



First Elements for six New Variable Stars in Several Fields, Part IV

Frank, Peter
Velden, Germany
email: frank.velden@t-online.de

Moschner, Wolfgang
Lennestadt, Germany
email: wolfgang.moschner@t-online.de

Bernhard, Klaus
Linz, Austria
email: klaus.bernhard@liwest.at

Bundesdeutsche Arbeitsgemeinschaft für Veränderliche Sterne e.V.

October 2017

Abstract: *6 new variable stars (GSC 02134-00028, GSC 02134-01608, GSC 02134-00590, UCAC3 238-155503, GSC 02671-02330, GSC 02670-02219) are presented, which were found in a search for new variable stars in the fields of several known variables.*

Introduction

During the investigation of several known variable stars, six further variables were found in their surroundings, which are new to our knowledge (not included in AAVSO VSX and GCVS). This paper is the fourth part of a series dealing with numerous discoveries.

These new variables were discovered on images of the 102mm-TeleVue-Refractor (P. Frank, Velden/Germany) by Peter Frank.

Further detailed observations were made using a 400mm-ASA-Astrograph (W. Moschner, Nerpio/Spain) and the 102mm-TeleVue-Refractor (P. Frank, Velden/Germany) in 2017 and earlier, which are discussed subsequently in detail:

Fr103 Lyr	=	GSC 02134-00028
Fr214 Lyr	=	GSC 02134-01608
Fr219 Lyr	=	GSC 02134-00590
Fr225 Lyr	=	UCAC3 238-155503
Fr184 Cyg	=	GSC 02671-02330
Fr185 Cyg	=	GSC 02670-02219

Observations

The discovery observations were carried out with a 102mm/5.0 TeleVue-Refractor (Velden/Germany) and a SIGMA 1603 CCD-Camera containing a cooled Kodak KAF1603ME chip. Normally, the exposures are 60 s through an IR & UV cut off filter.

Further observations were carried out between June 2015 and July 2017 with a robotic telescope 400 mm f/3.7 ASA-Astrograph (Nerpio, Spain) equipped with a cooled FLI Proline 16803 CCD-Camera and V-filter. The exposure times were between 60 and 120 seconds. The telescope was controlled from Lennestadt via internet.

Data analysis

Muniwin [1] and a self-written program by F. Agerer were used for the analysis of the frames, after bias, dark- and flatfield correction of the exposures.

Period analysis was performed with Peranso [2], the magnitudes of the variable stars (at maximum brightness) were obtained from the NOMAD 1 Catalog (Zacharias et al. 2015) [3] or the APASS DR9 Catalog (Henden et al. 2016) [4].

Presented elements were calculated with Peranso or by taking into account all minima (see tables below) with the method of least squares. The given amplitudes are uncorrected instrumental values.

Explanations:

HJD = heliocentric UTC timings of the observed minima

mag = Magnitude

The coordinates are taken from the USNO-B1.0 catalogue.

Explanations to the lightcurves:

The colour coding of the symbols plots denotes data taken on different nights.

Fr103 Lyr = GSC 02134-00028

Right ascension: 19h 04m 08.8453s (2000)

Declination: +29° 48' 02.377"

NOMAD 1 Catalog:

Vmag: 11.637 Bmag: 11.892 Bmag-Vmag = 0.255

Comparison star = UCAC3 240-155257

Check Star = UCAC3 239-156822

Amplitude Min I: 0.20 mag (instr.) Min II: 0.10 mag (instr.)

Type: EB type eclipsing binary

$$\text{Min} = \text{HJD } 2457935.5188 + 0.5440103 * E \\ \pm 0.0006 \pm 0.0000010$$

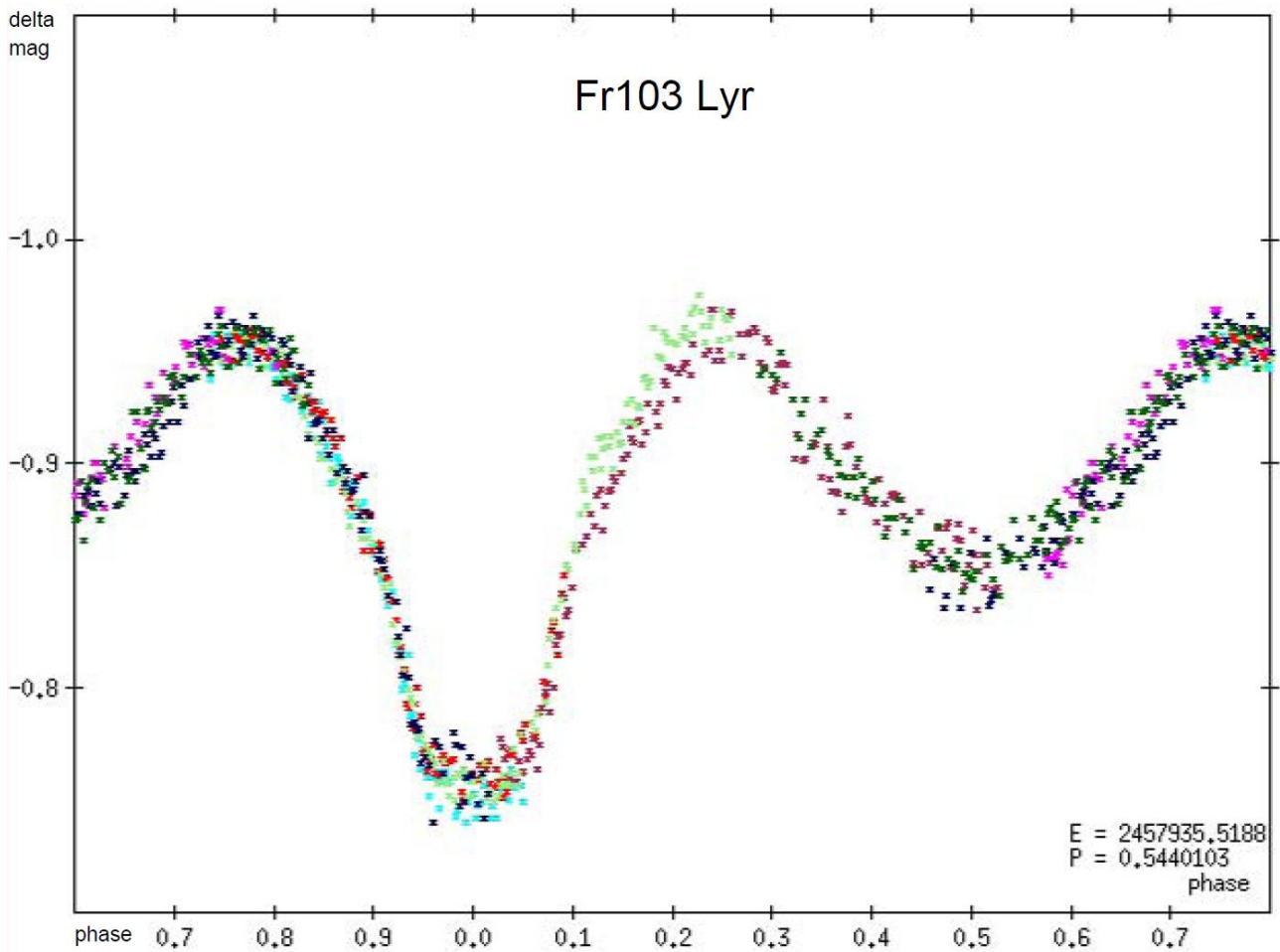


Fig 1: Phased lightcurve of Fr103 Lyr = GSC 02134-00028 using the ephemeris given above. FLI Proline 16803+V-filter. Presented elements were calculated by taking into account all minima (see tables below) with the method of least squares.

