



**First Elements for New Eclipsing Binaries in Several Fields, Part II**

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**Abstract:** *6 new eclipsing binaries (GSC 02111 00334, GSC 02695 03163, 3UCAC250-231289, GSC 03948-02316, 3UCAC251-232593, 3UCAC251-231400) 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 second part of a series dealing with numerous discoveries.

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

Further detailed observations were made using a 400mm-ASA-Astrograf (W. Moschner, Nerpio/Spain) and the 102mm-TeleVue-Refractor (P. Frank, Velden/Germany) in 2016 and earlier, which are discussed subsequently in detail:

Fr11 Her	= GSC 02111 00334
Fr38 Cyg	= GSC 02695 03163
Fr44 Cyg	= 3UCAC250-231289
Fr153 Cyg	= GSC 03948-02316
Fr240 Cyg	= 3UCAC251-232593
Fr241 Cyg	= 3UCAC251-231400

## 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 September 2016 with a robotic telescope a 0.40 m 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. Period analysis was performed with Peranso [2], the magnitudes of the variable (at maximum brightness) and of the comparison stars were obtained from GUIDE 9 [3].

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 positions were taken from Guide 9.0

### Explanations to the lightcurves

The coloured symbols in the lightcurve plots denote data taken on different nights.

**Fr11 Her = GSC 02111 00334 (12.29 mag V)**

Right ascension: 18h 39m 42.4539s (2000)

Declination: +24° 48' 54.454"

USNO-B1.0 (Blue/Red):

12.66/12.08 = 0.58

Comparison star = GSC 02111 00198 (12.05 mag) Blue-Red = 0.54 mag

Check Star = GSC 02111 00818 (11.63 mag) Blue-Red = 0.55 mag

Amplitude Min I: 1.00 mag (instr.) Min II: 0.92 mag (instr.)

Type: WUMa type eclipsing binary

Min I = HJD 2457619.5332 + 0.2831487\*E  
+0.0005 +0.0000004

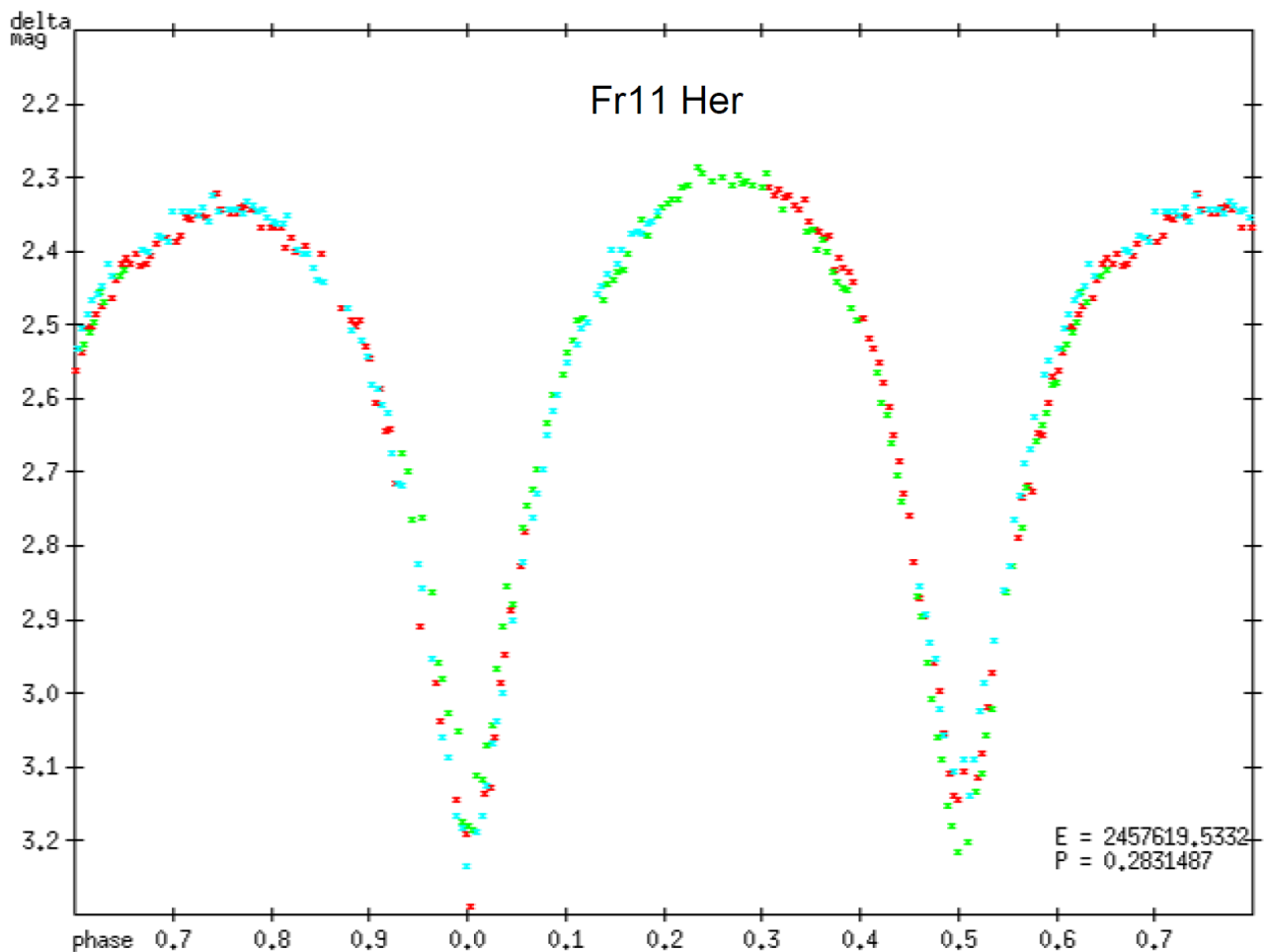


Fig 1: Phased lightcurve of Fr11 Her = GSC 02111 00334 using the ephemeris given above. FLI Proline 16803+V-filter. The period was calculated with Peranso.

