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

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Abstract: *6 new variable stars (UCAC3 284-221990, UCAC3 284-159698, UCAC3 285-155734, UCAC3 239-159278, UCAC4 598-071837; GSC 02135-00056) 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 sixth part of a series dealing with numerous discoveries.

Some new variables were discovered on images of the 102mm-TeleVue-Refractor (P. Frank, Velden/Germany) by Peter Frank, some were discovered by Wolfgang Moschner on images of the 400mm-ASA-Astrograph (W. Moschner, Nerpio/ Spain).

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:

MoV68 Lac	=	UCAC3 284-221990
MoV59 Cyg	=	UCAC3 284-159698
MoV60 Cyg	=	UCAC3 285-155734
Fr273 Lyr	=	UCAC3 239-159278
Fr280 Lyr	=	UCAC4 598-071837
Fr105 Lyr	=	GSC 02135-00056

Observations

Some discovery observations (Fr273 Lyr, Fr280 Lyr, Fr105 Lyr) were carried out with a 102mm/f5.0 TeleVue-Refractor (Velden/Germany) and a SIGMA 1603 CCD-Camera containing a cooled Kodak KAF1603ME chip. Normally, the exposures were 90 s resp. 120 s through an IR & UV cut off filter.

Some discovery observations (MoV68 Lac, MoV59 Cyg, MoV60 Cyg) were carried out with a 400 mm f/3.7 ASA-Astrograph (Nerpio, Spain) equipped with a cooled FLI Proline 16803 CCD-Camera and V-filter.

Further observations for five new variables were carried out between June 2015 and November 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 UCAC4 Catalog (Zacharis et al. 2012) [3], or the XPM Catalog (Fedorov et. al. 2009) [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 coloured coding of the symbols plots denotes data taken on different nights.

MoV68 Lac = UCAC3 284-221990
= XPM 283-0699858
Right ascension: 22h19m34.2633s (2000)
Declination: +51° 47' 41.411"

XPM Catalog:
Vmag: 16.390   Bmag: 16.9   Bmag-Vmag = 0.510

Comparison star   =   UCAC3 284-221940
Check Star   =   UCAC3-284-221899

Amplitude: Min I: 0.68 mag (instr.)   Min II: 0.68 mag (instr.)
Type: EW type eclipsing binary

Min =   HJD 2457642.5736 + 0.3079363*E
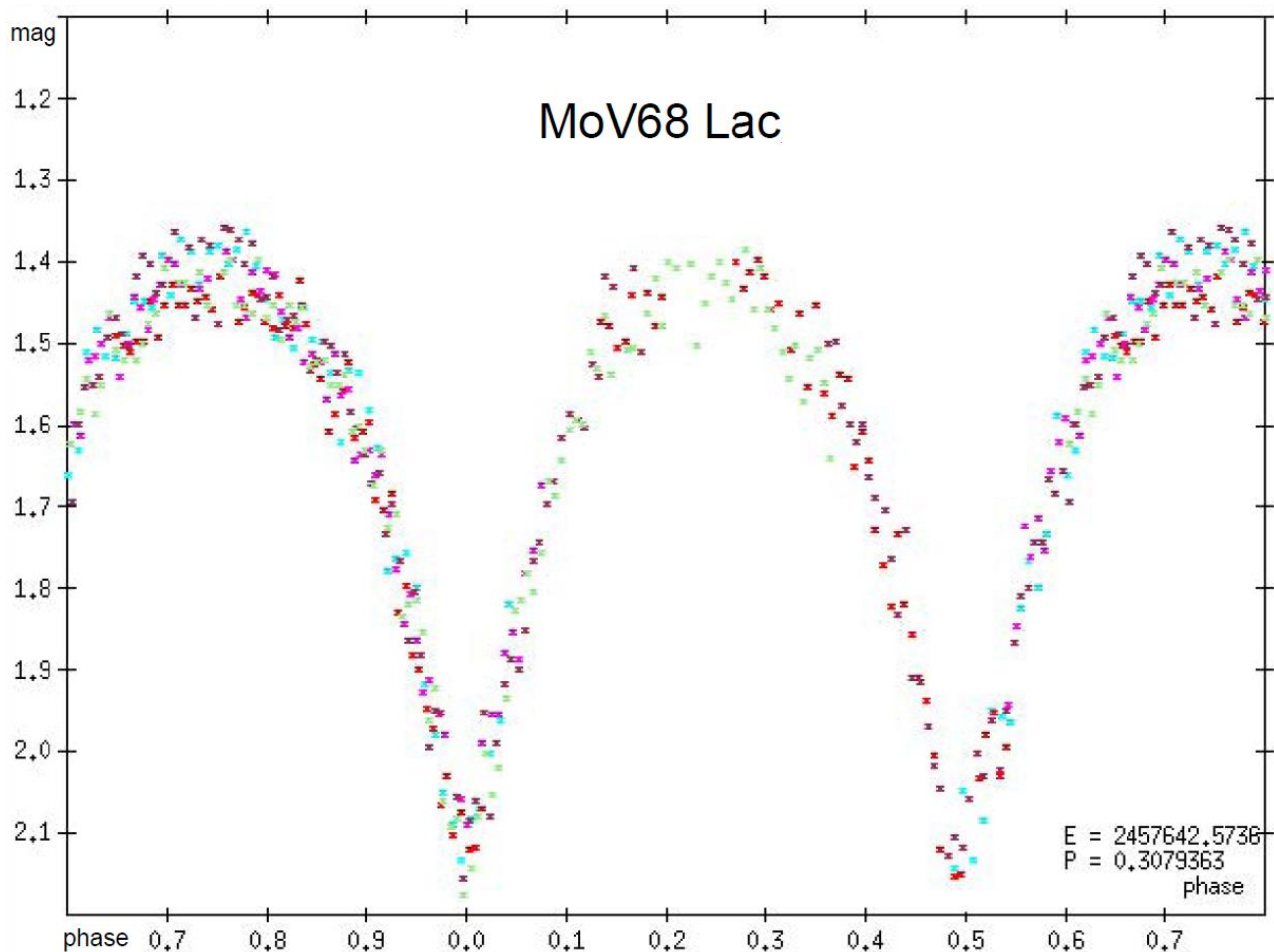   +-0.0007 +-0.0000012

