746-00366	06 40 22.91	+08 35 52.8	J064023.4+083601	11.75-12.10	3631.89(3)	3.7726(2)	9840702
110	02459-00865	07 17 56.58	+34 12 05.5	J071757.1+341206	11.35-11.65	1274.7(2)	24.21(5)	7228575
111	00182-02245	07 36 00.57	+03 16 48.7	J073601.1+031650	11.87-12.07	2794.44(2)	2.7530(1)	12710107
112	00184-02077	07 48 55.79	+03 24 09.6	J074854.4+032349	10.93-11.15	2724.60(4)	4.8836(4)	12728131
113	01377-01142	08 13 37.70	+15 27 15.2	J081337.4+152718	11.84-12.02	3715.760(4)	0.45743(1)	10092166
114	06020-00653	08 47 56.00	-20 25 33.4	J084756.7-202523	10.46-10.62	4142.72(6)	6.9678(4)	15608966
115	05464-01135	09 28 29.50	-09 22 57.9	J092829.9-092259	12.50-12.95	1498.92(6)	6.1092(5)	15690744
116	01961-01360	10 00 52.20	+24 40 20.9	J100053.1+244020	10.65-11.10	3767.696(9)	0.93912(5)	7492908
117	03010-01373	11 12 25.58	+39 50 56.6	J111225.8+395045	11.25-11.70	1277.68(5)	5.250(1)	4966617
118	00856-01223	11 33 37.01	+07 51 29.8	J113336.8+075131	11.24-11.46	2811.54(5)	5.708(1)	10358235
119	00278-00814	11 49 25.18	+05 29 50.2	J114925.2+052955	11.82-11.98	1578.873(6)	0.65589(4)	13147024
120	00915-01391	14 25 55.99	+14 12 10.6	J142555.6+141148	10.47-10.75	2750.79(4)	4.3429(3)	10502467
121	04427-01555	17 28 12.54	+72 39 22.4	J172812.2+723923	11.00-11.15	1457.6(1)	13.87(1)	1091608
122	04436-01377	17 44 11.01	+72 03 02.7	J174411.0+720304	9.80-10.12	1332.67(4)	4.2658(5)	1182069
123	04223-00399	18 48 29.48	+64 23 28.1	J184830.1+642330	10.84-11.07	1457.62(5)	5.279(1)	3011697
124	01063-00973	19 27 28.65	+12 32 16.0	J192729.2+123215	11.70-11.95	2918.56(3)	3.7735(3)	11289898
125	01062-01972	19 54 03.17	+10 41 45.4	J195402.5+104201	9.55-9.82	2867.5(1)	16.675(2)	11329550

Light curves, folded light curves (with the period given above) and comments:

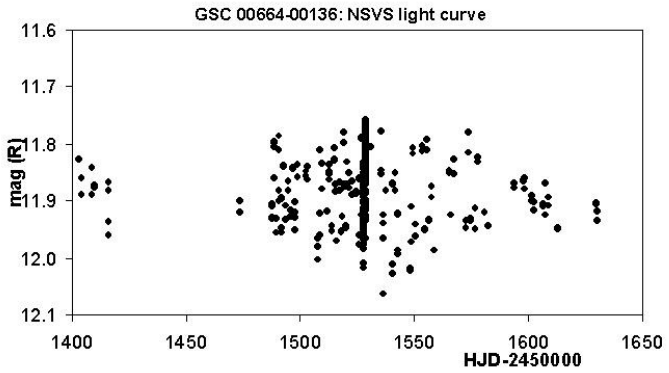
Some of the following stars showed a clear variation of the shape of the light curves.
Therefore the folded light curves are given for a distinct time period of time (described in figure as HJD 245 ....-....).

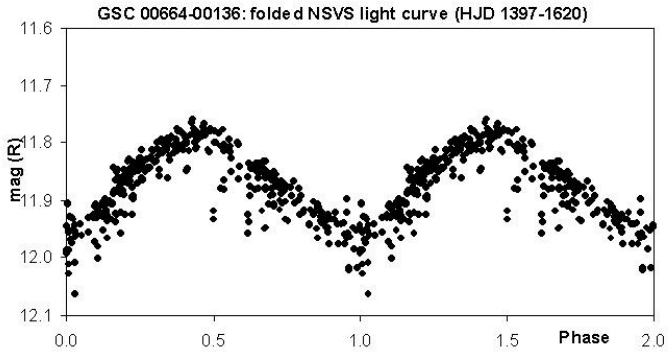
No. 101: GSC 03297-01671
Period: 0.67760(3) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=4067338&mask=32004
2MASS J-K: 0.792
ROSAT: HR1= 0.00, HR2= 0.48, fxfopt= -2.05
Proper motion: pmRA : -4.11 mas/yr, pmDE: -7.37 mas/yr (Roeser et al., 2008)
Known variable: NSVS 4067338, type RR (http://hal.physast.uga.edu/~jss/nsvs/)
Likely RS CVn variable



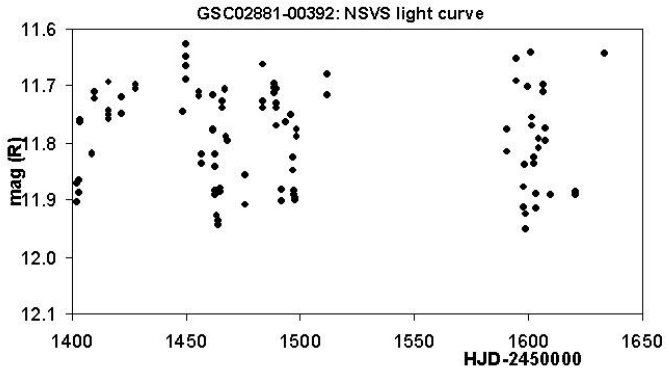


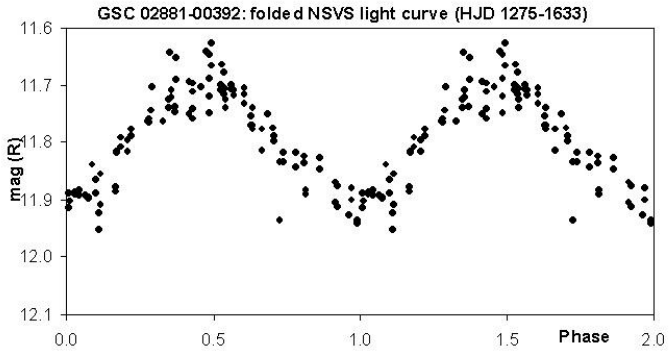
No. 102: GSC 00664-00136
Period: 0.66929(2) d
NSVS data http://skydot.lanl.gov/nsvs/star.php?num=9386318&mask=32004
2MASS J-K: 0.659
ROSAT: HR1=1.00, HR2=0.26, fxfopt= -2.20
Proper motion: pmRA: 19.4 mas/yr, pmDE: -28.1 mas/yr (Høg et. al, 2000)
Johnson B-V= 0.689 (derived from Tycho-2)
Likely RS CVn variable