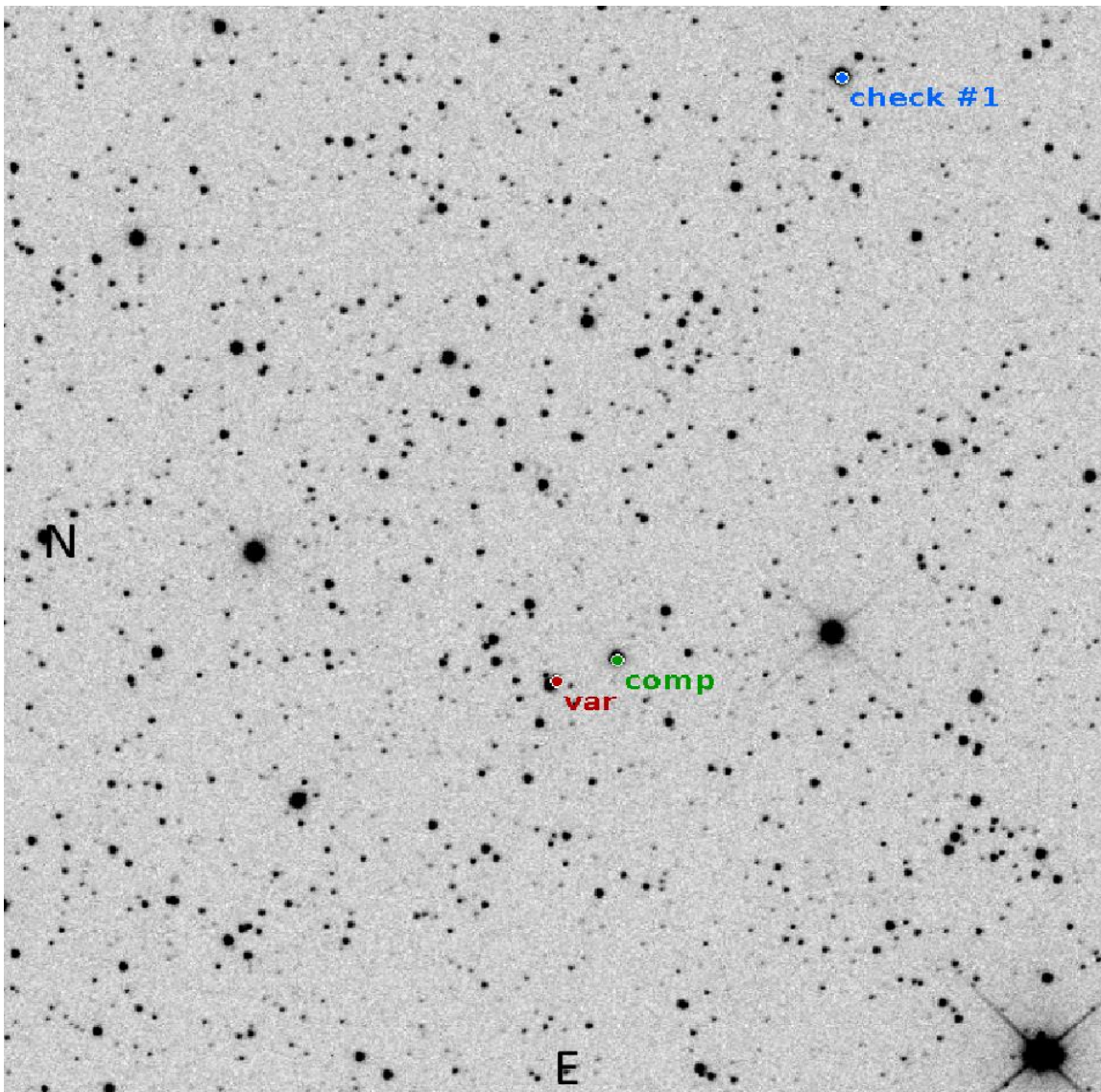


Fig 2: Fr11 Her = GSC 02111 00334 (**var**) in the field of BO Her. (**comp**) is the comparison star and (**check#1**) is the check star. North is left and East is down.

Table 1: Minima of Fr11 Her = GSC 02111 00334

Observer	HJD-Date		Type	Epoch	O-C (d)	Source
	Minimum					
P.Frank	2453282,2703		I	-15318	0,0089	
P.Frank	2453282,4096		II	-15317,5	0,0066	
P.Frank	2453284,3883		II	-15310,5	0,0033	
Moschner/Frank	2457619,3934		II	-0,5	0,0018	
Moschner/Frank	2457619,5332		I	0	0,0000	
Moschner/Frank	2457624,3472		I	17	0,0005	
Moschner/Frank	2457624,4894		II	17,5	0,0011	
Moschner/Frank	2457625,3385		II	20,5	0,0008	
Moschner/Frank	2457625,4795		I	21	0,0002	

Remarks: possible O'Connell-Effect

**Fr38 Cyg = GSC 02695 03163 (12.02 mag)**

Right ascension: 20h 50m 25.6449s (2000)

Declination: +34° 06' 22.337"

USNO-B1.0 (Blue/Red):

11.90/10.96 = 0.94 mag

Comparison star = GSC 02695 02709 (12.35 mag) Blue-Red = 1.98 mag

Check Star = GSC 02695 02473 (13.01 mag) Blue-Red = 2.44 mag

Amplitude Min I: 0.46 mag (instr.) Min II: 0.39 mag (instr.)