Fig 1: Phased lightcurve of MoV68 Lac = UCAC3 284-221990 using the ephemeris given above.
FLI Proline 16803+V-filter. Presented elements were calculated by taking into account all minima
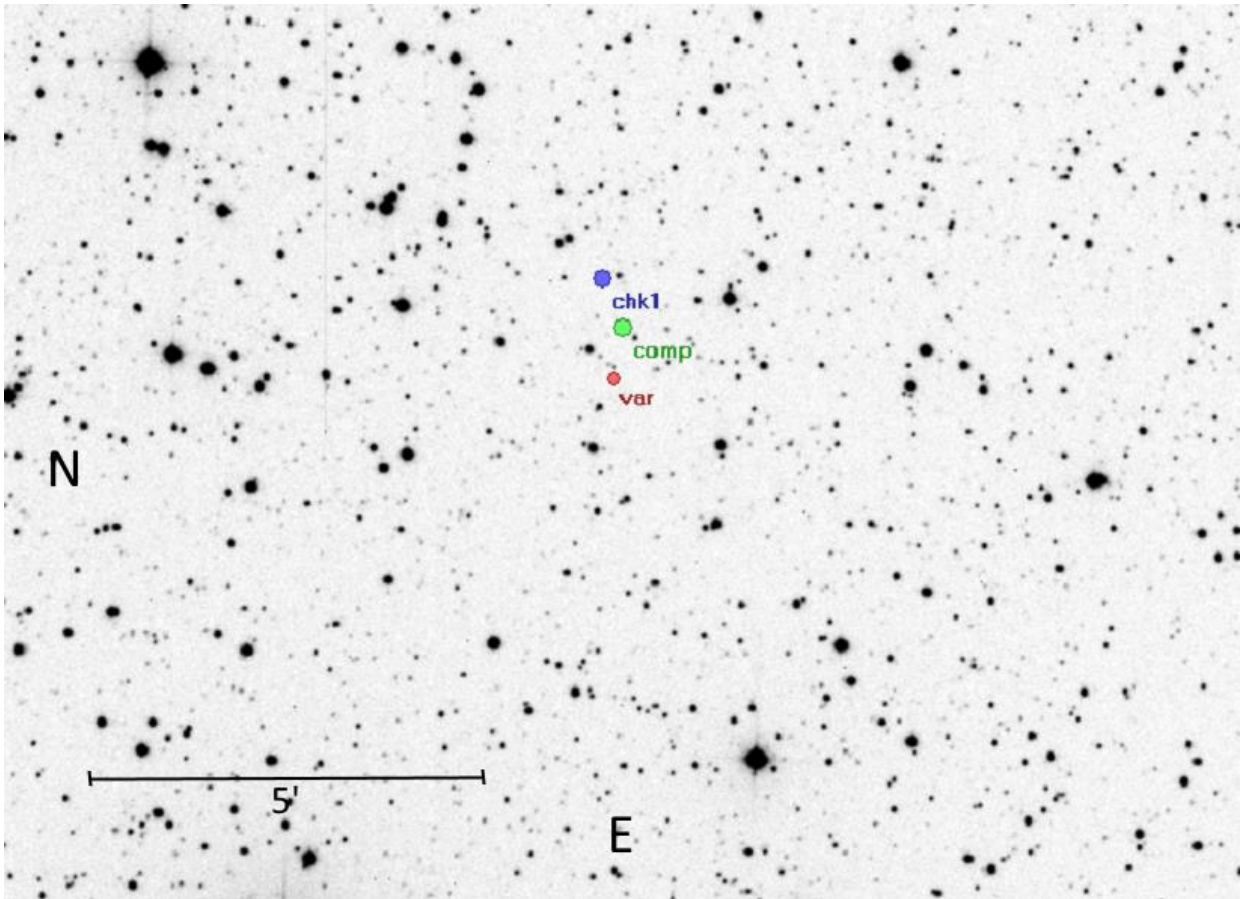(see tables below) with the method of least squares.

Fig 2: MoV68 Lac = UCAC3 284-221990 (var) in the field of ER Lac;
(comp) is the comparison star and (chk1) is the check star.

Table 1: Minima of MoV68 Lac = UCAC3 284-221990

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
W. Moschner	2457357,4236	I	-926	-0,0010	
W. Moschner	2457563,5857	II	-256,5	-0,0022	
F. Agerer	2457625,4819	II	-55,5	-0,0012	privat Com.
F. Agerer	2457628,4076	I	-46	-0,0009	privat Com.
F. Agerer	2457628,5604	II	-45,5	-0,0021	privat Com.
W. Moschner	2457633,4877	II	-29,5	-0,0018	
W. Moschner	2457634,5657	I	-26	-0,0016	
W. Moschner	2457638,4187	II	-13,5	0,0022	
W. Moschner	2457638,5700	I	-13	-0,0004	
W. Moschner	2457642,5736	I	0	0,0000	
W. Moschner	2457650,4241	II	25,5	-0,0019	
W. Moschner	2457650,5786	I	26	-0,0013	
W. Moschner	2457654,4293	II	38,5	0,0002	
W. Moschner	2457661,5099	II	61,5	-0,0018	
W. Moschner	2457677,3678	I	113	-0,0026	
W. Moschner	2457677,5241	II	113,5	-0,0003	
W. Moschner	2457678,4481	II	116,5	-0,0001	
W. Moschner	2457709,3945	I	217	-0,0013	

W. Moschner	2457971,6047	II		1068,5	0,0012	
W. Moschner	2457984,5355	II		1110,5	-0,0014	
W. Moschner	2458013,6348	I		1205	-0,0020	
W. Moschner	2458020,4132	I		1227	0,0018	

Remarks: none

MoV59 Cyg = UCAC3 284-159698
= XPM 283-0500225

Right ascension: 20h14m50.8960s (2000)
Declination: +51° 57' 35.111"

XPM Catalog:
Vmag: 16.129 /Bmag: 16.500 /Bmag-Vmag = 0.371

Comparison star   =   UCAC3 286-155711
Check Star   =   UCAC3-286-155536

Amplitude: Min I: 0.88 mag (instr.)   Min II: 0.74 mag (instr.)
Type: EW type eclipsing binary

Min =   HJD 2457605.5286 + 0.3236476
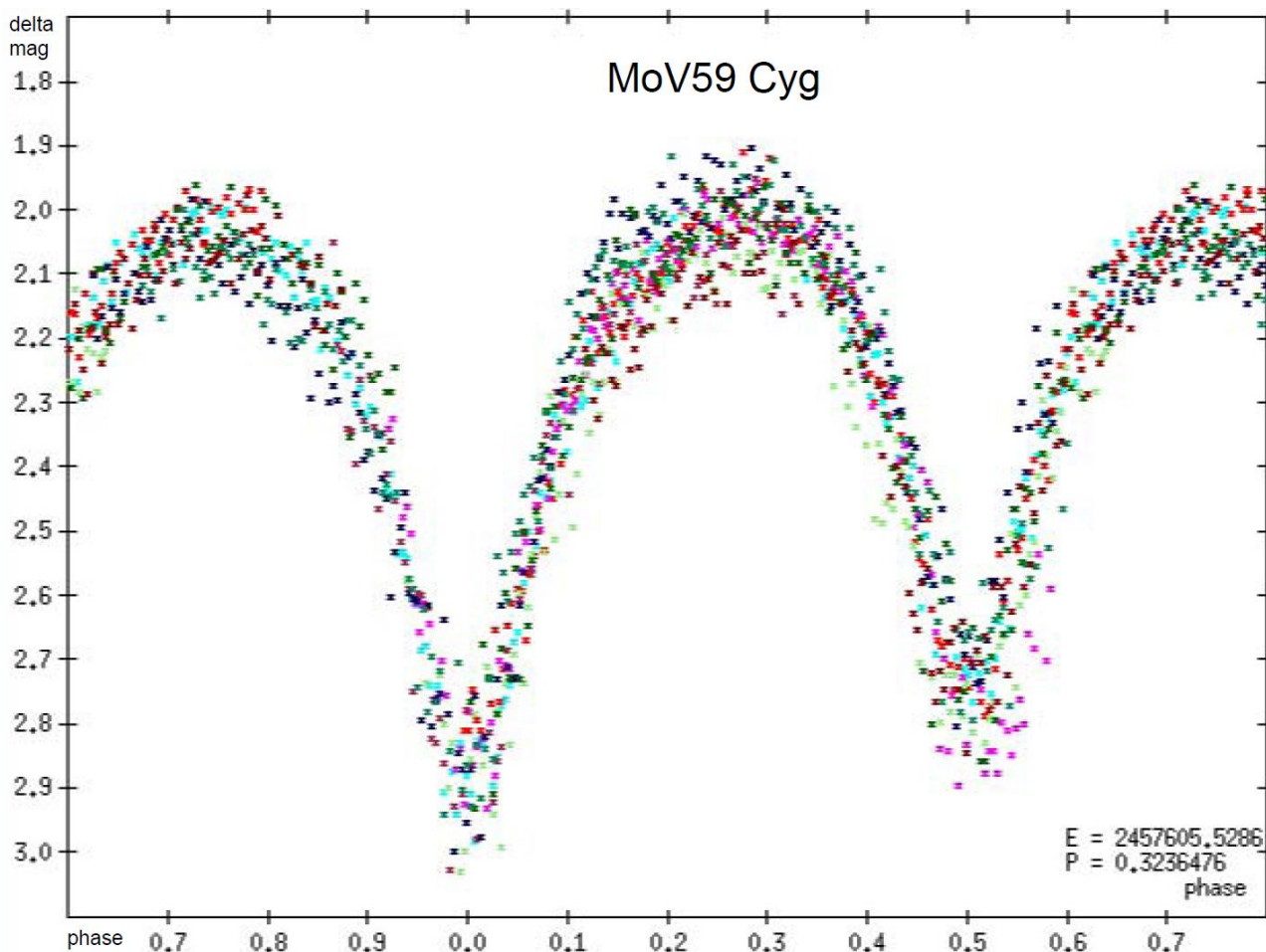   +-0.0005 +-0.0000008