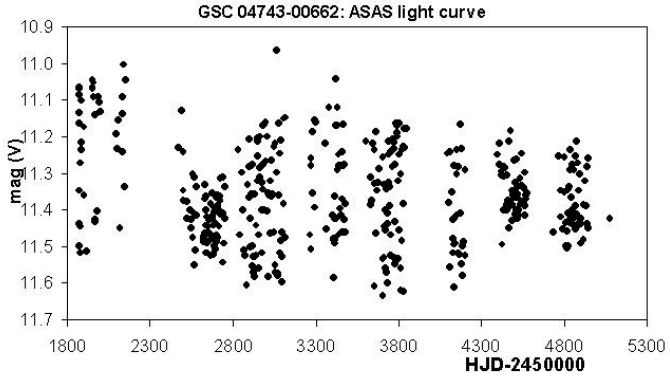


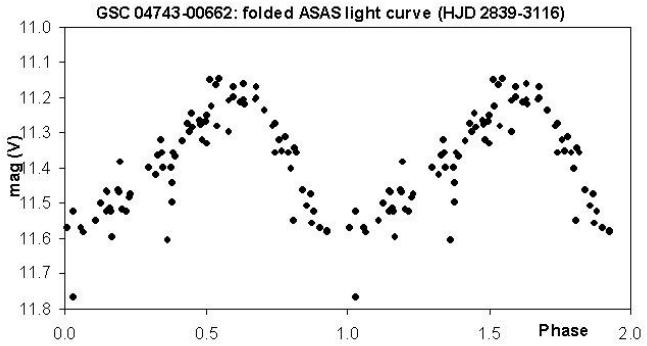
No. 103: GSC 02881-00392
Period: 5.595(2) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=4195255&mask=32004
2MASS J-K: 0.899
ROSAT: HR1=1.00, HR2=0.17, fxfopt= -2.19
Proper motion: pmRA: 6.15 mas/yr, pmDE: 2.98 mas/yr (Roeser et al., 2008)
Known variable: 1SWASP J040005.79+394137.2, type: VAR (Norton et al., 2007)
Probably a BY Dra variable



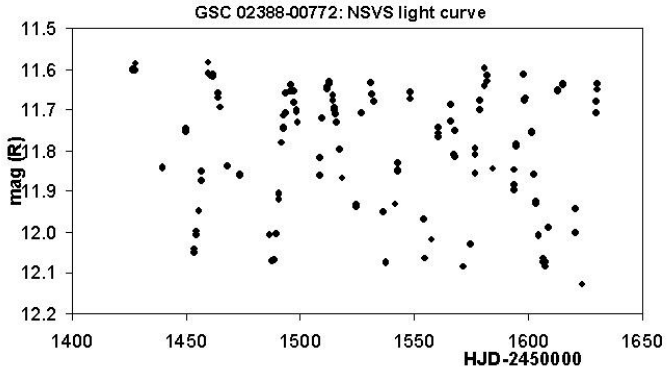


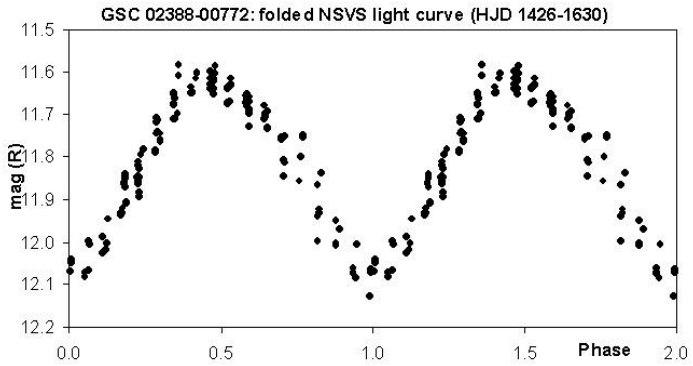
No. 104: GSC 04743-00662
Period: 1.7836(1) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=12253340&mask=32004
2MASS J-K: 0.809
ROSAT: HR1=0.35, HR2=0.12, fxfopt= -2.02
Proper motion: pmRA: 25.9 mas/yr, pmDE: -10.6 mas/yr (Høg et. al, 2000)
Johnson B-V=1.434 (derived from Tycho-2)
Spectral type: K7 (Riaz et al., 2006)
Known variable: ASAS J043939-0501.9, type: DCEP-FU (Pojmanski, 2002)
Probably a BY Dra variable



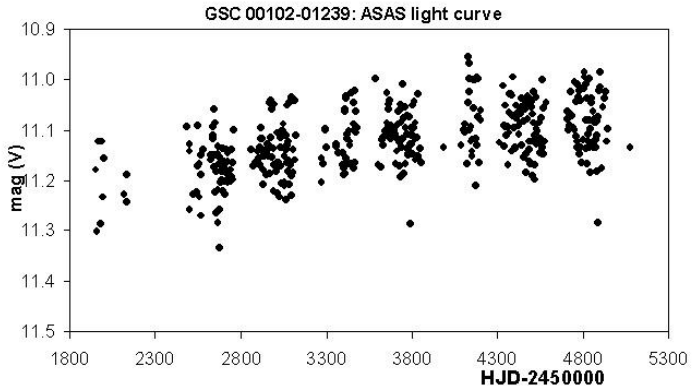


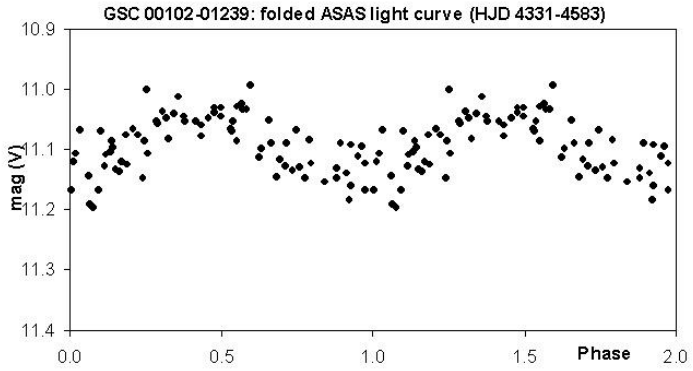
No. 105: GSC 02388-00772
Period: 17.01(2) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=6848896&mask=32004
2MASS J-K: 0.906
ROSAT: HR1=0.79, HR2=0.52, fxfopt= -2.20
Proper motion: pmRA: 3.76 mas/yr, pmDE: -11.45 mas/yr (Roeser et al., 2008)
Known variable (AAVSO-VSX): VSX J050329.6+310941, type: CWA (discoverer: S. Otero)
Likely RS CVn variable



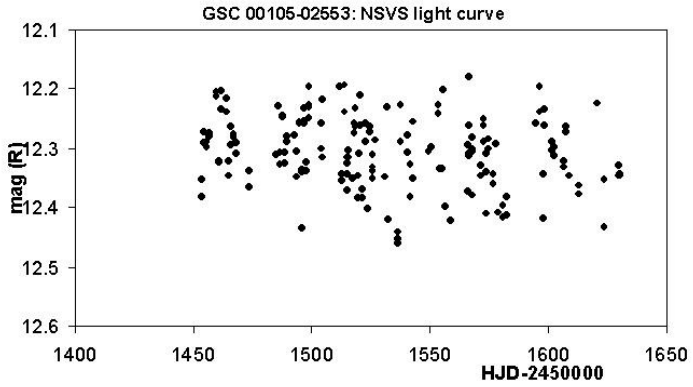


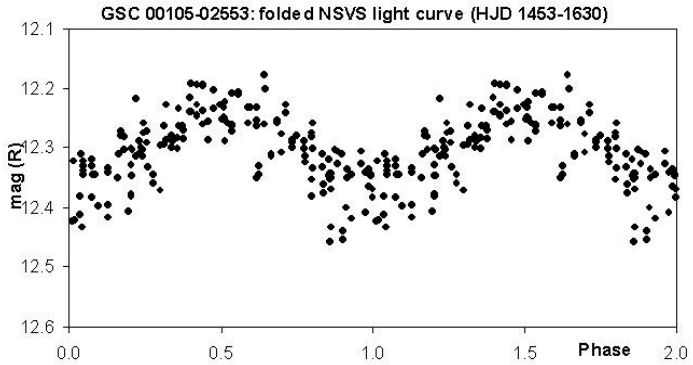
No. 106: GSC 00102-01239
Period: 1.9814(1) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=12307864&mask=32004
2MASS J-K: 0.692
ROSAT: HR1=0.80, HR2= 0.14, fxfopt= -1.72
Proper motion: pmRA: 4.3 mas/yr, pmDE: -5.6 mas/yr (Høg et. al, 2000)
Johnson B-V=1.242 (derived from Tycho-2)
Known variable: ASAS J050640+0208.5, type: EC / ESD (Pojmanski, 2002)
Likely RS CVn variable



