COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS
Number 4444

Konkoly Observatory
Budapest
28 February 1997
HU ISSN 0374 – 0676

DETECTION OF 43 NEW BRIGHT VARIABLE STARS BY THE TYCHO INSTRUMENT OF THE HIPPARCOS SATELLITE

The Tycho experiment on board of the Hipparcos satellite has led to a photometric catalogue that promises to improve our knowledge about variable stars greatly (Mauder, Høg, 1987). For about one million stars up to B=12 (completeness up to 10.7 mag) the brightness in two spectral bands (Tycho-V and Tycho-B, similar to Johnson-V and Johnson-B) is given at 100 to 400 moments, which are spread over the four-year lifetime of the satellite (1989-1993).

This database has great advantages against archived photoplates that are usually used to search for new variable stars. On the one hand, the brightness is given in magnitudes, no further photometric reduction is necessary. On the other hand, the moments of observations are almost completely independent of seasons and daytimes. This is important for variables having a period of about one day or one year, what makes them hardly detectable by ground-based observations.

We have searched the Tycho Mean Photometric Catalogue (TPMC) and the Tycho Photometric Observations Catalogue (TPOC 2) for new variable stars using merely two criteria. The first one is that variability causes a scattering of the brightnesses at single observations with respect to their median value. Therefore, the error of this median will be larger than one would expect for a constant star, if the amplitude of the variability is strong enough (Grossmann, private communication). The other criterion does only affect periodic variables. Periodogram analysis (Horne, Baliunas 1985) has been done with the time series from the catalogue. The height of maxima in the periodogram yields a probability for a correct period determination (Scargle 1982), that is usually more than 99% for the stars presented here.

This analysis is strongly affected by the extremely uneven sampling. The smallest time interval between two single measurements is about one second, but there can be several months without any observation of the star. This leads to instabilities of maxima in the periodogram. We tried to overcome this problem by computing the periodogram over different time intervals, but this is only an improvement and not a complete solution. The measurement technique of Tycho causes another problem: The presence of field stars in the neighborhood of a program star and especially an unknown multiplicity of the star can simulate a variability that in fact does not exist. For these reasons we encourage astronomers to observe the stars that are presented here. This will lead to a better confidence for the variability and – especially – the period determinations.

The periodic lightcurves shown here were produced as follows: The data were phased with respect to the period taken from the periodogram and then binned into 20 equal parts of the period. The figures show to cycles. The reason for this binning is that single observations may be disturbed and can lead to wrong conclusions, if they are taken too seriously.

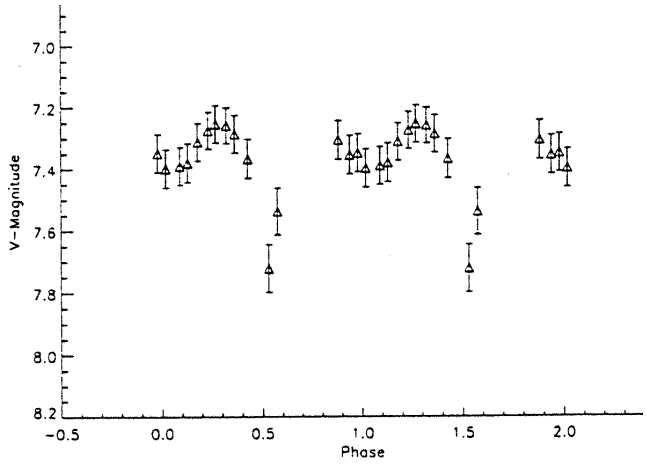

Figure 9. Phased lightcurve (P=$5^{\rm d}.252$) of the star HD 61551 in V. This may be an eclipsing binary of β Lyr type

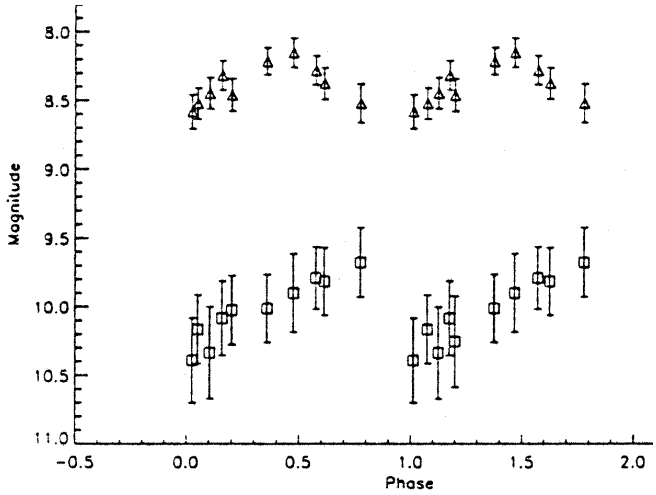

Figure 21. Phased lightcurve (P=$122^{\rm d}.0$) of the star HD 114267 in V (triangles) and B (squares). Note the variability of the colour index B−V

