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New Photometric Data on LY Aurigae

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The paper presents 463 UBV and 240 BV new photoelectric measurements of the bright early-type eclipsing variable LY Aurigae. The shape of the deepest parts of minima is discussed.

Jsou předložena nová fotoelektrická měření hvězdy LY Aurigae, jasné zákrytové proměnné raného typu (463 měření v systému UBV a 240 v systému BV). Je diskutován tvar nejhlubších partií minim.

1. Introduction

The eclipsing variable LY Aurigae (HD 35921; BD + 35°1137; ADS 4072 A) has been the subject of many photometric, spectroscopic and theoretical studies since the discovery of its eclipsing nature (Mayer, 1968). It is a bright early-type (in maximum $V = 6{\cdot}65$; sp. type 09·5 III) double-line binary with deep minima. Full references may be found e.g. in a recent paper about the solution of its light curves (Li and Leung, 1985). According to Popper (1982), this star is the one with the highest mass fairly reliably determined. The orbital period of this binary is very close to 4 days ($4{\cdot}0025^d$), therefore it is difficult to obtain a complete light curve from a place in a reasonable time; so the photometry by different authors has to be combined into the resulting light curve.

By now, for calculation of system elements, only the V curve compiled by Eaton (1978) has been used, together with six ultraviolet curves measured by the Orbiting Astronomical Observatory 2 (Heap, 1973). During several occasions, however, some additional photometry of the star was obtained; to present it is the aim of this paper. The source of the new data are summarized in Table 1.

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2. Comparison stars

LY Aur lies close to another early-type eclipsing binary, IU Aur, for which HD 35619 is a very convenient comparison star. HD 35619 is not only also of early type, with UBV colours nearly identical with IU Aur (as well as to LY Aur) and only 4′ distant from IU Aur; it is also included in one of the lists of standard stars of the UBV system (Johnson, 1955). Since on some occasions it proved to be convenient to measure both eclipsing binaries at the same time, HD 35619 served naturally as a comparison star for LY Aur too. The nonvariability of HD 35619 was tested relative to HD 35633, which was for some time used as a check star for IU Aur (Mayer, 1965). However, HD 35619 is nearly 2^m fainter than LY Aur in maximum, so a brighter comparison star would be more convenient, namely when one has in mind the possibility of using small telescopes for observing LY Aur. There are at least two brighter early-type stars nearby, HD 35653 and HD 36212 (Hiltner, 1956). Both stars were measured by us often and when the scatter of measurements was compared, the latter appeared to be the one for which the scatter was smaller and therefore it was used as the comparison star on some occasions. The magnitude differences HD 35619 minus HD 36212 were measured by both authors and are 0·779, 0·797 and 0·595 in *V*, *B* and *U* respectively.

The pertinent data about the stars mentioned can be found in Table 2. The source is Hiltner (1956), except the UBV data for HD 35619, which are given according to Landolt and Blondeau (1972).

3. The measurements

3.1. Measurements made at the Dyer Observatory

The measurements by dr. A. M. Heiser were obtained at the Dyer Observatory (Vanderbilt University, U.S.A.) after the paper by Hall and Heiser (1972) had been submitted for publication. The measurements were made available to P.M., and they are included in this paper with kind permission by dr. Heiser. Details of the observational procedure can be found in the paper mentioned.

3.2. Measurements made in Brno

The measurements were made at the Purkyně University Observatory in Brno, with a two-channel photometer attached to the 60 cm reflector. Blue and yellow colours were measured simultaneously with unrefrigerated EMI 6256S photomultipliers; the filter combination for the blue colour consisted of Schott filters BG 12 and GG 11, for the yellow colour of GG 13 (all filters were 2 mm thick). The resulting photometric system was close to the standard (U)BV system; the transor-

mation formulae were derived from the observations of 20 standard stars, and they can be written as

$$\Delta B = \Delta b + 0{\cdot}045\Delta(b - v)$$

and

$$\Delta V = \Delta v + 0{\cdot}112\Delta(b - v)\,.$$

The values Δb and Δv are the instrumental differences between the magnitudes of the variable and comparison stars, ΔB and ΔV are the same values but in the UBV system.

The measurements were recorded on two recording potentiometers simultaneously, the duration of one deflection was about 20 s. The correction for atmospheric extinction was applied by the usual way, the average extinction coefficients corresponding to atmospheric conditions being used. All measurements were made under good sky conditions.

3.3. Measurements made at Hvar

The measurements were made at the Yugoslav-Czechoslovak Observatory at Hvar with a 65 cm telescope. Details of the equipment were given by Harmanec at el. (1973). In the season 1978, the recording potentiometer was changed for a voltage-to-frequency converter with a counter. Average extinction coefficients were applied. In the season 1973, the star IU Aur was included into the observing cycle; the results of the IU Aur measurements were published earlier (Mayer, 1976).

