

## 8 New Variable Stars in the Field of 1RSX J075330.1+044606

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**Abstract:** Based on the observing campaign of the cataclysmic variable 1RSX J075330.1+044606 we have found in the same field eight candidates of new variable stars. The variable type and the elements of each candidate are identified and presented. HMB14= UCAC3-190-083329 is an EW type variable showing the O'Connell effect (succeeding maxima are of unequal height), HMB15= UCAC3-190-083257, HMB17= GSC 00189-01448, HMB18= GSC 00189-01715, HMB19= UCAC3-191-085589 and HMB21= UCAC3-191-085396 are EW type variables, HMB16= UCAC3-190-083374 is an EA type variable of which the period is not yet secured, HMB20= UCAC3-190-083261 is an RRLyrae type RRab variable.

### Introduction

Based on the worldwide campaign to observe the cataclysmic variable star **1RSX J075330.1+044606 (Atel3927)**, we followed the variation of this variable over a period of several days. Also older observations of this field have been used to identify in total eight variable stars presently not in the VSX database of the AAVSO. The All-Sky Automatic Survey ASAS shows for some of the candidates also variability, however due to the limiting magnitude of this survey, the data scatter much more than those of the present investigation.

For each star a finding chart is shown, as well as the calculated elements for epoch and period, a phase diagram and an identification of the variable type are given, too.

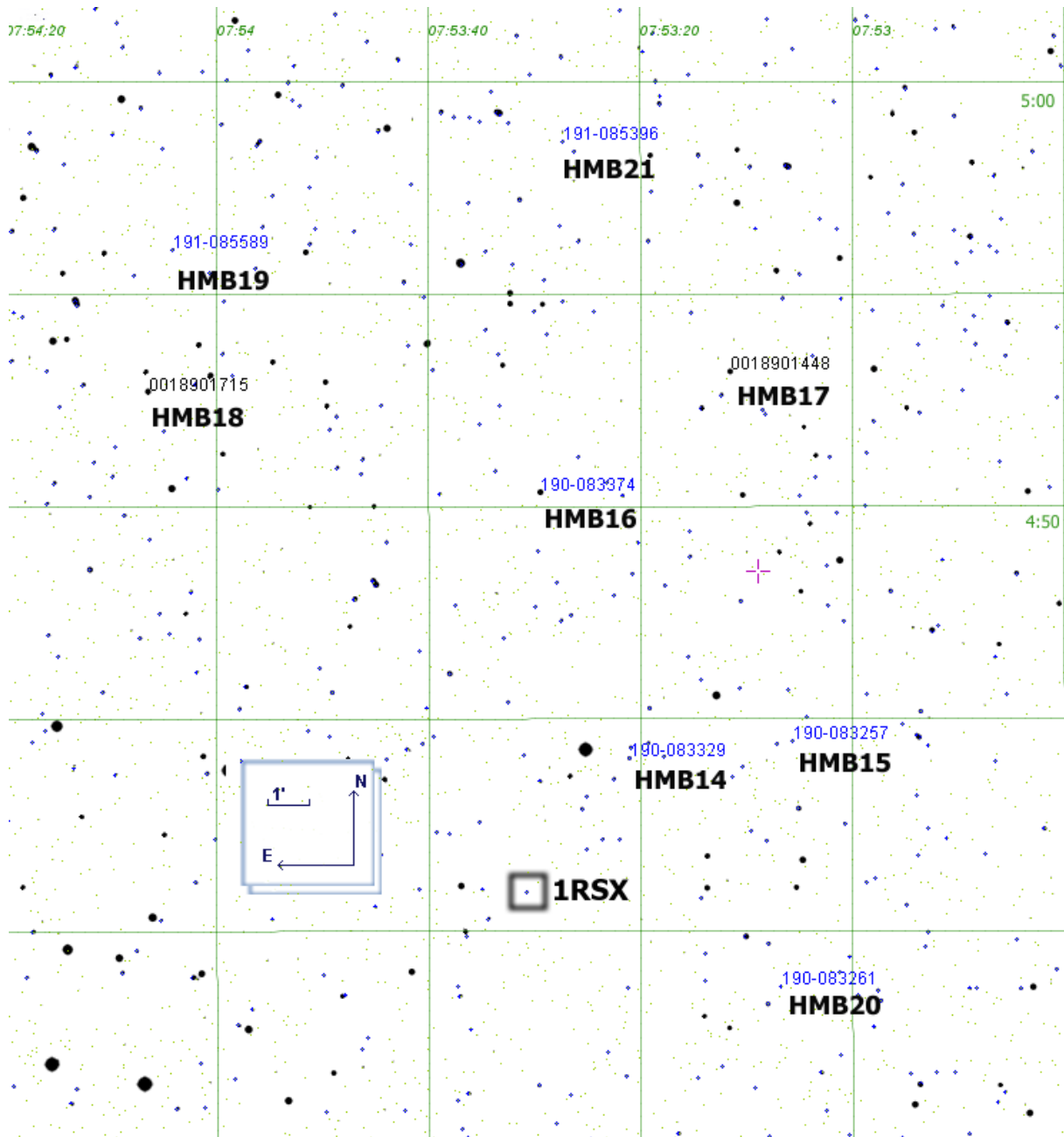


Fig. 1. Finding chart for identifications of the new variables in the field

All CCD images were taken using a clear filter. The images were dark subtracted and flat fielded. The analysis in terms of absolute magnitudes was done using software developed by P. de Ponthiere (2010). The magnitudes of the newly found variables are based on the AAVSO sequence for the cataclysmic Variable 1RSX J075330.1+044606. The AAVSO sequence uses the photometry information of APASS. All data of HMB14, 15, 16, 17, 18 and 20 result from observations taken remotely at the Astrokolkhoz remote observatory in Cloudcroft, New Mexico sharing one of the AAVSOnet telescopes. The telescope was a 35 cm Schmidt Cassegrain telescope with an ST8XME CCD camera. Image exposure was 60 sec.

All data of HMB19 and 21 result from observations taken remotely at the Remote Observatory Atacama Desert (ROAD) in Chile due to the larger field of view ( $47 \times 47$  arcmin<sup>2</sup>) of the used CCD camera. A 40 cm f/6.8 Optimized Dall Kirkham (ODK) telescope equipped with a FLI 16803 CCD has been used. The image exposure was 60 and 120 sec.

GSC 189-1381 ( $12.856 \pm 0.006$  mag in V,  $B-V = 0.388$  mag) was used for all measurements as comparison star and as check star GSC 189-1634 ( $13.096 \pm 0.022$  mag in V,  $B-V = 0.818$  mag) based on the AAVSO sequence on

the 1RSX star. The comparison stars were chosen to be in the field of view of both telescopes at the different locations. Fig. 1 shows a finder chart of 1RSX J0753+0446.

Star	RA	DEC	Name	Type
1RSXJ075330.1+044606	07 53 30.1	+04 46 06	1RSX J075330.1+044606	---
HMB 14	07 53 21.13	+04 49 06.4	UCAC3-190-083329	EW, O'Connell
HMB 15	07 53 05.70	+04 49 29.3	UCAC3-190-083257	EW
HMB 16	07 53 29.49	+04 55 19.2	UCAC3-190-083374	EA
HMB 17	07 53 11.54	+04 58 09.6	GSC 00189-01448 = UCAC3-190-083285	EW
HMB 18	07 54 06.57	+04 57 39.8	GSC 00189-01715 = UCAC3-190-083565	EW
HMB 19	07 54 04.28	+05 01 00.8	UCAC3-191-085589	EW
HMB 20	07 53 06.74	+04 43 41.2	UCAC3-190-083261	RR Lyrae RRab
HMB 21	07 53 27.32	+05 03 35.1	UCAC3-191-085396	EW

Tab 1, Identifications and positions of the new variables, coordinates taken from UCAC3 catalogue, epoch 2000.