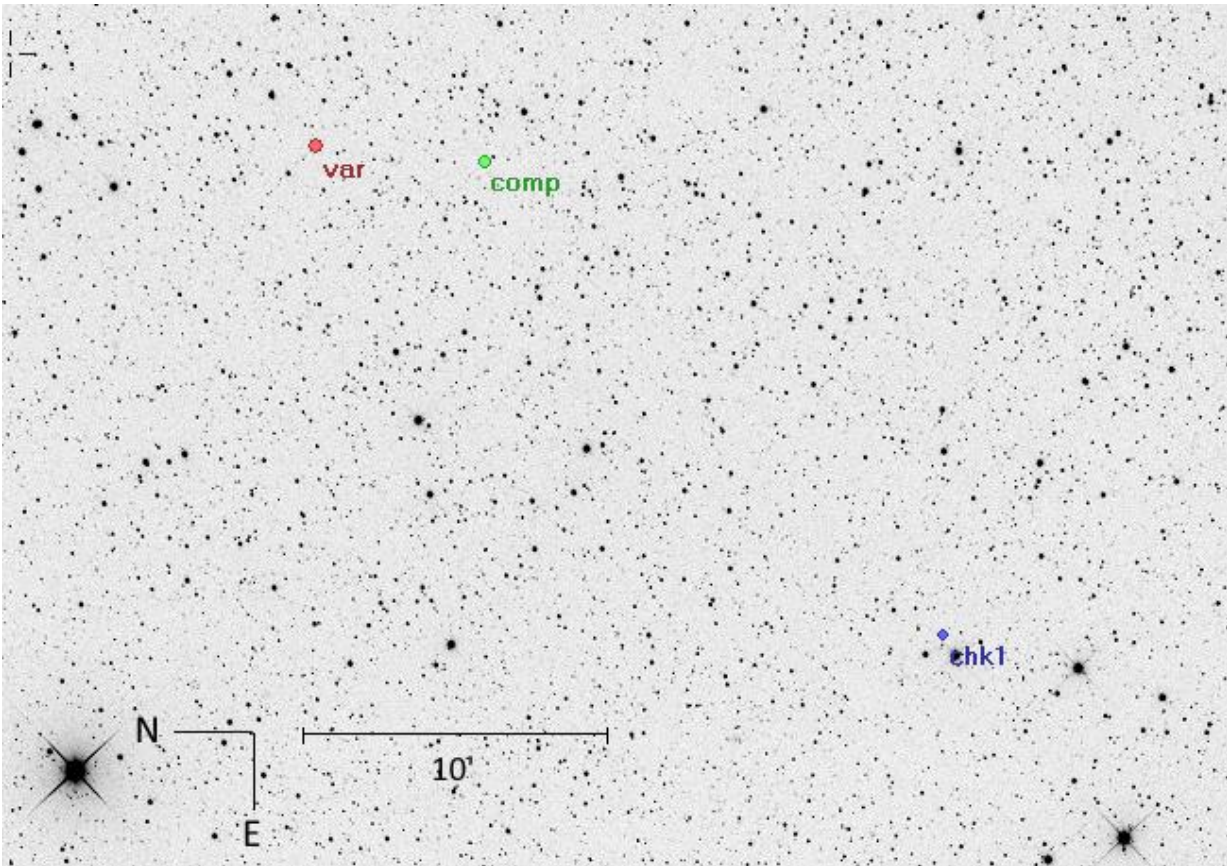


Fig 2: Fr103 Lyr = GSC 02134-00028 (**var**) in the field of AA Lyr; (**comp**) is the comparison star and (**chk1**) is the check star.

Table 1: Minima of Fr103 Lyr = GSC 02134-00028

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P. Frank	2455303,5950	I	-4838	-0,0020	
P. Frank	2455385,4709	II	-4687,5	0,0004	
P. Frank	2455387,3804	I	-4684	0,0058	
P. Frank	2455409,4080	II	-4643,5	0,0010	
P. Frank	2455418,3806	I	-4627	-0,0025	
P. Frank	2455429,5313	II	-4606,5	-0,0041	
P. Frank	2456500,4232	I	-2638	0,0036	
P. Frank	2456568,4223	I	-2513	0,0014	
P. Frank	2456577,3955	II	-2496,5	-0,0016	
P. Frank	2456579,3030	I	-2493	0,0019	
W.Moschner	2457899,6148	I	-66	0,0007	
W.Moschner	2457935,5188	I	0	0,0000	
W.Moschner	2457950,4827	II	27,5	0,0036	
W.Moschner	2457978,4974	I	79	0,0018	

Remarks: none

Fr214 Lyr = GSC 02134-01608

Right ascension: 19h 05m 33.9713s (2000)

Declination: +29° 17' 20.123"

NOMAD 1 Catalog:

Vmag: 12.750 Bmag: 13.220 Bmag-Vmag = 0.470

Comparison star = GSC 02134-00116

Check Star = UCAC3 239-156822

Amplitude Min I: 0.11 mag (instr.) Min II: 0.11 mag (instr.)

Type: EW type eclipsing binary

Min = HJD 2455074.4342 + 0.5254163 * E
±0.0007 ±0.0000009

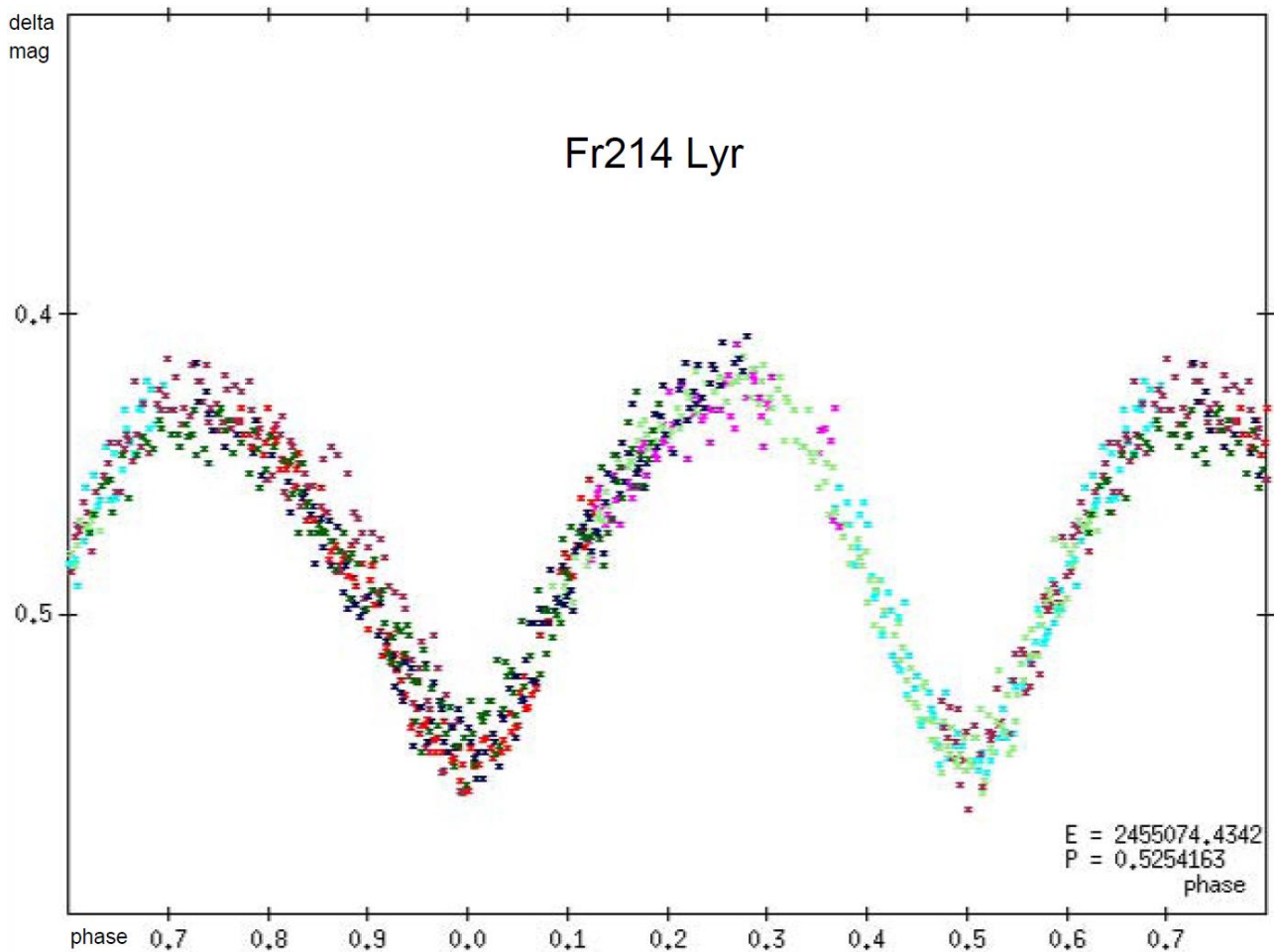


Fig 3: Phased lightcurve of Fr214 Lyr = GSC 02134-01608 using the ephemeris given above. FLI Proline 16803+V-filter. Presented elements were calculated by taking into account all minima (see tables below) with the method of least squares.