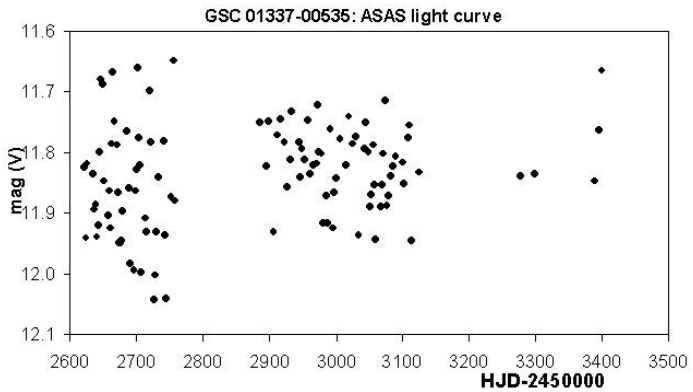


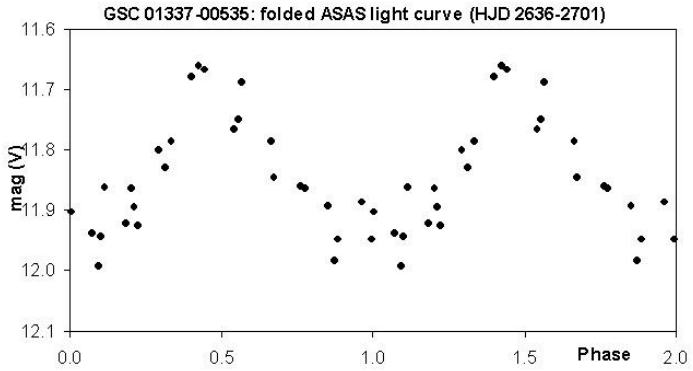
No. 107: GSC 00105-02553
Period: 2.175(1) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=12341801&mask=32004
2MASS J-K: 0.829
ROSAT: HR1=0.69, HR2=0.42, fxfopt= -1.55
Proper motion: pmRA: -0.09 mas/yr, pmDE: -4.61 mas/yr (Roeser et al., 2008)
Probably a BY Dra variable



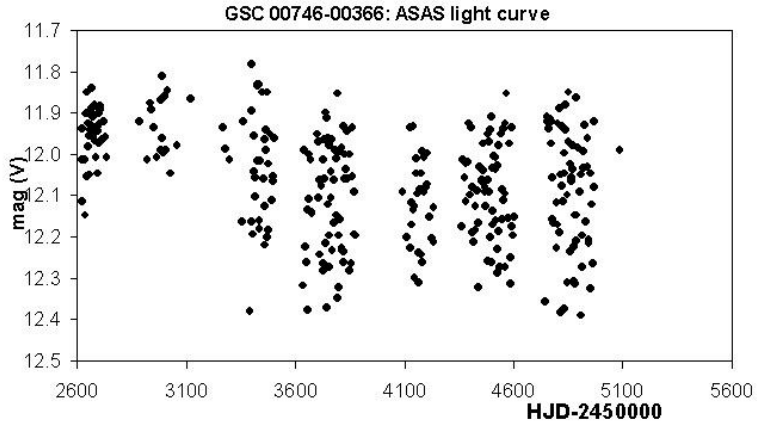


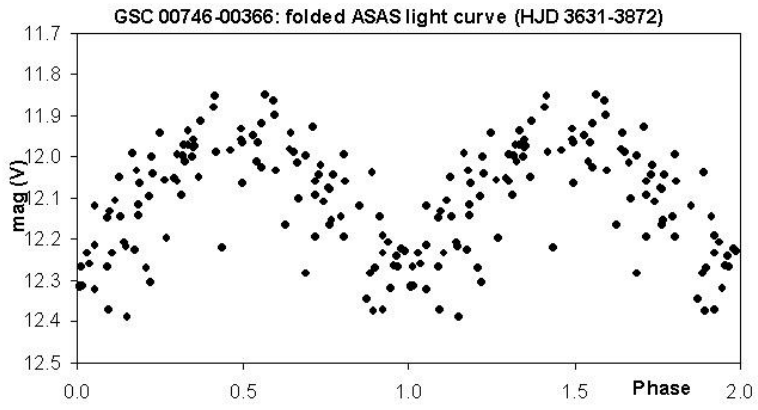
No. 108: GSC 01337-00535
Period: 18.14(3) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=9791679&mask=32004
2MASS J-K: 0.770
ROSAT: HR1=0.53, HR2=0.39, fxfopt= -2.35
Proper motion: pmRA: 7.49 mas/yr, pmDE: -18.03 mas/yr (Roeser et al., 2008)
Known variable: ASAS J063958+2000.3, type: MISC (Pojmanski, 2002)
Likely RS CVn variable



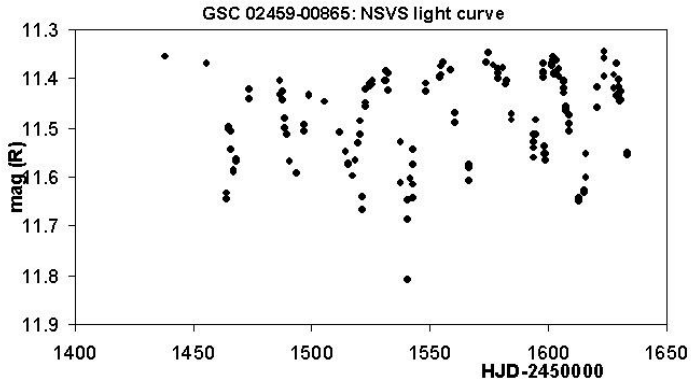


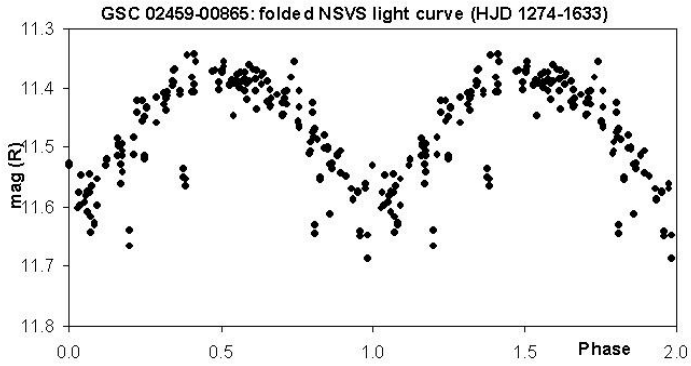
No. 109: GSC 00746-00366
Period: 3.7726(2) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=9840702&mask=32004
2MASS J-K: 0.656
ROSAT: HR1=0.14, HR2=0.02, fxfopt= -2.05
Proper motion: pmRA: -16.42 mas/yr, pmDE: -12.01 mas/yr (Roeser et al., 2008)
Known variable: ASAS J064023+0835.9, type: MISC / DCEP (Pojmanski, 2002)
Likely RS CVn variable