Elements	T <sub>0</sub> HJD	P [d]	$\Delta m$ mag	Max- M mag	Min-M mag	further	Obs / days
HMB 14	2455976.84632 Minimum I	0.32353 ± 0.00023	0.30 ± 0.02	14.45 ± 0.01	14.75 ± 0.01	Max-m= 14.48 ± 0.01	1449/4.2
HMB 15	2455976.69803	0.34172 ± 0.00062	0.25 ± 0.05	15.95 ± 0.05	16.20 ± 0.05		1449/4.2
HMB 16	2455191.50628	2.01938± 0.00118	0.50 ± 0.02	13.25 ± 0.02	13.75 ± 0.02	D=0.1 p ± 0.05	2415/792
HMB 17	2455976.81798	0.43665 ± 0.00025	0.3 ± 0.01	13.18 ± 0.01	13.48 ± 0.01		1449/4.2
HMB 18	2455976.79935 Minimum I	0.32011 ± 0.00025	0.16 ±0.02	13.22 ± 0.02	13.38 ± 0.02		963/4.2
HMB 19	2455948.67692	0.27448 ± 0.00107	0.55 ± 0.01	15.2 ± 0.01	15.75 ± 0.01		161/1.3
HMB 20	2455978.65710	0.51830 ± 0.00170	0.65 ± 0.15	15.75 ± 0.05	16.40 ± 0.15	M-m = 21% d= 4h	1441/4.2
HMB 21	2455948.69893	0.32580 ± 0.00686	0.5 ± 0.1	15.8 ± 0.05	16.3 ± 0.08		152/1.3

Tab 2, Elements of the new variable stars and observing periods.

All results were determined using Peranso, light curve workbench. A polynomial fitting curve of 3<sup>rd</sup> order to determine the minima of the EW stars as well as the maxima of the RR Lyr star listed in table 2 was used.

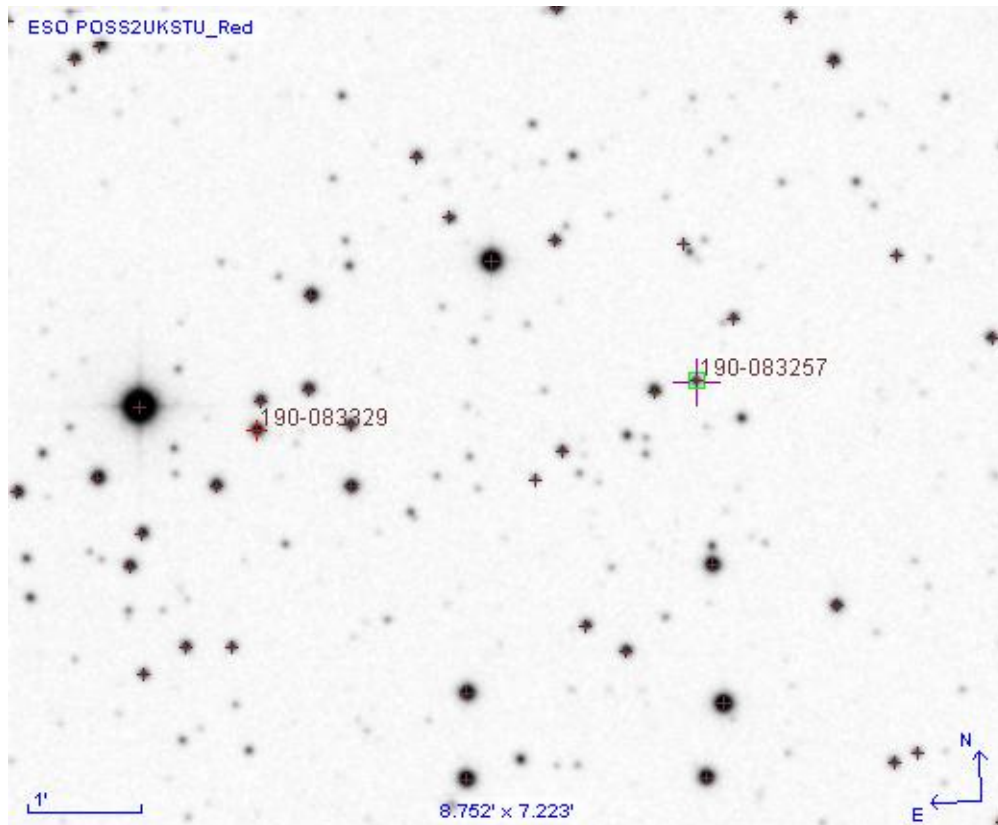
**Observations of HMB14**

Fig. 2 DSS image for the identification of HMB14 as 2MASS 07532110+0449037 (=UCAC3-190-083329). HMB15 (=UCAC3-190-083257) is also in the field of view.

**Minima timings**

From the observations the following minima times have been calculated:  
HMB14:

HJD	std error	Minimum Brightness, Mag	Minimum Type
T Observed	$\pm d$		
2455976.68479	0.00158	14.74	II
2455976.84632	0.00183	14.78	I
2455978.62711	0.00169	14.74	II
2455978.78578	0.00142	14.78	I
2455979.59647	0.00181	14.74	II
2455979.75736	0.00144	14.77	I
2455980.72903	0.00197	14.78	I

Tab. 3, HMB14, Times of minimum and maximum due to the O'Connell effect are given in HJD.

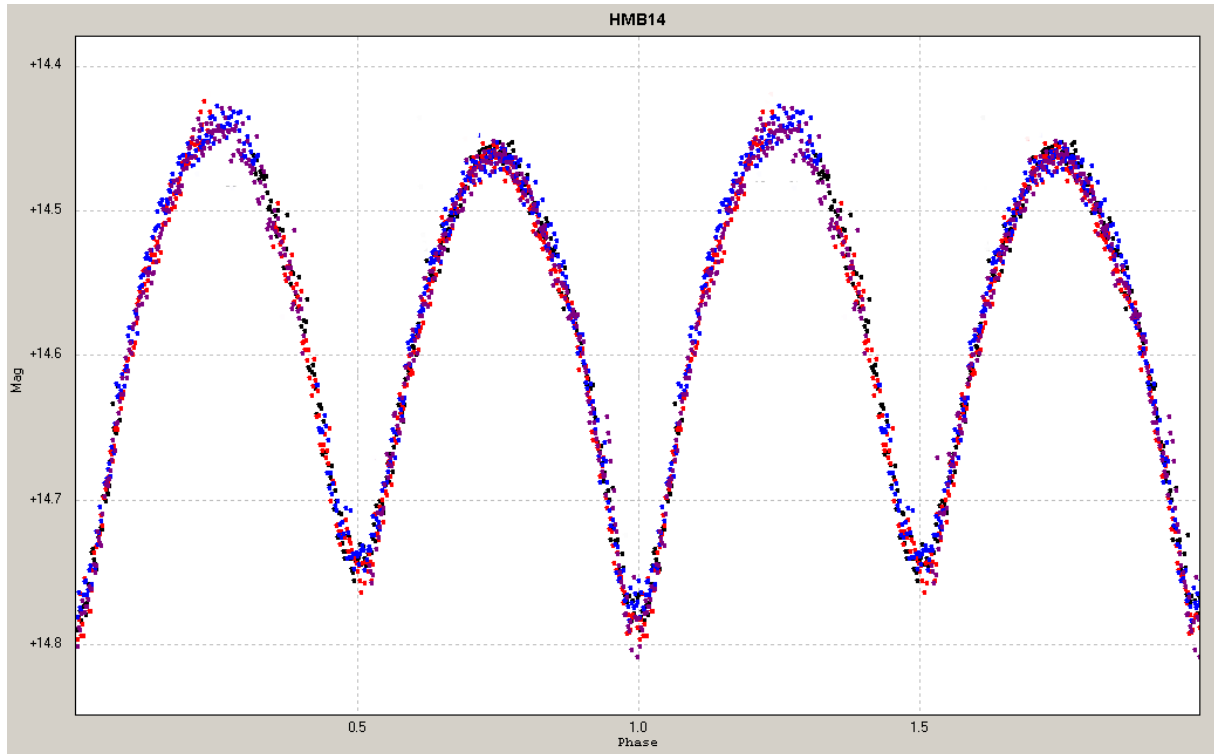


Fig. 3, Phase diagram (light curve) for HMB14, each colour represents another observation set.

The deduced parameters for epoch and period are given as heliocentric elements:

Epoch:  $T_0 = 2455976.84632$ HJD

Period:  $P = 0.32353 \pm 0.00023$  [d] for minimum I, minimum II is about 0.05 mag brighter

Amplitude of light variation: of  $\Delta m = 0.30 \pm 0.02$  mag

Maximum magnitude: Max-M =  $14.45 \pm 0.01$  mag, Max-m =  $14.48 \pm 0.01$  mag

Minimum magnitude: Min-M =  $14.75 \pm 0.01$  mag, Min-m =  $14.80 \pm 0.01$  mag

In total 1449 observations were used, that span about 4 days. This variable star is of EW-Type.