Fig 3: Phased lightcurve of MoV59 Cyg = UCAC3 284-159698 using the ephemeris given above.
FLI Proline 16803+V-filter (2016-2017). Presented elements were calculated by taking into account
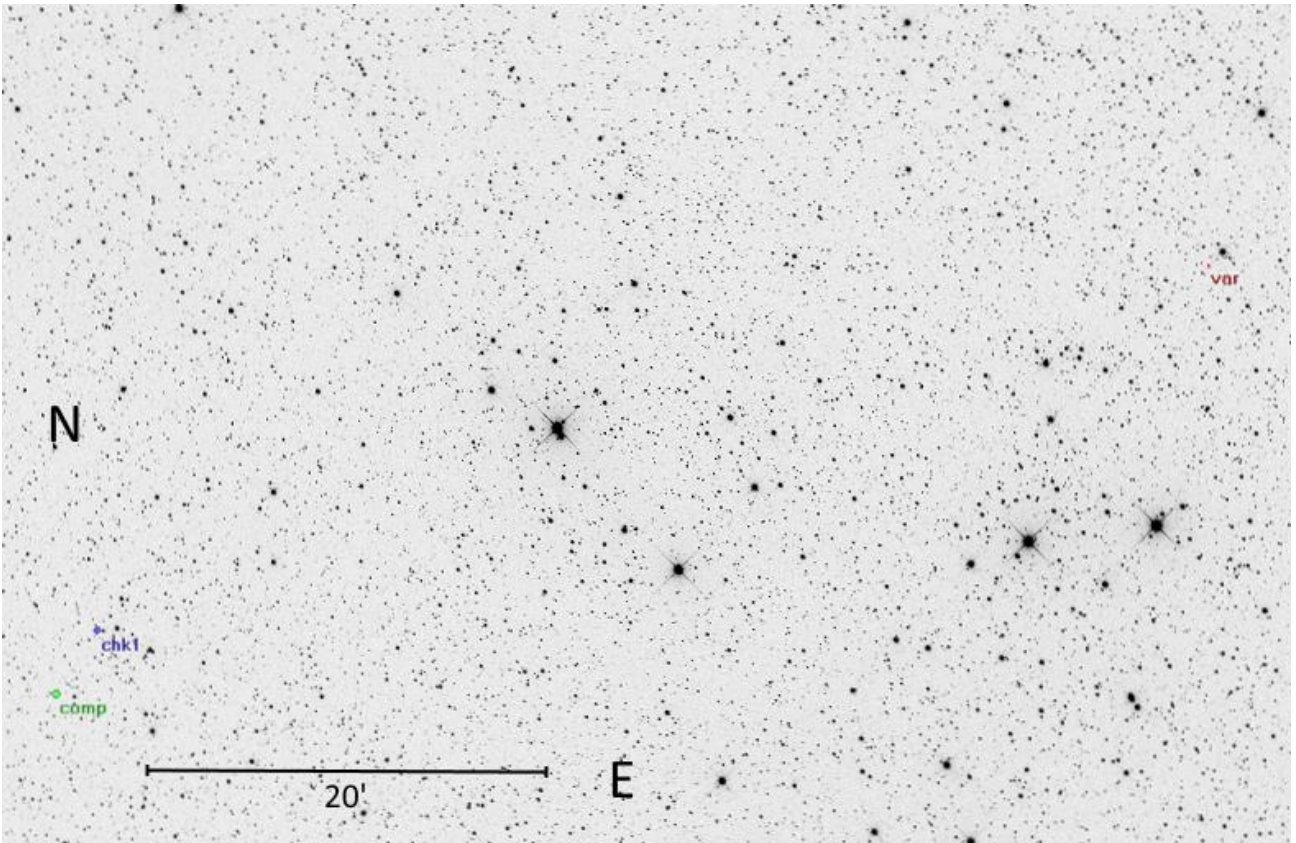all minima (see tables below) with the method of least squares.

Fig 4: MoV59 Cyg = UCAC3 284-159698 (var) in the field of V1047 Cyg;
(comp) is the comparison star and (chk1) is the check star.

Table 2: Minima of MoV59 Cyg = UCAC3 284-159698

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
W. Moschner	2457574,4573	I	-96	-0,0011	
W. Moschner	2457574,6198	II	-95,5	-0,0005	
W. Moschner	2457576,5625	II	-89,5	0,0004	
W. Moschner	2457581,5791	I	-74	0,0004	
W. Moschner	2457605,5286	I	0	0,0000	
W. Moschner	2457623,4910	II	55,5	0,0000	
W. Moschner	2457691,2962	I	265	0,0010	
W. Moschner	2457691,4618	II	265,5	0,0048	
W. Moschner	2457916,5535	I	961	-0,0004	
W. Moschner	2457955,3918	I	1081	0,0001	
W. Moschner	2457955,5535	II	1081,5	0,0000	
W. Moschner	2457963,4822	I	1106	-0,0006	
W. Moschner	2457963,6442	II	1106,5	-0,0005	
W. Moschner	2457979,5043	II	1155,5	0,0009	
W. Moschner	2458010,4092	I	1251	-0,0025	
W. Moschner	2458010,5779	II	1251,5	0,0043	
W. Moschner	2458015,4282	II	1266,5	-0,0001	

Remarks: none

MoV60 Cyg = UCAC3 285-155734
= XPM 284-0493321

Right ascension: 20h12m18.7290s (2000)
Declination: +52° 19' 00.166"

XPM Catalog:
Vmag: 15.368 /Bmag: 16.800 /Bmag-Vmag = 1.432

Comparison star   =   UCAC3 286-155711
Check Star   =   UCAC3-286-155536

Amplitude: Min I: 0.34 mag (instr.)   Min II: 0.27 mag (instr.)
Type: EW type eclipsing binary