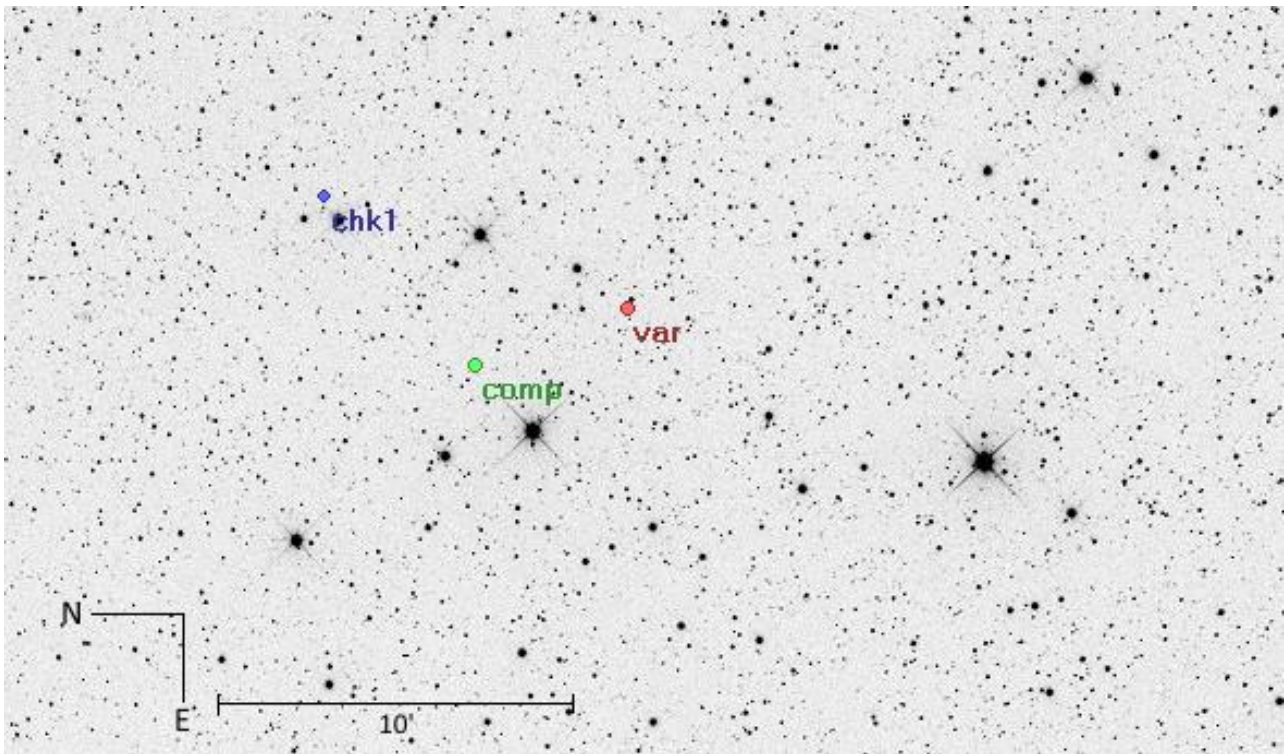


Fig 4: Fr214 Lyr = GSC 02134-01608 (**var**) in the field of AA Lyr; (**comp**) is the comparison star and (**chk1**) is the check star.

Table 2: Minima of Fr214 Lyr = GSC 02134-01608

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P. Frank	2455074,4342	I	0	0,0000	
P. Frank	2455380,4905	II	582,5	0,0013	
P. Frank	2455385,4808	I	592	0,0002	
P. Frank	2455409,3898	II	637,5	0,0027	
P. Frank	2455429,3576	II	675,5	0,0047	
P. Frank	2456500,4173	I	2714	0,0033	
P. Frank	2456568,4581	II	2843,5	0,0027	
P. Frank	2456577,3946	II	2860,5	0,0071	
P. Frank	2456590,2618	I	2885	0,0016	
P. Frank	2456596,3081	II	2896,5	0,0056	
P. Frank	2456918,3847	II	3509,5	0,0020	
W.Moschner	2457618,4988	I	4842	-0,0011	
W.Moschner	2457626,3832	I	4857	0,0020	
W.Moschner	2457893,5568	II	5365,5	0,0014	
W.Moschner	2457899,5962	I	5377	-0,0014	
W.Moschner	2457921,4041	II	5418,5	0,0017	
W.Moschner	2457935,5869	II	5445,5	-0,0018	
W.Moschner	2457949,5088	I	5472	-0,0034	
W.Moschner	2457950,5639	I	5474	0,0009	
W.Moschner	2457978,4069	I	5527	-0,0032	

Remarks: none

Fr219 Lyr = GSC 02134-00590

Right ascension: 19h 03m 55.2179s (2000)

Declination: +29° 15' 15.124"

NOMAD 1 Catalog:

Vmag: 13.510 Jmag: 13.125

Comparison star = GSC 02134-00116

Check Star = UCAC3 239-156822

Amplitude Min I: 0.55 mag (instr.) Min II: 0.50 mag (instr.)