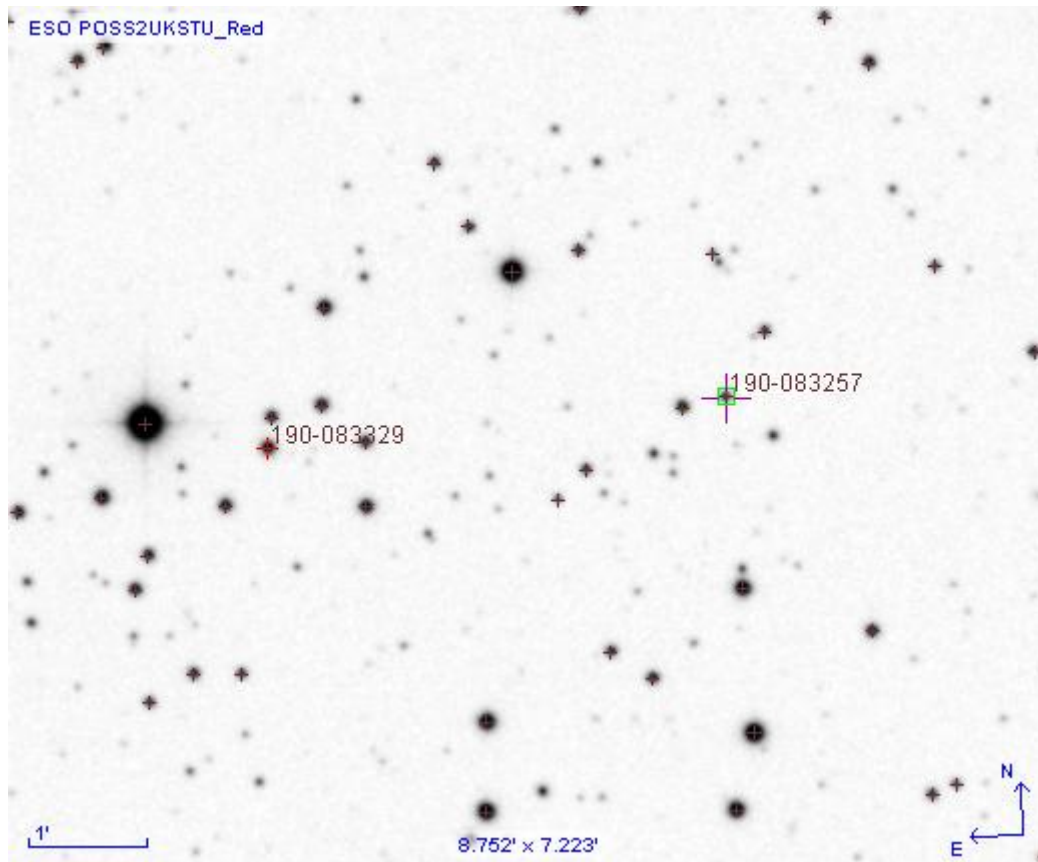
**Observations of HMB15**

Fig. 4, DSS image for the identification of HMB15 as UCAC3-190-083257 at 07 53 05.70 +04 49 29.3.

**Minima**

From the observations these minima times have been calculated and used:

HMB15:

HJD	std error	Minimum
T Observed	±	brightness
2455976.69804	0.00341	16.19
2455978.75000	0.00310	16.16
2455979.77423	0.00353	16.18
2455980.79695	0.00353	16.18

Tab. 4, HMB15, Times of minima given in HJD.

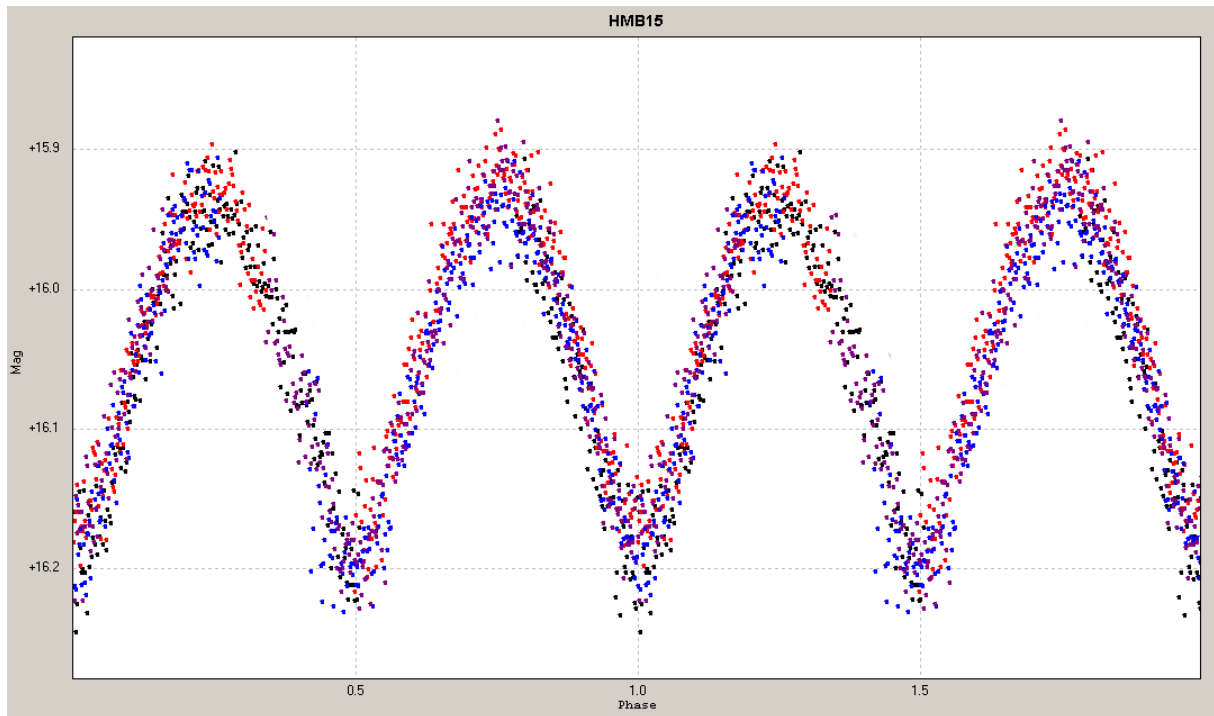


Fig. 5, Phase diagram (light curve) for HMB15, each colour represents another observation set.

The deduced parameters for epoch and period are given as heliocentric elements:

Epoch:  $T_0 = 2455976.69803\text{HJD}$

Period:  $P = 0.34172 \pm 0.00062$  [d]

Amplitude of light variation: of  $\Delta m = 0.25 \pm 0.05$  mag

Maximum magnitude:  $\text{Max-M} = 15.95 \pm 0.05$  mag

Minimum magnitude:  $\text{Min-M} = 16.20 \pm 0.05$  mag

In total 1449 observations were used, that span about 4.2 days. This variable star is of EW-Type.

Due to the scatter of the data in both minima it was not possible to determine min I and Min II separately.

