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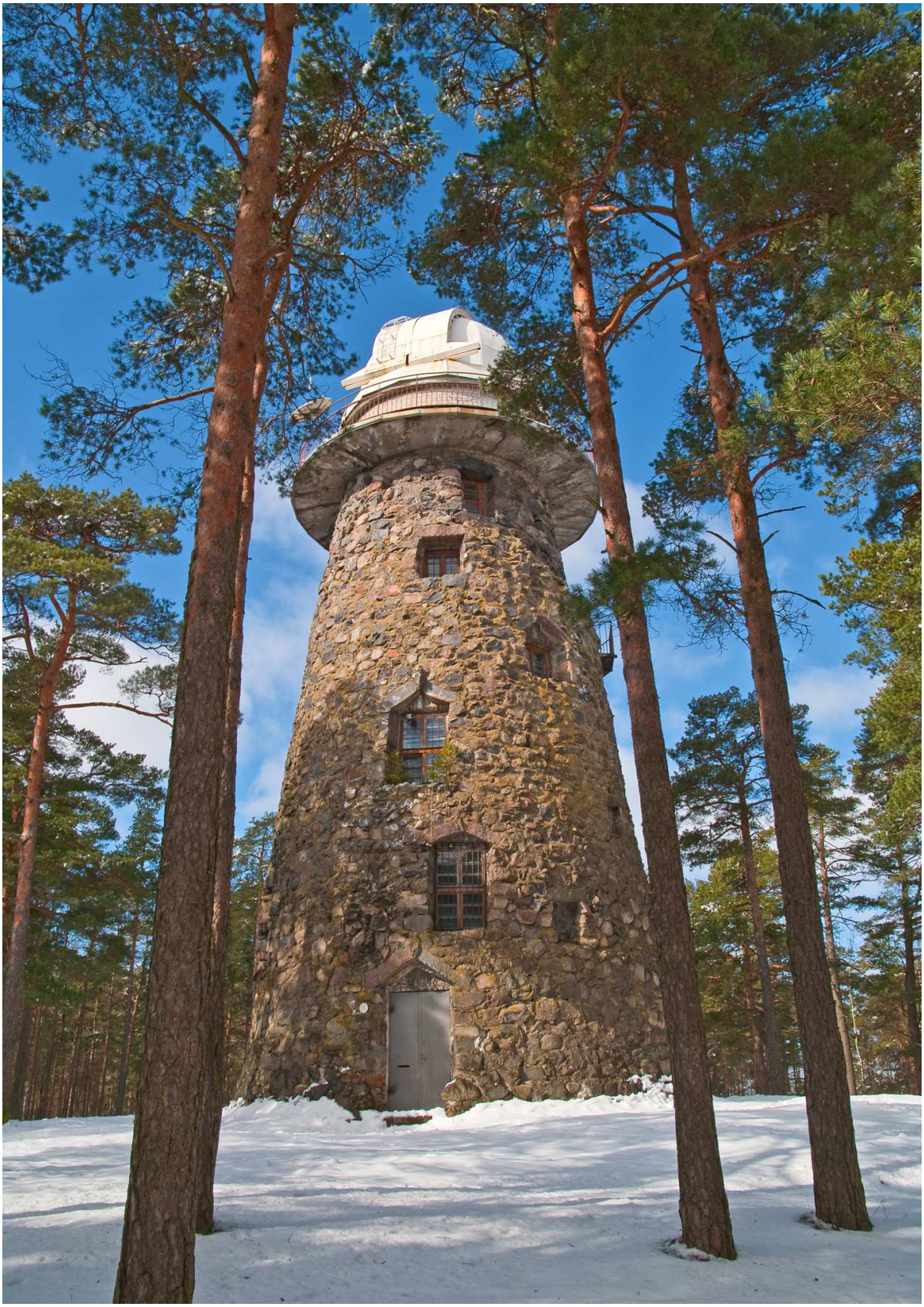

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The observations of BM Cas.

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Introduction

Variability of BD+63°110 discovered by Guthnick (1929). BM Cassiopeia observed visually by Beyer (1935, 1942, 1952, 1964) for long time.

A long period eclipsing binary BM Cas with a primary A5-A7Ia,b supergiant and an invisible secondary component was an observational target for photometric studies at Tallinn Observatory. A number of seasonal light curves of this peculiar system in *UBVR* colors were obtained between 1967 and 1996. Some examples are given in Figures 7 and 9. A complete light curve (see Figure 4) was calculated according to

$$\text{JD Hel} = 2434648\overset{\text{d}}{.}0 + 197\overset{\text{d}}{.}304 \times \text{E}$$

In cooperation with late Dr. Izold Pustylnik we developed a quantitative model of BM Cassiopeiae (Pustylnik et al. 2007), but it is possibe that the observations carried out at Tallinn Observatory during 29 years could be useful for investigators in the future.

Analysis of the O–C diagram based on these observations and a brief discussion on the observed properties of BM Cas, as well as on its probable evolutionary history, were published four years ago in our earlier paper (Kalv et al. 2005). A complete table of available O–C data is given in Table 2 and Figure 2.

Nha and Zola (1996) attempted to obtain a fit to observed light curves using the Wilson-Devinny model with the Monte Carlo method. They failed to obtain solution with the W-D model and considered also a thick disk hypothesis for BM Cas. Due to large scatter in the observed light curves they were unable to find any unique solution with this model. They derived a grid of preliminary models for fixed mass ratio.

Results of detailed spectroscopic investigations and some photometric data of BM Cas by Fernie and Evans (1997) generally agree with our earlier conclusions about the probable range of physical parameters of the binary.

We summarized the main results of the semi-quantitative analysis of our seasonal light curves. Because of a pronounced intrinsic variability and asymmetry of the light curves as well as of anomalous radial velocity curves (available only for the primary component up to now) nobody has proposed any self-consistent quantitative model of BM Cas nor determined reliable physical parameters of the components and the orbit of the binary (an earlier detailed model assuming the extended scattering envelope elaborated by Barwig (Barwig 1976) contradicts the recent IUE data in *UV* which do not confirm the presence of circumbinary envelope claimed by Barwig).

On the plates of the Harvard Patrol Collection, 6037 photographic estimates were obtained by Shao and Gaposchkin (1962) for this eclipsing system. They studied behavior of the variable over an interval of more then 50 years and confirmed irregularities in its maximum brightness and particularly existence of the „hump“ after the primary minimum.

*P. Kalv passed away on 1 January 2002

This „hump“ is clearly seen in our formal approximative curves of light-curves in U, B and V, in R-light the number of observations is too small (see Figures 6, 7, and 8).

Peculiarities of the observed $UBVR$ light curves

Individual $UBVR$ light curves manifest the following peculiarities:

Temporal variations of the depths of both minima.

There are significant differences between individual light curves in the depths of both minima and to a smaller extent, in their duration. The average values of light in units of the total luminosity normalized to the local maximum at the bottom of the primary minimum range between 0.56P and 0.61P for the primary and between 0.86P and 0.89P for the secondary minimum in all four colors, the average semi-widths of the primary minimum range between 0.14P and 0.17P. In some cases the primary minimum is even more shallow: the brightness at the bottom of the primary minimum is 0.667P in B color and is 0.70P in V was measured from one partial light curve obtained in 1974.

Sporadic displacements of the moment of the primary minimum.

Sporadic displacements of the moment of the primary minimum from the predicted ephemeris (amounting up to 0.02P) have been detected (despite the fact that no significant systematic period variations have been found in our earlier paper). The same applies to the secondary minimum but because of a conspicuous asymmetry and scattering of observed points it is virtually impossible to give even an approximate numerical estimates.

The absence of contribution to the total light from the secondary component.

Spectroscopic data do not show any evidence for presence of the spectrum of the companion both in the visible and UV, see (Fernie and Evans 1997) for a more detailed discussion. Our multicolor photometric data support this conclusion.

Observations

RX Cas was observed with the Tallinn 48-cm telescope (BV from 1968, $UBVR$ from 1980) up to 1996, (usually one normal point per night, Figure 4). BD+62°152 (SAO 11408) was used as a comparison star. Magnitude differences are given in Table 1. The instrument and the reduction technique used are described in (Kalv et al. 2007)

The root-mean-square errors of the normal points, as calculated from the measurements of the comparison and the check stars, are less than $0\overset{\mathrm{m}}{.}01$ for V, $B-V$ and $V-R$. In the ultraviolet, RX Cas was too faint for the Observatory telescope. Often the sky background was bright due to a full or nearly full Moon, and we have tried also to observe at relatively poor atmospheric conditions. Therefore, in many nights the error in U may reach up to $0\overset{\mathrm{m}}{.}04$.

The observed magnitudes (variable minus comparison star) are given in Table 1.

Acknowledgements.

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BM Cas vaatlustest

BD+63°110 muutlikkuse avastamisest teatas Guthnick (1929). Pikka aega vaatles visuaalselt BM Cassiopeiat Beyer (1935, 1942, 1952, 1964) ja avaldas 1396 vaatlust. Shao ja Gaposchkin (1962) said 6037 heleduse hinnangut Harvardi fototeegi plaatide põhjal.

Peale seda, kui Thiessen (1956) esitas väite, et BM Cas üheks komponendiks on 27 päevase perioodiga tsefeiid, kasvas veelgi huvi selle objekti vastu ja lisaks Thiessenile vaatlesid seda fotoelektriliselt ka mitmed teised uurijad, kuid suhteliselt lühikese ajavahemiku vältel.

