

## RS CVn STARS AMONG VARIABLES WITH POSSIBLE CW CLASSIFICATION IN THE ASAS-3 SURVEY

L.N. Berdnikov<sup>1</sup>, E.N. Pastukhova<sup>2</sup>

<sup>1</sup> Sternberg Astronomical Institute, Moscow State University, Russia; e-mail: berdnik@sai.msu.ru

<sup>2</sup> Institute of Astronomy, Russian Academy of Sciences, Russia; e-mail: pastukhova@sai.msu.ru

We present a list of 109 probable RS CVn variables among stars in the ASAS-3 catalog with Population II Cepheid classification as the main one or an alternative one. These stars are identified with X-ray sources and have light curves (from ASAS-3 data) in no contradiction with the suggested RS CVn classification.

Classical Cepheids are very important as distance indicators as well as for studies of stellar evolution, structure and kinematics of our Galaxy. An extensive program of Cepheid studies is under way in the Sternberg Astronomical Institute and Institute of Astronomy (Russian Academy of Sciences) (Samus et al. 2007). Population II Cepheids are also of astrophysical interest, and some of them enter our programs of observations. We are interested in the largest possible volume of our Cepheid sample and in clear separation of Population I and Population II Cepheids from objects of other nature resembling them by periods and light-curve shapes.

Recently, thousands of new variable stars were discovered in the ASAS-3 automatic survey (Pojmanski 2002). Many of them have ASAS-3 classification as Cepheids or possible Cepheids. However, our trial observations of objects from the ASAS-3 variable star catalog revealed that some stars had photometric behavior incompatible with their Cepheid classification. Most of them can be identified with Galactic X-ray sources and thus, most probably, are RS CVn variables.

In this study, we analyzed the complete list of stars in the ASAS-3 variable-star catalog with Population II (CW) classification as the main one or as an alternative possibility. Among stars we were able to identify with known X-ray sources of the following catalogs: 1RXS (Voges et al. 1999, 2000), 1RXH (ROSAT Consortium 2000), 1WGA (White et al. 2000), and 2E (Harris 1994), 109 objects have light curves (from ASAS-3 data) permitting us to consider them RS CVn variables.

The list of our RS CVn candidates is presented in the Table. The lines of the Table contain: coordinates (right ascension and declination) from the 2MASS catalog; the X-ray catalog identification; the ASAS-3 catalog identification; the star's variability period from the ASAS-3 catalog; our revised period value (if available); the GCVS/NSV designation and GCVS type (if available). The revised periods are often twice shorter than those suggested in the ASAS-3 catalog.

Note that the star ASAS-3 032406+0729.5 is probably an eclipsing RS CVn star, the only case in our sample. Alternatively, it could even be an EW variable with the period 0<sup>d</sup>.67645. The ASAS-3 data give no possibility to rule out any of these options.

The star ASAS-3 082250+0151.6 (NSV 17868) was correctly identified as an RS CVn variable in Henry et al. (1995). The period given for this star in the Table is from the cited paper, we retained the star in the Table for the sake of completeness.

**Acknowledgements:** The authors gratefully acknowledge support for this work by research funding awarded through the Russian Foundation of Basic Research (RFBR,

grants 07-02-00380 and 08-02-00375), through the Program of Support for Leading Scientific Schools of Russia, and through the program “Origin and Evolution of Stars and Galaxies” of the Presidium of Russian Academy of Sciences. Thanks are due to the Editor, N.N. Samus, for valuable suggestion towards improvement of the manuscript.

#### References:

- Harris, D.E., Forman, W., Gioia, I.M., et al., 1994, *VizieR On-line Data Catalog: IX/13*  
Henry, G.W., Fekel, F.C., Hall, D.S., 1995, *Astron. J.*, 110, 2926  
Pojmanski, G., 2002, *Acta Astron.*, 52, 397  
ROSAT Consortium, 2000, *VizieR On-line Data Catalog: IX/28A*  
Samus, N.N., Antipin, S.V., Berdnikov, L.N., et al., 2007, *Odessa Astron. Publ.*, **20**, 197  
Voges, W., Aschenbach, B., Boller, Th., et al., 1999, *VizieR On-line Data Catalog: IX/10A*  
Voges, W., Aschenbach, B., Boller, Th., et al., 2000, *VizieR On-line Data Catalog: IX/29*  
White, N.T., Giommi, P., Angelini, L., 2000, *VizieR On-line Data Catalog: IX/31*