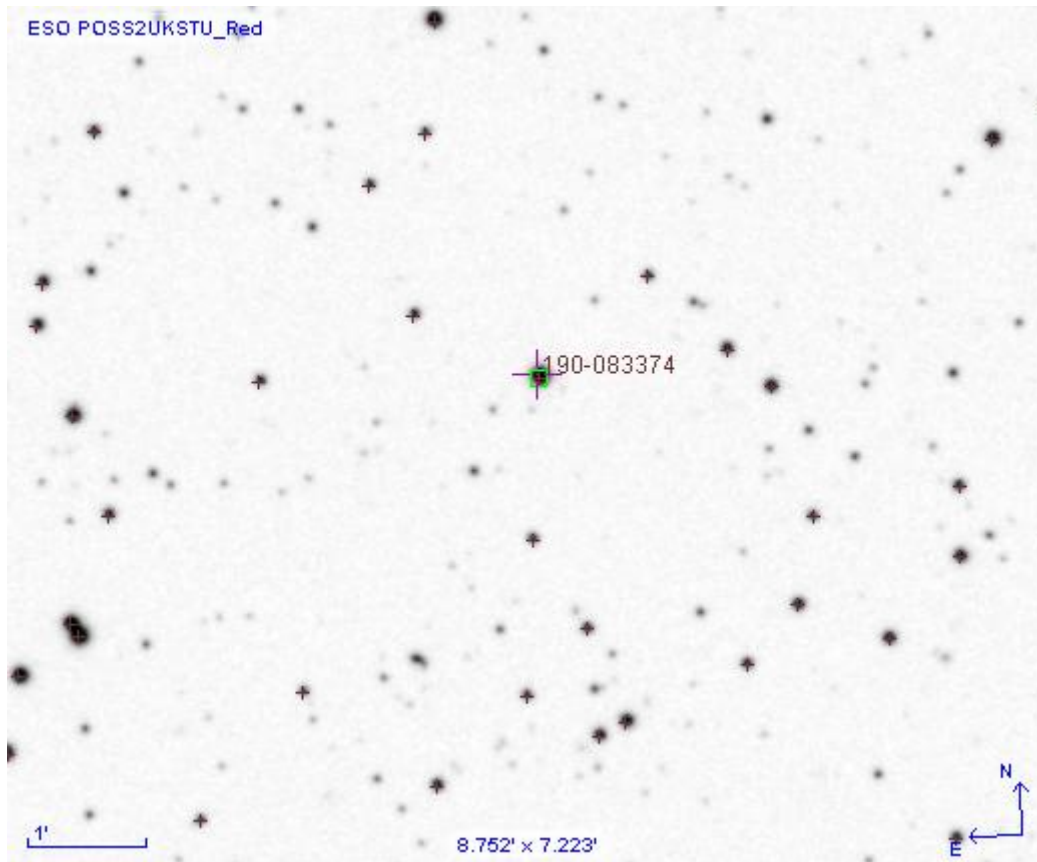
**Observations for HMB16**

Fig. 6, DSS image for the identification of HMB16 as UCAC3-190-083374 at R.A. 07 53 29.49 Dec. +04 55 19.2.

**Minima**

From the observations these minima times have been calculated and used:  
HMB16:

HJD	std error	Minimum
T Observed	±	brightness
2455191.50628	0.00607	13.75
2455948.75227	0.00551	13.74

Tab. 5, HMB16, Times of minima given in HJD.



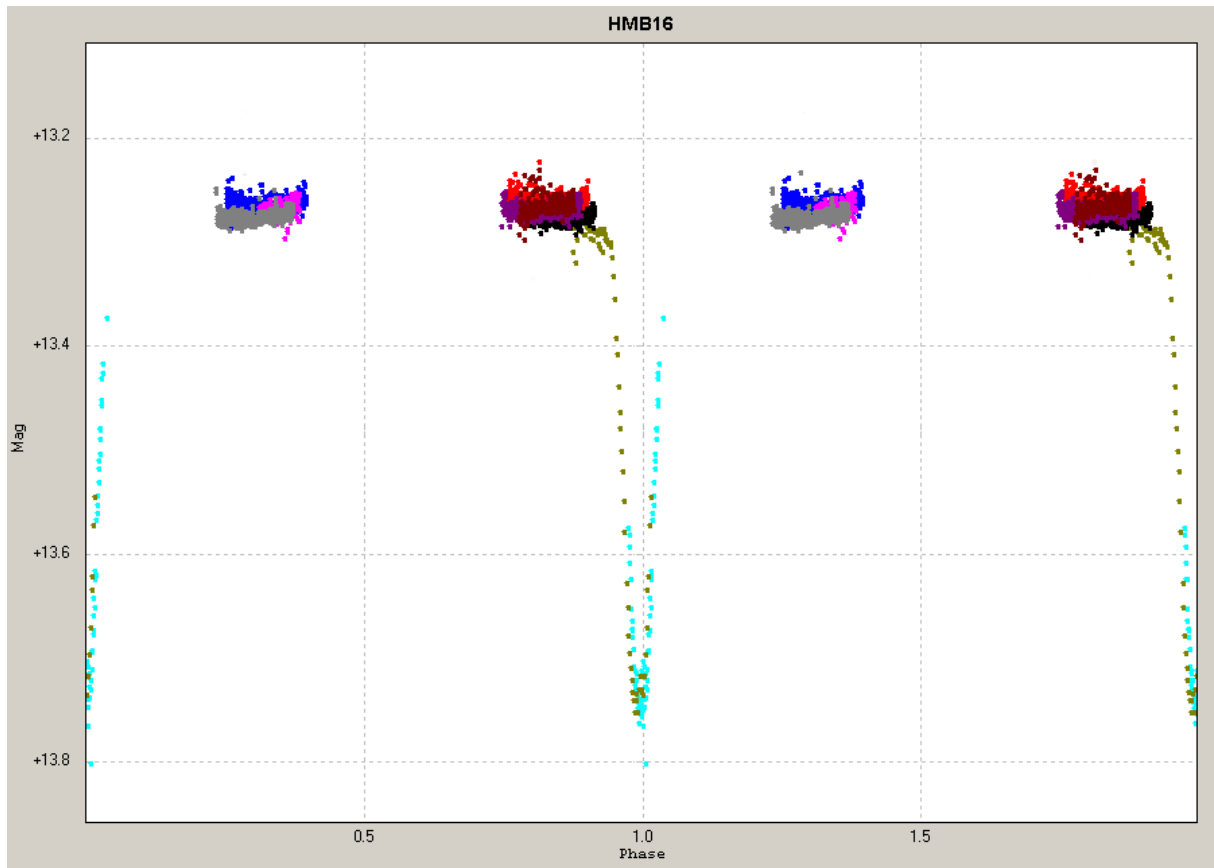


Fig. 6, Phase diagram (light curve) for HMB16, each colour represents another observation set.

The deduced parameters for epoch and period are given as heliocentric elements:

Epoch:  $T_0 = 2455191.50628$  HJD

Period:  $P = 2.01938 \pm 0.00118$  [d]

Amplitude of light variation: of  $\Delta m = 0.50 \pm 0.02$  mag

Maximum magnitude:  $\text{Max-M} = 13.25 \pm 0.02$  mag

Minimum magnitude:  $\text{Min-M} = 13.75 \pm 0.02$  mag

Delay in minimum:  $D = 0.1 p \pm 0.05$  (estimated from Fig. 6)

In total 2415 observations were used, that span about 792 days. This variable star seems to be of EA-Type. As this star was observed during two seasons the span is larger than in the case of the other variables mentioned in this work.

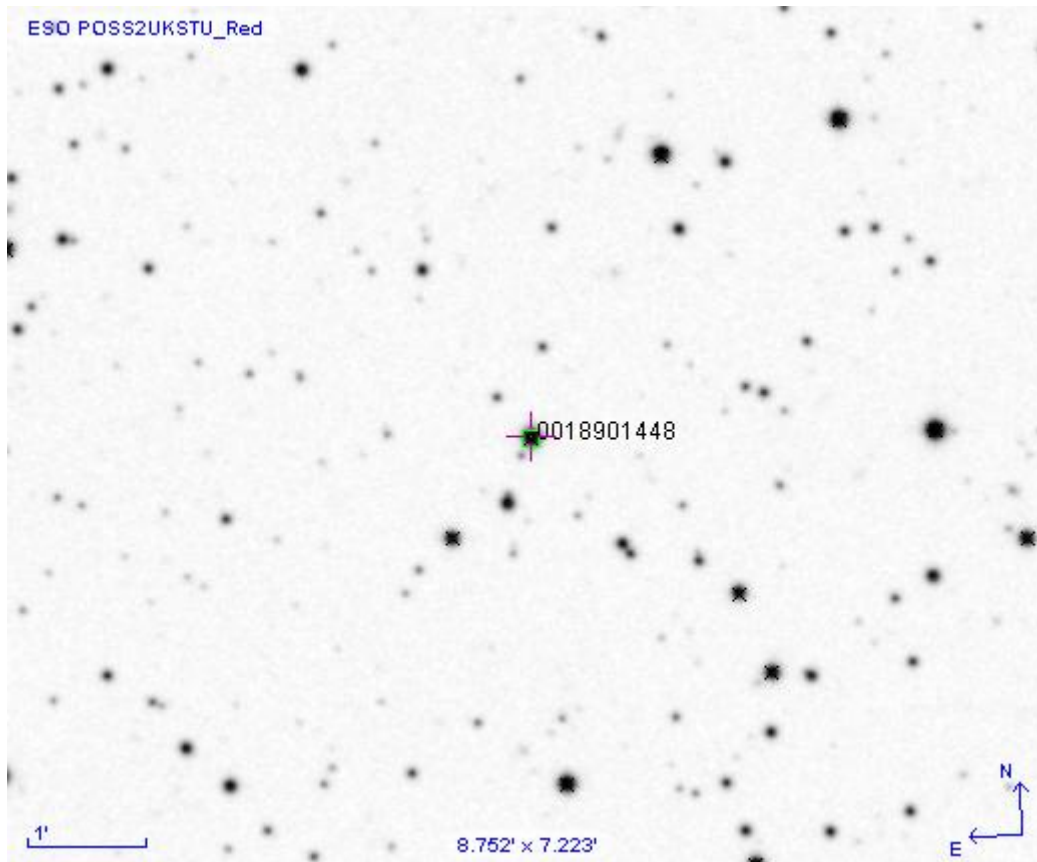
**Observations of HMB17**

Fig. 8, DSS image for the identification HMB17 as GSC 00189-01448 at 07 53 11.54 +04 58 09.6.