Lähtudes tsefeiidi-hüpoteesist määrati ka näiteks tsefeiidide statistilise sõltuvuse nullpunkt. Hiljem aga tsefeiidi-hüpoteeses kinnitust ei leidnud. BM Cassiopeiat uurisid spektroskoopiliselt Popper (1977) ja Barwig (1976). Kaksiksüsteemi peakomponent on (A5Ia) ülihiid ja teise komponenti „jälgi“ spektris ei leitud. See, et on leitud ainult ühe komponendi radiaalkiiruste kõver ja lisaks sellele on ka heleduskõver „anomaaliatega“, mis võimaldab interpreteerida vaatlusi väga erinevalt. Näiteks Nha ja Zola (1996) püüdsid leida vaadeldavaga kooskõlalist heleduskõverat kasutades Wilson-Devinny mudelt Monte Carlo meetodil. Ühese lahendi leidmine aga ebaõnnestus ja seejärel leidsid nad rea esialgseid mudeleid etteantud massisuhete korral.

Ka meie, koostöös hiljuti lahkunud Dr. Izold Pustõlnikuga, esitasime järjekordse katse kvantitatiivselt interpreteerida vaatlusandmeid (Pustylnik et al.2007).

Kuna me arvame, et Tallinna Tähetornis 29 aasta vältel teostatud vaatlused võivad ehk mõnele uurijale tulevikus huvi pakkuda, avaldame nad käesolevas tehnilises aruandes.

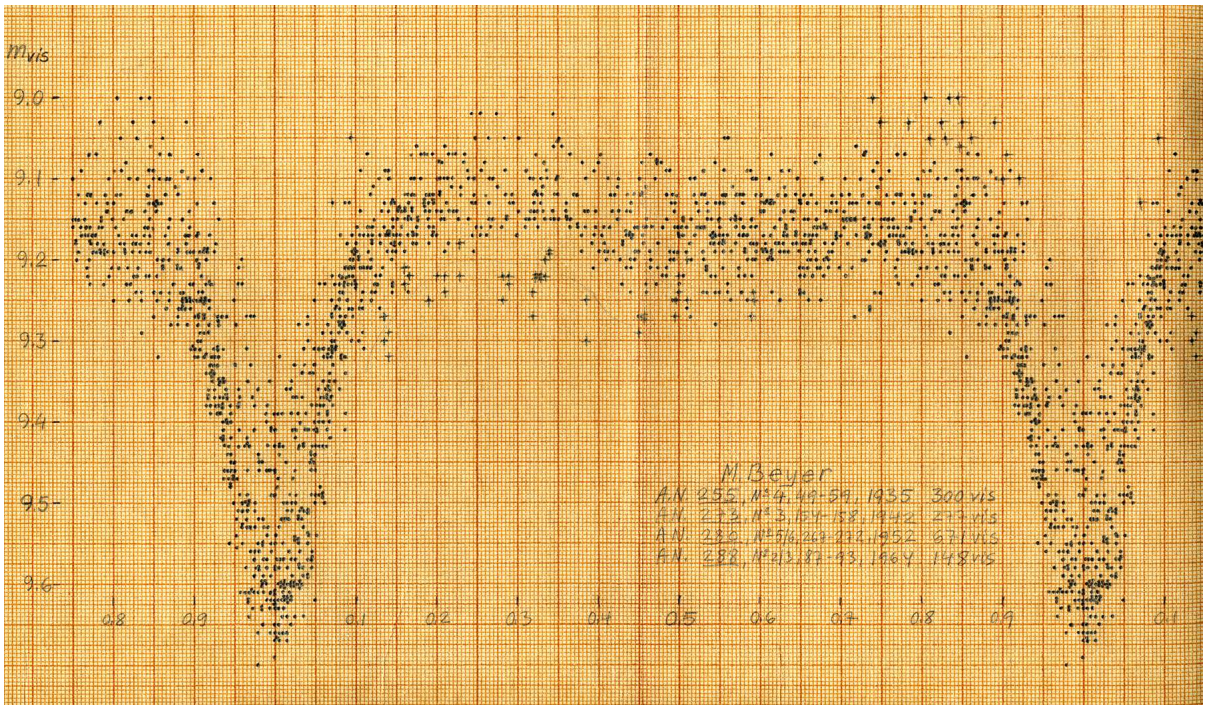

Figure 1: Beyeri vaatluste põhjal umbes 40 aastat tagasi Peep Kalvi poolt millimeeterpaberile kantud BM Cas heleduskõver