Table. RS CVn variables among stars with CW classification in the ASAS-3 catalogue

2MASS coordinates (2000.0)	X-ray Identification	ASAS-3	$P$ , ASAS-3	$P$	GCVS, NSV
00 <sup>h</sup> 22 <sup>m</sup> 03 <sup>s</sup> .44 +13°03'35".2	1RXS J002204.0+130351	002203+1303.6	34 <sup>d</sup> 62		
00 41 34.48 +21 18 02.6	1RXS J004133.3+211817	004135+2118.1	5.882	2 <sup>d</sup> 941	
01 05 06.40 +09 35 08.3	1RXS J010506.8+093505	010507+0935.1	9.98		
01 05 15.94 +01 59 14.2	1RXH J010516.0+015915	010516+0159.2	6.9058		
01 21 39.26 +25 17 47.4	1RXS J012140.1+251743	012139+2517.8	12.994		
01 22 15.44 +20 21 30.2	1RXS J012215.4+202139	012216+2021.5	10.21		
01 36 27.81 +25 08 35.6	1RXS J013628.0+250835	013628+2508.5	1.335951		
02 20 32.40 +20 07 28.7	1RXS J022033.7+200759	022032+2007.5	18.36	9.18	
02 42 36.22 +07 07 26.1	2E 647	024236+0717.4	52.84		
03 12 34.29 +09 44 57.0	1RXS J031232.3+094426	031234+0944.9	12.419	6.209	
03 24 05.62 +07 29 27.0	1RXS J032405.3+072926	032406+0729.5	40.89	20.43	
04 18 10.78 +23 17 04.9	1RXS J041811.1+231700	041811+2317.1	1.8969	1.8787	NSV 15941
04 30 49.18 +21 14 10.6	1RXS J043049.5+211356	043049+2114.2	2.835		
04 42 18.61 +01 17 39.9	1RXS J044219.2+011741	044219+0117.7	8.771		
04 48 57.99 +19 14 56.1	1RXS J044858.4+191500	044858+1915.0	16.055		
05 00 49.28 +15 27 00.6	1RXS J050049.1+152658	050049+1527.0	2.763		
05 13 05.82 +08 51 31.4	1RXS J051305.8+085122	051306+0851.5	4.0182		
05 13 19.01 +01 34 47.0	1RXS J051319.1+013525	051319+0134.8	7.431	3.656	
05 22 54.79 +08 58 04.7	1RXS J052254.9+085803	052255+0858.1	5.941		
05 36 30.99 +11 19 40.2	1RXS J053632.0+111935	053631+1119.7	12.285		
05 39 14.80 +00 31 13.4	1RXS J053914.8+003110	053915+0031.2	8.105	4.0525	
05 39 27.10 -03 47 04.4	1RXS J053927.0-034655	053927-0347.1	1.92952		
05 39 58.77 +07 08 30.5	1RXS J053959.1+070832	053959+0708.5	2.1133		
05 43 52.80 -02 50 43.5	1RXS J054353.4-025038	054353-0250.7	1.73393	6.64	
07 16 50.45 +21 45 00.1	1RXS J071650.8+214509	071650+2145.0	80.7	40.35	
08 22 49.96 +01 51 33.6	1RXS J082250.2+015152	082250+0151.6	6.6	3.296	NSV 17868
08 35 26.86 +24 15 39.6	1RXS J083526.4+241538	083527+2415.7	20.74		
08 49 19.81 +05 52 29.8	1RXS J084919.7+055234	084920+0552.5	14.593	7.2965	
10 12 17.64 -03 44 40.4	1RXS J101217.2-034442	101218-0344.8	21.535		