**Minima**

From the observations these minima times have been calculated and used:

HMB17:

HJD	std error	Minimum
T Observed	±	brightness
2455976.81798	0.00195	13.48
2455978.78268	0.00144	13.48
2455979.65772	0.00180	13.48
2455980.74811	0.00146	13.48

Tab. 6, HMB17, Times of minima given in HJD.

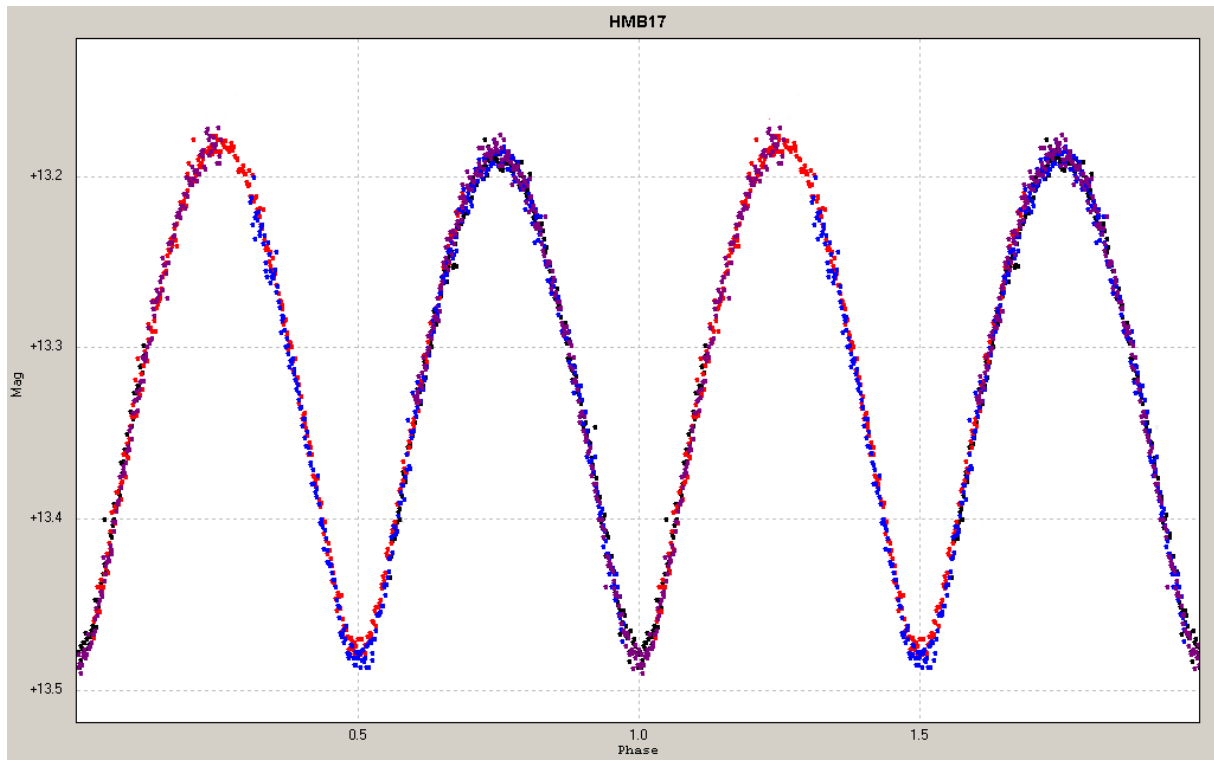


Fig. 9, Phase diagram (light curve) for HMB17, each colour represents another observation set.

The deduced parameters for epoch and period are given as heliocentric elements:

Epoch:  $T_0 = 2455976.81798$  HJD

Period:  $P = 0.43665 \pm 0.00025$  [d]

Amplitude of light variation: of  $\Delta m = 0.3 \pm 0.01$  mag

Maximum magnitude:  $\text{Max-M} = 13.18 \pm 0.01$  mag

Minimum magnitude:  $\text{Min-M} = 13.48 \pm 0.01$  mag

In total 1449 observations were used, that span about 4.2 days. This variable star is of EW-Type. Both minimum I and II have the same depth, which points to similar bright stars.

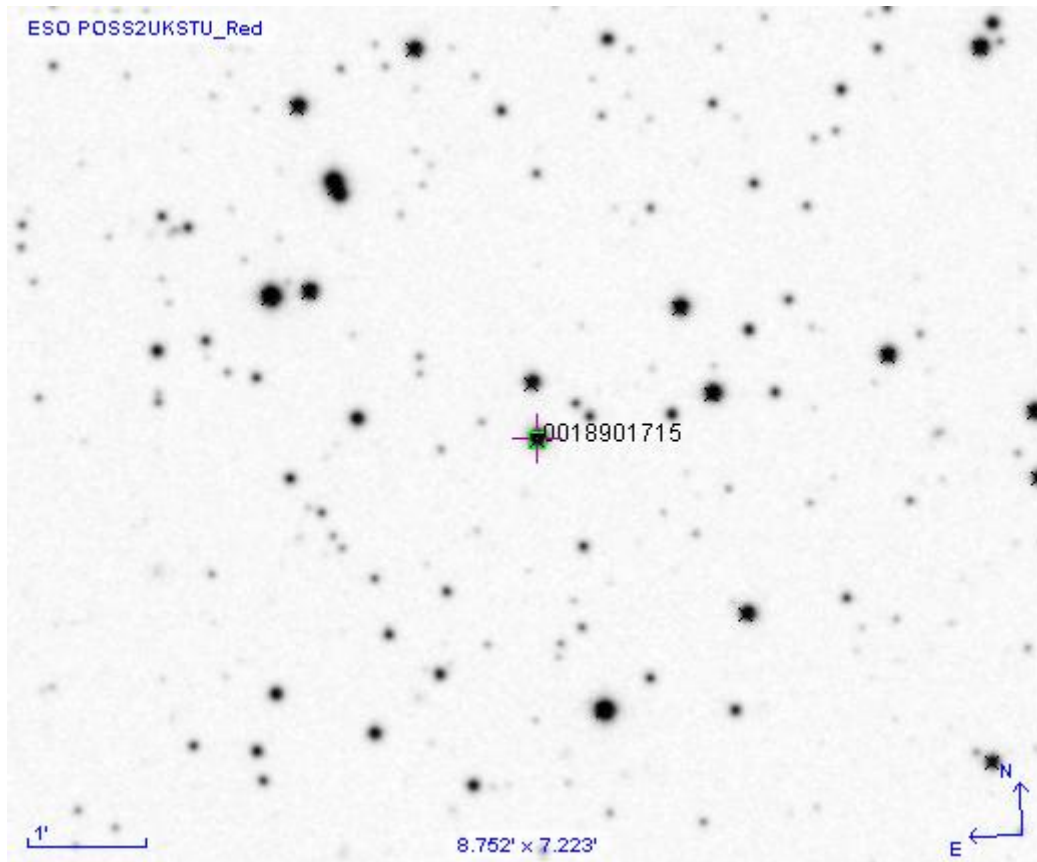
**Observations of HMB18**

Fig. 10, DSS image for the identification of HMB18 as GSC 00189-01715 at 07 54 06.57 +04 57 39.8.

**Minima**

From the observations these minima times have been calculated and used:

HMB18:

HJD	std error	Minimum	Minimum
T Observed	±	brightness	type
2455976.79936	0.00257	13.41	I
2455979.67939	0.00223	13.42	I
2455980.64045	0.00204	13.42	I
2455976.6452*	0.00257	13.38	II

Tab. 7, HMB18, Times of minima given in HJD.

Based on the present dataset only one minimum timing for minimum II could be determined.