Type: EW type eclipsing binary

Min = HJD 2455429.3597 + 0.42636345*E
±0.0007 ±0.00000063

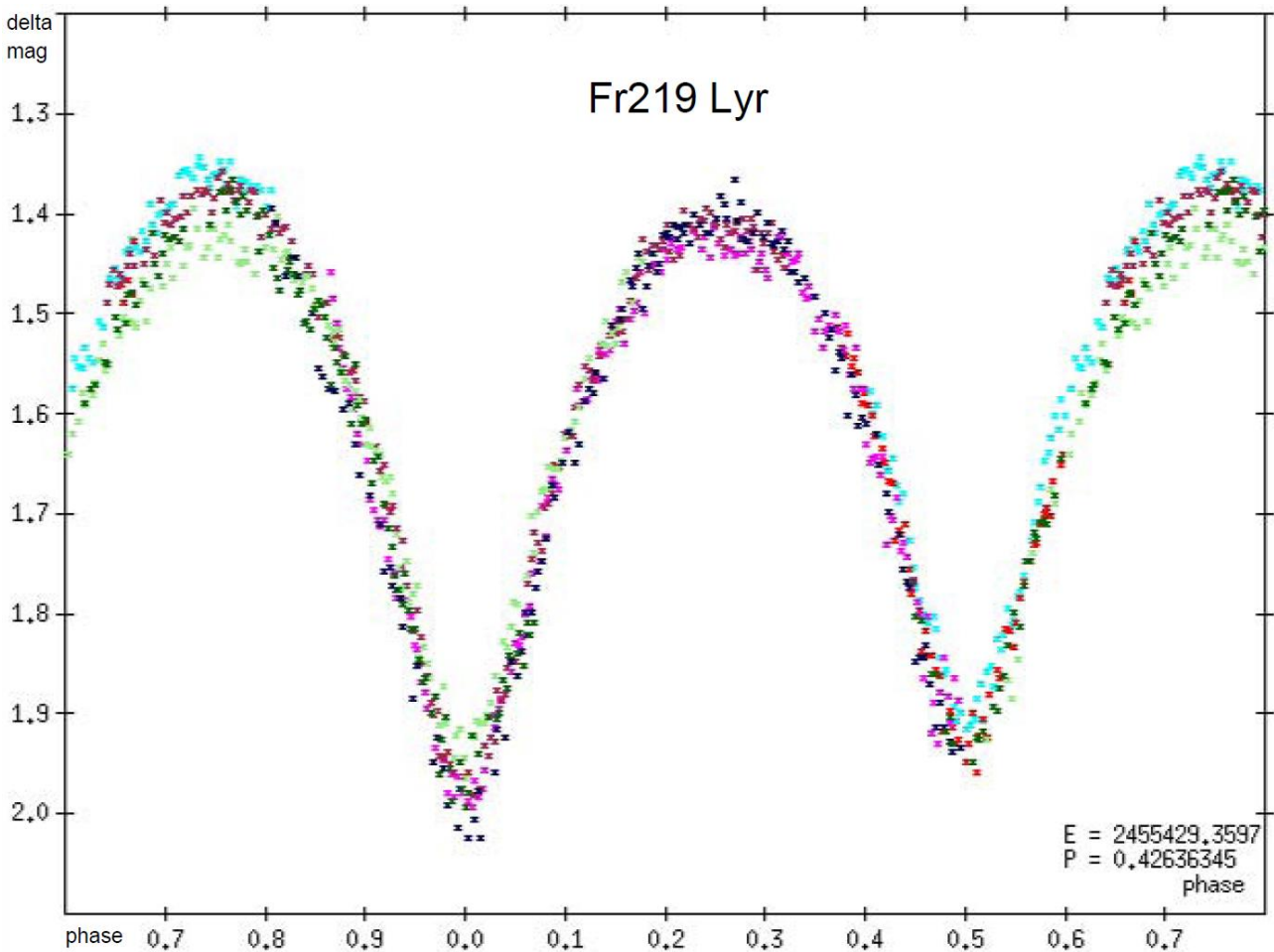


Fig 5: Phased lightcurve of Fr219 Lyr = GSC 02134-00590 using the ephemeris given above. FLI Proline 16803+V-filter. Presented elements were calculated by taking into account all minima (see tables below) with the method of least squares.

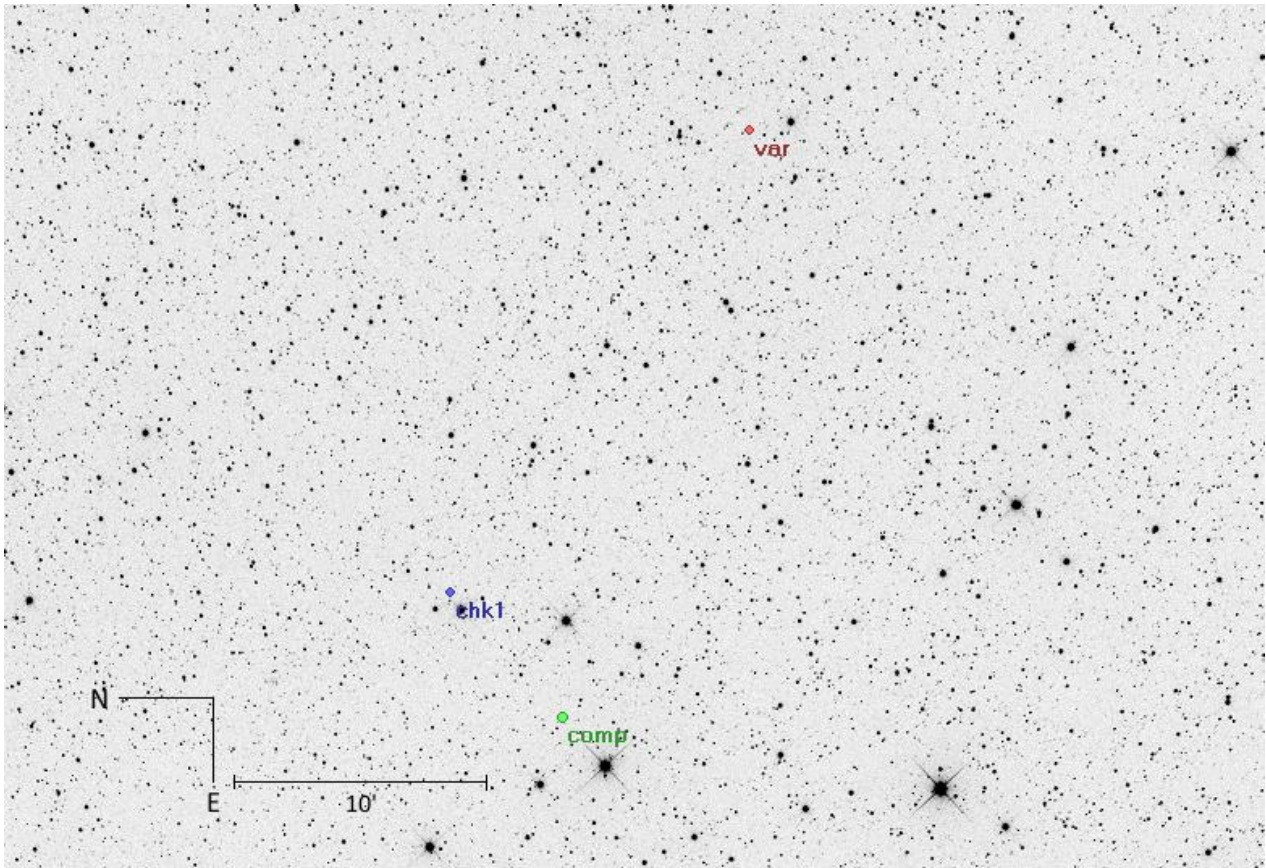


Fig 6: Fr219 Lyr = GSC 02134-00590 (**var**) in the field of AA Lyr; (**comp**) is the comparison star and (**chk1**) is the check star.

Table 3: Minima of Fr219 Lyr = GSC 02134-00590

Observer	HJD-Date	Type	Epoch	O-C (d)	Source
	Minimum				
P. Frank	2455074,4128	II	-832,5	0,0007	
P. Frank	2455380,5419	II	-114,5	0,0008	
P. Frank	2455385,4445	I	-103	0,0002	
P. Frank	2455409,5331	II	-46,5	-0,0007	
P. Frank	2455418,4863	II	-25,5	-0,0011	
P. Frank	2455429,3597	I	0	0,0000	
P. Frank	2455429,5722	II	0,5	-0,0007	
P. Frank	2456500,3851	I	2512	0,0004	
P. Frank	2456568,3894	II	2671,5	-0,0003	
P. Frank	2456577,3423	II	2692,5	-0,0010	
P. Frank	2456579,2612	I	2697	-0,0007	
P. Frank	2456590,3496	I	2723	0,0022	
P. Frank	2456596,3170	I	2737	0,0005	
P. Frank	2456624,2439	II	2802,5	0,0006	
P. Frank	2456918,4333	II	3492,5	-0,0007	
W.Moschner	2457618,5230	II	5134,5	0,0002	
W.Moschner	2457626,4112	I	5153	0,0006	
W.Moschner	2457893,5282	II	5779,5	0,0009	
W.Moschner	2457899,4960	II	5793,5	-0,0003	
W.Moschner	2457907,5978	II	5812,5	0,0005	

W.Moschner	2457921,4534	I	5845	-0,0007
W.Moschner	2457935,5246	I	5878	0,0005
W.Moschner	2457949,5935	I	5911	-0,0006
W.Moschner	2457950,4462	I	5913	-0,0006
W.Moschner	2457978,3744	II	5978,5	0,0008
W.Moschner	2457978,5865	I	5979	-0,0003

Remarks: none

Fr225 Lyr = UCAC3 238-155503

Right ascension: 19h 04m 32.7078s (2000)

Declination: +28° 59' 58.318"

NOMAD 1 Catalog:

Vmag: 14.760 Bmag: 15.170 Bmag-Vmag = 0.410

Comparison star = UCAC3 239-156437

Check Star = UCAC3 239-156822

Amplitude Min I: 0.88 mag (instr.) Min II: 0.77 mag (instr.)