Type: WUMa type eclipsing binary

Min I = HJD 2456159.4049 + 0.652195 \* E  
          +-0.0005 +-0.000004

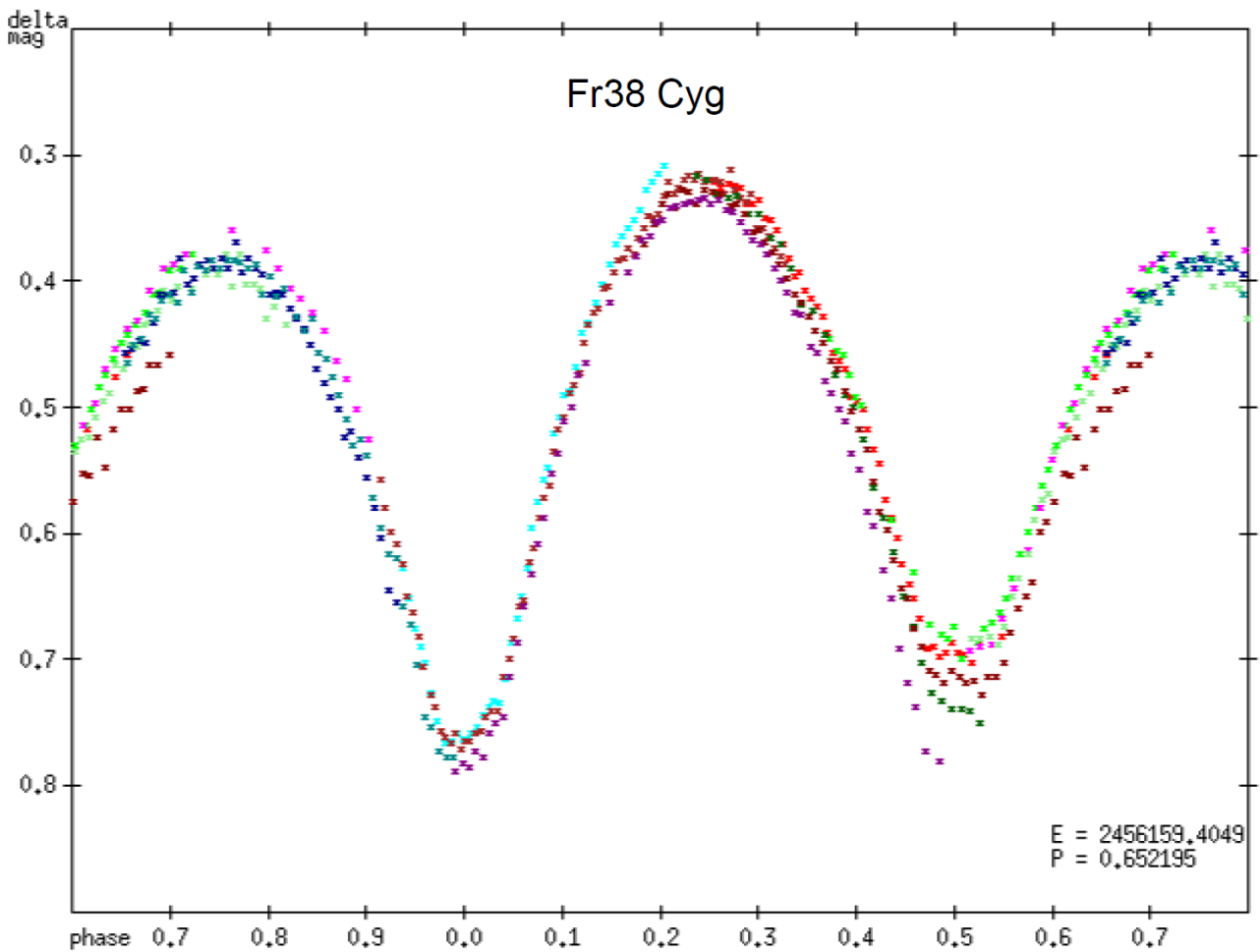


Fig 3: Phased lightcurve of Fr38 Cyg = GSC 02695 03163 using the ephemeris given above. SIGMA 1603: Kodak KAF1603ME+IR & UV-filter. The period was calculated with Peranso.



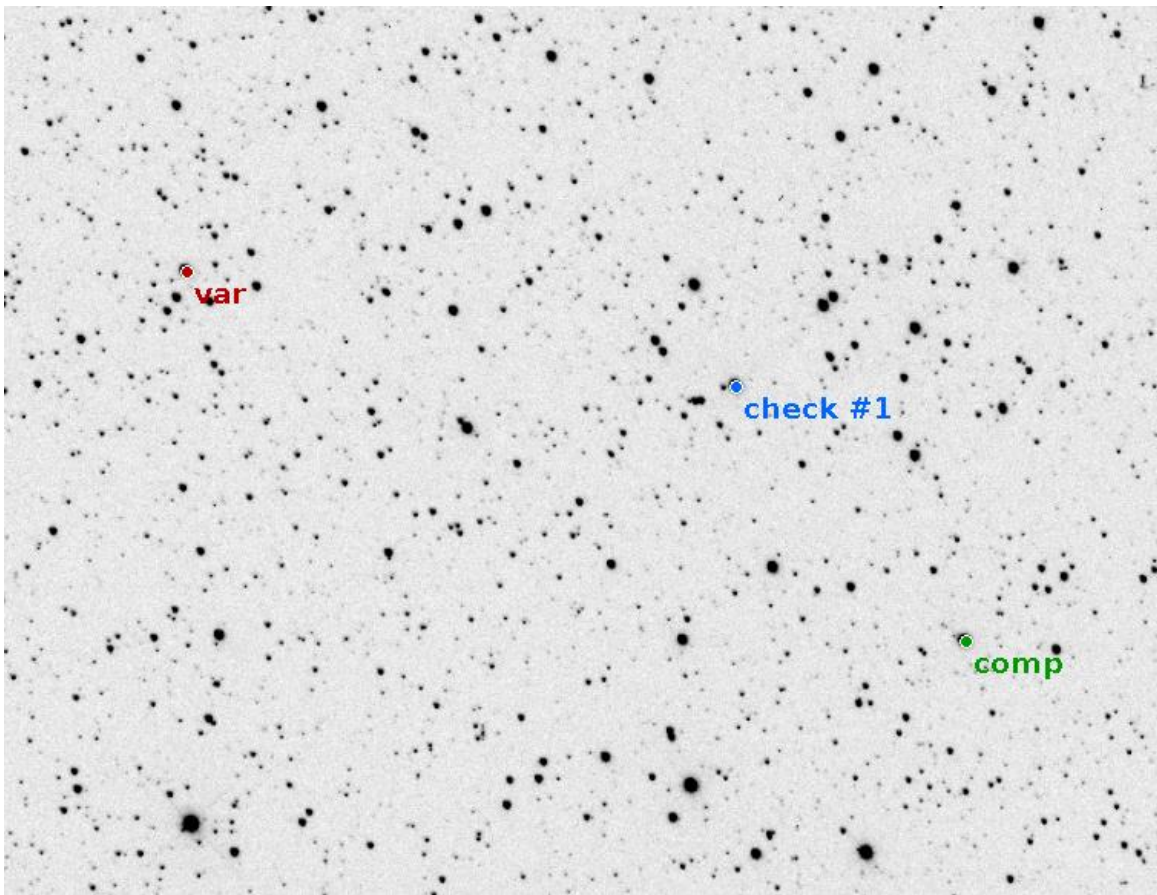


Fig 4: Fr38 Cyg = GSC 02695 03163 (**var**) in the field of V374 Cyg. (**comp**) is the comparison star and (**check#1**) is the check star. North is right and East is up.

Table 2: Minima of Fr38 Cyg = GSC 02695 03163

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P.Frank	2454682,5165	II	-2264,5	0,0072	
P.Frank	2454684,4721	II	-2261,5	0,0062	
P.Frank	2454719,3582	I	-2208	-0,0001	
P.Frank	2456159,4049	I	0	0,0000	
P.Frank	2457287,3816	II	1729,5	0,0054	
P.Frank	2457307,2670	I	1760	-0,0011	
P.Frank	2457658,4830	II	2298,5	0,0079	
Moschner/Frank	2457692,3948	II	2350,5	0,0056	
Moschner/Frank	2457693,3675	I	2352	0,0000	
Moschner/Frank	2457708,3674	I	2375	-0,0006	
P.Frank	2457722,3992	II	2396,5	0,0090	
P.Frank	2457727,2806	I	2404	-0,0011	

Remarks: possible O'Connell-Effect. Secondary minima (Type II) have been shifted by 1% of the period in the O-C-diagram in order to account for a slightly eccentric orbit and align them to phase 0.5.

**Fr44 Cyg = 3UCAC250-231289 (14.95 mag)**

Right ascension: 20h 48m 04.4985s (2000)

Declination: +34° 42' 16.857"

USNO-B1.0 (Blue/Red):

15.55/14.46 = 1.09 mag

Comparison star = GSC 02695-02444 (14.20 mag) Blue-Red = 0.58 mag

Check Star = 3UCAC250-231233 (13.89 mag) Blue-Red = 0.60 mag

Amplitude Min I: 0.58 mag (instr.) Min II: 0.58 mag (instr.)