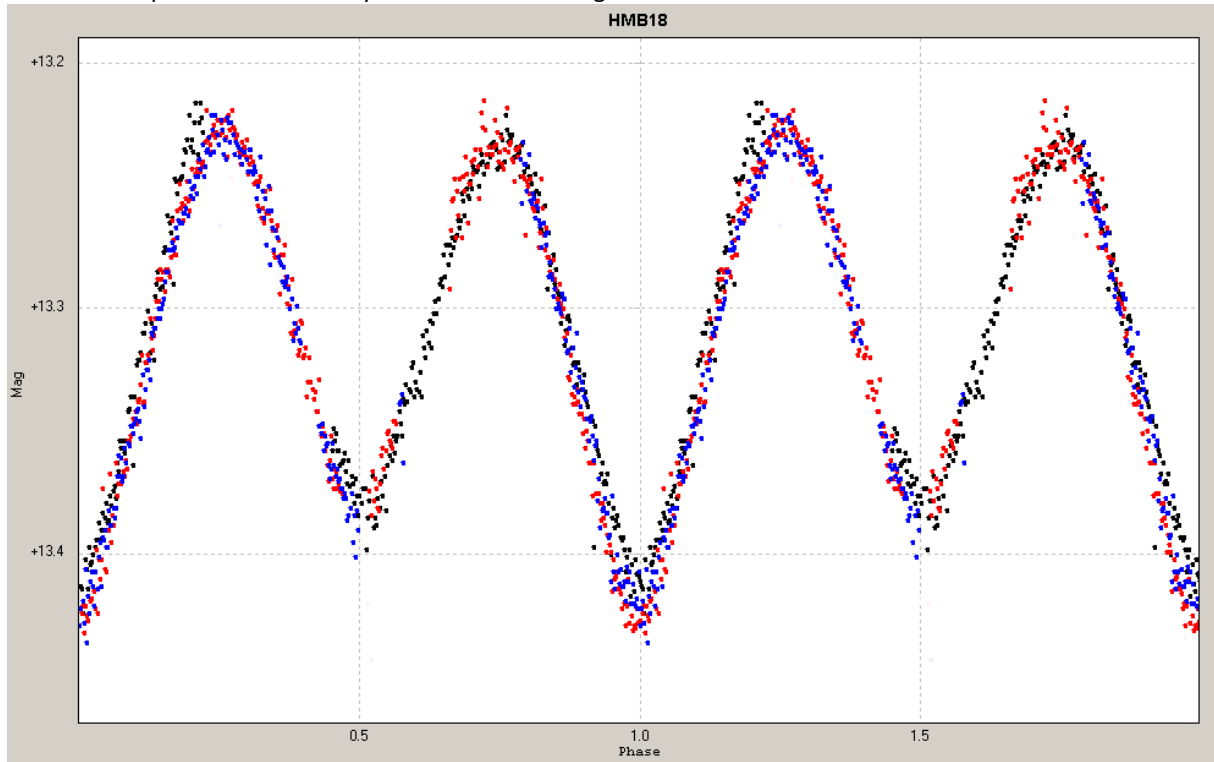


Fig. 11, Phase diagram (light curve) for HMB18, each colour represents another observation set.

The deduced parameters for epoch and period are given as heliocentric elements:

Epoch:  $T_0 = 2455976.79935$  HJD

Period:  $P = 0.32011 \pm 0.00025$  [d] for minimum I, minimum II is 0.04 mag brighter

Amplitude of light variation: of  $\Delta m = 0.16 \pm 0.02$  mag

Maximum magnitude:  $\text{Max-M} = 13.22 \pm 0.02$  mag

Minimum magnitude:  $\text{Min-M} = 13.38 \pm 0.02$  mag,  $\text{Min-m} = 13.42 \pm 0.02$  mag

In total 963 observations were used, that span about 4.2 days. This variable star is of EW-Type.

**Observations of HMB19**

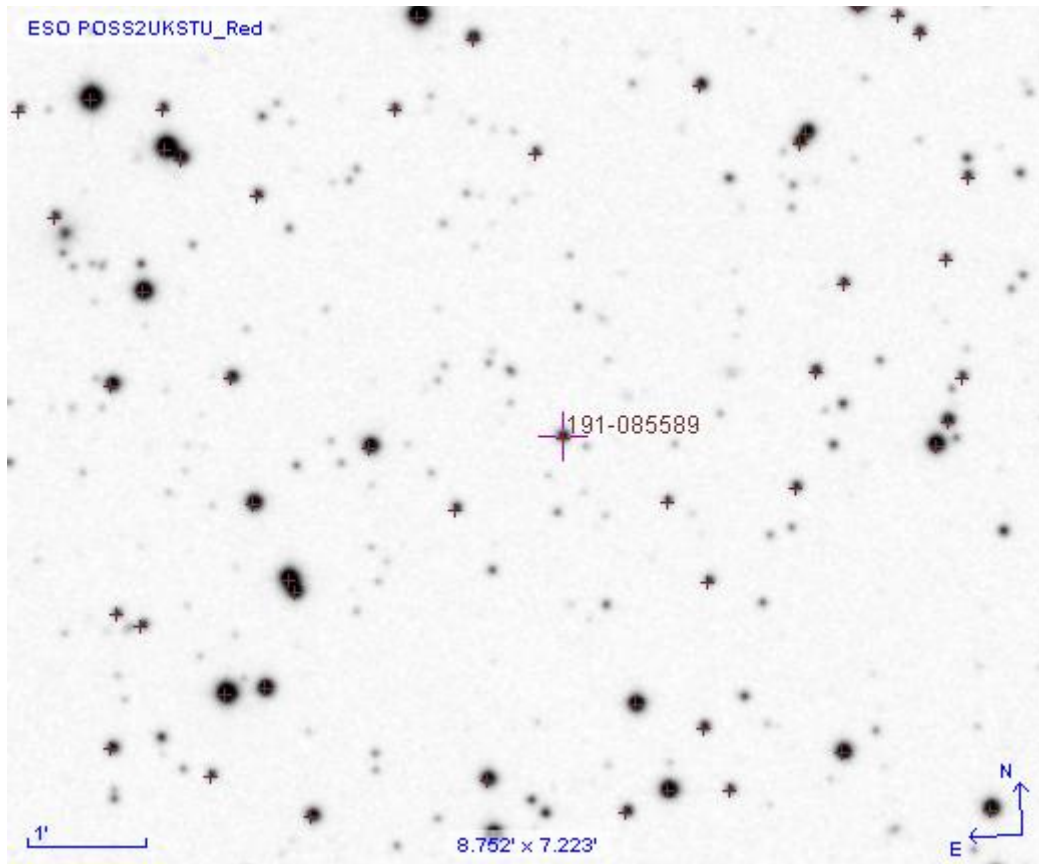


Fig. 12, DSS image for the identification of HMB19 as UCAC3-191-085589 at 07 54 04.28 +05 01 00.8.

**Minima**

From the observations these minima times have been calculated and used:  
 HMB19:

HJD	std error	Minimum
T Observed	±	brightness
2455948.67692	0.00405	15.79
2455949.63762	0.00142	15.79

Tab. 8, HMB19, Times of minima given in HJD.