10 13 23.88 +12 08 45.8	1RXS J101324.2+120849	101324+1208.7	34.23	34.00	EQ Leo (LB:)
10 30 02.68 -00 47 32.0	1RXS J103002.8-004726	103003-0047.5	30.74	15.37	
10 39 59.00 +13 27 22.1	1RXS J103958.4+132733	103959+1327.4	6.198	6.217	
10 59 20.11 +04 53 17.4	1RXS J105920.5+045308	105920+0453.3	2.1155	17.50	
11 56 51.66 +08 27 21.9	1RXS J115651.8+082726	115652+0827.3	4.4821	4.402	
12 03 15.65 +16 06 37.7	1RXS J120316.6+160634	120316+1606.6	3.5274	3.530	
12 15 30.72 -39 48 42.6	1RXS J121527.9-394843	121531-3948.7	5.067861		
12 16 52.98 +05 41 26.2	1WGA J1216.8+0541	121653+0541.4	13.94847	14.26	
12 19 06.45 +18 21 21.2	1RXS J121906.1+132119	121906+1821.4	5.653	5.658	FN Com (LB)
12 25 49.91 +09 45 46.6	1RXS J1225.8+0945	122550+0945.8	7.736	7.718	
12 48 48.20 +14 45 32.3	1RXS J124848.7+144531	124848+1445.5	2.45647	2.455	
12 50 51.67 -51 56 36.1	1RXS J125051.3-515655	125051-5156.6	2.76116		
13 05 29.53 +12 49 45.1	1RXS J130528.5+124925	130529+1249.6	3.6885		
13 12 53.57 +08 23 35.4	1RXS J131253.3+082341	131254+0823.6	9.886	9.870	NSV 19563
13 56 49.20 +24 29 27.4	1RXS J135649.4+242941	135649+2429.4	1.08555	12.23	
14 07 01.16 -42 33 00.7	1RXS J140657.7-423325	140701-4233.0	1.693846		
15 02 07.25 -12 01 51.7	1RXS J150206.0-120206	150207-1201.9	2.684136	2.6831	
15 02 47.37 +22 18 20.7	1RXS J150246.8+221821	150248+2218.4	7.395547		
15 17 21.23 -19 00 59.0	1RXS J151720.9-190103	151721-1901.0	11.33163	11.38	
15 22 16.27 -26 52 25.2	1RXS J152216.6-265215	152216-2652.4	6.835125		
15 23 46.11 -00 44 24.7	1RXS J152346.8-004434	152346-0044.4	11.561	11.685	
15 35 07.61 -08 49 49.5	1RXS J153506.2-085002	153508-0849.8	39.44995	19.725	
15 36 34.46 +12 19 31.5	1RXS J153633.6+121919	153634+1219.5	5.4026	5.407	
15 48 40.95 -03 10 44.2	1RXS J154840.5-031106	154841-0310.7	3.8587	1.9236	
15 51 07.58 +11 16 18.8	1RXS J155108.0+111559	155108+1116.3	6.606	6.603	
15 54 44.94 -07 52 04.5	1RXS J155442.6-075142	155445-0752.0	5.617744	5.624	
15 55 06.71 -19 46 31.3	1RXS J155506.8-194638	155507-1946.5	4.877127	4.880	
15 57 06.80 -87 29 49.0	1RXS J155706.8-872949	155703-8730.1	3.115622	3.114	
16 02 53.96 -20 22 48.1	1RXS J160254.9-202242	160254-2022.8	1.95349		
16 07 04.28 +02 38 24.4	1RXS J160704.4+023823	160704+0238.4	3.7836		