Min = HJD 2457605.4102 + 0.2824403*E
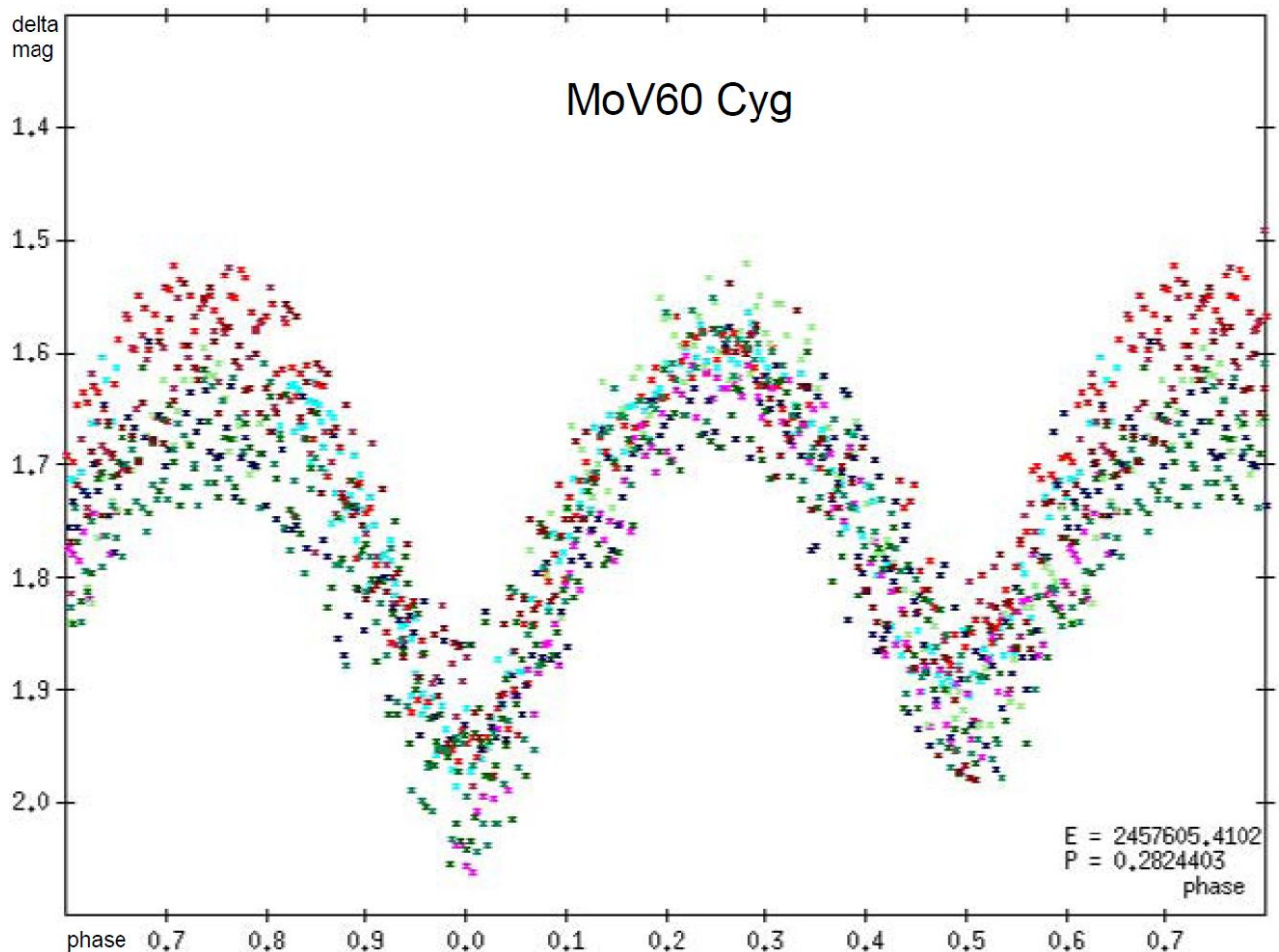   +-0.0007 +-0.0000011

Fig 5: Phased lightcurve of MoV60 Cyg = UCAC3 285-155734 using the ephemeris given above.
FLI Proline 16803+V-filter (2016-2017). Presented elements were calculated by taking into account
all minima (see tables below) with the method of least squares.
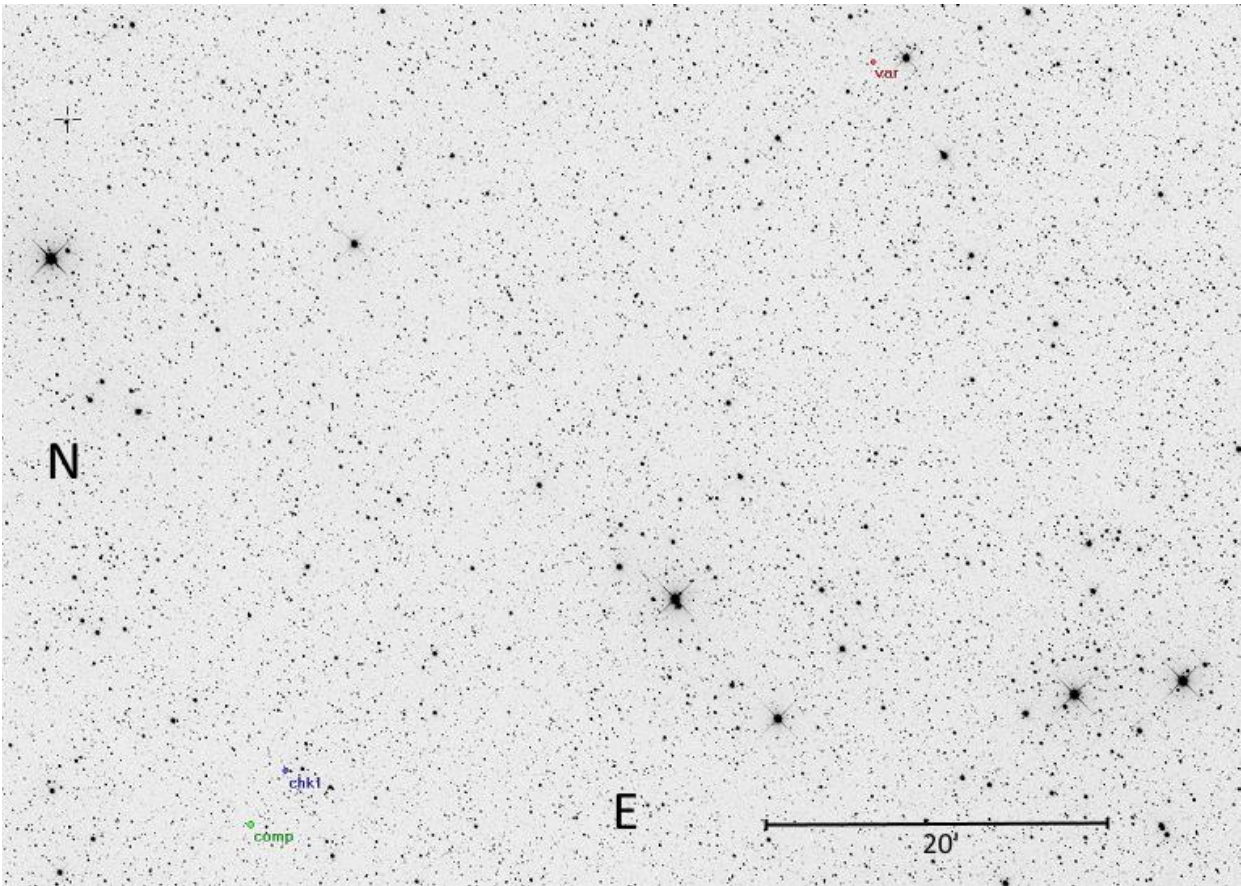
Fig 6: MoV60 Cyg = UCAC3 285-155734 (var) in the field of V1047 Cyg;
(comp) is the comparison star and (chk1) is the check star.