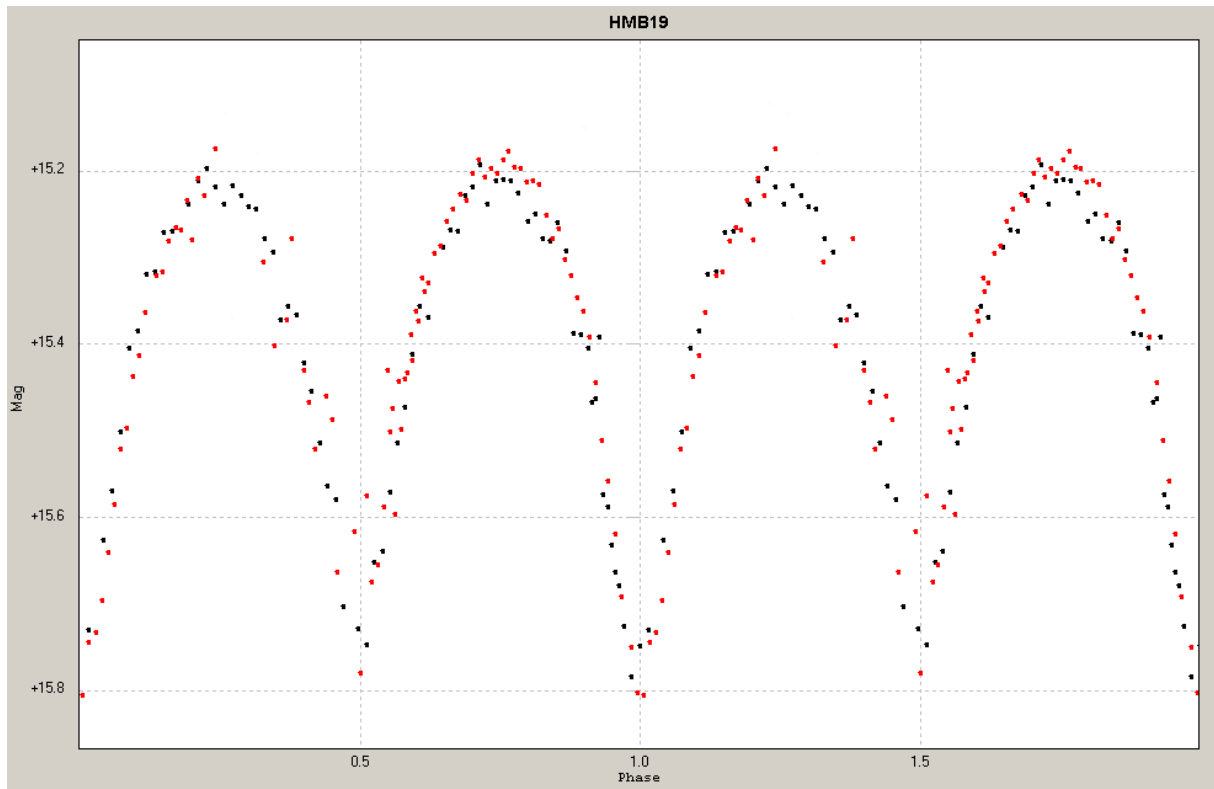


Fig. 13, Phase diagram (light curve) for HMB19, each colour represents another observation set.

The deduced parameters for epoch and period are given as heliocentric elements:

Epoch:  $T_0 = 2455948.67692$  HJD

Period:  $P = 0.27448 \pm 0.00107$  [d]

Amplitude of light variation: of  $\Delta m = 0.55 \pm 0.01$  mag

Maximum magnitude:  $\text{Max-M} = 15.2 \pm 0.01$  mag

Minimum magnitude:  $\text{Min-M} = 15.75 \pm 0.01$  mag,  $\text{Min-m} = 15.80 \pm 0.01$  mag

In total 161 observations were used, that span about 1.3 days. As this star was observed only for a bit more than 1 day it is difficult to determine also the secondary minimum due to the limited number of points in the light curve. Further observations are required. Nevertheless it is obvious that this star is varying and of type EW.

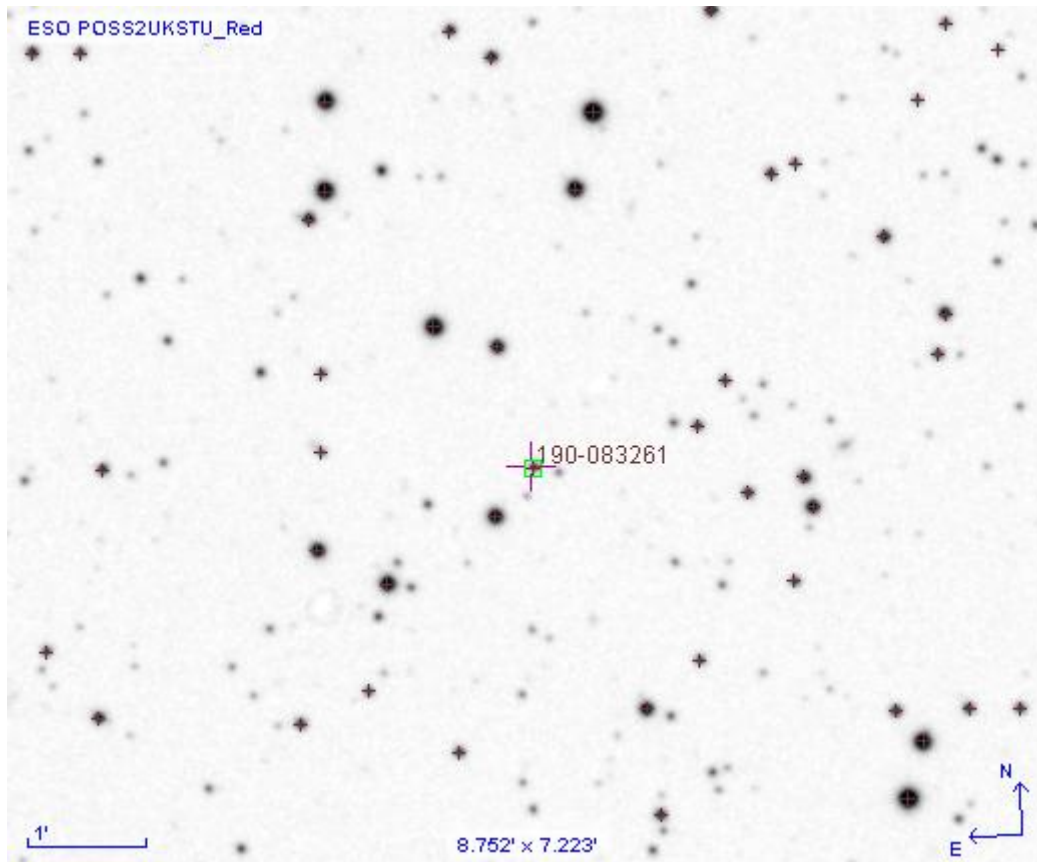
**Observations of HMB20**

Fig. 14, DSS image for the identification of HMB20 as UCAC3-190-083261 at 07 53 06.74 +04 43 41.2.

**Maxima**

From the observations these maxima times have been calculated and used:  
HMB20:

HJD	std error	Max
T Observed	±	brightness
2455978.65710	0.00256	15.76
2455979.69482	0.00252	15.78
2455980.73025	0.00298	15.81

Tab. 9, HMB20, Times of maxima given in HJD.



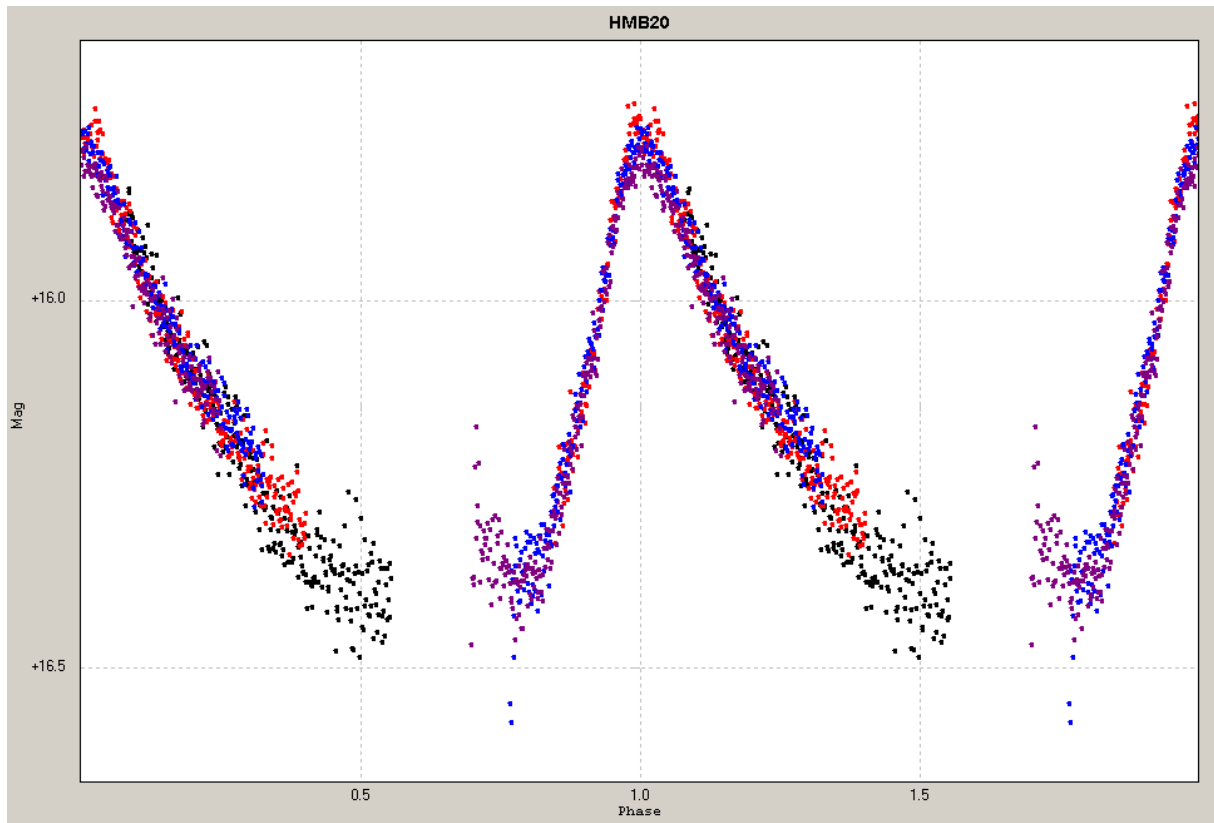


Fig. 15, Phase diagram (light curve) for HMB20, each colour represents another observation set.