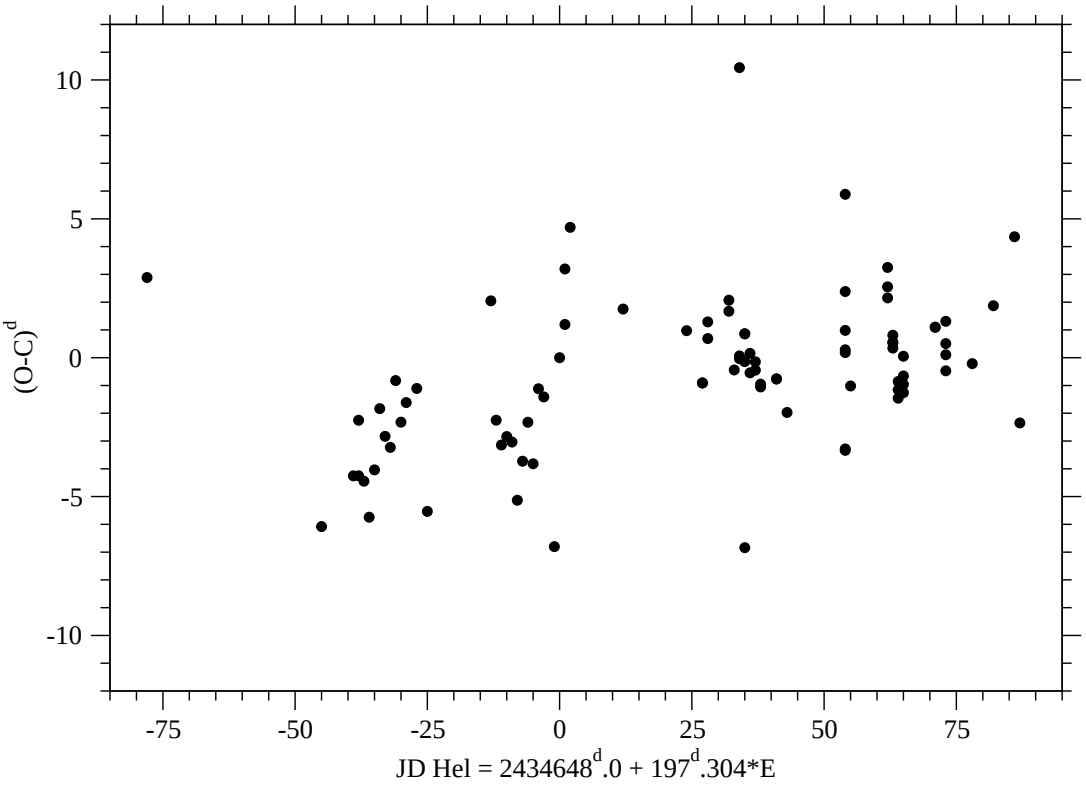

Figure 2: All available minima

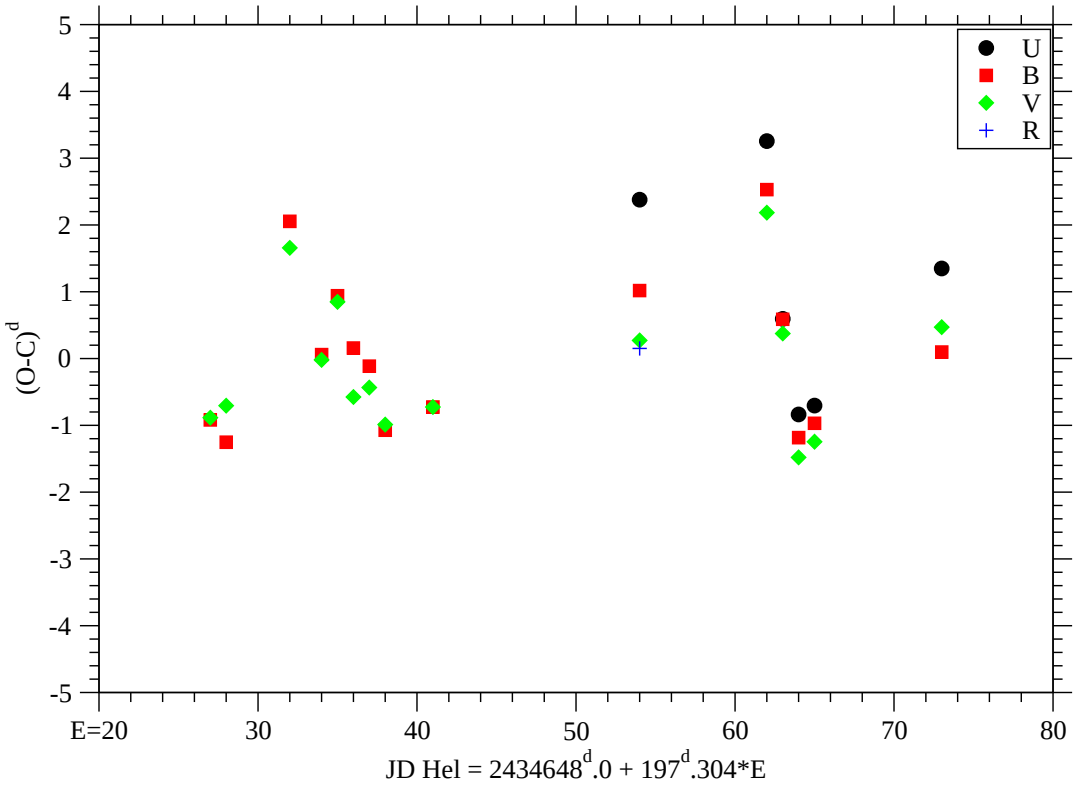

Figure 3: Minima, only this paper

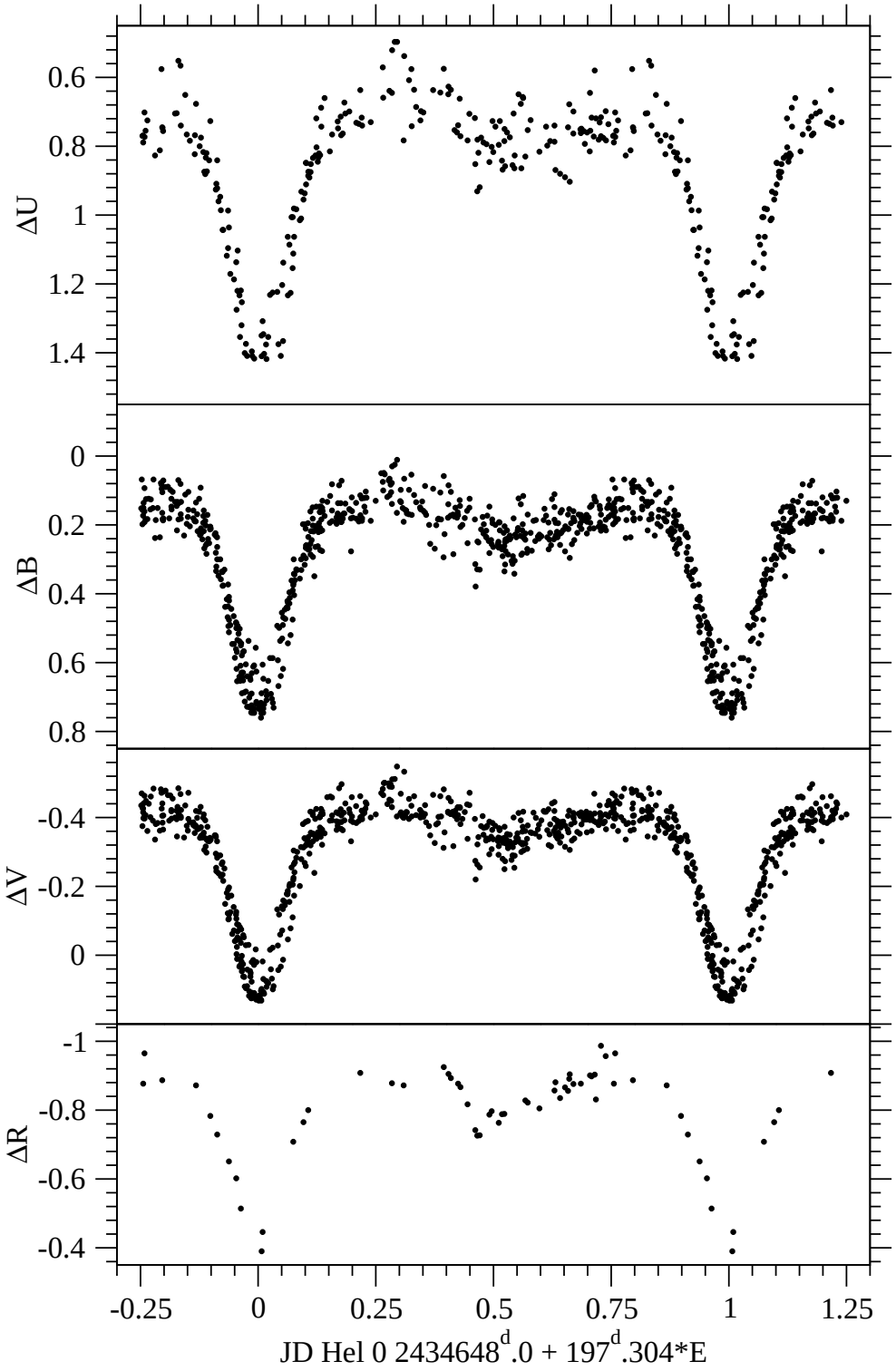

Figure 4: Light curves of eclipsing system BM Cas (all observations). The mean-square-root error of a single measurement has been determined from the measurements of comparision and the check stars are ΔV=$\pm 0\overset{m}{.}009$ and Δ(B-V)=$\pm 0\overset{m}{.}01$

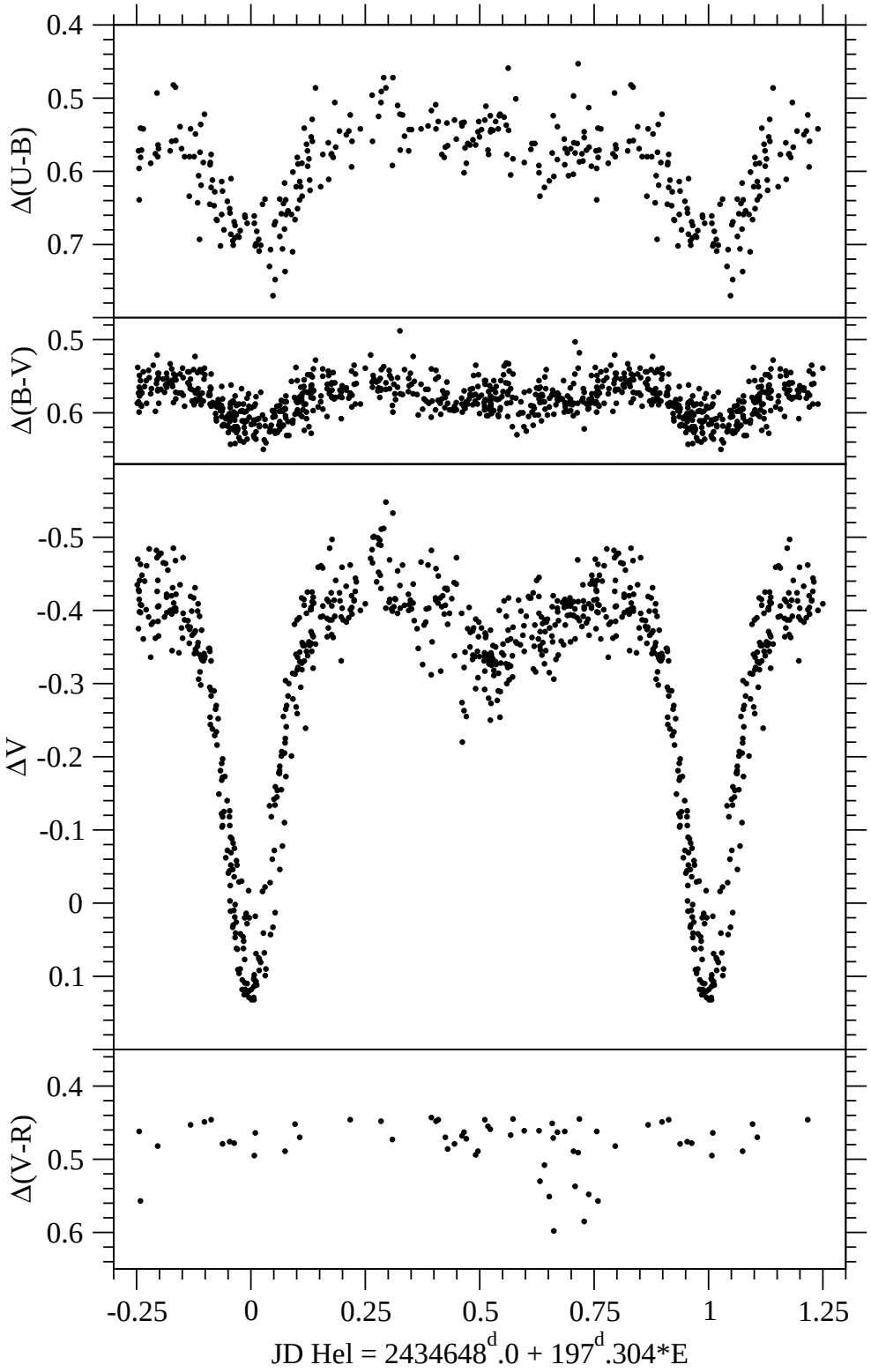

Figure 5: Light and colour curves of eclipsing system BM Cas (all observations). The mean-square-root error of a single measurement has been determined from the measurements of comparision and the check stars are $\Delta V = \pm 0\overset{m}{.}009$ and $\Delta(B\text{-}V) = \pm 0\overset{m}{.}01$

The formal approximation of our observations is found by formula:

$$y = a + b \times \left(exp\left(-\left(\frac{x}{c}\right)^2 \right) + exp\left(-\left(\frac{x-1.0}{c}\right)^2 \right) \right) + d \times exp\left(-\left(\frac{x-f}{e}\right)^2 \right) + g \times exp\left(-\left(\frac{x-h}{i}\right)^2 \right)$$

where $x = frac((JDHel. - 2434648.0)/197.304)$
and parameters a, b, ... i are given below:

Para-meter	U		B		V		R	
	Value	Error	Value	Error	Value	Error	Value	Error
a	0.714213	0.011	0.148567	0.004	-0.413485	0.003	-0.905455	0.009
b	0.684278	0.014	0.561969	0.006	0.512516	0.005	0.475634	0.016
c	0.084548	0.002	0.078260	0.001	0.075677	0.001	0.083113	0.003
d	0.119967	0.054	0.095833	0.007	0.079672	0.006	0.140955	0.015
e	0.253014	0.048	0.134740	0.012	0.109746	0.011	0.100092	0.014
f	0.401310	0.049	0.543628	0.008	0.536607	0.007	0.516697	0.008
g	-0.204787	0.059	-0.075962	0.014	-0.069600	0.012		
h	0.321665	0.014	0.276654	0.006	0.278013	0.006		
i	-0.120751	0.025	-0.030160	0.008	-0.028594	0.008		