Type: WUMa type eclipsing binary

Min I = HJD 2456159.4169 + 0.3358741 \* E  
          + -0.0005    + -0.0000006

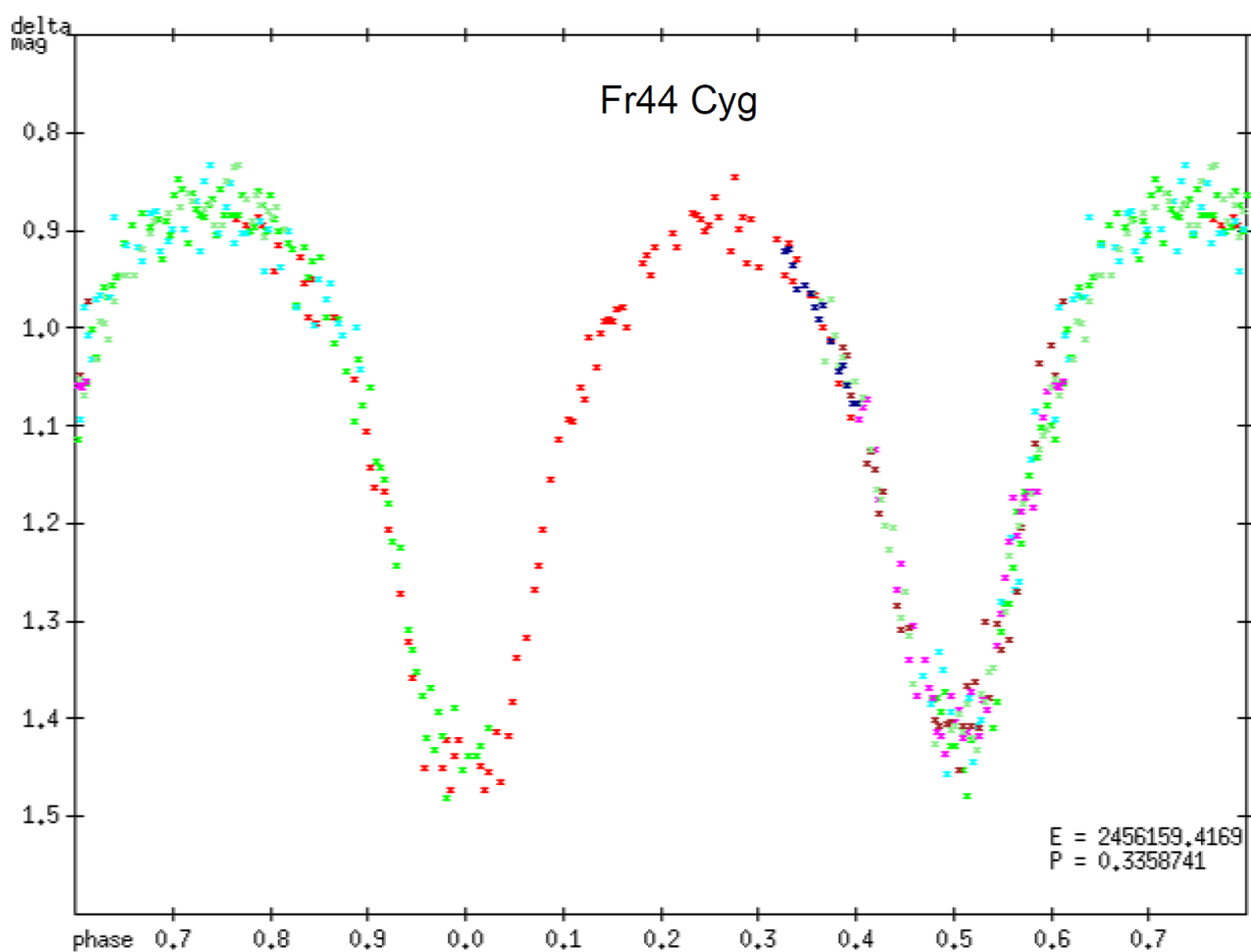


Fig 5: Phased lightcurve of Fr44 Cyg = 3UCAC250-231289 using the ephemeris given above. FLI Proline 16803+V-filter. Presented elements were calculated by taking into account all minima (see tables below) with the method of least squares.

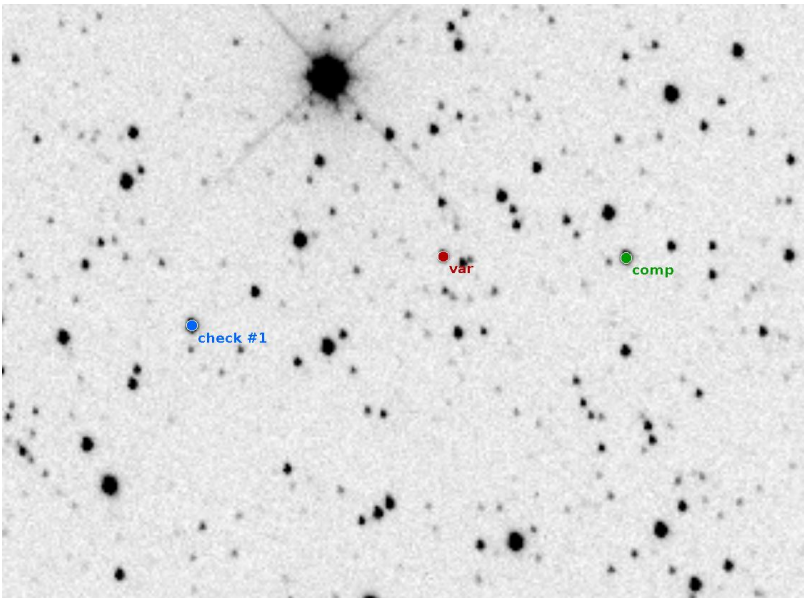


Fig 6: Fr44 Cyg = 3UCAC250-231289 (**var**) in the field of V374 Cyg. (**comp**) is the comparison star and (**check#1**) is the check star. North is right and East is up.

Table 3: Minima of Fr44 Cyg = 3UCAC250-231289

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P.Frank	2454682,4184	II	-4397,5	0,0074	
P.Frank	2454684,4343	II	-4391,5	0,0081	
P.Frank	2454719,3649	II	-4287,5	0,0078	
P.Frank	2456159,4169	I	0	0,0000	
P.Frank	2456159,5817	II	0,5	-0,0031	
P.Frank	2456650,2951	II	1461,5	-0,0017	
P.Frank	2456654,3246	II	1473,5	-0,0026	
P.Frank	2456657,3521	II	1482,5	0,0020	
P.Frank	2456937,3008	I	2316	-0,0003	
P.Frank	2457287,4480	II	3358,5	-0,0017	
P.Frank	2457297,3586	I	3388	0,0006	
P.Frank	2457297,5242	II	3388,5	-0,0017	
P.Frank	2457298,3652	I	3391	-0,0004	
P.Frank	2457307,2625	II	3417,5	-0,0038	
P.Frank	2457307,4302	I	3418	-0,0040	
P.Frank	2457658,4213	I	4463	-0,0013	
P.Frank	2457684,2859	I	4540	0,0010	
P.Frank	2457684,4550	II	4540,5	0,0022	
Moschner/Frank	2457692,3463	I	4564	0,0005	
Moschner/Frank	2457693,3552	I	4567	0,0017	
Moschner/Frank	2457701,4142	I	4591	-0,0002	
Moschner/Frank	2457703,2673	II	4596,5	0,0056	
Moschner/Frank	2457704,2713	II	4599,5	0,0019	
Moschner/Frank	2457706,2849	II	4605,5	0,0003	
Moschner/Frank	2457707,2920	II	4608,5	-0,0002	
Moschner/Frank	2457708,3003	II	4611,5	0,0004	
P.Frank	2457722,2393	I	4653	0,0007	
P.Frank	2457722,4087	II	4653,5	0,0021	
P.Frank	2457733,3213	I	4686	-0,0012	