3.4. Measurements made at Ondřejov

These measurements were made with the 65 cm reflector of the Charles University. The uncooled EMI 6256B photomultiplier with standard filters and a recording potentiometer was used.

3.5. The ephemeris used

The phases as given in Tabs. 3–8 have been calculated according to the ephemeris found by Mayer (1980):

Pri.Min. = J.D.hel. 2439061.4640 + $4.0024943^{d}.E$.

4. The shapes of the deepest parts of minima

When the whole light curve of LY Aur is displayed, the exact shape of minima bottoms is not clearly visible. Therefore, we present here the central parts of both

minima compiled from all published data. In Fig. 1 the normal points formed from 8 to 11 measurements are plotted. In all colours, the shapes of minima are practically identical. The secondary minimum clearly suggests a total occultation, however, to explain the shape of the primary minimum, a very large limb darkening of the primary component is necessary (as was pointed out already by Eaton, 1978). The secondary minimum displays a remarkable asymmetry; it can not be due to an orbital eccentricity, since the asymmetry is present only in the phase from 0·46 to 0·54, other phases being symmetrical. Perhaps some circumstellar matter affects both minima.

5. Conclusions

By now, altogether 783 UBV measurements of LY Aur have been published in papers by Mayer and Horák (1971), Landolt and Blondeau (1972) and Hall and Heiser (1972). Heap (1973) published measurements made by OAO 2 in six ultraviolet bands, each curve consisting of 29 to 71 points. This paper presents 463 UBV and 240 BV measurements, hence significantly extends the observational base for studies of this important eclipsing variable.

One of the authors (P.M.) acknowledges sending to him the data by dr. A. M. Heiser.

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Table 1. Observations presented

Observatory	Year	Observer	Photometric system	Number of data	Comparison star	Table No.
Dyer	1971	Heiser	UBV	40	HD 35619	3
Brno	1971	Papoušek	BV	204	HD 36212	4
Hvar	1973	Mayer	UBV	300	HD 35619	5
Hvar	1978	Mayer	UBV	109	HD 35619	6
Hvar	1978	Mayer	BV	36	HD 36212	7
Ondřejov	1983	Mayer	UBV	14	HD 36212	8

Table 2. Stars measured

Name	Spectral type	V	$B-V$	$U-B$	Distance from LY Aur (arcmin)
LY Aur	09.5 III	var	+0.20	−0.78	—
HD 35619	07	8.572	+0.241	−0.701	44
HD 35633	B0.5 IV	8.04	+0.32	−0.66	56
HD 35653	B0.5 V	7.44	+0.12	−0.75	89
HD 36212	B3 II	7.77	+0.24	−0.52	40

Table 3

JDH	V	B	U	Phase
2441296				
.7040	1.453	1.502	1.559	.4618
.7065	1.450	1.502	1.556	.4624
.7124	1.440	1.475	1.543	.4639
.7210	1.427	1.480	1.533	.4660
.7233	1.425	1.475	1.528	.4666
.7292	1.421	1.467	1.520	.4681
.7383	1.407	1.457	1.510	.4703
.7409	1.405	1.454	1.508	.4710
.7677	1.369	1.420	1.476	.4777
.7710	1.364	1.417	1.474	.4785
.7813	1.352	1.406	1.458	.4811
.7873	1.346	1.400	1.452	.4826

Table 3 continued

JDH	*V*	*B*	*U*	Phase
.7899	1.346	1.397	1.448	.4832
.7921	1.345	1.392	1.450	.4850
.7996	1.338	1.386	1.445	.4857
.8047	1.338	1.387	1.444	.4869
.8172	1.330	1.383	1.437	.4901
.8204	1.331	1.384	1.439	.4909
.8275	1.332	1.384	1.441	.4926
.8306	1.331	1.385	1.439	.4934
.8429	1.328	1.383	1.435	.4965
.8744	1.323	1.383	1.440	.5043
.8775	1.324	1.370	1.440	.5051
.8850	1.328	1.390	1.442	.5070
.8884	1.331	1.391	1.437	.5078
.8989	1.327	1.382	1.444	.5105
.9059	1.334	1.394	1.452	.5122
.9089	1.333	1.399	1.455	.5130
.9160	1.327	1.381	1.426	.5147
.9191	1.331	1.389	1.450	.5155
.9294	1.343	1.405	1.452	.5181
2441297				
.7692	1.883	1.926	1.991	.7271
.7756	1.884	1.932	1.996	.7295
2441306				
.6551	1.475	1.516	1.568	.9480
.6580	1.477	1.506	1.575	.9487
.6677	1.476	1.517	1.575	.9511
.6701	1.478	1.523	1.571	.9517
.6725	1.466	1.505	1.561	.9523
.6791	1.467	1.505	1.530:	.9540
.6815	1.463:	1.503:	1.523:	.9546