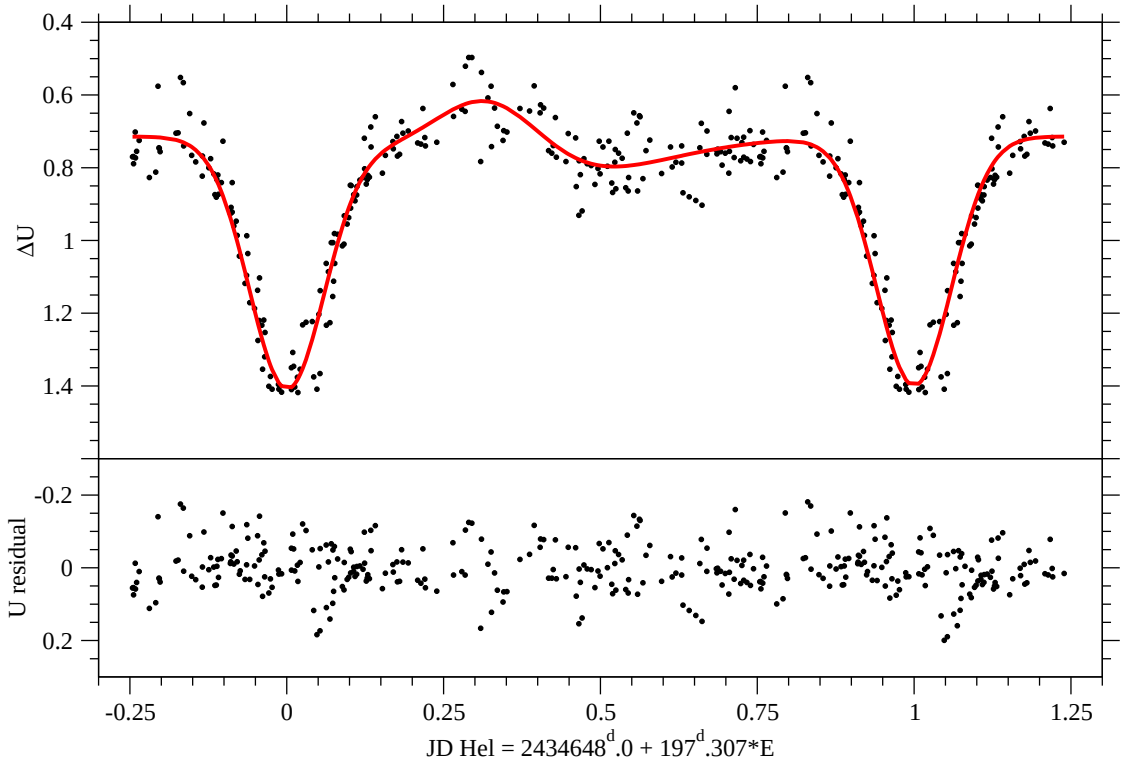

Figure 6: ΔU of the observed light curve together with the approximative curve (upper) and their residuals (lower)

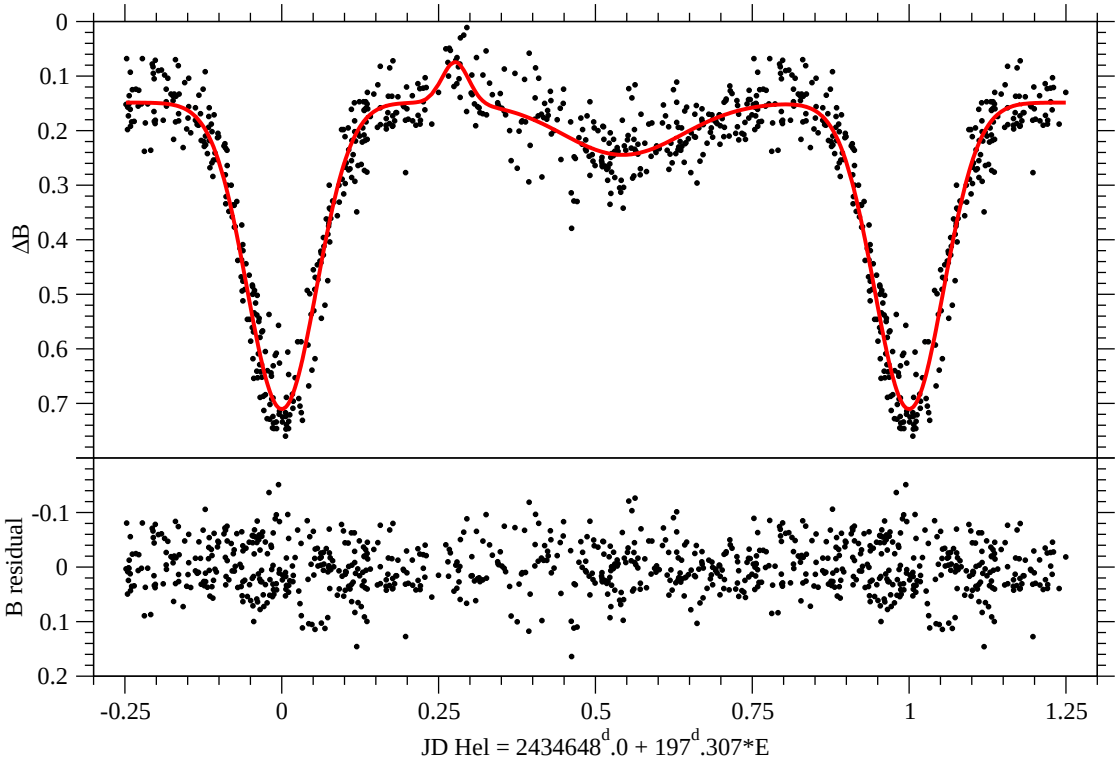

Figure 7: ΔB of the observed light curve together with the approximative curve (upper) and their residuals (lower)

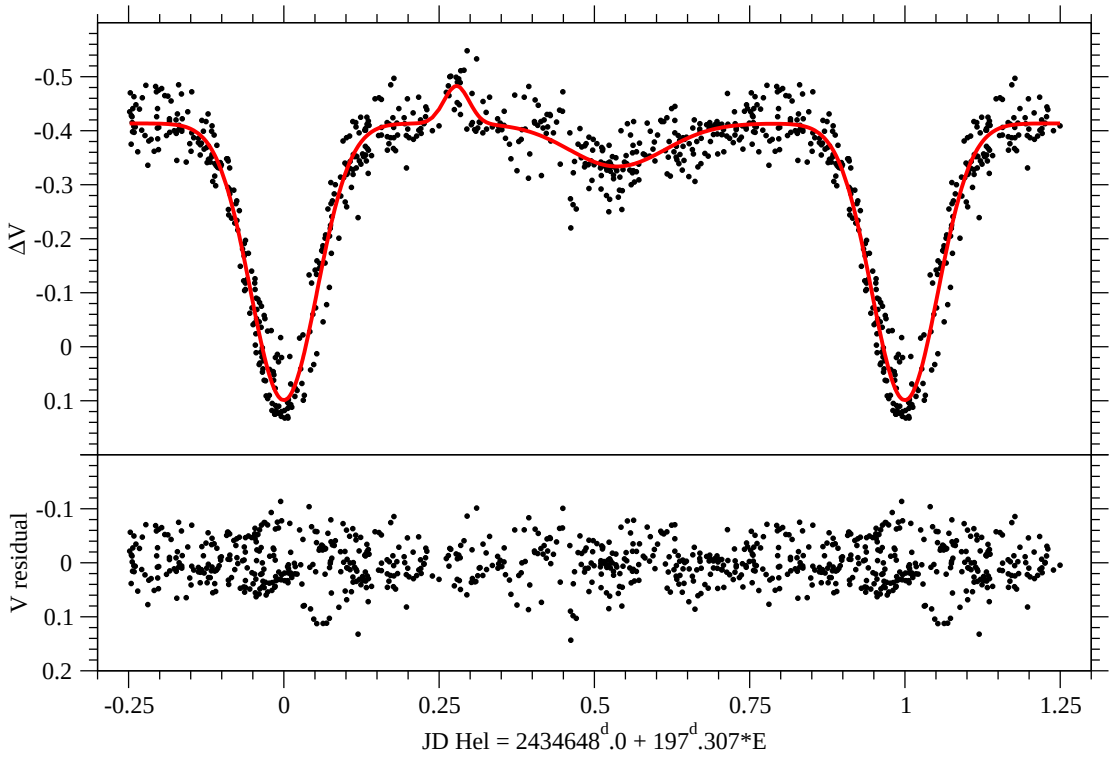

Figure 8: ΔV of the observed light curve together with the approximative curve (upper) and their residuals (lower)