Table 3: Minima of MoV60 Cyg = UCAC3 285-155734

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
W. Moschner	2457574,4796	II	-109,5	-0,0034	
W. Moschner	2457574,6244	I	-109	0,0002	
W. Moschner	2457576,4573	II	-102,5	-0,0028	
W. Moschner	2457581,5393	II	-84,5	-0,0047	
W. Moschner	2457605,4102	I	0	0,0000	
W. Moschner	2457605,5481	II	0,5	-0,0033	
W. Moschner	2457623,3462	II	63,5	0,0010	
W. Moschner	2457623,4862	I	64	-0,0002	
W. Moschner	2457691,4125	II	304,5	-0,0008	
W. Moschner	2457955,4996	II	1239,5	0,0046	
W. Moschner	2457963,4074	II	1267,5	0,0041	
W. Moschner	2457963,5443	I	1268	-0,0002	
W. Moschner	2457979,3635	I	1324	0,0023	
W. Moschner	2457979,5054	II	1324,5	0,0030	
W. Moschner	2457979,6369	I	1325	-0,0067	
W. Moschner	2458010,4272	I	1434	-0,0024	
W. Moschner	2458015,3681	II	1451,5	-0,0042	
W. Moschner	2458015,5130	I	1452	-0,0005	

Remarks: none

Fr273 Lyr = UCAC3 239-159278
              = XPM 238-0484820
Right ascension: 19h09m03.6831s (2000)
Declination: +29° 29' 05.002"

XPM Catalog:
Vmag: 15.212   Bmag: 16.3   Vmag-Bmag = 1.088

Comparison star   =   UCAC3 239-159385
Check Star   =   UCAC3 239-159248

Amplitude: Min I: 0.60 mag (instr.)   Min II: 0.50 mag (instr.)
Type: EW type eclipsing binary

Min =   HJD 2455418.4390 + 0.482665*E
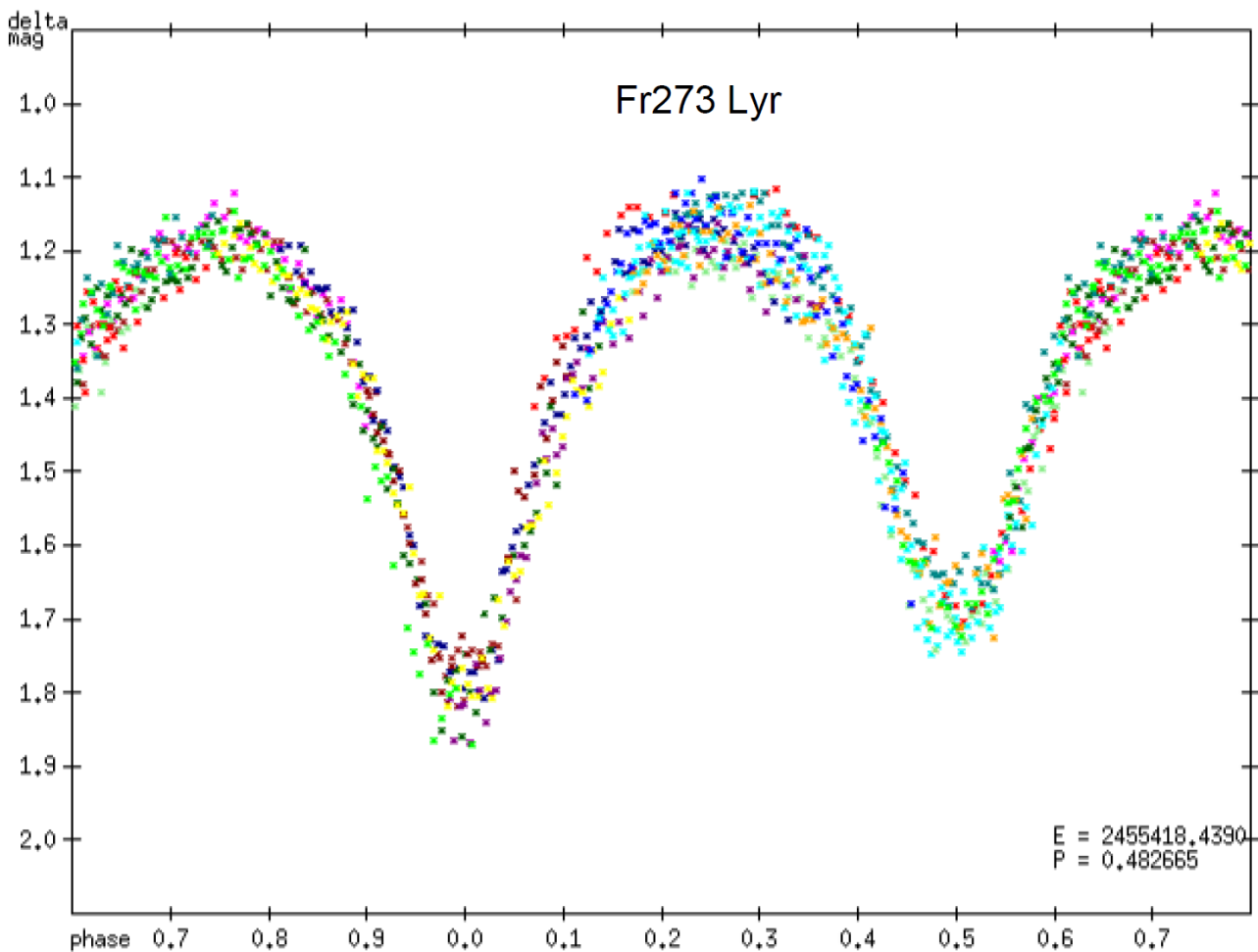   +-0.0008 +-0.000012

Fig 7: Phased lightcurve of Fr273 Lyr = UCAC3 239-159278 using the ephemeris given above.
SIGMA 1603 CCD-Camera and IR & UV cut off filter. Presented elements were calculated by
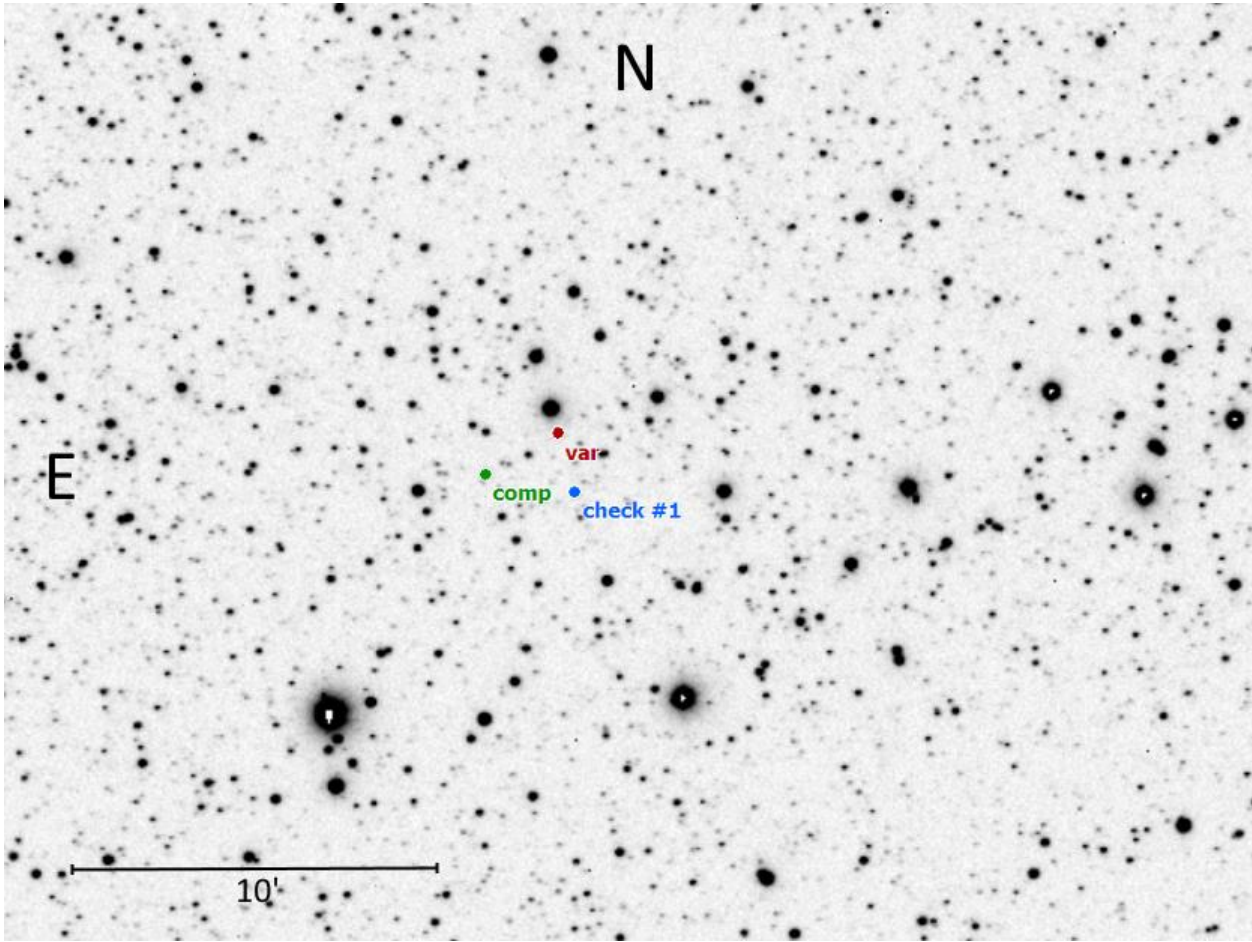taking into account all minima (see tables below) with the method of least squares.