Table 1. Continued

2MASS coordinates (2000.0)	X-ray Identification	ASAS-3	$P$ , ASAS-3	$P$	GCVS, NSV
16 <sup>h</sup> 09 <sup>m</sup> 38 <sup>s</sup> .05 +05°52′37″.2	1RXS J160938.4+055238	160938+0552.6	1 <sup>d</sup> 085670		PX Ser (LB:)
16 19 59.93 +04 36 46.8	1RXS J161959.5+043636	162000+0436.8	1.438	1 <sup>d</sup> 437	
16 23 07.83 -23 00 59.7	1RXS J162308.8-230046	162308-2301.0	8.107618	4.0538	
16 24 02.03 -29 10 44.9	1RXS J162402.5-291042	162402-2910.8	4.018315		
16 24 23.39 +04 45 22.1	1RXS J162423.5+044507	162423+0445.4	9.929	4.963	
16 25 10.00 +05 14 54.0	1RXS J162509.9+051446	162510+0514.9	3.4482		
16 49 42.93 +22 20 03.8	1RXS J164943.4+222009	164943+2220.1	11.586		
16 53 57.72 +07 34 50.4	1RXS J165357.6+073450	165358+0734.8	11.58509	11.510	
17 03 13.52 +24 53 21.0	1RXS J170313.2+245332	170313+2453.3	11.565		
18 46 52.56 -62 10 36.7	1RXS J184657.3-621037	184653-6210.3	5.373217		NSV 24575
19 05 25.05 -78 26 44.3	1RXS J190524.3-782658	190525-7826.8	2.8037		
19 11 34.70 -34 35 08.8	1RXS J191134.7-343500	191135-3435.2	3.378621		
19 17 43.75 -44 00 16.4	1RXS J191744.3-440021	191743-4400.3	9.424		
19 39 06.45 -25 44 05.7	1RXS J193906.7-254358	193906-2544.1	12.745	12.76	
20 01 51.98 -17 52 00.9	1RXS J200152.7-175211	200152-1752.0	6.579693		
20 05 56.41 -32 16 59.2	1RXS J200556.1-321651	200556-3217.0	8.307		
20 09 55.06 -45 59 45.2	1RXS J200955.9-460002	200955-4559.8	10.705		
20 19 02.95 -14 02 04.5	1RXS J201903.1-140205	201903-1402.1	11.722	11.794	
20 28 42.27 -09 43 17.0	1RXS J202843.1-094217	202842-0943.3	2.40015	2.402	
20 36 08.30 -36 07 11.5	1RXS J203608.6-360713	203609-3607.2	2.1256		
20 41 42.25 -22 19 20.5	1RXS J204142.6-221910	204142-2219.4	5.2987	5.3080	NSV 25239
20 44 30.10 -00 28 45.5	1RXS J204430.1-002845	204430-0028.6	5.874621		
20 48 59.59 -06 44 54.4	1RXS J204859.5-064453	204900-0644.9	1.93626		
20 49 22.86 +06 47 39.3	1RXS J204924.0+064737	204923+0647.6	8.958		
21 01 21.54 -49 33 04.6	1RXS J210121.2-493322	210121-4933.1	6.235	6.238	
21 10 44.82 +16 23 23.7	1RXS J211044.8+162312	211045+1623.4	10.576	10.590	
21 10 54.19 +08 58 16.4	1RXS J211053.1+085810	211055+0858.2	13.988		
21 13 05.27 -17 29 12.6	1RXS J211305.8-172912	211305-1729.2	4.9274	4.820	
21 16 32.71 +19 42 13.0	1RXS J211633.6+194214	211633+1942.2	15.246		
21 20 44.09 -54 37 59.3	1RXS J212043.3-543801	212044-5438.0	2.39861	2.3988	
21 41 05.79 +02 22 15.4	1RXS J214108.2+022239	214106+0222.2	10.956		
21 56 16.94 -40 08 27.2	1RXS J215616.4-400829	215617-4008.4	2.7398	2.7388	
21 57 51.47 -68 12 50.1	1RXS J215753.2-681237	215752-6812.8	3.3765		NSV 25792
22 00 18.93 -10 02 47.8	1RXS J220019.8-100300	220019-1002.8	7.114		
22 18 46.62 -84 38 29.6	1RXS J221851.8-843847	221846-8438.5	15.231	15.28	
22 20 07.49 -48 37 38.4	1RXS J222008.8-483734	222008-4837.6	2.9028	2.901	
22 23 00.44 -03 22 56.4	1RXS J222259.9-032303	222300-0322.9	7.593	7.589	NSV 25885
22 38 35.71 -63 34 21.4	1RXS J223836.2-633439	223836-6334.3	1.10603	1.1138	NSV 14251
22 42 26.53 -34 04 29.4	1RXS J224227.1-340434	224226-3404.5	11.53804	11.56	
22 46 46 13 -20 58 37.9	1RXS J224647.8-205837	224646-2058.6	5.0237		
22 47 05.53 +26 52 54.7	1RXS J224705.3+265257	224705+2652.9	2.2207		
22 47 22.72 +23 13 16.7	1RXS J224721.8+231256	224723+2313.4	5.543	5.541	
22 56 58.59 -45 13 20.4	1RXS J225659.0-451319	225659-4513.3	9.609	9.590	
22 57 26.02 -56 45 41.1	1RXS J225725.9-564544	225726-5645.7	6.0245		
23 08 40.17 -16 22 59.9	1RXS J230841.0-162313	230840-1623.0	0.83783	5.160	
23 10 34.25 +09 29 51.2	1RXS J231034.3+093000	231034+0929.9	3.7693	3.772	
23 12 29.01 +17 09 21.8	1RXS J231229.1+170935	231229+1709.4	3.0896		
23 14 55.88 +27 39 59.3	1RXS J231456.5+273957	231456+2740.0	11.75		
23 17 32.21 -52 48 07.5	1RXS J231732.2-524807	231733-5248.2	11.084	11.223	
23 50 51.08 -01 09 22.6	1RXS J235051.1-010916	235051-0109.4	5.6184		