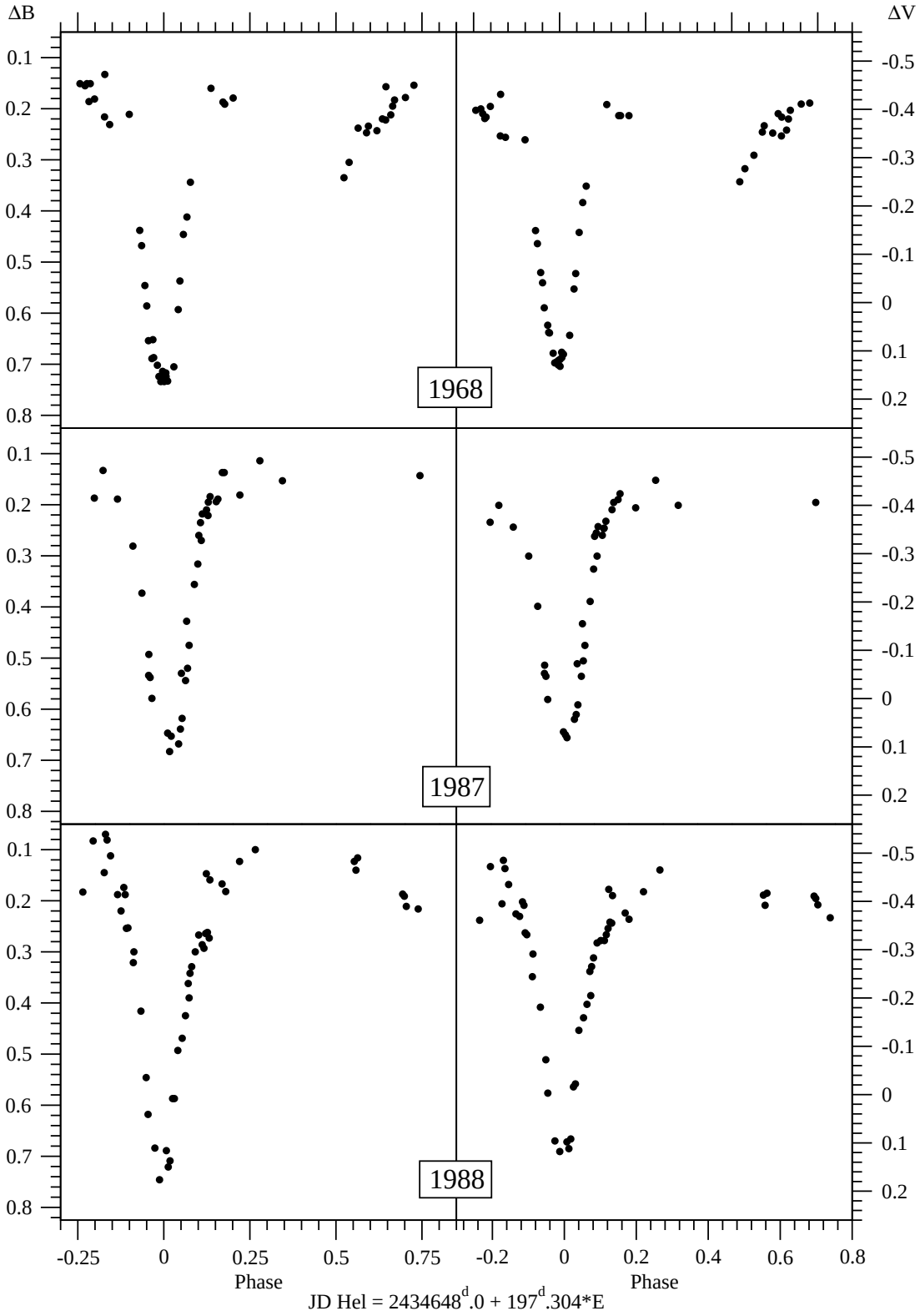

Figure 9: Seasonal light-curves (note differences in shape of minima)

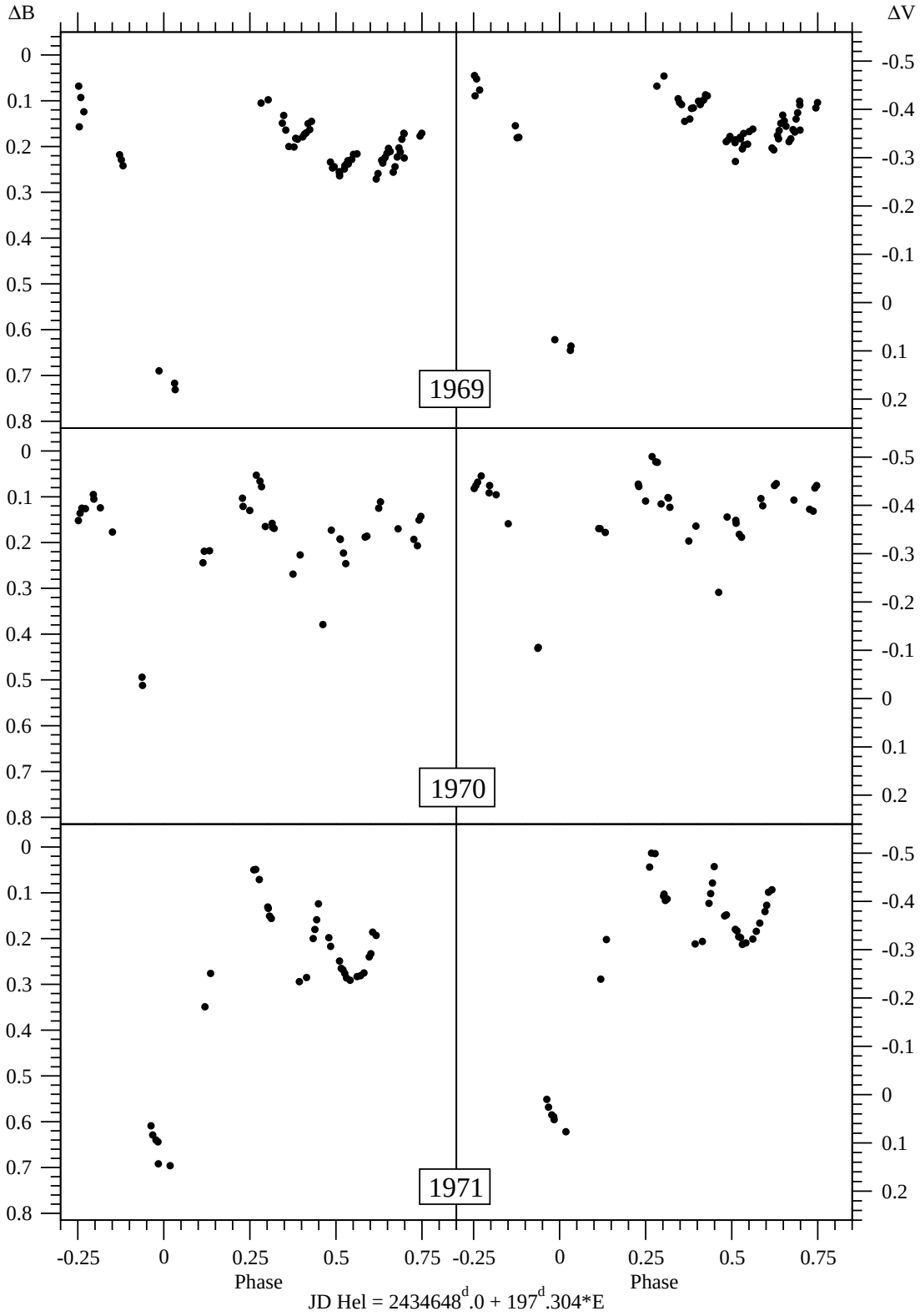

Figure 10: Seasonal light-curves (note different variations in maxima)

Table 1: The differential observations of BM Cas

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
39797.3262		0.198	−0.340	
39822.3908		0.122	−0.413	
39848.3303		0.171	−0.386	
39889.2636		0.238	−0.305	
39905.2477		0.157	−0.384	
39916.4082		0.178	−0.411	
39932.2850		0.186	−0.381	
39935.4493		0.181	−0.406	
39941.3886		0.133	−0.431	
39955.3578		0.211	−0.337	
39961.3812		0.438	−0.149	
39962.4497		0.468	−0.122	
39964.3702		0.546	−0.062	
39965.4296		0.586	−0.041	
39966.3855		0.654	0.011	
39968.3955		0.689	0.047	
39969.3831		0.687	0.063	
39971.5043		0.702	0.105	
39972.4273		0.724	0.125	
39973.4683		0.734	0.123	
39974.3824		0.720	0.129	
39974.4835		0.714	0.120	
39975.3850		0.734	0.118	
39975.4745		0.725	0.132	
39976.3881		0.717	0.103	
39976.4645		0.724	0.114	
39977.4055		0.733	0.107	
39983.4656		0.593	−0.028	
39984.4246		0.537	−0.060	
39986.4203		0.446	−0.145	
39988.4703		0.412	−0.207	
39990.4364		0.344	−0.241	
40078.4518		0.335	−0.250	
40081.4513		0.305	−0.277	
40091.3889		0.247	−0.353	
40092.4659		0.234	−0.366	
40097.3435		0.243	−0.351	
40100.4794		0.220	−0.391	
40102.3303		0.222	−0.345	
40105.3152		0.212	−0.357	
40106.3906		0.195	−0.380	
40107.4383		0.183	−0.398	
40118.5659		0.154	−0.413	
40124.4196		0.151	−0.398	
40127.3426		0.155	−0.401	
40128.3873		0.151	−0.391	
40130.3566		0.151	−0.384	
40138.4953		0.216	−0.345	
40141.4817		0.231	−0.342	
40166.2454		0.652	0.062	
40178.2555		0.705	0.068	
40199.5332		0.160	−0.410	