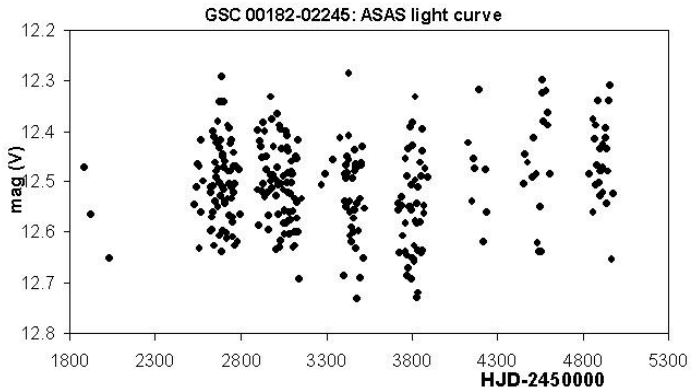


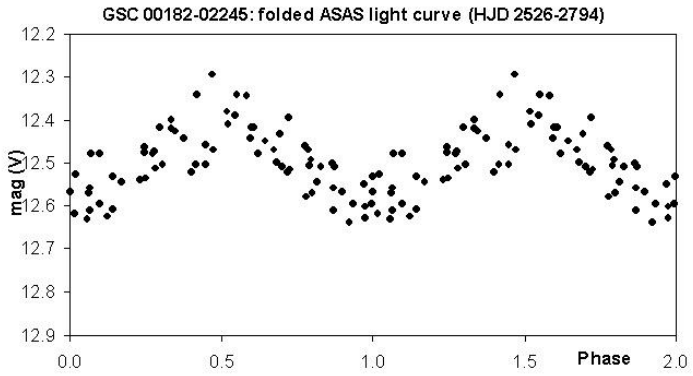
No. 110: GSC 02459-00865
Period: 24.21(5) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=7228575&mask=32004
2MASS J-K: 0.764
ROSAT: HR1=0.28, HR2=0.48, fxfopt= -2.37
Proper motion: pmRA: -3.93 mas/yr, pmDE: -6.51 mas/yr (Roeser et al., 2008)
Johnson B-V= 1.365 (derived from Tycho-2)
Likely RS CVn variable



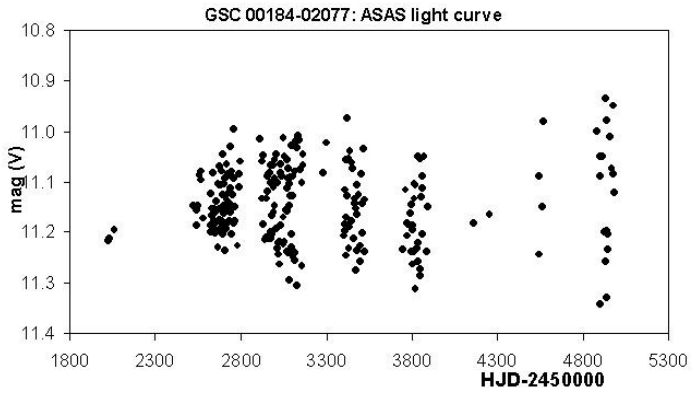


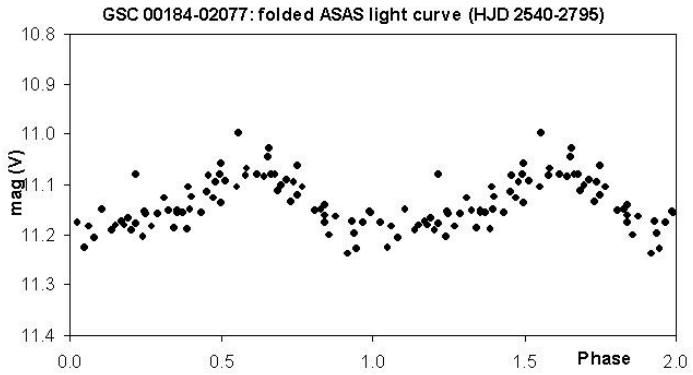
No. 111: GSC 00182-02245
Period: 2.7530(1) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=12710107&mask=32004
2MASS J-K: 0.915
ROSAT: HR1=0.07, HR2=0.07, fxfopt= -1.84
Proper motion: pmRA: -58.68 mas/yr, pmDE: -40.78 mas/yr (Roeser et al., 2008)
Known variable: NSVS 12710107, type: LPV: (http://hal.physast.uga.edu/~jss/nsvs/)
Probably a BY Dra variable



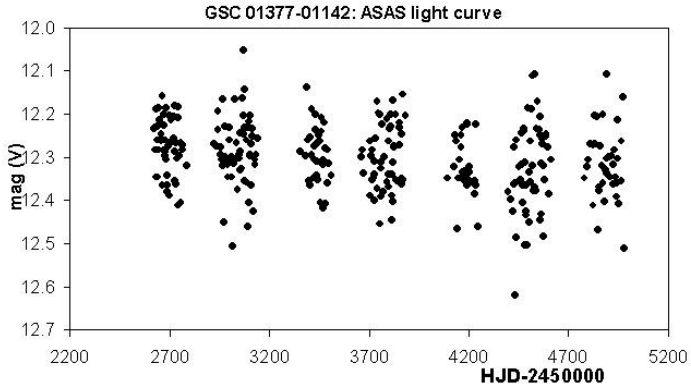


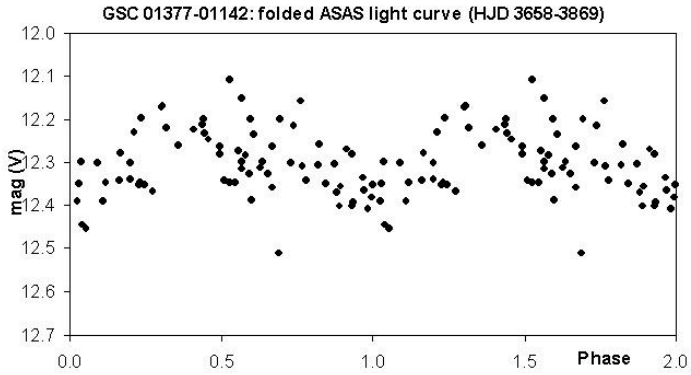
No. 112: GSC 00184-02077
Period: 4.8836(4) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=12728131&mask=32004
2MASS J-K: 0.75
ROSAT: HR1=0.04 , HR2=-0.11, fxfopt= -2.20
Proper motion: pmRA: -16.8 mas/yr, pmDE: 38.0 mas/yr (Høg et. al, 2000)
Johnson B-V= 0.531 (derived from Tycho-2)
Known variable: ASAS 074856+0324.1, type MISC (Pojmanski, 2002)
Likely RS CVn variable