Type: EA type eclipsing binary

Min = HJD 2455385.4796 + 0.9155115*E
±0.0006 ±0.0000042

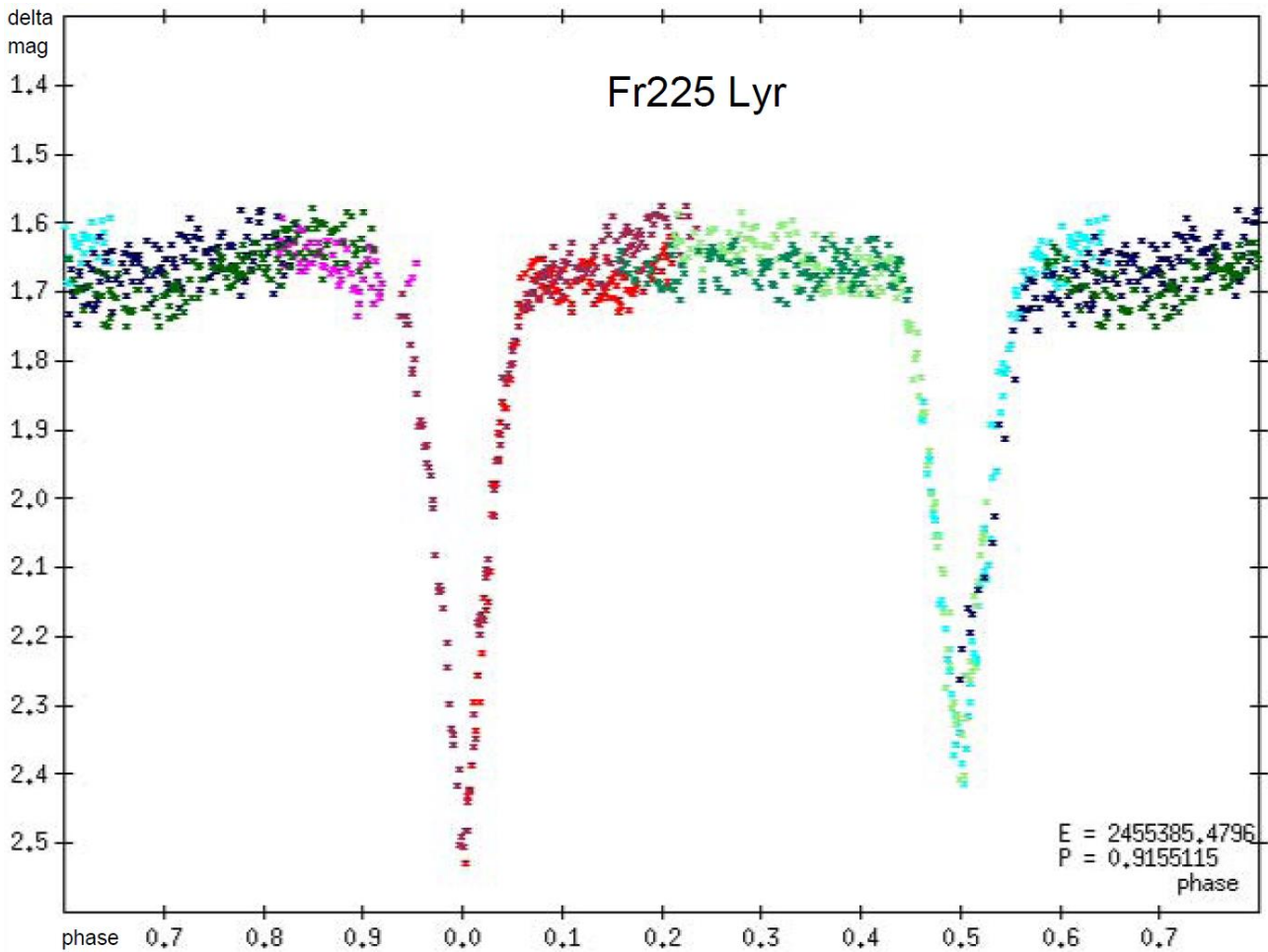


Fig 7: Phased lightcurve of Fr225 Lyr = UCAC3 238-155503 using the ephemeris given above. FLI Proline 16803+V-filter. Presented elements were calculated by taking into account all minima (see tables below) with the method of least squares.

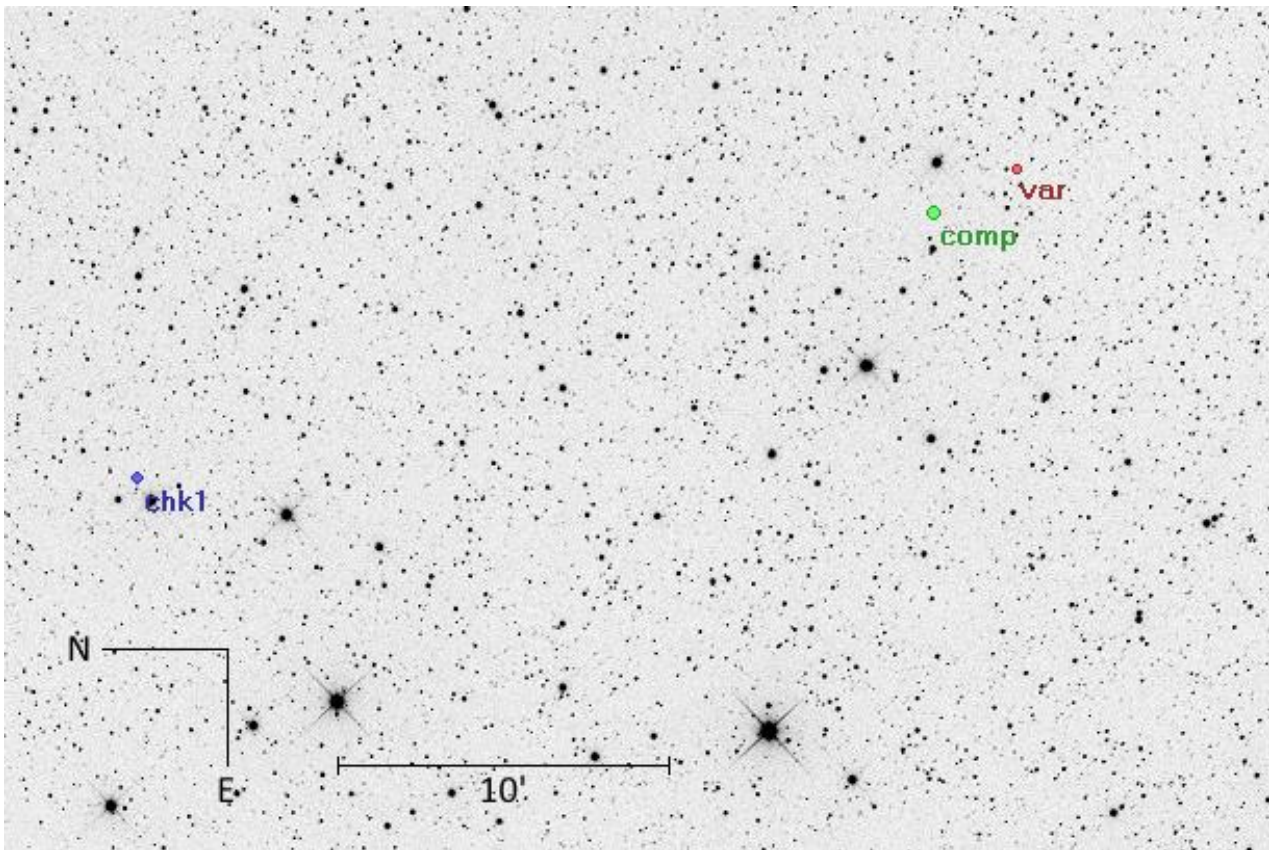


Fig 8: Fr225 Lyr = UCAC3 238-155503 (*var*) in the field of AA Lyr; (*comp*) is the comparison star and (*chk1*) is the check star.