The deduced parameters for epoch and period are given as heliocentric elements:

Epoch:  $T_0 = 2455978.65710$  HJD

Period:  $P = 0.51830 \pm 0.00170$  [d]

Amplitude of light variation: of  $\Delta m = 0.65 \pm 0.15$  mag

Maximum magnitude:  $\text{Max-M} = 15.75 \pm 0.05$  mag

Minimum magnitude:  $\text{Min-M} = 16.40 \pm 0.15$  mag

M-m: 21%

Delay in minimum:  $d = 4$  h

In total 1441 observations were used, that span about 4.2 days. This variable star is of RR-Lyr Type RRAb.

**Observations of HMB21**

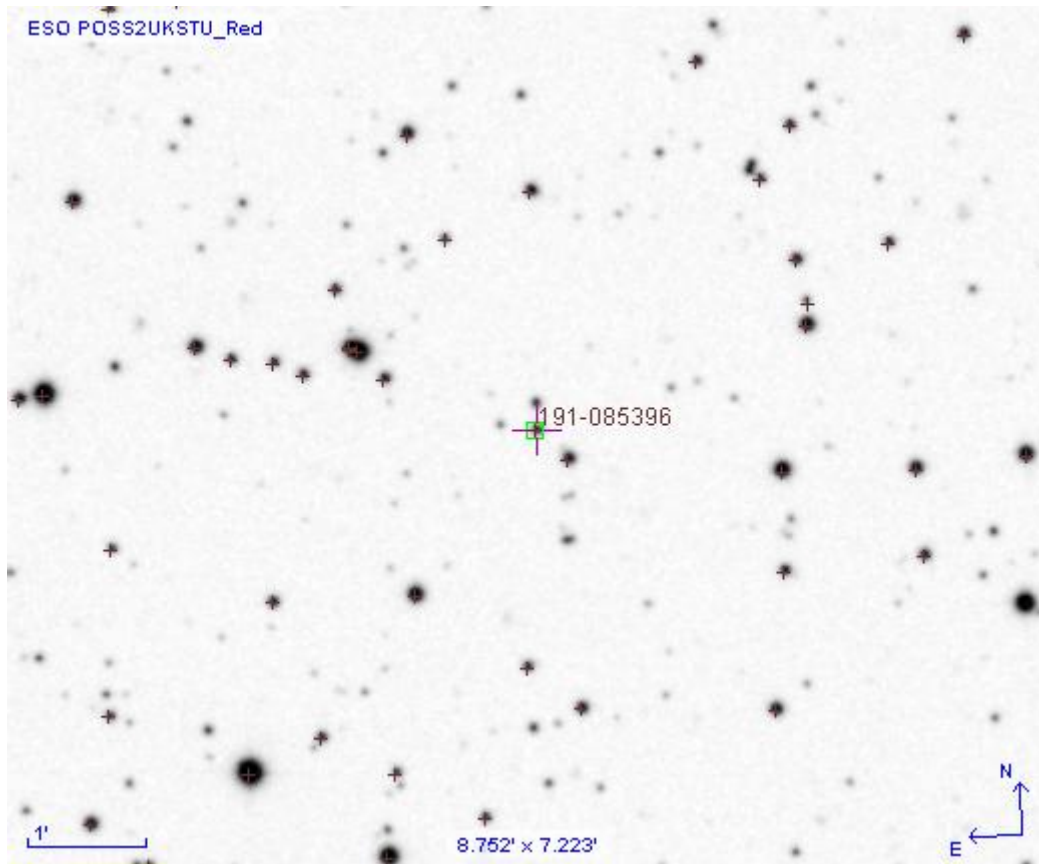


Fig. 16, DSS image for the identification of HMB21 as UCAC3-191-085396 at 07 53 27.32 +05 03 35.1

**Minima**

From the observations these minima times have been calculated and used:

HMB21:

HJD	std error	Minimum
T Observed	±	brightness
2455948.69893	0.00432	16.19
2455949.67726	0.00391	16.19

Tab. 10, HMB21, Times of minima given in HJD.

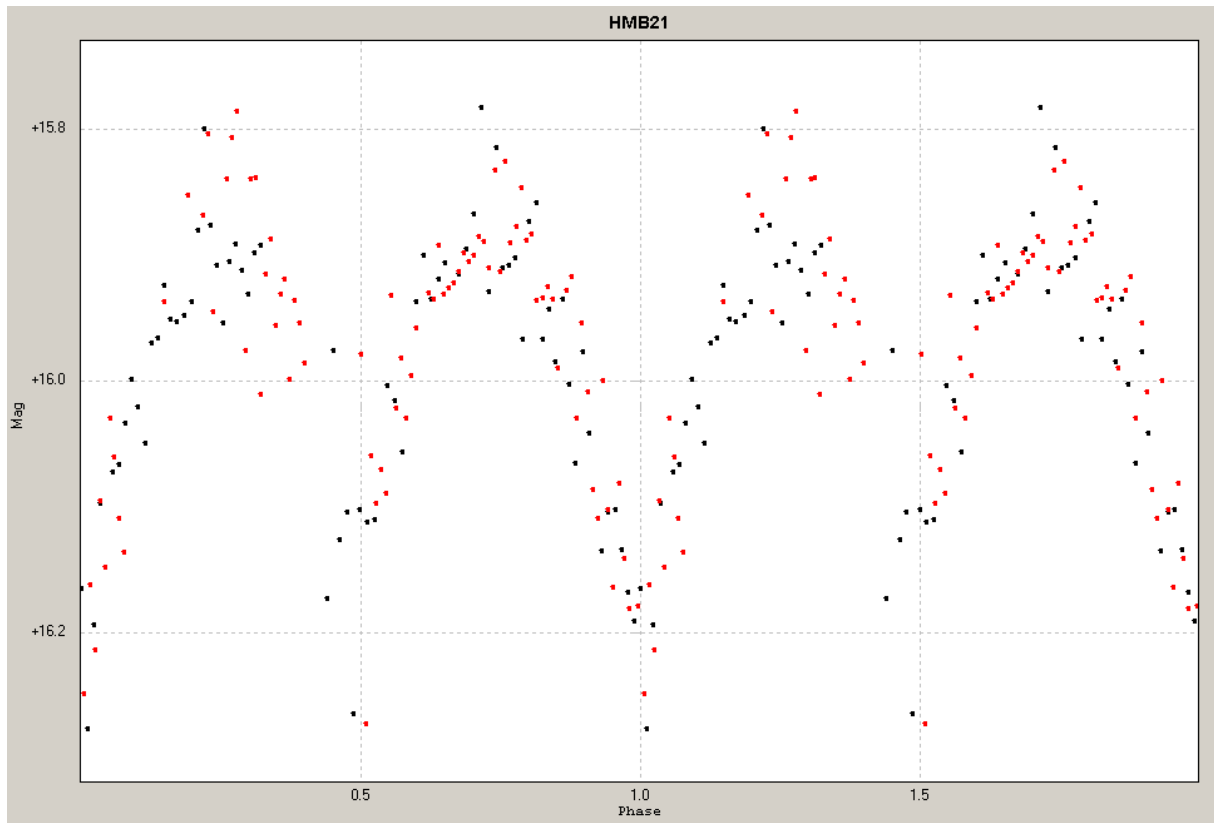


Fig. 17, Phase diagram (light curve) for HMB21, each colour represents another observation set.

The deduced parameters for epoch and period are given as heliocentric elements:

Epoch:  $T_0 = 2455948.69893$  HJD

Period:  $P = 0.32580 \pm 0.00686$  [d]

Amplitude of light variation: of  $\Delta m = 0.5 \pm 0.1$  mag

Maximum magnitude:  $\text{Max-M} = 15.8 \pm 0.05$  mag

Minimum magnitude:  $\text{Min-M} = 16.3 \pm 0.08$  mag

In total 152 observations were used, that span about 1.3 days.

As this star was observed only for a bit more than 1 day it is difficult to determine also the secondary minimum due to the limited number of points in the light curve. Further observations are required. Nevertheless it is obvious that this star is varying and of type EW.

Acknowledgements:

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  - ATEL3927, <http://www.astronomerstelegam.org/?read=3927>
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