Remarks: none



**Fr153 Cyg = GSC 03948-02316 (14.0 mag)**

Right ascension: 20h 12m 19.2080s (2000)

Declination: +58° 46' 00.016"

USNO-B1.0 (Blue/Red):

15.48/14.16 = 1.32

Comparison star = GSC 03948-02244 (13.5 mag) Blue-Red = 1.63 mag

Check Star = GSC 03948-00186 (13.4 mag) Blue-Red = 1.34 mag

Amplitude Min I: 0.43 mag (instr.) Min II: 0.27 mag (instr.)

Type: EB type eclipsing binary

Min I = HJD 2455831.4641 + 0.4577586\*E  
          + -0.0005       + -0.000004

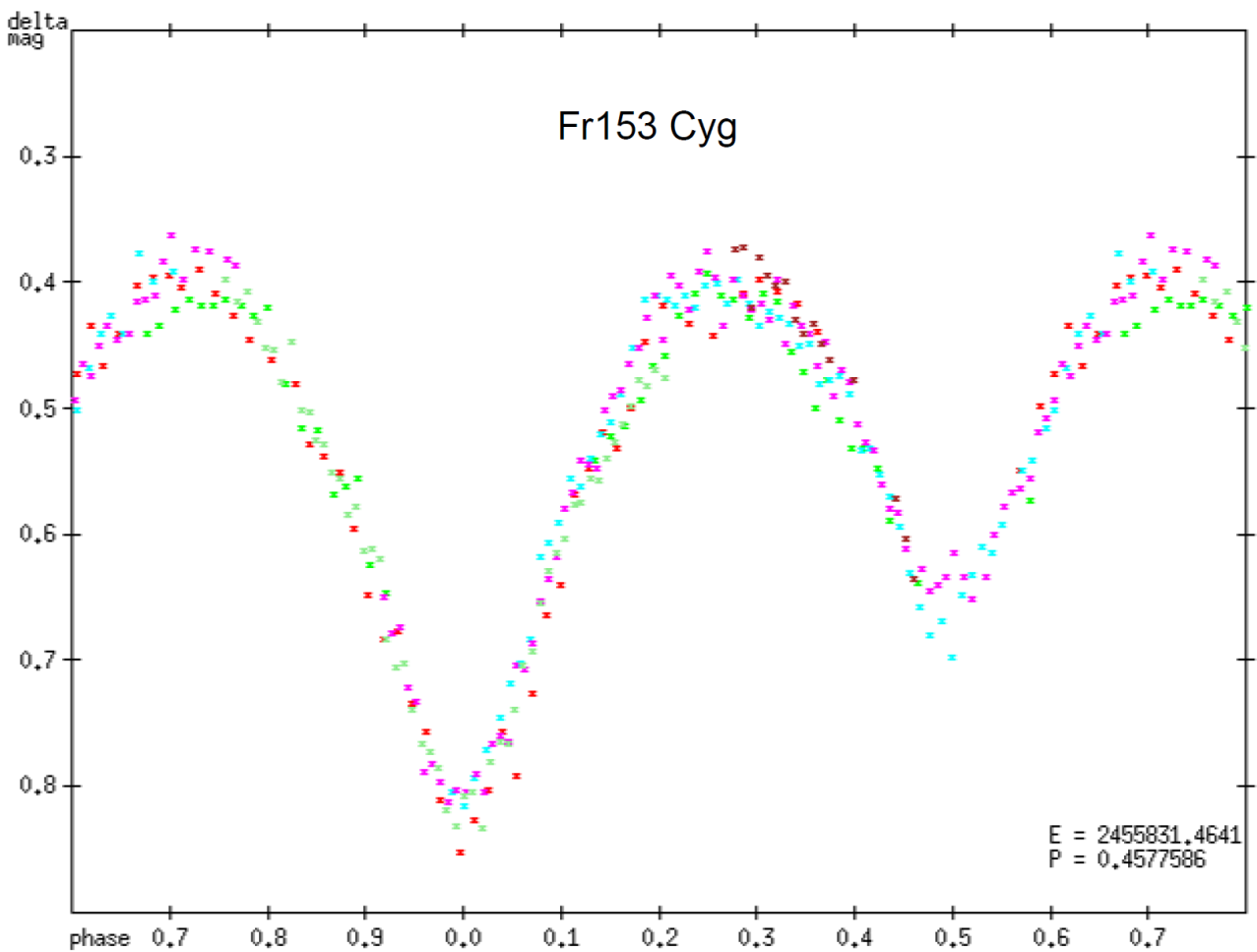


Fig 7: Phased lightcurve of Fr153 Cyg = GSC 03948-02316 using the ephemeris given above. SIGMA 1603: Kodak KAF1603ME+IR & UV-filter. The period was calculated with Peranso.