Table 4: Minima of Fr225 Lyr = UCAC3 238-155503

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P. Frank	2455380,4437	I	-5,5	-0,0006	
P. Frank	2455385,4796	I	0	0,0000	
P. Frank	2455418,4376	I	36	-0,0004	
P. Frank	2455429,4233	I	48	-0,0009	
P. Frank	2456500,5741	I	1218	0,0015	
P. Frank	2456568,3211	I	1292	0,0006	
P. Frank	2456579,3072	I	1304	0,0006	
P. Frank	2456590,2934	I	1316	0,0007	
P. Frank	2456596,2441	I	1322,5	0,0005	
W.Moschner	2457893,5231	II	2739,5	-0,0003	
W.Moschner	2457921,4459	I	2770	-0,0006	
W.Moschner	2457935,6361	II	2785,5	-0,0008	

Remarks: none

Fr184 Cyg = GSC 02671-02330

Right ascension: 20h 11m 06.6003s (2000)

Declination: +30° 38' 54.297"

APASS DR9 Catalog:

Vmag: 12.525 Bmag: 13.638 Bmag-Vmag = 1.113

Comparison star = GSC 02671-02256

Check Star = GSC 02671-02088

Amplitude Min I: 0.65 mag (instr.) Min II: 0.45 mag (instr.)

Type: EA type eclipsing binary

Min = HJD 2456186.5864 + 0.61696176*E
±0.0006 ±0.00000054

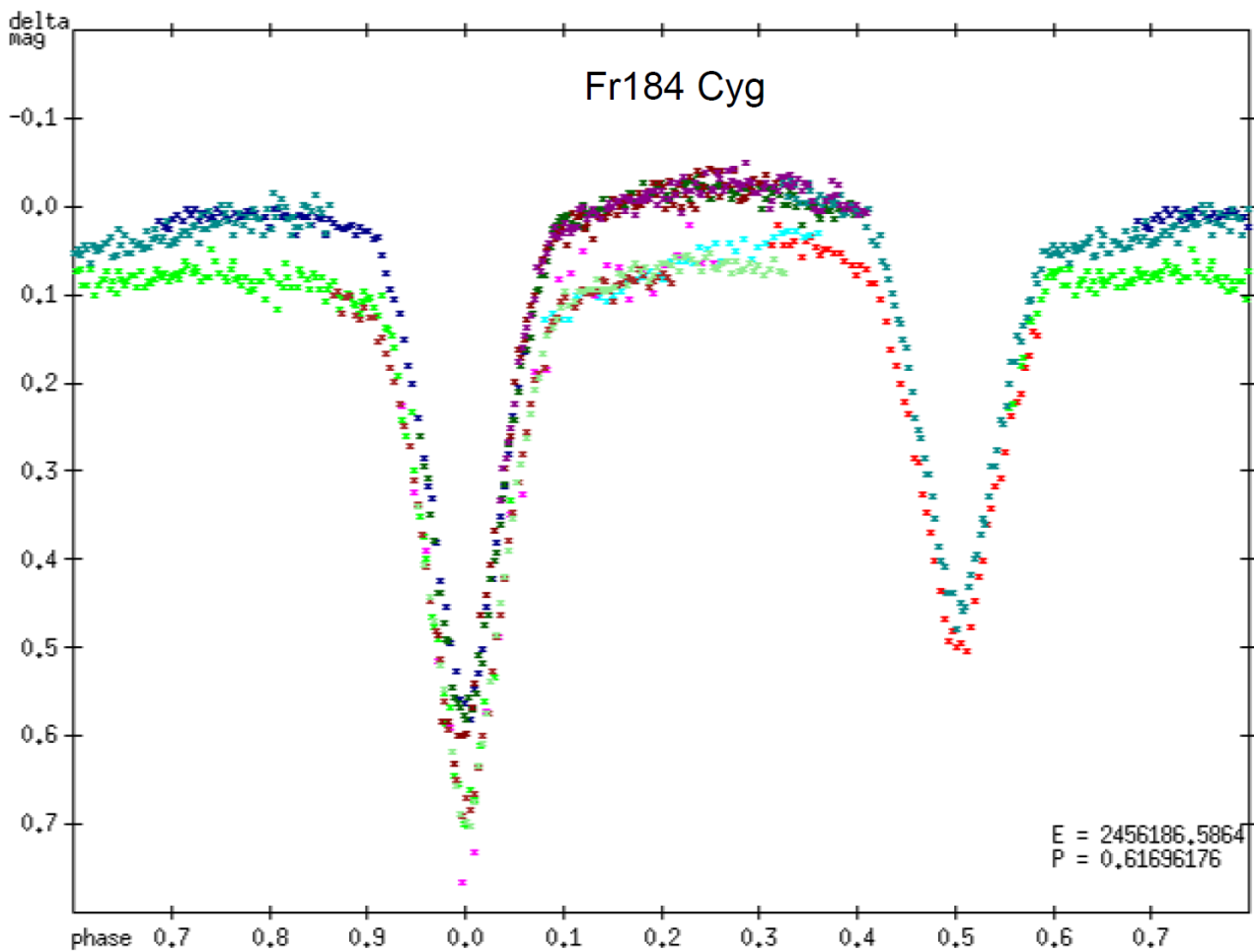


Fig 9: Phased lightcurve of Fr184 Cyg = GSC 02671-02330 using the ephemeris given above. SIGMA 1603 CCD-Camera and IR & UV cut off filter. Presented elements were calculated by taking into account all minima (see tables below) with the method of least squares.