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
40206.3795		0.187	−0.387	
40207.4487		0.191	−0.387	
40212.2627		0.179	−0.387	
40228.2618		0.105	−0.448	
40232.3042		0.098	−0.469	
40240.4157		0.149	−0.422	
40241.2565		0.132	−0.414	
40242.4547		0.164	−0.410	
40273.2745		0.264	−0.292	
40277.2378		0.238	−0.318	
40278.2600		0.238	−0.326	
40280.2589		0.228	−0.328	
40281.2409		0.217	−0.354	
40283.2493		0.216	−0.359	
40294.2926		0.271	−0.320	
40295.2859		0.259	−0.316	
40297.3698		0.230	−0.346	
40298.3403		0.229	−0.356	
40299.3458		0.224	−0.371	
40300.4091		0.215	−0.388	
40301.2822		0.204	−0.376	
40302.2905		0.211	−0.365	
40306.2765		0.223	−0.358	
40307.3100		0.203	−0.353	
40310.3285		0.225	−0.357	
40319.3953		0.177	−0.403	
40320.3855		0.171	−0.414	
40321.3534		0.157	−0.428	
40344.4552		0.218	−0.366	
40345.4323		0.229	−0.341	
40346.4079		0.242	−0.342	
40441.4702		0.200	−0.375	
40444.4544		0.201	−0.380	
40445.4202		0.182	−0.402	
40446.4834		0.184	−0.403	
40449.4132		0.179	−0.417	
40450.4756		0.173	−0.410	
40451.4728		0.170	−0.417	
40452.4865		0.150	−0.420	
40453.4313		0.163	−0.430	
40454.4564		0.145	−0.428	
40465.3354		0.234	−0.333	
40466.4883		0.247	−0.337	
40467.4547		0.244	−0.344	
40470.3815		0.255	−0.331	
40470.5206		0.259	−0.337	
40473.3116		0.249	−0.342	
40473.5333		0.242	−0.339	
40475.3143		0.231	−0.350	
40495.3164		0.236	−0.339	
40501.3530		0.256	−0.333	
40502.3346		0.244	−0.339	

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
40505.3455		0.212	−0.380	
40506.2945		0.184	−0.393	
40507.4081		0.171	−0.417	
40507.4941		0.172	−0.409	
40518.3219		0.068	−0.470	
40519.4944		0.093	−0.463	
40521.2554		0.124	−0.440	
40564.3792		0.690	0.077	
40573.2783		0.717	0.099	
40573.6021		0.731	0.090	
40589.5781		0.244	−0.352	
40590.3089		0.219	−0.352	
40593.3233		0.218	−0.344	
40612.2167		0.103	−0.444	
40612.5367		0.121	−0.439	
40616.4147		0.130	−0.409	
40625.2706		0.165	−0.403	
40629.4701		0.167	−0.415	
40630.3398		0.169	−0.396	
40645.2580		0.227	−0.357	
40658.2837		0.379	−0.220	
40671.4136		0.246	−0.334	
40682.5446		0.188	−0.414	
40683.5308		0.186	−0.399	
40690.3244		0.125	−0.441	
40691.3385		0.111	−0.445	
40701.4345		0.170	−0.411	
40710.4367		0.193	−0.392	
40712.4637		0.207	−0.388	
40713.4534		0.151	−0.436	
40714.4433		0.143	−0.441	
40715.4368		0.152	−0.435	
40716.4216		0.136	−0.441	
40717.4316		0.125	−0.448	
40719.4575		0.126	−0.461	
40817.4593		0.053	−0.501	
40819.5288		0.066	−0.490	
40820.4384		0.078	−0.489	
40826.4920		0.158	−0.416	
40838.4680		0.269	−0.326	
40860.4470		0.173	−0.376	
40865.4108		0.192	−0.369	
40865.6114		0.193	−0.363	
40867.3825		0.223	−0.340	
40921.3046		0.095	−0.426	
40921.5784		0.105	−0.441	
40925.3580		0.124	−0.422	
40932.2476		0.177	−0.362	
40949.2486		0.494	−0.104	
40949.5050		0.512	−0.106	
40954.3679		0.609	0.010	
40955.3757		0.629	0.026	

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
40957.2086		0.640	0.042	
40958.3371		0.644	0.046	
40958.5715		0.692	0.052	
40965.3365		0.696	0.077	
40985.3070		0.349	−0.239	
40988.5279		0.276	−0.321	
41013.3280		0.050	−0.471	
41014.4204		0.049	−0.500	
41016.4558		0.071	−0.499	
41021.3032		0.131	−0.411	
41021.6039		0.134	−0.415	
41022.3263		0.151	−0.402	
41023.3359		0.156	−0.405	
41039.4423		0.294	−0.312	
41043.5455		0.285	−0.317	
41047.3642		0.200	−0.396	
41048.3402		0.180	−0.416	
41049.3291		0.159	−0.438	
41050.3527		0.124	−0.472	
41056.3390		0.198	−0.370	
41057.3446		0.217	−0.372	
41062.4426		0.249	−0.342	
41063.4183		0.265	−0.339	
41064.3524		0.268	−0.327	
41065.4601		0.276	−0.325	
41066.4678		0.286	−0.311	
41068.4931		0.291	−0.314	
41072.4645		0.283	−0.322	
41074.4671		0.281	−0.338	
41076.4355		0.275	−0.355	
41079.4349		0.240	−0.379	
41080.4432		0.233	−0.392	
41081.4464		0.186	−0.419	
41083.4258		0.193	−0.424	
41329.1848		0.158	−0.386	
41332.3489		0.210	−0.372	
41333.3082		0.194	−0.351	
41333.5294		0.218	−0.356	
41334.3902		0.202	−0.339	
41335.3491		0.241	−0.332	
41354.2679		0.612	0.014	
41378.2709		0.255	−0.328	
41379.2847		0.202	−0.353	
41382.2672		0.162	−0.401	
41383.2708		0.130	−0.410	
41385.3071		0.133	−0.459	
41386.5529		0.116	−0.461	
41387.3091		0.082	−0.458	
41390.2855		0.085	−0.485	
41391.2921		0.072	−0.497	
41395.5760		0.120	−0.459	
41397.4046		0.136	−0.433	

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
41401.3334		0.162	−0.426	
41428.4616		0.255	−0.348	
41450.4111		0.177	−0.404	
41454.4263		0.184	−0.364	
41535.4582		0.228	−0.348	
41536.4448		0.236	−0.331	
41539.4909		0.330	−0.252	
41543.3997		0.465	−0.140	
41544.5011		0.500	−0.106	
41568.4517		0.370	−0.225	
41576.4689		0.149	−0.415	
41579.3715		0.147	−0.401	
41579.5564		0.163	−0.404	
41580.4970		0.151	−0.418	
41584.6134		0.158	−0.392	
41586.4938		0.178	−0.389	
41592.5322		0.181	−0.391	
41596.5193		0.172	−0.401	
41666.4374		0.270	−0.309	
41677.5864		0.242	−0.361	
41678.3651		0.194	−0.371	
41679.3745		0.195	−0.382	
41680.3827		0.164	−0.387	
41686.2300		0.189	−0.386	
41691.3455		0.172	−0.394	
41693.3111		0.145	−0.402	
41717.5331		0.184	−0.402	
41725.3880		0.169	−0.399	
41744.2914		0.642	0.041	
41756.2953		0.691	0.041	
41762.3237		0.473	−0.154	
41763.2792		0.442	−0.181	
41766.3616		0.361	−0.270	
41767.3072		0.331	−0.300	
41777.3230		0.147	−0.425	
41789.3422		0.156	−0.413	
41794.4535		0.188	−0.404	
41795.4742		0.147	−0.414	
41806.4855		0.083	−0.496	
41904.4082		0.068	−0.484	
41907.5139		0.078	−0.482	
41908.4681		0.071	−0.475	
41909.4186		0.090	−0.478	
41910.4211		0.089	−0.465	
41911.4147		0.098	−0.464	
41912.4263		0.104	−0.455	
41923.5092		0.124	−0.417	
41925.4368		0.158	−0.409	
41930.3695		0.224	−0.348	
41930.5553		0.232	−0.344	
41940.3986		0.641	0.033	
41944.4382		0.729	0.118	

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
41945.3336		0.745	0.125	
41949.4275		0.760	0.129	
41949.5660		0.747	0.132	
41950.3825		0.746	0.110	
41958.6057		0.491	−0.134	
41960.2626		0.439	−0.178	
41960.5362		0.421	−0.177	
41961.3375		0.396	−0.201	
41987.6009		0.160	−0.403	
42002.4132		0.119	−0.439	
42018.2241		0.087	−0.436	
42023.6381		0.184	−0.384	
42045.1842		0.147	−0.388	
42056.4410		0.236	−0.342	
42057.1793		0.209	−0.339	
42058.1684		0.232	−0.327	
42059.2515		0.234	−0.326	
42060.2407		0.243	−0.324	
42068.2964		0.153	−0.417	
42108.2685		0.181	−0.391	
42109.2780		0.155	−0.397	
42111.2786		0.136	−0.420	
42112.2649		0.137	−0.410	
42113.2565		0.133	−0.422	
42116.2960		0.156	−0.396	
42118.3876		0.181	−0.378	
42119.3626		0.190	−0.377	
42130.2911		0.336	−0.265	
42130.5975		0.337	−0.270	
42133.3516		0.420	−0.197	
42134.2955		0.444	−0.173	
42136.2974		0.483	−0.118	
42137.3085		0.516	−0.088	
42138.4359		0.544	−0.075	
42139.3004		0.569	−0.058	
42139.5255		0.567	−0.052	
42140.3730		0.605	−0.029	
42141.5231		0.537	−0.030	
42144.5195		0.557	−0.017	
42154.3437		0.499	−0.118	
42160.4669		0.300	−0.304	
42164.3454		0.198	−0.381	
42165.4334		0.211	−0.387	
42166.4230		0.195	−0.390	
42167.4545		0.161	−0.417	
42168.4681		0.182	−0.407	
42169.4614		0.203	−0.396	
42171.4392		0.208	−0.371	
42172.4304		0.216	−0.364	
42178.4396		0.197	−0.364	
42180.4433		0.173	−0.406	
42181.4348		0.167	−0.414	