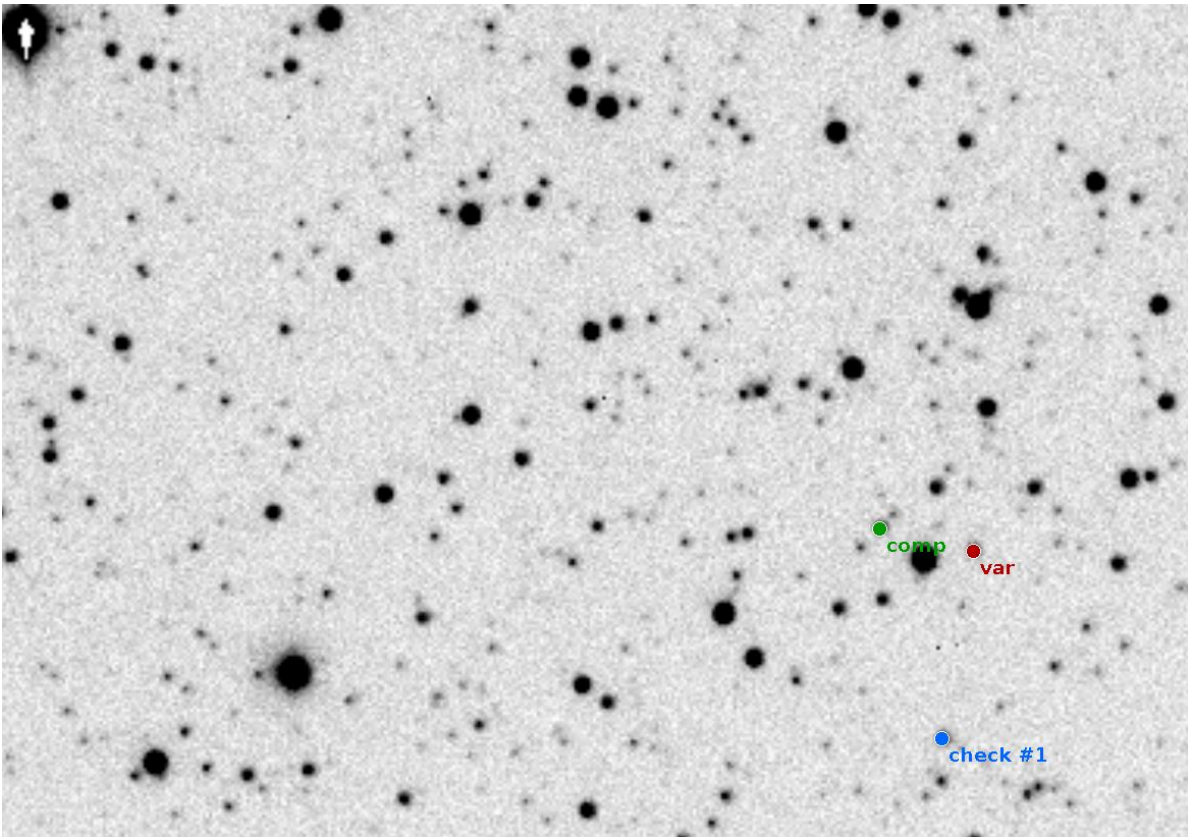


Fig 8: Fr153 Cyg = GSC 03948-02316 (**var**) in the field of V374 Cyg. (**comp**) is the comparison star and (**check#1**) is the check star. North is up and East is left.

Table 4: Minima of Fr153 Cyg = GSC 03948-02316

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P.Frank	2455831,4641	I	0	0,0000	BAVM
P.Frank	2455834,4403	II	6,5	0,0008	BAVM
P.Frank	2455839,4718	II	17,5	-0,0031	BAVM
P.Frank	2456933,2883	I	2407	-0,0008	BAVM
P.Frank	2456933,5168	II	2407,5	-0,0011	BAVM
W.Moschner	2457231,5196	II	3058,5	0,0008	
W.Moschner	2457258,5268	II	3117,5	0,0003	
W.Moschner	2457279,3545	I	3163	-0,0001	
P.Frank	2457625,4200	I	3919	-0,0001	

Remarks: none

**Fr240 Cyg = 3UCAC251-232593 (15.18 mag)**

Right ascension: 20h 50m 17.1007s (2000)

Declination: +35° 02' 49.676"

3UCAC: J-K = 0.42 mag

Comparison star = GSC 02695 00442 (13.5 mag) J-K=0.36

Check Star = 3UCAC251-231351 (14.03 mag) J-K=0.66

Amplitude Min I: 0.50 mag (instr.) Min II: 0.48 mag (instr.)

Type: WUMa type eclipsing binary

Min I = HJD 2457287.4002 + 0.347187572\*E  
+0.0005 +0.000000009

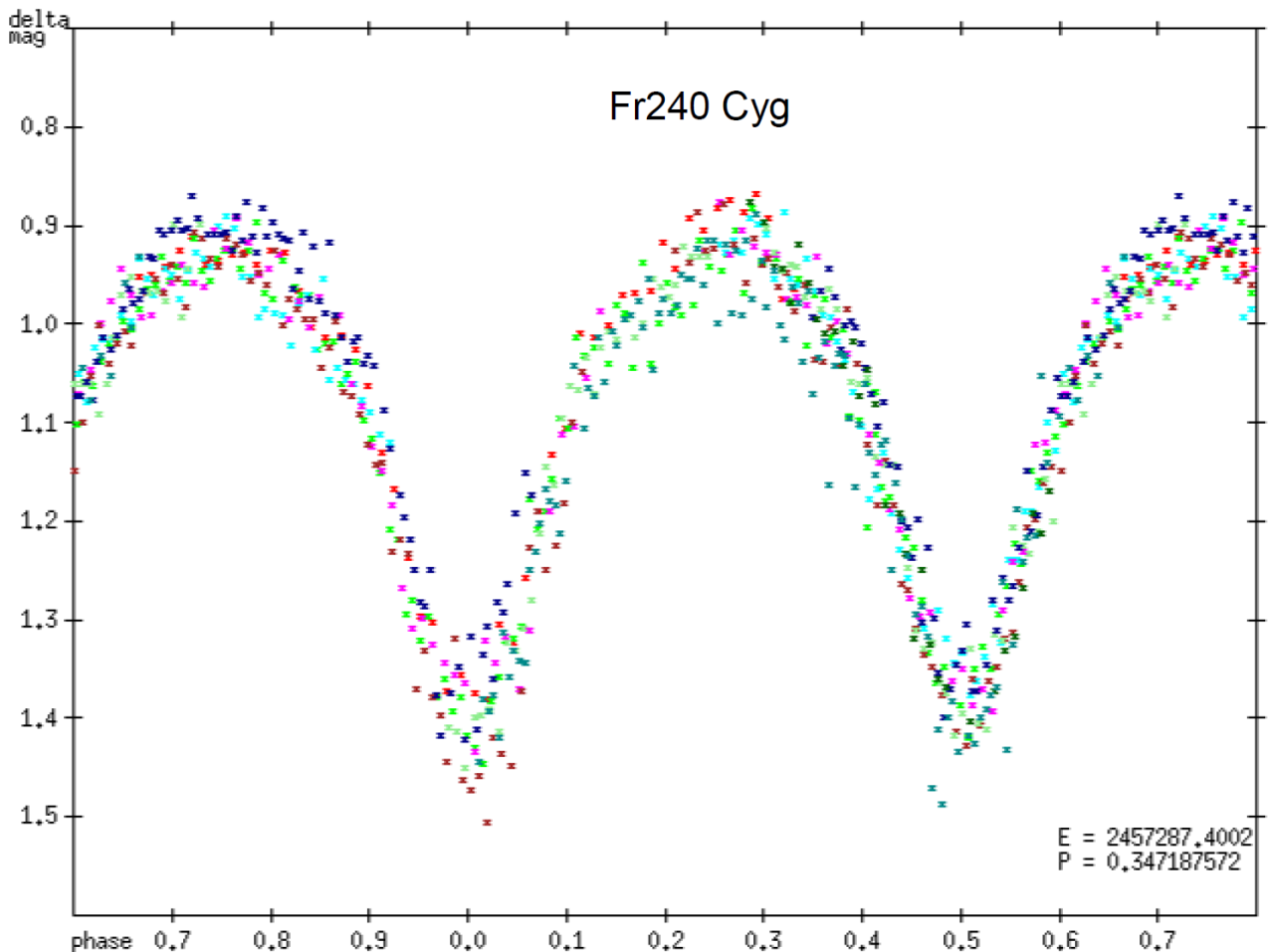


Fig 9: Phased lightcurve of Fr240 Cyg = 3UCAC251-232593 using the ephemeris given above. SIGMA 1603: Kodak KAF1603ME+IR & UV-filter. The period was calculated with Peranso.