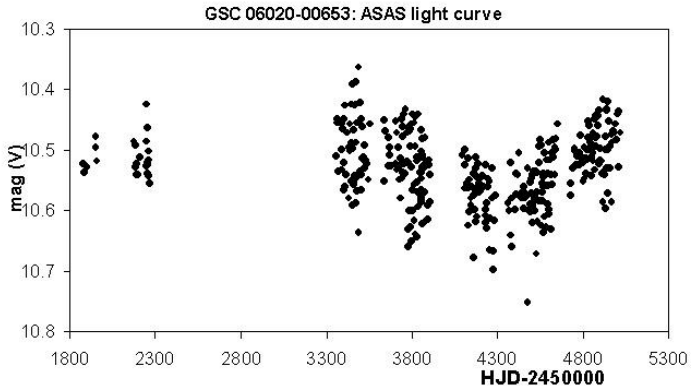


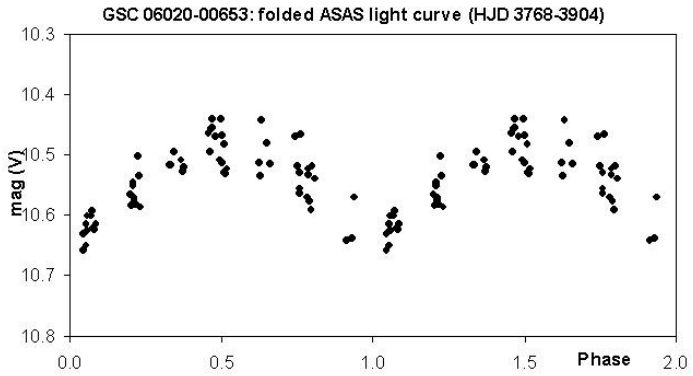
No. 113: GSC 01377-01142
Period: 0.45743(1) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=10092166&mask=32004
2MASS J-K: 0.735
ROSAT: HR1=-0.21, HR2=0.22, fxfopt= -1.58
Proper motion: pmRA: -157.4 mas/yr, pmDE: -8.1 mas/yr (Ivanov, 2008)
Known variable: NSVS 10092166, type EW (http://hal.physast.uga.edu/~jss/nsvs/)
Likely RS CVn variable



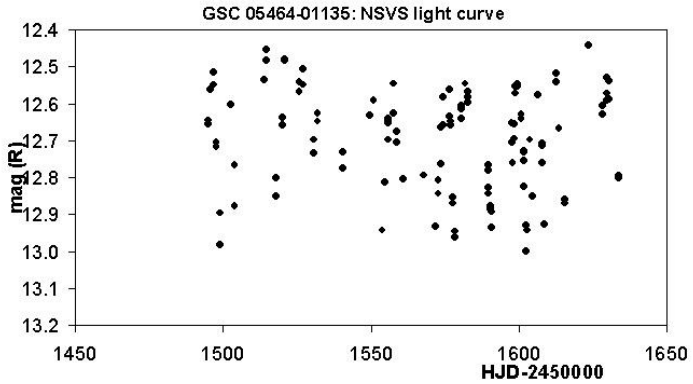


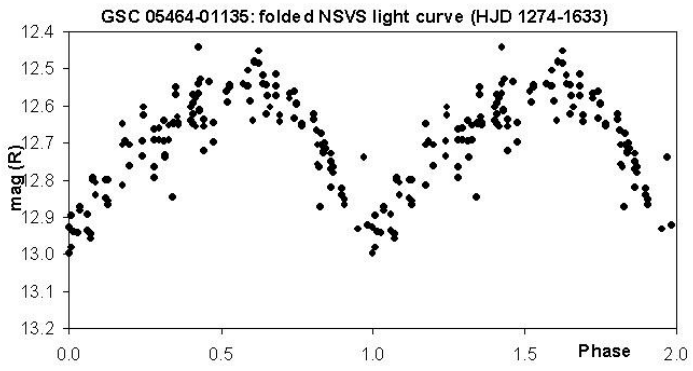
No. 114: GSC 06020-00653
Period: 6.9678(4) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=15608966&mask=32004
2MASS J-K: 0.526
ROSAT: HR1=0.82, HR2=0.56, fxfopt= -2.44
Proper motion: pmRA: 21.9 mas/yr, pmDE: -7.3 mas/yr (Høg et. al, 2000)
Johnson B-V=0.873 (derived from Tycho-2)
Known variable: ASAS J084756-2025.6, type: DCEP-FU (Pojmanski, 2002)
Likely RS CVn variable



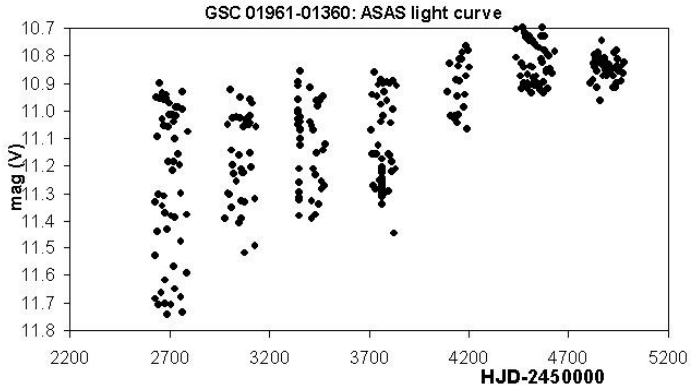


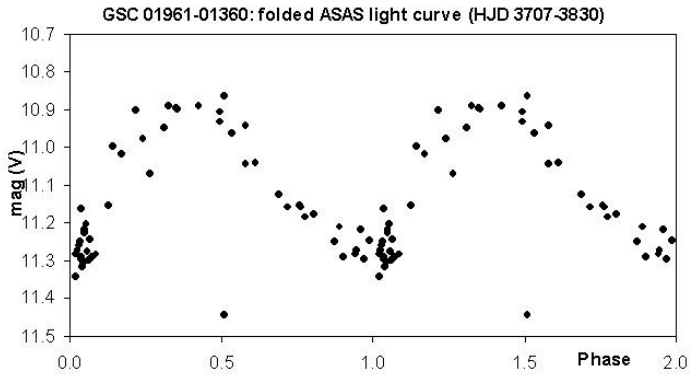
No. 115: GSC 05464-01135
Period: 6.1092(5) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=15690744&mask=32004
2MASS J-K: 0.837
ROSAT: HR1=0.69, HR2=0.23, fxfopt= -1.35
Proper motion: pmRA: -8.96 mas/yr, pmDE: 9.28 mas/yr (Roeser et al., 2008)
Known variable: ASAS J092830-0923.0, type: DCEP-FU / DCEP-FO / EC / ESD (Pojmanski, 2002)
Not possible to distinguish between RS CVn and BY Dra