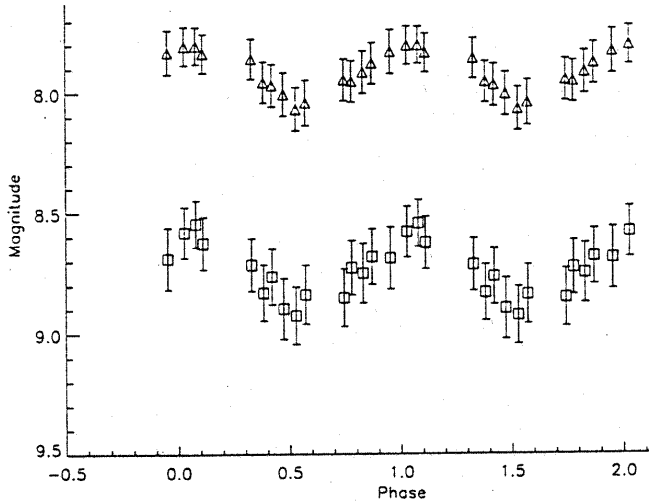

Figure 38. Phased lightcurve (P=$2^{\rm d}.91$) of the star HD 213233 in V (triangles) and B (squares)

Table 1. Results on the 43 new variables

No.	TICID[1]	Cross Identification	RA 2000.0	Dec. 2000.0	Period [days]	Type
1	3303/979/1	HD 15992	$02^h31^m48^s.65$	$+49°51'38''.0$	0.40	RRc
2	9152/1800/1	HD 22909	03 35 53.0	−69 11 35 2		L
3	2429/274/1	HD 43476	06 18 02.7	+35 35 51 5	28.4	
4	8535/222/1	HD 44363	06 18 22.3	−54 24 15 6		L
5	3769/1982/1	HD 46101	06 34 32.73	+55 21 10 5	62.9	SR
6	2426/414/1	HD 46552	06 35 37.63	+32 34 37 1	0.53	EW
7	4539/864/1	HD 60062	07 46 52.6	+81 40 56 8		
8	8551/1508/1	HD 60649	07 32 46.24	−53 33 19 3	0.49	EW
9	5405/2897/1	HD 61551	07 39 27.2	−11 33 50 9	5.52	EB
10	8911/2750/1	HD 65321	07 54 29.4	−61 12 15 8	50.3	SR
11	2504/188/1	HD 84615	09 47 20.12	+32 46 57 5		L
12	8606/502/1	HD 85025	09 47 02	−57 21		L
13	8600/3290/1	HD 90371	10 24 39.66	−54 19 19 1		L
14	9219/2587/1	HD 93325	10 44 10.2	−72 03 51	1.19	EB
15	8958/2448/1	HD 95687	11 01 35.75	−61 02 55 4	2.91	
16	8628/1620/1	HD 98434	11 18 43.92	−58 11 11 3	1.71	
17	8959/2596/1	HD 98817	11 21 06	−60 50		L
18	8972/291/1	HD 101104	11 37 34.4	−60 54 12 4	2.05	
19	7240/1270/1	HD 106865	12 17 29.58	−34 30 17 4	217	SR
20	881/680/1	HD 109983	12 38 51.5	+13 48 13 5		L
21	5537/1087/1	HD 114267	13 09 36.05	−07 46 50 5	122	SR
22	323/930/1	HD 125488	14 19 37.8	+05 53 46 8	0.20	RRb
23	8682/2013/1	HD 125687	14 22 52.1	−55 57 43 0	109	SR
24	3038/566/1	HD 126080	14 22 17.6	+41 27 03 5	0.69	RRa
25	7851/500/1	HD 143996	16 05 01.1	−39 12 57 8	12.5	
26	9039/2221/1	HD 152982	17 00 36.6	−61 24 16 8		L
27	8354/1640/1	HD 158479	17 32 10.4	−51 04 25 1		L
28	9297/1770/1	HD 160326	17 46 22.4	−72 49 18	349	SR
29	8344/931/1	HD 162985	17 56 08.32	−45 09 20 8	0.78	EA
30	3913/1509/1	HD 172022	18 34 26.3	+57 48 06 4		
31	1073/1391/1	HD 192689	20 15 53.5	+07 40 13 0		L
32	6929/1233/1	HD 197785	20 46 40.13	−27 13 59 9	11.1	EB
33	1656/2033/1	HD 200271	21 01 53.2	+18 59 54 9		L
34	8818/1040/1	HD 204611	21 32 00.6	−58 48 54 4		L
35	7990/374/1	HD 208016	21 54 22.2	−41 15 57 7	97.1	SR
36	8825/1029/1	HD 210741	22 14 02.4	−57 13 06 3		L
37	8442/1011/1	HD 212508	22 25 46.05	−49 49 34 7	6.15	
38	3619/2726/1	HD 213233	22 28 58.24	+50 57 47 4	2.91	δ Cep
39	9127/307/1	HD 223470	23 49 58.0	−61 08 08 6	1.47	
40	2772/1716/1	HD 224326	23 56 57.97	+32 20 14 3	27.95	
41	2091/1465/1	HD 341508	18 03 19.15	+23 48 53 0	5.89	δ Cep
42	6497/892/1	SAO 170690	05 40 58.7	−27 57 07 3		L
43	8958/3540/1	CSI-60-11041 1	11 06 09.0	−60 31 21	0.33	RRb

1) The TICID is the "name" of a star in the Tycho Catalogue. The first number gives the GSC-region, the second one is a running number inside this region, and the last one numbers components of multiple systems.

Because the space is limited, not all of the 43 lightcurves can be presented here. They are available on the IBVS ftp site: ftp.konkoly.hu/pub/ibvs/4401/4444-f<No.>.ps where No. is the serial number in Table 1.

Acknowledgements: I am thankful to Prof. Horst Mauder, Tübingen, for giving me the possibility to work with Tycho-data. Andreas Wicenec and Volkmar Grossmann helped me very much in doing my diploma thesis. This research has made use of the SIMBAD database, operated at CDS, France.

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