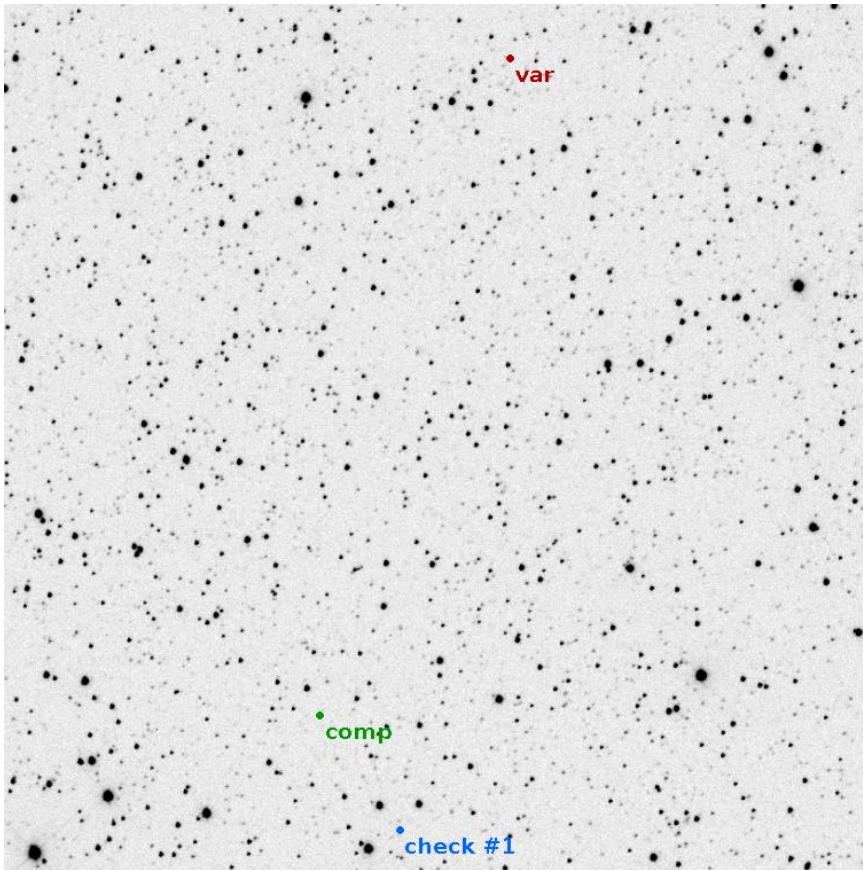


Fig 10: Fr240 Cyg = 3UCAC251-232593 (var) in the field of V374 Cyg. (comp) is the comparison star and (check#1) is the check star. North is right and East is up.

Table 5: Minima of Fr240 Cyg = 3UCAC251-232593

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P.Frank	2457287,4002	I	0	0,0000	
P.Frank	2457297,2956	II	28,5	0,0006	
P.Frank	2457297,4673	I	29	-0,0013	
P.Frank	2457298,3358	II	31,5	-0,0008	
P.Frank	2457307,3631	II	57,5	-0,0004	
P.Frank	2457307,5372	I	58	0,0001	
P.Frank	2457658,3709	II	1068,5	0,0008	
P.Frank	2457658,5449	I	1069	0,0012	
P.Frank	2457684,4111	II	1143,5	0,0019	
Moschner/Frank	2457692,3954	II	1166,5	0,0009	
Moschner/Frank	2457693,4379	II	1169,5	0,0018	
Moschner/Frank	2457701,4189	II	1192,5	-0,0025	
Moschner/Frank	2457703,3295	I	1198	-0,0014	
Moschner/Frank	2457704,3743	I	1201	0,0018	
Moschner/Frank	2457706,2831	II	1206,5	0,0011	
Moschner/Frank	2457708,3651	II	1212,5	0,0000	
P.Frank	2457722,2537	II	1252,5	0,0011	
P.Frank	2457722,4236	I	1253	-0,0026	
P.Frank	2457731,2822	II	1278,5	0,0027	
P.Frank	2457733,3631	II	1284,5	0,0005	

Remarks: none

**Fr241 Cyg = 3UCAC251-231400 (14.34 mag)**

Right ascension: 20h 49m 03.0169s (2000)

Declination: +35° 00' 12.127"

3UCAC: J-K = 0.40 mag

Comparison star = GSC 02695 00442 (13.5 mag) J-K=0.36

Check Star = 3UCAC251-231351 (14.03 mag) J-K=0.66

Amplitude Min I: 0.38 mag (instr.) Min II: 0.18 mag (instr.)