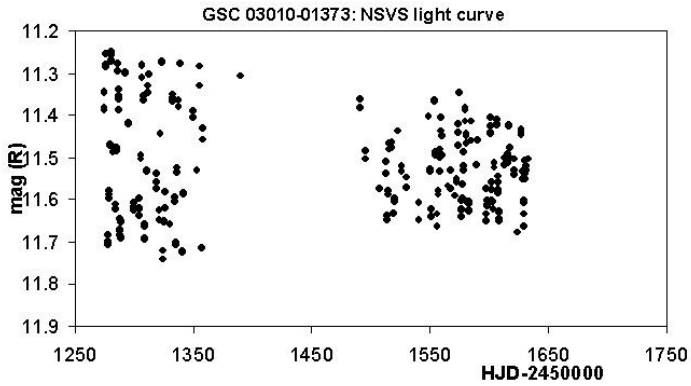


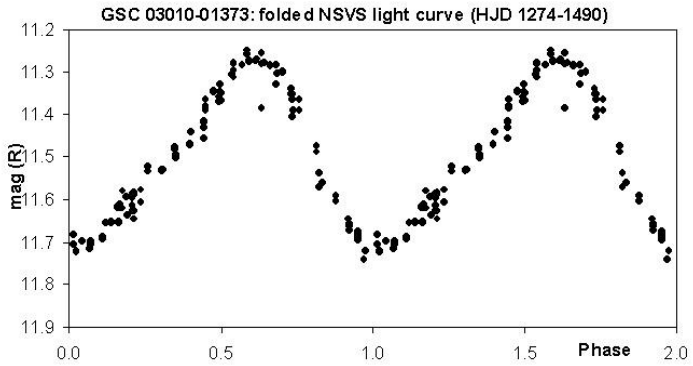
No. 116: GSC 01961-01360
Period: 0.93912(5) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=7492908&mask=32004
2MASS J-K: 0.805
ROSAT: HR1=0.65, HR2=0.26, fxfopt= -2.63
Proper motion: pmRA: -24.5 mas/yr, pmDE: -9.2 mas/yr (Høg et. al, 2000)
Johnson B-V=1.321 (derived from Tycho-2)
Known variable: ASAS J100052+2440.4, type: MISC (Pojmanski, 2002)
Probably a BY Dra variable



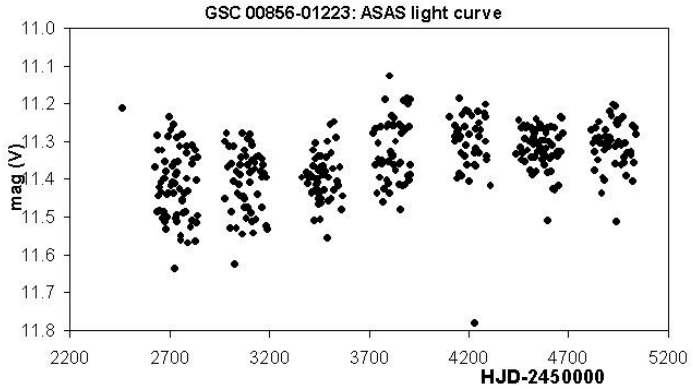


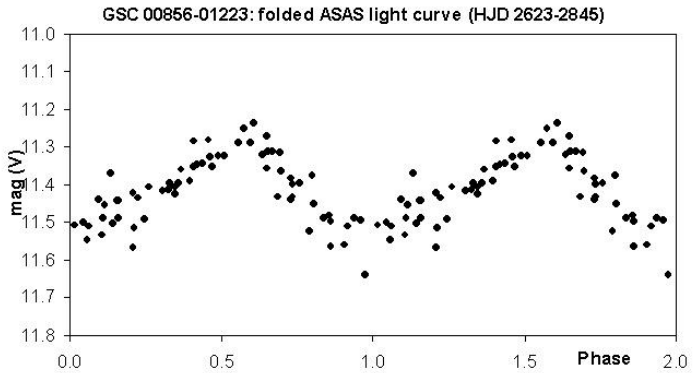
No. 117: GSC 03010-01373
Period: 5.250(1) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=4966617&mask=32004
2MASS J-K: 0.816
ROSAT: HR1= -0.03, HR2= -0.04, fxfopt= -1.83
Proper motion: pmRA: 11.9 mas/yr, pmDE: -18.7 mas/yr (Høg et. al, 2000)
Johnson B-V= 0.963 (derived from Tycho-2)
Known variable: NSVS 4966617, type: CEP (http://hal.physast.uga.edu/~jss/nsvs/)
Likely RS CVn variable



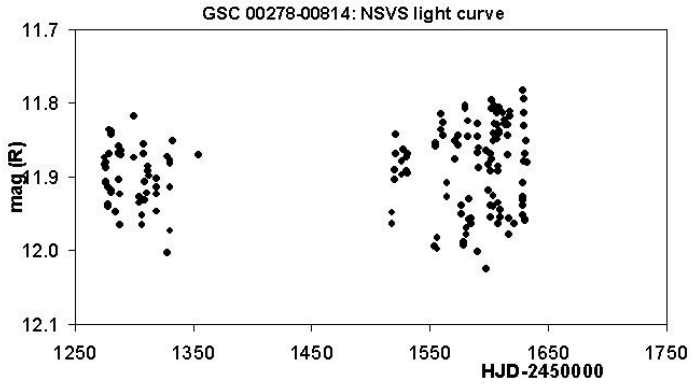


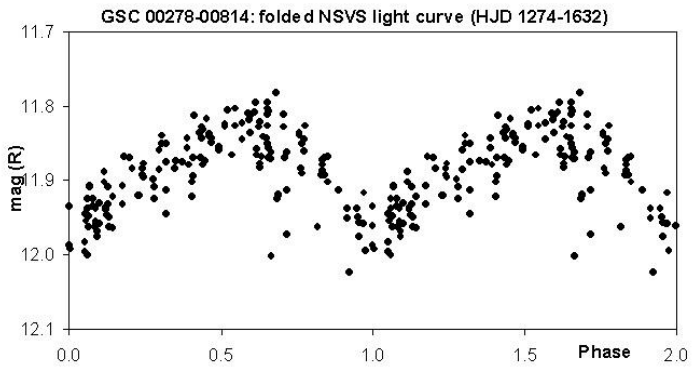
No. 118: GSC 00856-01223
Period: 5.708(1) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=10358235&mask=32004
2MASS J-K: 0.733
ROSAT: HR1=0.29, HR2=-0.23, fxfopt= -2.15
Proper motion: pmRA: -34.6 mas/yr, pmDE: -51.6 mas/yr (Ivanov, 2008)
Johnson B-V= 1.344 (derived from Tycho-2)
Known variable: ASAS J113337+0751.5, type: MISC (Pojmanski, 2002)
Likely RS CVn variable



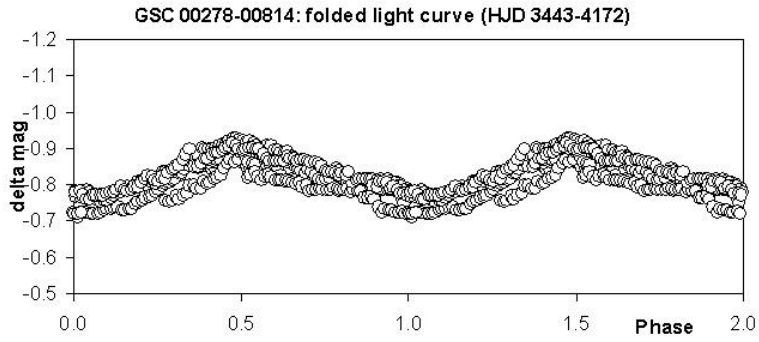


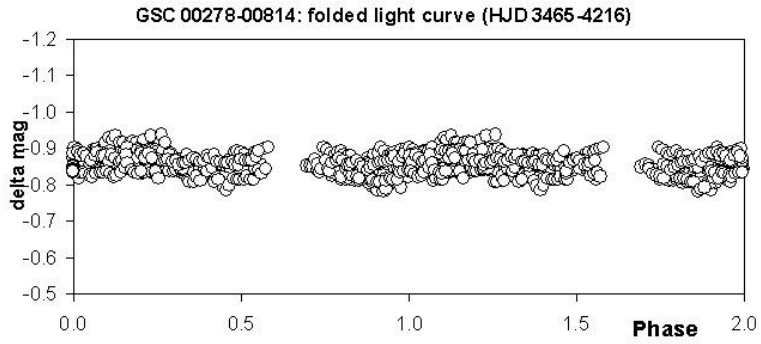
No. 119: GSC 00278-00814
Period: 0.65589(4) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=13147024&mask=32004
2MASS J-K: 0.783
ROSAT: HR1= -0.31, HR2= -0.10, fxfopt= -2.03
Proper motion: pmRA: -83.0 mas/yr, pmDE: -230.0 mas/yr (Ivanov, 2008)
Likely RS CVn variable