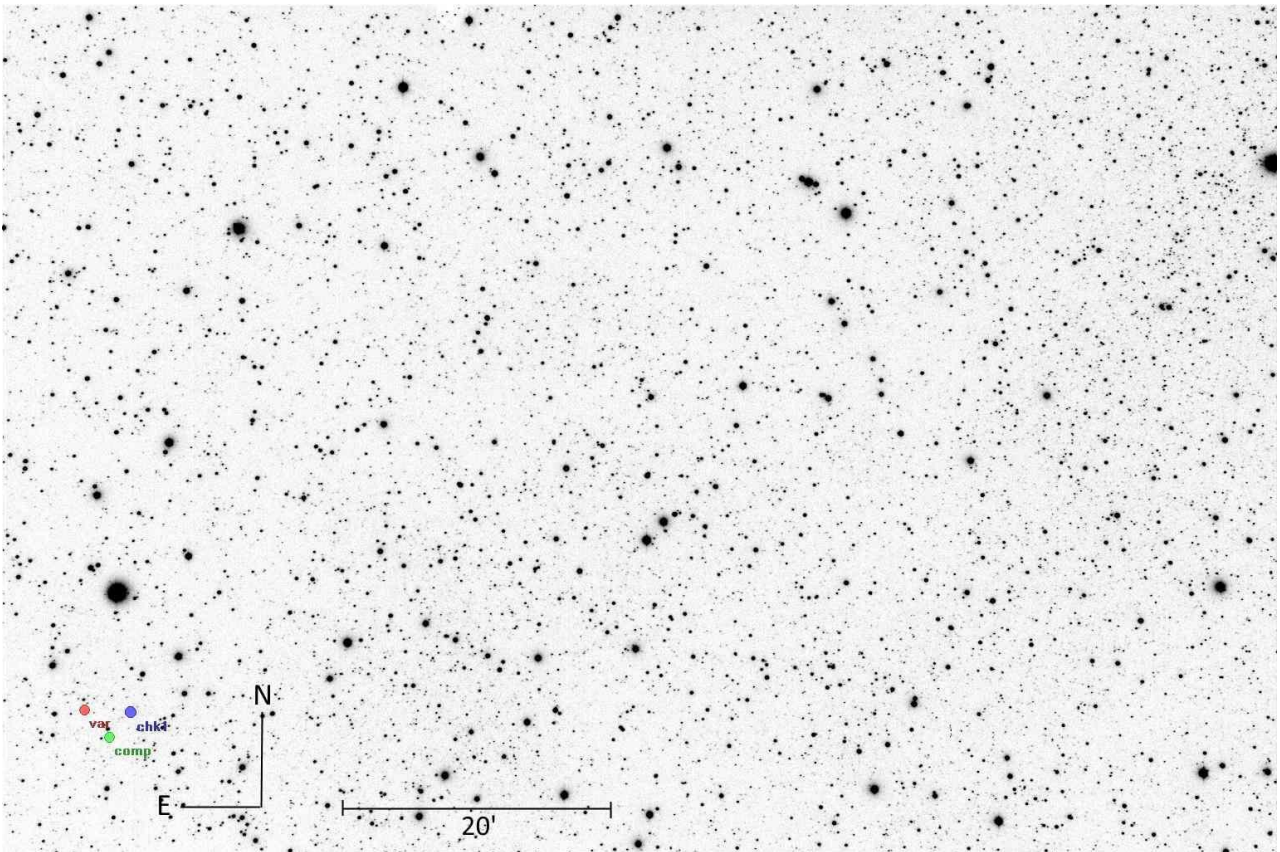


Fig 10: Fr184 Cyg = GSC 02671-02330 (**var**) in the field of V725 Cyg; (**comp**) is the comparison star and (**chk1**) is the check star.

Table 5: Minima of Fr184 Cyg = GSC 02671-02330

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P. Frank	2456158,5165	II	-45,5	0,0019	
P. Frank	2456186,5864	I	0	0,0000	
P. Frank	2457214,4447	I	1666	0,0000	
P. Frank	2457219,3803	I	1674	-0,0001	
P. Frank	2457225,5500	I	1684	0,0000	
P. Frank	2457240,3563	I	1708	-0,0008	
P. Frank	2457260,4107	II	1740,5	0,0024	
P. Frank	2457939,3695	I	2841	-0,0053	

Remarks:

The variable shows changes in the mean level of brightness and of the shape of the light curve, which should encourage further observations to determine the causes.

Fr185 Cyg = GSC 02670-02219

Right ascension: 20h 05m 27.5883s (2000)

Declination: +30° 33' 02.206"

APASS DR9 Catalog:

Vmag: 12.870 Bmag: 13.679 Bmag-Vmag = 0.809

Comparison star = GSC 02670-01931

Check Star = GSC 02670-01997

Amplitude Min I: 0.13 mag (instr.) Min II: 0.11 mag (instr.)

Type: EW type eclipsing binary

Min = HJD 2456158.5363 + 0.5923420 * E
±0.0008 ±0.000012

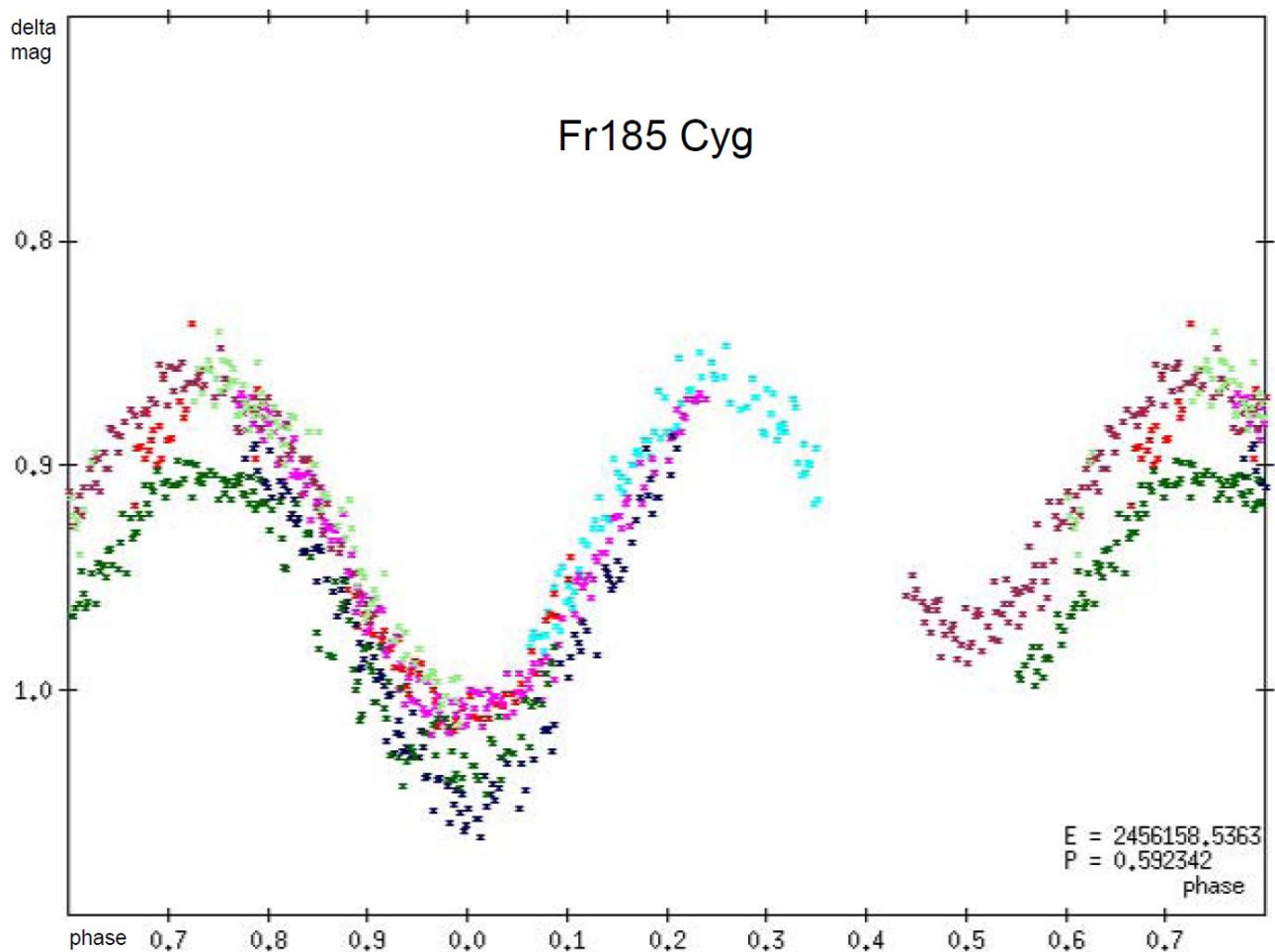


Fig 11: Phased lightcurve of Fr185 Cyg = GSC 02670-02219 using the ephemeris given above. FLI Proline 16803+V-filter. Presented elements were calculated by taking into account all minima (see tables below) with the method of least squares.