Type: EB type eclipsing binary

Min I = HJD 2457297.4133 + 0.5050502\*E  
          + -0.0006 + -0.0000005

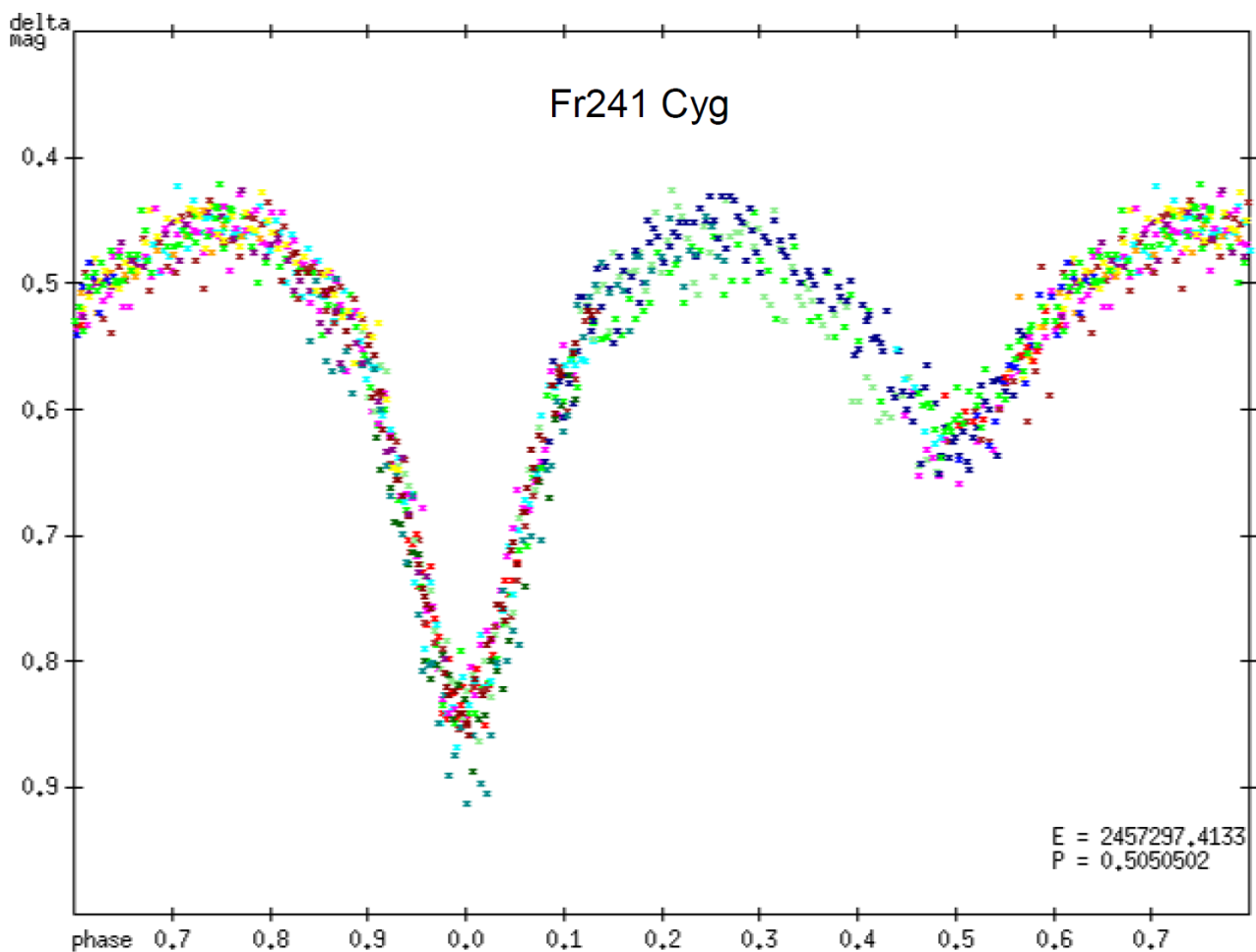


Fig 11: Phased lightcurve of Fr241 Cyg = 3UCAC251-231400 using the ephemeris given above. SIGMA 1603: Kodak KAF1603ME+IR & UV-filter. The period was calculated with Peranso.



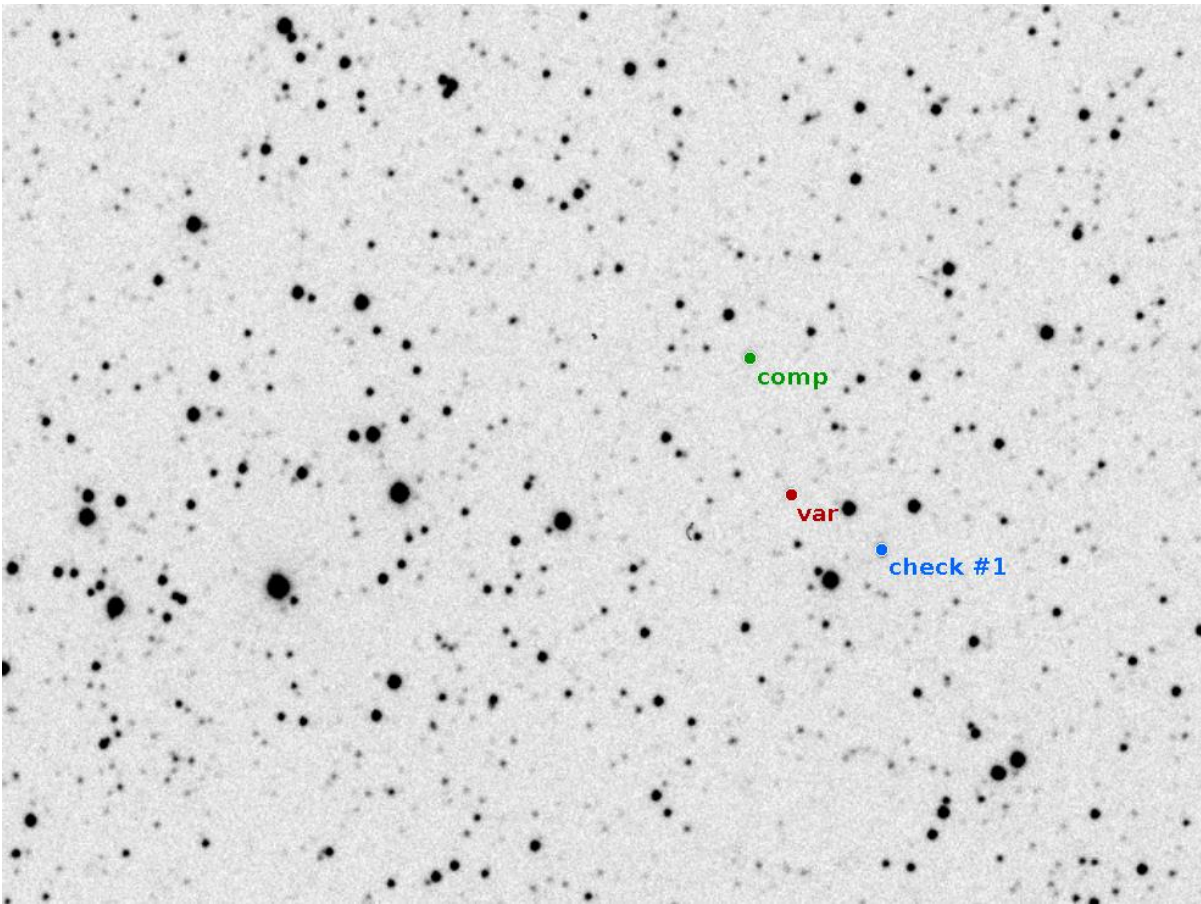


Fig 12: Fr241 Cyg = 3UCAC251-231400 (**var**) in the field of V374 Cyg. (**comp**) is the comparison star and (**check#1**) is the check star. North is right and East is up.

Table 6: Minima of Fr241 Cyg = 3UCAC251-231400

Observer	HJD-Date Minimum	Type	Epoch	O-C (d)	Source
P.Frank	2457287,3115	I	-20	-0,0008	
P.Frank	2457297,4133	I	0	0,0000	
P.Frank	2457298,4230	I	2	-0,0004	
P.Frank	2457307,5131	I	20	-0,0012	
Moschner/Frank	2457692,3614	I	782	-0,0012	
Moschner/Frank	2457693,3772	I	784	0,0045	
Moschner/Frank	2457708,2686	II	813,5	-0,0030	
P.Frank	2457722,4127	II	841,5	-0,0003	
P.Frank	2457731,2519	I	859	0,0005	
P.Frank	2457733,2721	I	863	0,0005	

Remarks: none



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## **References**

- [1] Motl, David: MuniWin, <http://c-munipack.sourceforge.net>
- [2] Vanmunster, Tony: Peranso, <http://www.peranso.com/>
- [3] Guide 9: <http://www.projectpluto.com>