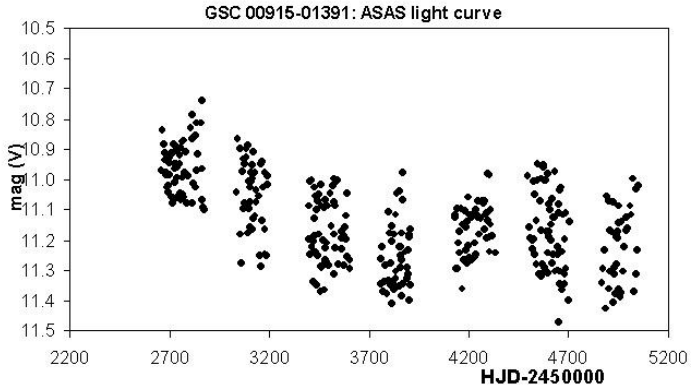


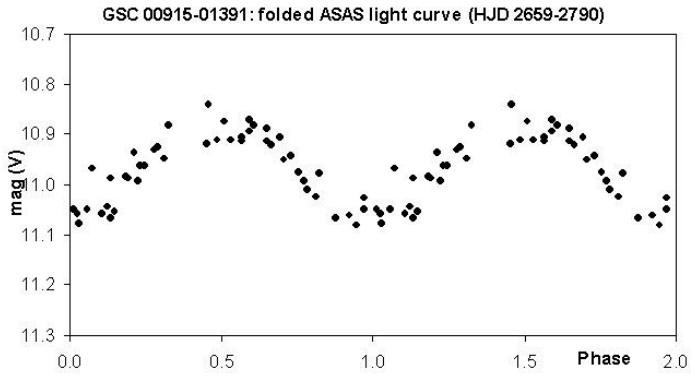
Since the ASAS3 data did not show a significant variability of GSC 00278-00814, further observations were made using a Flatfield Camera 576/2.0 with a CCD camera OES-LcCCD12 and IR-cutting filter in Velden, Germany (PF, 2005 and 2007). The comparison star used was GSC 278-0464 and the check star was GSC 278-0673. These observations showed a highly variable light curve between 2005 (HJD 3443-3465) and 2007 (HJD 4172-4216), which is typical for chromospherically active stars.



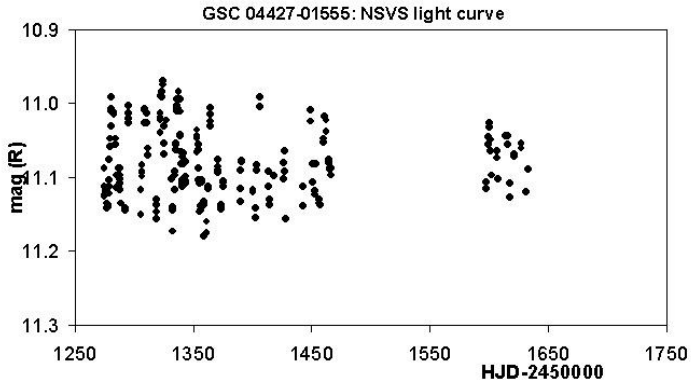


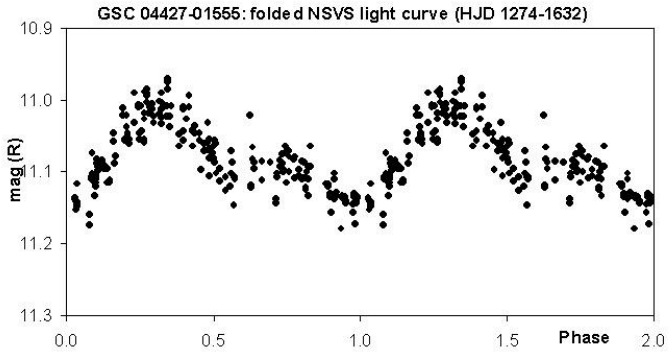
No. 120: GSC 00915-01391
Period: 4.3429(3) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=10502467&mask=32004
2MASS J-K: 0.861
ROSAT: HR1= 0.21, HR2= -0.09, fxfopt= -1.62
Proper motion: pmRA: -59.8 mas/yr, pmDE: -25.8 mas/yr (Høg et. al, 2000)
Johnson B-V= 1.063 (derived from Tycho-2)
Spectral type: K4 (Stephenson, 1986)
Known variable: ASAS J142556+1412.1, type MISC (Pojmanski, 2002)
Probably a BY Dra variable



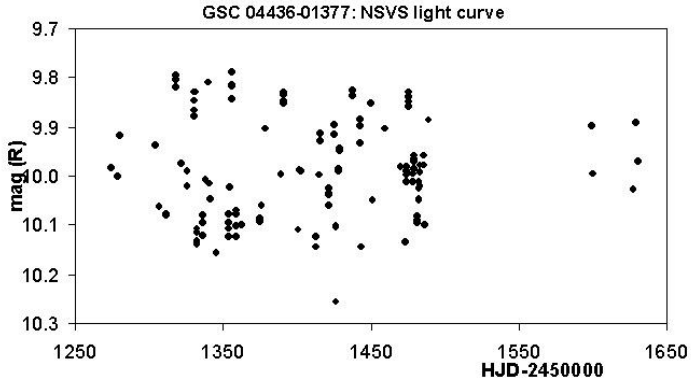


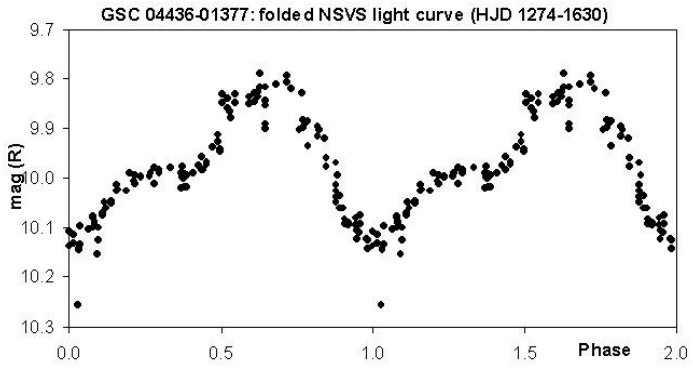
No. 121: GSC 04427-01555
Period: 13.87(1) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=1091608&mask=32004
2MASS J-K: 0.781
ROSAT: HR1=0.32, HR2=0.24, fxfopt= -2.21
Proper motion: pmRA: -18.7 mas/yr, pmDE: 27.6 mas/yr (Høg et. al, 2000)
Spectral type: K4IVe (Skiff, 2009)
Known variable: NSVS 1178920, type CEP (http://hal.physast.uga.edu/~jss/nsvs/)
Likely RS CVn variable