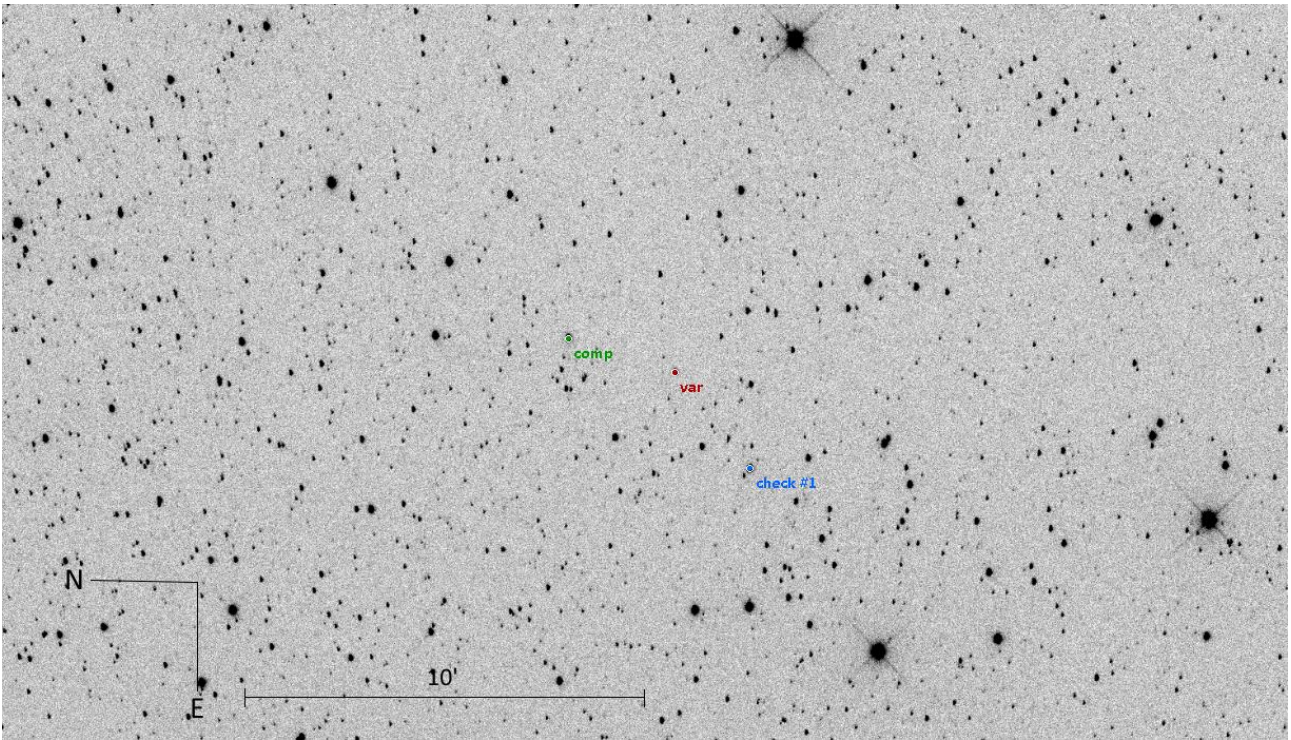


Fig 12: Fr185 Cyg = GSC 02670-02219 (**var**) in the field of V725 Cyg; (**comp**) is the comparison star and (**check#1**) is the check star.

Table 6: Minima of Fr185 Cyg = GSC 02670-02219

Observer	HJD-Date	Type	Epoch	O-C (d)	Source
	Minimum				
P. Frank	2456158,5363	I	0	0,0000	
P. Frank	2456186,3778	I	47	0,0014	
P. Frank	2457214,3892	II	1782,5	0,0033	
P. Frank	2457219,4213	I	1791	0,0005	
P. Frank	2457240,4479	II	1826,5	-0,0011	
P. Frank	2457260,5818	II	1860,5	-0,0068	
Moschner/Frank	2457932,5975	I	2995	-0,0031	
Moschner/Frank	2457938,5269	I	3005	0,0029	
P. Frank	2457939,4137	II	3006,5	0,0012	
Moschner/Frank	2457939,4145	II	3006,5	0,0020	
Moschner/Frank	2457952,4415	II	3028,5	-0,0025	
Moschner/Frank	2457954,5155	I	3032	-0,0017	
Moschner/Frank	2457961,6205	I	3044	-0,0048	

Remarks:

The variable shows changes in the mean level of brightness and of the shape of the light curve at both locations (Nerpio and Velden), which is confirmed by the long-term brightness-development of the ASAS-SN-Data [5] (see Fig. 13), which should encourage further observations to determine the causes [6].

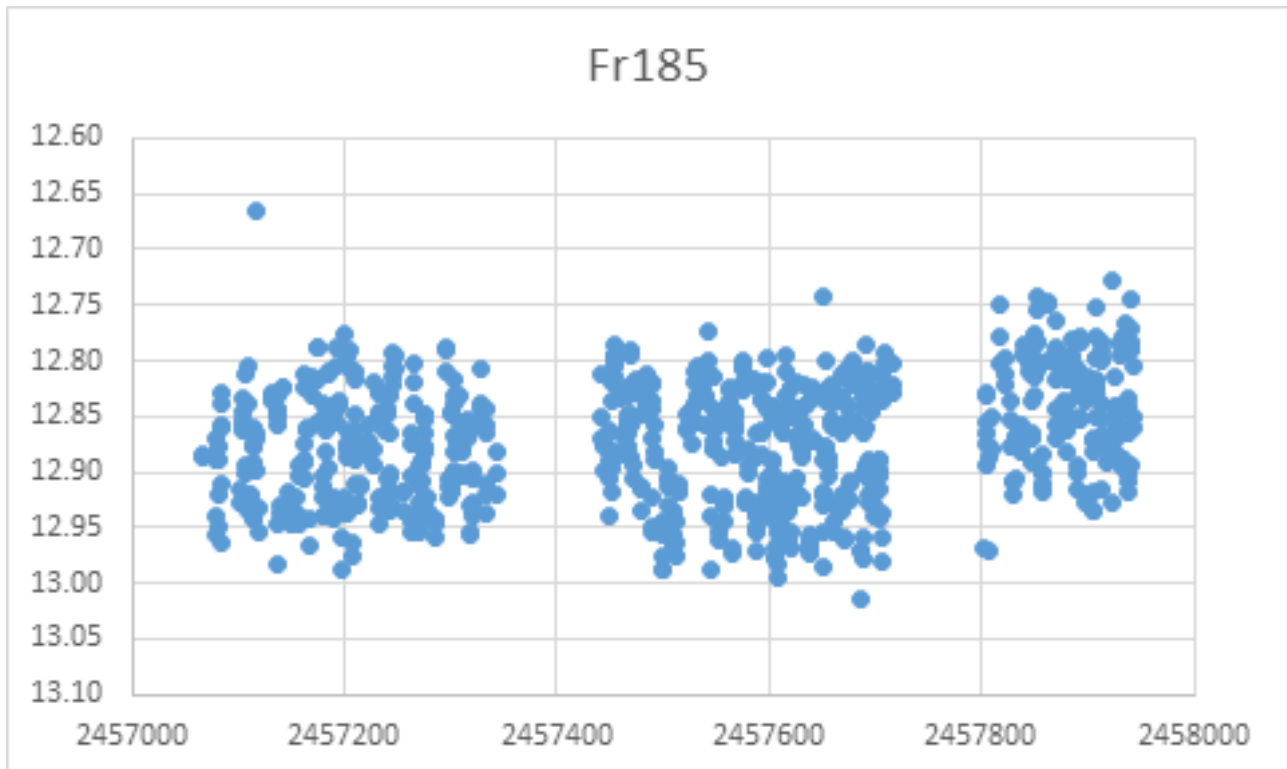


Fig 13: Fr185 Cyg = GSC 02670-02219
 Long-term brightness-development of the ASAS-SN-Data

Acknowledgements

This research has made use of the SIMBAD database, operated at CDS, Strasbourg, France and of the International Variable Star Index (VSX) database, operated at AAVSO, Cambridge, Massachusetts, USA.

The authors thank Franz Agerer (BAV) for providing his personal data-analysis program.

References

- [1] Motl, David: MuniWin, <http://c-munipack.sourceforge.net>
- [2] Vanmunster, Tony: Peranso, <http://www.peranso.com/>
- [3] NOMAD 1 Catalog,
<http://cdsarc.u-strasbg.fr/viz-bin/Cat?I/297>
Zacharias N., Monet D.G., Levine S.E., Urban S.E., Gaume R., Wycoff G.L., 2004, AAS, 205, 4815
- [4] APASS: The AAVSO Photometric All-Sky Survey - Data Release 9
<http://vizier.u-strasbg.fr/viz-bin/VizieR?-source=II/336>
Henden A.A., Templeton M., Terrell D., Smith T.C., Levine S., Welch D., 2015, AAS, 22533616
- [5] ASAS All Star Catalogue) <http://www.astrouw.edu.pl/asas/>
ASAS-SN <https://asas-sn.osu.edu/>
- [6] Shappee, B. J. et al., 2014, ApJ, 788, 48
<http://adsabs.harvard.edu/abs/2014ApJ...788...48S>
Kochanek, C. S. et al. 2017, PASP, 129, 104502
<http://adsabs.harvard.edu/abs/2017PASP..129j4502K>