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
42286.4736		0.118	−0.469	
42292.5341		0.126	−0.448	
42306.4920		0.147	−0.418	
42310.4081		0.169	−0.403	
42531.3631		0.498	−0.090	
42532.4548		0.502	−0.082	
42537.4557		0.631	0.020	
42538.4637		0.608	0.028	
42539.4252		0.626	0.020	
42708.2036		0.104	−0.472	
42713.3653		0.092	−0.431	
42716.1952		0.171	−0.373	
42717.2574		0.213	−0.341	
42725.2546		0.476	−0.118	
42728.1930		0.561	−0.044	
42728.5708		0.569	−0.024	
42734.2309		0.650	0.062	
42747.3945		0.455	−0.142	
42757.4100		0.297	−0.259	
42770.2554		0.190	−0.415	
42776.4186		0.277	−0.331	
45229.3121	0.787	0.185	−0.396	−0.857
45235.4888	0.678	0.154	−0.420	−0.891
45237.2794	0.699	0.160	−0.413	−0.876
45240.4094	0.762	0.171	−0.415	−0.877
45254.2414	0.789	0.150	−0.415	−0.877
45262.2302	0.745	0.165	−0.405	−0.887
45276.3682	0.677	0.135	−0.419	−0.872
45282.3560	0.727	0.205	−0.334	−0.783
45285.2591	0.841	0.264	−0.283	−0.729
45290.1724	1.036	0.409	−0.172	−0.651
45293.2484	1.137	0.486	−0.126	−0.602
45295.2002	1.219	0.550	−0.036	−0.514
45304.2832	1.308	0.606	0.018	−0.446
45317.1593	1.112	0.375	−0.219	−0.708
45321.4129	0.955	0.289	−0.313	−0.765
45323.4319	0.886	0.272	−0.330	−0.800
45345.2317	0.637	0.114	−0.462	−0.908
45358.5147	0.645	0.139	−0.430	−0.878
45363.4118	0.783	0.191	−0.399	−0.872
45380.2265	0.575	0.058	−0.482	−0.925
45382.2309	0.627	0.085	−0.457	−0.905
45383.2023	0.636	0.104	−0.447	−0.893
45386.2141	0.739	0.172	−0.407	−0.877
45387.2136	0.771	0.206	−0.381	−0.867
45390.2112	0.783	0.253	−0.338	−0.817
45393.4519	0.852	0.314	−0.274	−0.742
45394.2888	0.931	0.329	−0.263	−0.726
45395.3002	0.919	0.330	−0.255	−0.727
45399.3262	0.846	0.282	−0.293	−0.787
45400.2887	0.802	0.256	−0.308	−0.797
45403.2870	0.796	0.266	−0.317	−0.763

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
45404.6360	0.842	0.271	−0.333	−0.788
45405.6135	0.785	0.261	−0.330	−0.789
45414.4251	0.830	0.225	−0.361	−0.828
45415.3959	0.753	0.170	−0.377	−0.822
45420.2980	0.816	0.228	−0.344	−0.805
45432.3416	0.745	0.170	−0.405	−0.856
45441.5385	0.645	0.148	−0.412	−0.901
45443.4848	0.580	0.127	−0.412	−0.903
45698.4961	1.410	0.739	0.105	−0.390
46830.3512	0.736	0.143	−0.406	
46854.2688	0.823	0.189	−0.355	
46868.2607	0.987	0.373	−0.191	
46872.2699	1.103	0.493	−0.069	
46889.3254	1.375	0.668	0.043	
46890.3367	1.409	0.639	0.033	
46891.2957	1.366	0.618	0.013	
46893.3193	1.233	0.544	−0.046	
46894.4364	1.226	0.520	−0.078	
46895.3150	1.154	0.475	−0.110	
46898.3210	1.015	0.356	−0.201	
46900.3422	0.937	0.316	−0.268	
46902.3201	0.891	0.270	−0.295	
46905.3258	0.803	0.210	−0.338	
46906.3410	0.821	0.195	−0.353	
46907.3479	0.743	0.184	−0.367	
46914.3576	0.748	0.137	−0.412	
46915.4714	0.714	0.137	−0.424	
46924.4544	0.740	0.181	−0.395	
47038.3211	0.756	0.187	−0.365	
47043.3037	0.705	0.133	−0.400	
47060.4115	0.926	0.281	−0.295	
47069.4627	1.220	0.534	−0.052	
47070.3199	1.233	0.538	−0.046	
47071.3054	1.253	0.579	0.002	
47080.3220	1.346	0.647	0.069	
47081.4946	1.376	0.683	0.075	
47082.3532	1.354	0.653	0.081	
47088.2332	1.203	0.530	−0.072	
47091.2539	1.086	0.428	−0.155	
47098.2278	0.911	0.260	−0.336	
47099.1971	0.874	0.235	−0.343	
47100.2175	0.852	0.218	−0.356	
47103.4532	0.833	0.221	−0.352	
47108.2124	0.815	0.194	−0.391	
47109.1772	0.766	0.189	−0.406	
47133.1997	0.639	0.114	−0.452	
47146.1626	0.725	0.153	−0.400	
47187.3012	0.649	0.123	−0.413	
47188.2694	0.677	0.140	−0.392	
47189.2562	0.660	0.116	−0.417	
47241.2926	0.704	0.145	−0.395	
47252.4867	0.817	0.174	−0.399	

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
47253.3031	0.881	0.188	−0.392	
47258.2858	0.922	0.300	−0.291	
47262.3207	1.118	0.416	−0.181	
47265.3059	1.187	0.546	−0.072	
47266.4052	1.275	0.618	−0.003	
47270.3247	1.374	0.684	0.096	
47280.4512	1.232	0.587	−0.016	
47281.5186	1.225	0.587	−0.022	
47283.4573	1.223	0.493	−0.133	
47289.4425	1.006	0.362	−0.255	
47290.4334	0.981	0.342	−0.265	
47291.4476	0.983	0.329	−0.283	
47293.4417	1.010	0.300	−0.314	
47295.4444	0.848	0.267	−0.319	
47297.4427	0.875	0.286	−0.319	
47298.4469	0.834	0.293	−0.331	
47299.4387	0.827	0.264	−0.344	
47300.4471	0.845	0.262	−0.357	
47301.4462	0.826	0.273	−0.355	
47412.3904	0.793	0.187	−0.411	
47413.3508	0.760	0.191	−0.406	
47414.4785	0.815	0.211	−0.393	
47421.2758	0.783	0.216	−0.366	
47426.3429	0.725	0.183	−0.361	
47432.2523	0.576	0.083	−0.472	
47439.3222	0.552	0.070	−0.485	
47440.2316	0.566	0.081	−0.468	
47442.2216	0.651	0.112	−0.435	
47446.2429	0.768	0.188	−0.374	
47448.2378	0.800	0.220	−0.369	
47451.2727	0.873	0.254	−0.335	
47452.2102	0.841	0.253	−0.331	
47455.2427	0.909	0.321	−0.244	
47470.2685	1.409	0.746	0.118	
47474.1967	1.350	0.689	0.098	
47475.2591	1.403	0.721	0.112	
47476.2805	1.418	0.709	0.092	
47483.2721	1.138	0.469	−0.159	
47485.1796	1.063	0.425	−0.187	
47487.2604	1.006	0.390	−0.205	
47497.1479	0.719	0.147	−0.425	
47499.1725	0.688	0.159	−0.412	
47506.1295	0.728	0.167	−0.376	
47508.2437	0.763	0.182	−0.363	
47516.1802	0.717	0.123	−0.420	
47525.2000	0.659	0.100	−0.465	
47537.1497	0.742	0.171	−0.403	
47552.4451	0.649	0.140	−0.414	
47557.2546	0.662	0.128	−0.430	
47561.2959	0.706	0.150	−0.436	
47563.6188	0.718	0.184	−0.396	
47566.2213	0.775	0.213	−0.375	

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
47567.2208	0.789	0.225	−0.350	
47568.4885	0.794	0.237	−0.339	
47571.3144	0.817	0.264	−0.337	
47575.2512	0.868	0.291	−0.280	
47576.2629	0.858	0.315	−0.273	
47579.3775	0.855	0.313	−0.290	
47580.2921	0.827	0.304	−0.289	
47593.4582	0.743	0.173	−0.417	
47613.4570	0.772	0.210	−0.390	
47615.5363	0.781	0.205	−0.378	
47616.4717	0.771	0.217	−0.405	
47617.4647	0.776	0.205	−0.383	
47621.5452	0.770	0.198	−0.375	
47622.4834	0.773	0.192	−0.397	
47641.4275	0.784	0.204	−0.387	
47647.4762	0.874	0.268	−0.306	
47648.4095	0.820	0.284	−0.298	
47652.4360	0.925	0.334	−0.254	
47653.4296	0.960	0.348	−0.238	
47654.4533	0.986	0.358	−0.229	
47655.4325	1.043	0.376	−0.216	
47657.4429	1.096	0.437	−0.168	
47658.4277	1.171	0.491	−0.125	
47662.4396	1.354	0.653	0.030	
47664.4406	1.401	0.713	0.091	
47665.4482	1.409	0.728	0.090	
47667.4392	1.396	0.736	0.109	
47668.4285	1.417	0.746	0.110	
47735.4231	0.636	0.113	−0.462	
47743.3954	0.637	0.095	−0.466	
47746.4210	0.644	0.106	−0.462	
47752.4001	0.753	0.176	−0.405	
47753.4346	0.760	0.179	−0.395	
47762.4035	0.819	0.251	−0.343	
47768.3305	0.727	0.195	−0.384	
47769.5031	0.743	0.200	−0.376	
47771.3891	0.727	0.216	−0.366	
47773.3748	0.750	0.204	−0.373	
47774.4251	0.760	0.216	−0.352	
47775.5541	0.774	0.242	−0.330	
47777.4555	0.864	0.342	−0.254	
47780.4112	0.864	0.287	−0.300	
47791.2689	0.798	0.236	−0.363	
47792.4734	0.785	0.223	−0.380	
47805.5801	0.749	0.180	−0.408	
47806.5214	0.756	0.181	−0.406	
47809.3031	0.755	0.194	−0.393	
47827.2955	0.747	0.183	−0.385	
47851.4712	0.947	0.300	−0.290	
47895.2291	0.660	0.174	−0.354	
47902.1701	0.768	0.192	−0.367	
47959.3066	0.781	0.248	−0.322	