Fig 8: Fr273 Lyr = UCAC3 239-159278 (var) in the field of AA Lyr;
(comp) is the comparison star and (chk1) is the check star.

Table 4: Minima of Fr273 Lyr = UCAC3 239-159278

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P. Frank	2455074,5450	II	-712,5	0,0048	
P. Frank	2455380,5462	II	-78,5	-0,0036	
P. Frank	2455387,5491	I	-64	0,0007	
P. Frank	2455409,5091	II	-18,5	-0,0006	
P. Frank	2455418,4390	I	0	0,0000	
P. Frank	2455429,5379	I	23	-0,0024	
P. Frank	2456500,5732	I	2242	-0,0007	
P. Frank	2456568,3887	II	2382,5	0,0003	
P. Frank	2456577,3140	I	2401	-0,0037	
P. Frank	2456590,3507	I	2428	0,0011	
P. Frank	2456596,3821	II	2440,5	-0,0008	
P. Frank	2456918,3186	II	3107,5	-0,0019	
P. Frank	2458043,4165	II	5438,5	0,0039	

Remarks: none

Fr280 Lyr = UCAC4 598-071837
= USNO B1.0: 1195-0325821
= XPM 239-0483078

Right ascension: 19h08m18.83s (2000)
Declination: +29° 35' 18.6"

XPM Catalog:
Vmag: 14.477   Bmag: 14.8   Bmag-Vmag = 0.323

Comparison star   =   UCAC3 240-157580
Check Star   =   UCAC3 240-157439

Amplitude: Min I: 0.39 mag (instr.)   Min II: 0.31 mag (instr.)
Type: EW type eclipsing binary

Min =   HJD 2458022.3651 + 0.408626*E
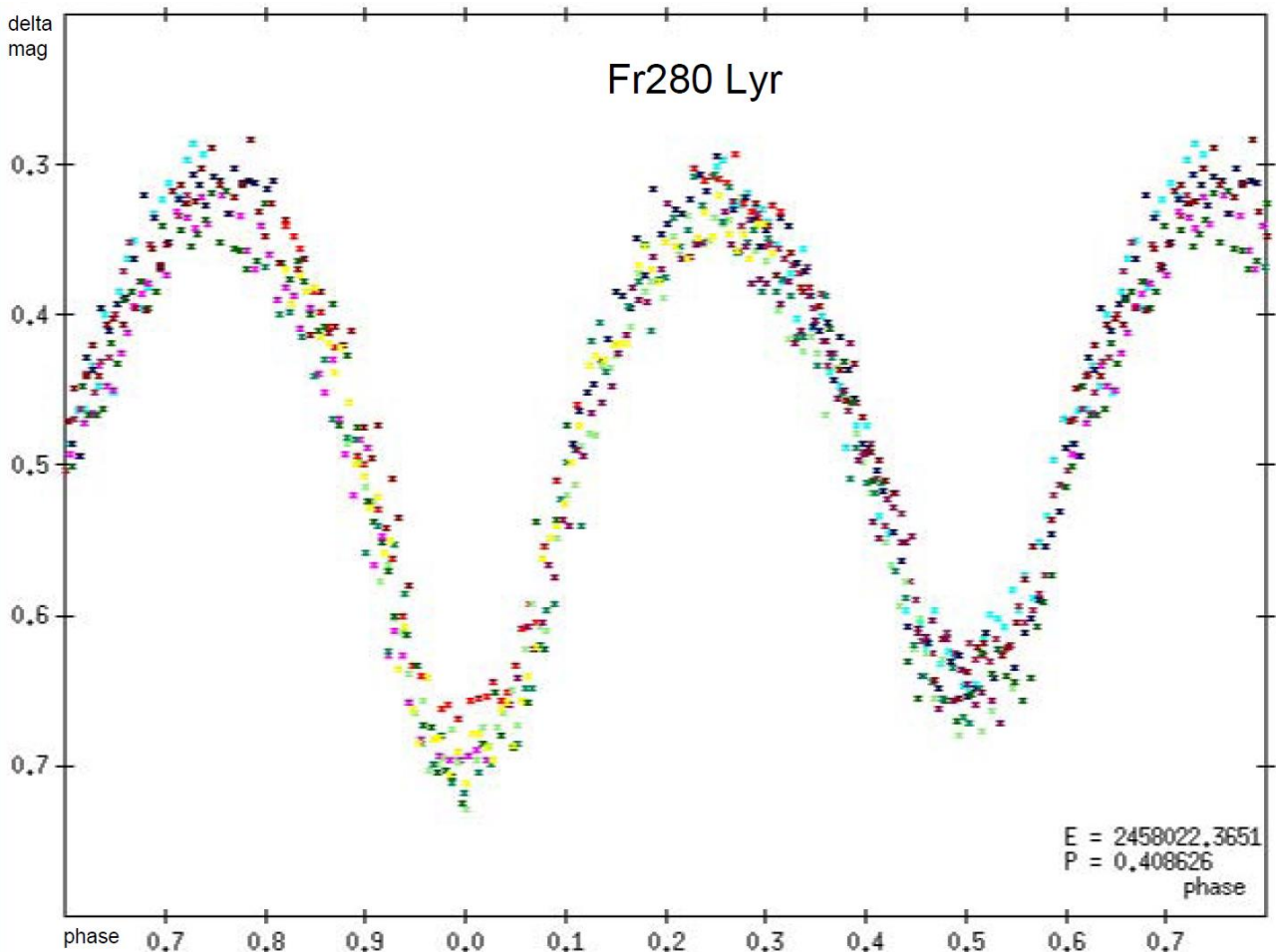   +-0.0006 +-0.000009