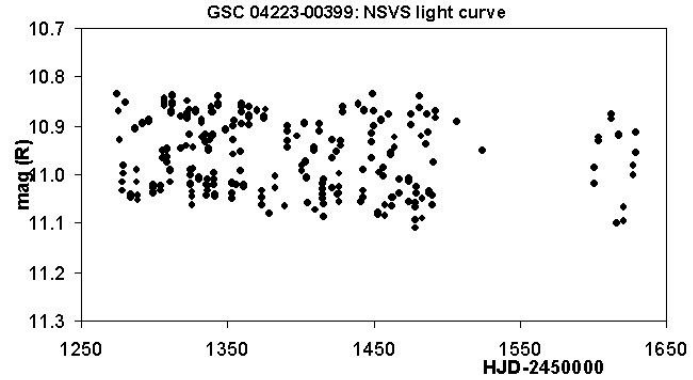


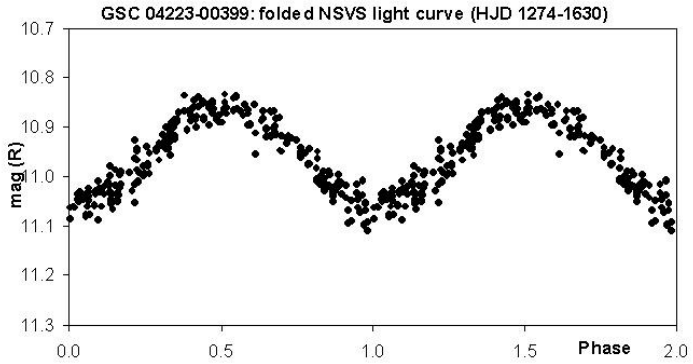
No. 122: GSC 04436-01377
Period: 4.2658(5) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=1182069&mask=32004
2MASS J-K: 0.678
ROSAT: HR1=0.23, HR2=0.16, fxfopt= -2.47
Proper motion: pmRA: -5.1 mas/yr, pmDE: 20.6 mas/yr (Høg et. al, 2000)
Johnson B-V=0.886 (derived from Tycho-2)
Known variable: NSVS 1182069, type CEP (http://hal.physast.uga.edu/~jss/nsvs/)
Likely RS CVn variable



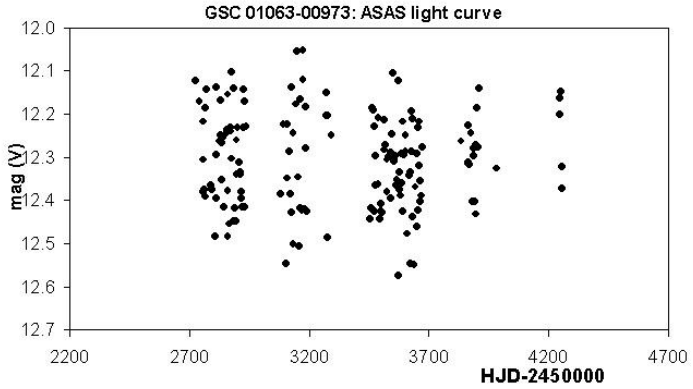


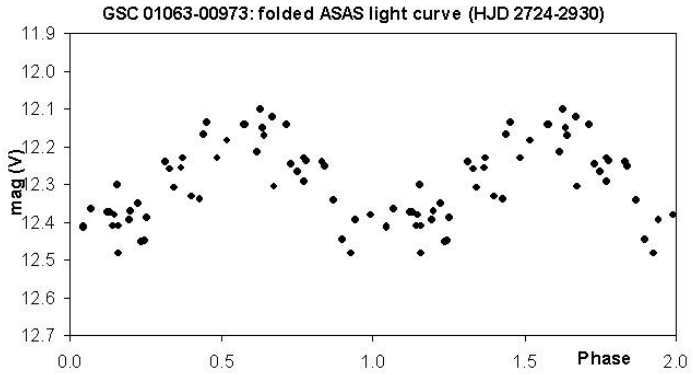
No. 123: GSC 04223-00399
Period: 5.279(1) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=3011697&mask=32004
2MASS J-K: 0.647
ROSAT: HR1=0.43, HR2=0.15, fxfopt= -2.26
Proper motion: pmRA: -14.1 mas/yr, pmDE: -10.8 mas/yr (Høg et. al, 2000)
Johnson B-V=0.947 (derived from Tycho-2)
Known variable: NSVS 3011697, type: CEP (http://hal.physast.uga.edu/~jss/nsvs/)
Likely RS CVn variable



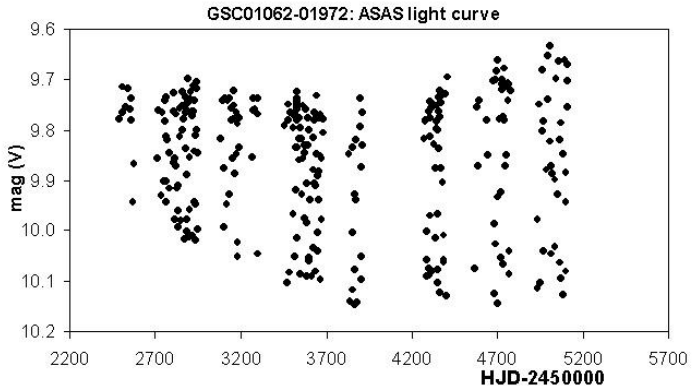


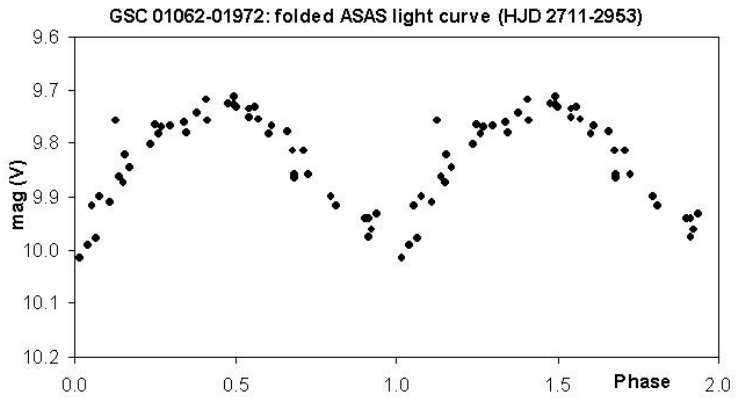
No. 124: GSC 01063-00973
Period: 3.7735(3) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=11289898&mask=32004
2MASS J-K: 1.186
ROSAT: HR1= 0.90, HR2= -0.11, fxfopt= -2.03
Proper motion: pmRA: 7.36 mas/yr, pmDE: -16.32 mas/yr (Roeser et al., 2008)
Known variable: ASAS J192729+1232.3, type DCEP-FU/DCEP-FO (Pojmanski, 2002)
Probably a BY Dra variable





No. 125: GSC 01062-01972
Period: 16.675(2) d
NSVS data: http://skydot.lanl.gov/nsvs/star.php?num=11329550&mask=32004
Johnson B-V=0.965 (derived from Tycho-2)
2MASS J-K: 0.687
ROSAT: HR1= 0.67, HR2= 0.26, fxfopt= -2.35
Known variable: ASAS J195403+1041.8 0, type: DCEP-FU / EC (Pojmanski, 2002)
Likely RS CVn variable





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