Table 1: The differential observations of BM Cas - *continued*

JD Hel. 2400000+	ΔU	ΔB	ΔV	ΔR
47974.4696	0.705	0.181	−0.400	
47978.2991	0.657	0.198	−0.373	
47981.5647	0.724	0.223	−0.357	
47991.5613	0.740	0.148	−0.419	
47999.4897	0.763	0.179	−0.403	
48002.4800	0.751	0.195	−0.404	
48010.5177	0.731	0.145	−0.435	
48016.4375	0.769	0.173	−0.426	
48017.4579	0.755	0.184	−0.407	
48021.4639	0.827	0.238	−0.336	
48023.4579	0.812	0.236	−0.362	
48229.5515	0.740	0.182	−0.399	
48890.4362	0.705	0.138	−0.441	
49021.2795	0.766	0.197	−0.376	
49027.2453	0.775	0.226	−0.347	
49029.2242	0.833	0.259	−0.316	
49036.2665	1.043	0.377	−0.234	
49044.2341	1.320	0.629	0.019	
49066.2850	1.063	0.404	−0.173	
49069.2821	0.932	0.331	−0.279	
49071.4417	0.849	0.259	−0.322	
49087.3183	0.673	0.167	−0.392	
49089.3840	0.699	0.154	−0.424	
49092.3539	0.732	0.182	−0.384	
49093.3697	0.735	0.190	−0.390	
49098.3877	0.730	0.188	−0.400	
49103.4536	0.571	0.075	−0.483	
49107.3934	0.521	0.030	−0.511	
49108.4360	0.497	0.025	−0.512	
49109.4098	0.497	0.011	−0.548	
49112.4224	0.538	0.066	−0.533	
49114.4403	0.608	0.098	−0.454	
49115.4450	0.576	0.054	−0.434	
49117.4350	0.686	0.134	−0.407	
49119.4389	0.698	0.155	−0.408	
49120.4377	0.702	0.159	−0.402	
50162.3241	0.869	0.235	−0.351	−0.881
50164.2753	0.880	0.258	−0.327	−0.835
50166.3489	0.890	0.277	−0.315	−0.866
50168.3280	0.903	0.296	−0.306	−0.904
50177.4869	0.717	0.142	−0.361	−0.898
50179.3243	0.719	0.132	−0.386	−0.831
50181.3998	0.716	0.170	−0.402	−0.987
50183.3741	0.698	0.185	−0.409	−0.957
50187.3663	0.702	0.161	−0.408	−0.965

Table 2: The list of minima of BM Cas

No	Min. JD	Min	Obs	Author	Published	Year	Vol	p.
1	2419255.4	pri	p	Kukarkin,B.	Perem.Zv.	1930	2	49
2	2425775.4	pri	p	Beyer,M.	A.N.	1935	255	49
3	2426957.4	pri	p	Beyer,M.	A.N.	1935	255	49
4	2427152.7	pri	pg n	Woodward,E.J.	Harvard Bull.	1943	917	7
5	2427154.7	pri	p	Beyer,M.	A.N.	1935	255	49
6	2427352.2	pri	p	Beyer,M.	A.N.	1935	255	49
7	2427550.8	pri	p	Beyer,M.	A.N.	1935	255	49
8	2427746.4	pri	p	Beyer,M.	A.N.	1935	255	49
9	2427941.5	pri	p	Beyer,M.	A.N.	1943	273	154
10	2428139.8	pri	p	Beyer,M.	A.N.	1943	273	154
11	2428337.5	pri	p	Beyer,M.	A.N.	1943	273	154
12	2428532.4	pri	p	Beyer,M.	A.N.	1943	273	154
13	2428731.2	pri	p	Beyer,M.	A.N.	1943	273	154
14	2428927.8	pri	p	Beyer,M.	A.N.	1943	273	154
15	2429321.9	pri	p	Beyer,M.	A.N.	1943	273	154
16	2429720.933	pri	pg n	Gaposchkin,S.	Harvard Ann.	1953	113	69
17	2432081.0	pri	p	Beyer,M.	A.N.	1952	280	267
18	2432282.6	pri	p	Beyer,M.	A.N.	1952	280	267
19	2432480.8	pri	p	Beyer,M.	A.N.	1952	280	267
20	2432677.8	pri	p	Beyer,M.	A.N.	1952	280	267
21	2432875.3	pri	p	Beyer,M.	A.N.	1952	280	267
22	2433074.7	pri	p	Beyer,M.	A.N.	1952	280	267
23	2433270.6	pri	p	Beyer,M.	A.N.	1952	280	267
24	2433466.5	pri	p	Beyer,M.	A.N.	1952	280	267
25	2433665.3	pri	p	Beyer,M.	A.N.	1952	280	267
26	2433859.9	pri	p	Beyer,M.	A.N.	1952	280	267
27	2434057.5	pri	v	Beyer,M.	A.N.	1964	288	87
28	2434457.5	pri	v	Beyer,M.	A.N.	1964	288	87
29	2434648.0	pri	e	Beyer,M.	A.N.	1964	288	87
30	2434846.5	pri	v	Beyer,M.	A.N.	1964	288	87
31	2434848.5	pri	v	Beyer,M.	A.N.	1964	288	87
32	2435047.3	pri	v	Beyer,M.	A.N.	1964	288	87
33	2437017.4	pri	p	Berthold,T.	Hartha Beob.Zirk.	1977	69	
34	2439384.27	pri	p	Berthold,T.	Hartha Beob.Zirk.	1977	69	
35	2439974.3	pri	B		this paper			
36	2439974.3	pri	V		this paper			
37	2440173.2	pri	V		this paper			
38	2440173.8	pri	B		this paper			
39	2440963.4	pri	V		this paper			
40	2440963.8	pri	B		this paper			
41	2441158.59	pri	v	Diethelm,R. et al.	Orion	1971	126	
42	2441356.3	pri	V		this paper			
43	2441356.4	pri	B		this paper			
44	2441366.78	pri	v	BBSAG observers	BBSAG Bull.	1972	2	
45	2441546.8	pri	v	BBSAG observers	BBSAG Bull.	1973	7	
46	2441553.5	pri	e	Nha,I.S.,Zola,S.	J.Astron.Space Sci.	1996	13	99
47	2441554.5	pri	V		this paper			
48	2441554.5	pri	B		this paper			
49	2441750.4	pri	V		this paper			
50	2441751.1	pri	B		this paper			

Table 2: The list of minima of BM Cas - *continued*

No	Min. JD	Min	Obs	Author	Published	Year	Vol	p.
51	2441947.8	pri	V		this paper			
52	2441948.1	pri	B		this paper			
53	2442144.5	pri	B		this paper			
54	2442144.6	pri	V		this paper			
55	2442625.2	sec	v	BBSAG observers	BBSAG Bull.	1975	23	
56	2442736.7	pri	B		this paper			
57	2442736.7	pri	V		this paper			
58	2443130.1	pri	v	BBSAG observers	BBSAG Bull.	1977	31	
59	2445208.9	sec	v	Isles,J.E.	BAA VSS Circ.	1985	60	15
60	2445299.08	pri	eB	Braune,W. et al.	B.A.V.Mitt.	1983	36	
61	2445299.13	pri	eV	Braune,W. et al.	B.A.V.Mitt.	1983	36	
62	2445302.6	pri	R		this paper			
63	2445302.7	pri	V		this paper			
64	2445303.4	pri	B		this paper			
65	2445304.8	pri	U		this paper			
66	2445308.3	pri	v	Isles,J.E.	BAA VSS Circ.	1985	60	15
67	2445393.55	sec	eB	Braune,W. et al.	B.A.V.Mitt.	1983	36	
68	2445393.75	sec	eV	Braune,W. et al.	B.A.V.Mitt.	1983	36	
69	2445498.70	pri	e	Huebscher,J. Mundry,E.	B.A.V.Mitt.	1984	38	
70	2446883.0	pri	V		this paper			
71	2446883.4	pri	B		this paper			
72	2446884.1	pri	U		this paper			
73	2447078.5	pri	V		this paper			
74	2447078.7	pri	B		this paper			
75	2447078.7	pri	U		this paper			
76	2447078.96	pri	e	Nha,I.S.,Zola,S.	J.Astron.Space Sci.	1996	13	99
77	2447274.0	pri	V		this paper			
78	2447274.3	pri	B		this paper			
79	2447274.6	pri	U		this paper			
80	2447471.5	pri	V		this paper			
81	2447471.8	pri	B		this paper			
82	2447472.1	pri	U		this paper			
83	2447472.812	pri	e	Nha,I.S.,Zola,S.	J.Astron.Space Sci.	1996	13	99
84	2448657.68	pri	eB	Diethelm, R.	BBSAG Bull.	1992	100	
85	2448657.68	pri	eB	Diethelm,R.	BBSAG Bull.	1992	100	
86	2449050.72	pri	eB	Diethelm,R.	BBSAG Bull.	1993	104	
87	2449051.3	pri	B		this paper			
88	2449051.7	pri	V		this paper			
89	2449052.5	pri	U		this paper			
90	2450037.5	pri	v	Huebscher,J. et al.	B.A.V.Mitt.	1997	101	
91	2450828.80	pri	v :	Huebscher,J. et al.	B.A.V.Mitt.	1998	113	
92	2451620.5	pri	v n	Brno observers	Brno Contr.	2002	32	4
93	2451811.1	pri	v	Huebscher,J.	B.A.V.Mitt.	2001	143	

Tagakaane foto: „Vaatleja“