Fig 9: Phased lightcurve of Fr280 Lyr = UCAC4 598-071837 using the ephemeris given above.
FLI Proline 16803+V-filter (2016-2017). Presented elements were calculated by taking into account all minima (see tables below) with the method of least squares.
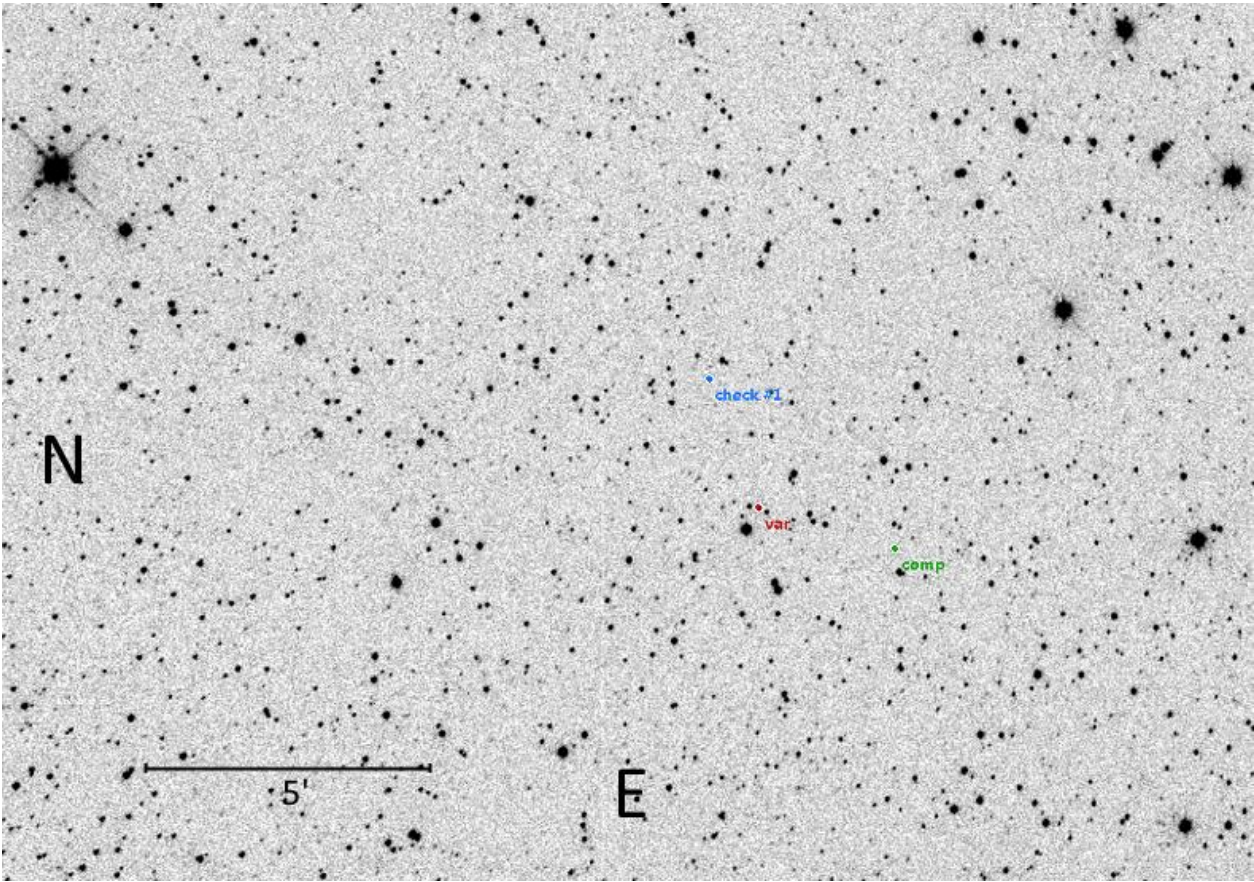
Fig 10: Fr280 Lyr = UCAC4 598-071837 (var) in the field of AA Lyr;
(comp) is the comparison star and (chk1) is the check star.

Table 5: Minima of Fr280 Lyr = UCAC4 598-071837

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P. Frank	2455074,5394	I	-7214	0,0023	
P. Frank	2455380,4004	II	-6465,5	0,0067	
P. Frank	2455385,4986	I	-6453	-0,0029	
P. Frank	2455409,4067	II	-6394,5	0,0006	
P. Frank	2455418,3919	II	-6372,5	-0,0040	
P. Frank	2455429,4327	II	-6345,5	0,0039	
P. Frank	2456568,4716	I	-3558	-0,0022	
P. Frank	2456579,3008	II	-3531,5	-0,0016	
P. Frank	2456590,3310	II	-3504,5	-0,0043	
P. Frank	2456596,2552	I	-3490	-0,0052	
P. Frank	2456918,4633	II	-2701,5	0,0013	
Moschner/Frank	2457618,4372	II	-988,5	-0,0011	
Moschner/Frank	2457626,4061	I	-969	-0,0004	
Moschner/Frank	2457899,5749	II	-300,5	0,0019	
Moschner/Frank	2457921,4346	I	-247	0,0001	
Moschner/Frank	2457921,6427	II	-246,5	0,0039	
Moschner/Frank	2457935,5334	II	-212,5	0,0013	

Moschner/Frank	2457949,4267	II	-178,5	0,0013
Moschner/Frank	2457949,6298	I	-178	0,0001
Moschner/Frank	2457950,4470	I	-176	0,0001
Moschner/Frank	2458022,3651	I	0	0,0000
P. Frank	2458043,4089	II	51,5	-0,0004

Remarks: none

Fr105 Lyr = UCAC4 598-071887
= GSC 02135-00056
= XPM 238-0483324

Right ascension: 19h08m27.0838s (2000)
Declination: +29° 25' 25.744"

UCAC4 Catalog:
Vmag: 11.146 Bmag: 11.765   Bmag-Vmag = 0.619

Comparison star   =   GSC 02135 01175
Check Star   =   GSC 02135 01109

Amplitude: Min I: 0.20 mag (instr.)   Min II: 0.04 mag (instr.)
Type: EB type eclipsing binary

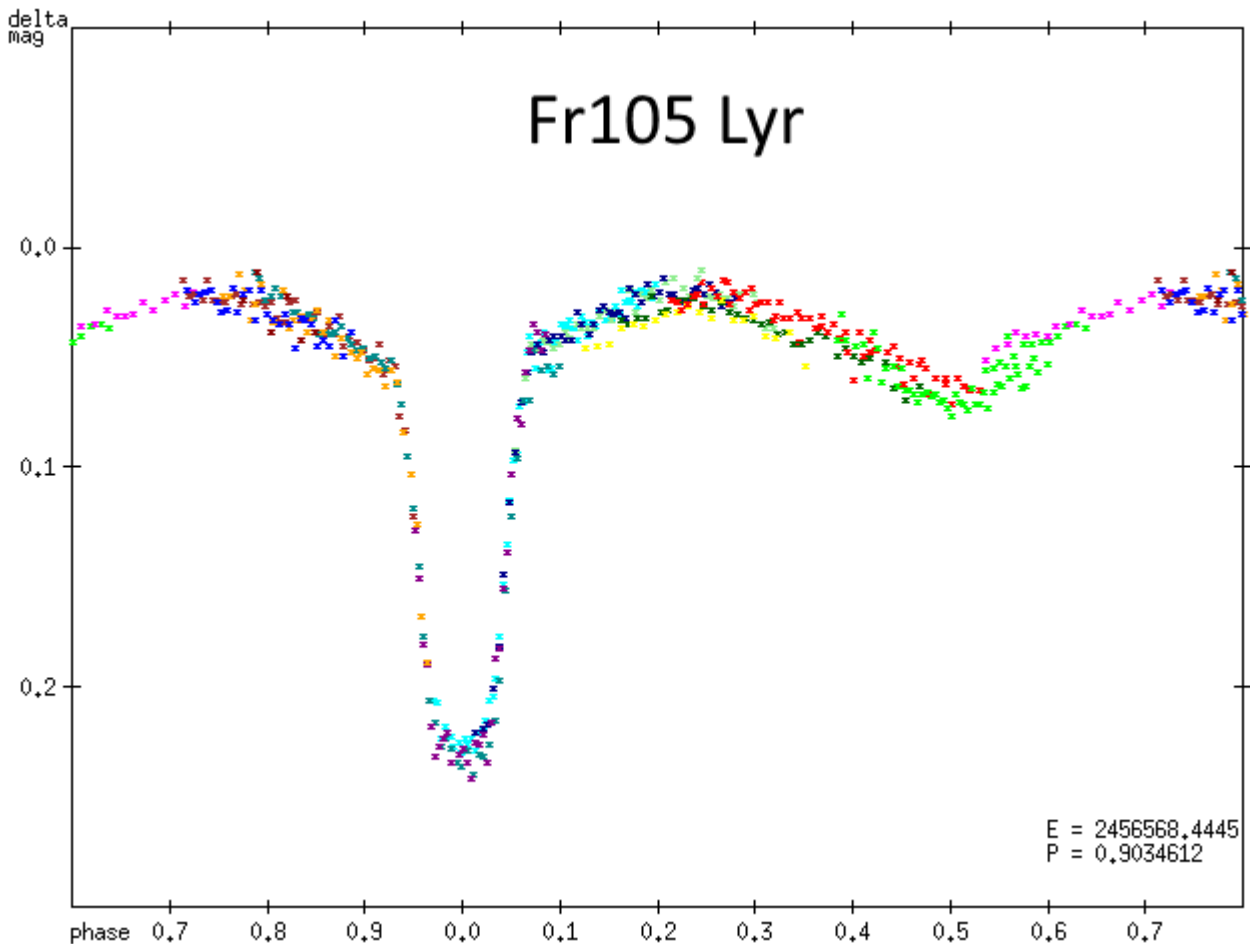Min = HJD 2456568.4445 + 0.9034612*E
              +-0.0009 +-0.0000064

Fig 11: Phased lightcurve of Fr105 Lyr = GSC 02135-00056 using the ephemeris given above.
SIGMA 1603 CCD-Camera and IR & UV cut off filter. Presented elements were calculated by
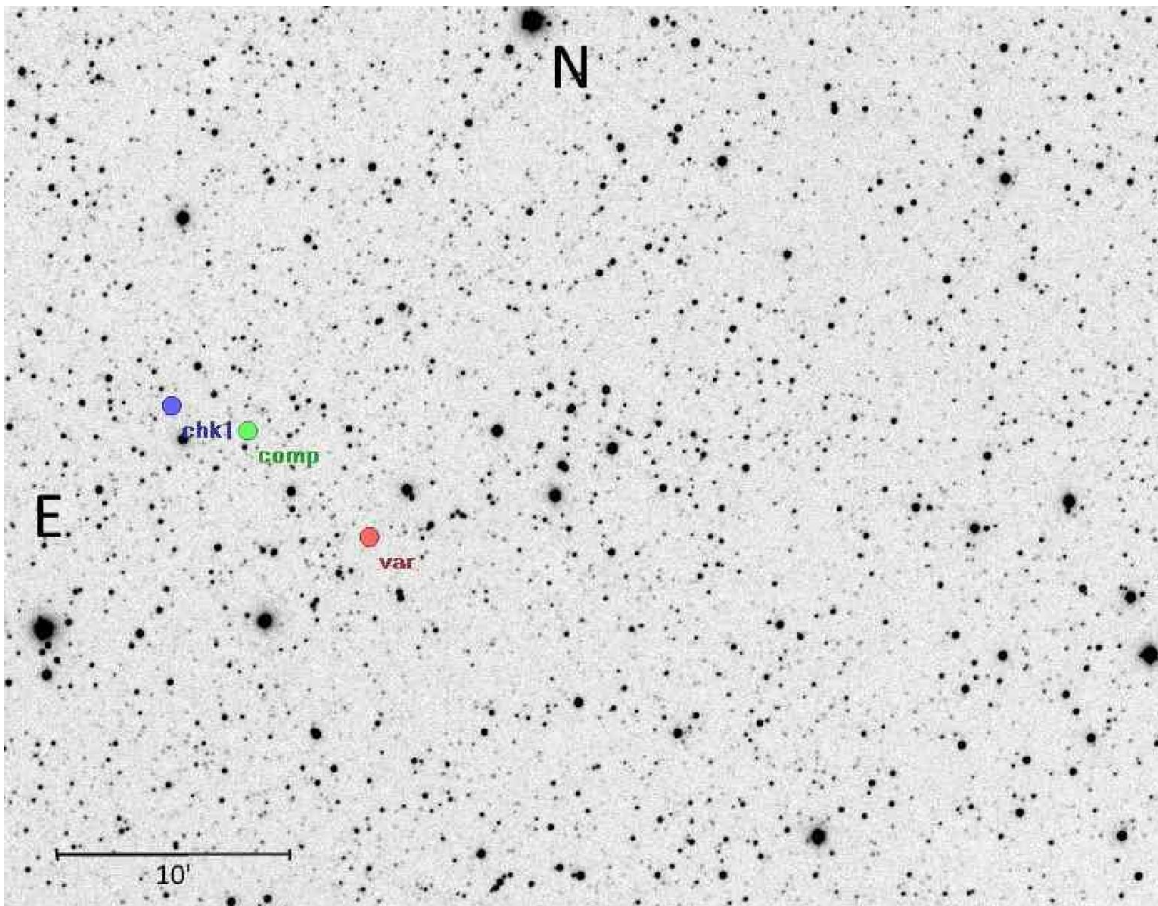taking into account all minima (see tables below) with the method of least squares.

Fig 12: Fr105 Lyr = GSC 02135-00056 (var) in the field of AA Lyr;
(comp) is the comparison star and (chk1) is the check star.

Table 6: Minima of Fr105 Lyr = GSC 02135-00056

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P. Frank	2455418,3460	I	-1273	0,0076	
P. Frank	2456136,5878	I	-478	-0,0022	
P. Frank	2456568,4445	I	0	0,0000	
P. Frank	2456579,2844	I	12	-0,0016	
W. Moschner	2457626,3984	I	1171	0,0008	
W. Moschner	2458009,4654	I	1595	0,0003	
P. Frank	2458043,3535	II	1632,5	0,0086	

Remarks: none

References

[1] Motl, David: MuniWin, http://c-munipack.sourceforge.net

[2] Paunzen, E., Vanmunster, T., 2016, AN, 337, 239
   http://adsabs.harvard.edu/abs/2016AN....337..239P.

[3] UCAC4 Catalogue (Zacharias+, 2012)
   Fourth U.S. Naval Observatory CCD Astrograph Catalog
   http://vizier.u-strasbg.fr/viz-bin/VizieR?-source=I/322A
   Zacharias N., Finch C.T., Girard T.M., Henden A., Bartlett J.L., Monet D.G.,
   Zacharias M.I. <Astron. J. 145, 44 (2013)

[4] The XPM Catalogue: absolute proper motions of 280 million stars
   http://vizier.u-strasbg.fr/viz-bin/VizieR?-source=I/319
   Fedorov, P. N., Myznikov, A. A., Akhmetov, V. S., 2009, MNRAS, 393, 133