Table 4

JDH	*V*	*B*	Phase
2441244			
.4487	0.927	0.988	.4061
.4496	0.939	1.001	.4063

Table 4 continued

JDH	*V*	*B*	Phase
.4540	0.946	0.982	.4074
.4551	0.947	0.983	.4077
.4576	0.946	0.984	.4083
.4595	0.948	0.996	.4088
.4606	0.930	0.982	.4091
.4618	0.940	0.990	.4094
.4631	0.929	0.994	.4097
.4739	0.937	0.993	.4124
.4751	0.916	0.972	.4127
.4762	0.907	0.964	.4130
.4774	0.911	0.958	.4133
.4813	0.912	0.950	.4142
.4832	0.918	0.945	.4147
.4843	0.914	0.957	.4150
.4853	0.923	0.931	.4152
.4866	0.905	0.949	.4156
.4878	0.905	0.952	.4159
.4908	0.905	0.945	.4166
.4915	0.894	0.941	.4167
.4924	0.907	0.947	.4170
.4932	0.923	0.947	.4172
.4940	0.905	0.950	.4174
.4953	0.901	0.948	.4177
2441248			
.4329	0.977	1.005	.4015
.4339	0.983	1.017	.4017
.4347	0.986	0.981	.4020
.4377	0.955	1.008	.4027
.4388	0.953	0.981	.4030
.4397	0.963	1.006	.4032
.4408	0.961	1.001	.4035
.4968	0.933	0.964	.4175
.4985	0.928	0.976	.4179
.5006	0.931	0.977	.4184
.5017	0.918	0.962	.4187
.5029	0.923	0.948	.4190
.5049	0.903	0.950	.4195
.5057	0.902	0.923	.4197
.5069	0.905	0.925	.4200
.5078	0.904	0.933	.4203
.5089	0.887	0.932	.4205
.5119	0.907	0.924	.4213
.5487	0.854	0.918	.4305

Table 4 continued

JDH	*V*	*B*	Phase
.5498	0.850	0.902	.4308
.5507	0.852	0.891	.4310
.5539	0.859	0.897	.4317
.5546	0.863	0.902	.4319
.5552	0.846	0.883	.4321
.5562	0.845	0.898	.4323
2441249			
.4324	1.049	1.103	.6512
.4333	1.069	1.091	.6514
.4344	1.071	1.101	.6517
.4375	1.077	1.135	.6525
.4384	1.072	1.118	.6527
.4392	1.074	1.115	.6529
.4403	1.069	1.139	.6532
.4410	1.073	1.121	.6534
2441251			
.4213	1.012	1.056	.1481
.4255	1.020	1.060	.1492
.4272	1.034	1.061	.1496
.4302	1.035	1.068	.1504
.4311	1.040	1.080	.1506
.4322	1.015	1.060	.1509
.4411	1.032	1.083	.1531
.4423	1.066	1.109	.1534
.4435	1.040	1.095	.1537
.4760	1.057	1.110	.1618
.4770	1.063	1.101	.1621
.4781	1.062	1.086	.1624
.4793	1.066	1.083	.1627
.4802	1.069	1.093	.1629
.4814	1.041	1.091	.1632
.4823	1.058	1.104	.1635
.4835	1.063	1.102	.1637
.4965	1.085	1.088	.1669
.4977	1.066	1.089	.1672
.4985	1.080	1.099	.1674
.4995	1.062	1.082	.1677
.5008	1.079	1.077	.1680
.5019	1.069	1.078	.1683
.5028	1.075	1.080	.1685
.5043	1.060	1.095	.1689
.5053	1.055	1.086	.1691

Table 4 continued

JDH	*V*	*B*	Phase
.5061	1.068	1.114	.1693
.5071	1.065	1.103	.1696
.5080	1.075	1.112	.1698
.5088	1.071	1.099	.1700
.5099	1.066	1.102	.1703
.5370	1.075	1.123	.1771
.5378	1.088	1.117	.1773
.5388	1.080	1.114	.1775
.5399	1.072	1.111	.1778
.5545	1.090	1.123	.1814
.5554	1.071	1.107	.1816
.5564	1.069	1.097	.1819
.5573	1.077	1.106	.1821
.5582	1.098	1.132	.1824
.5601	1.083	1.093	.1826
.5609	1.098	1.111	.1830
.5620	1.096	1.132	.1833
.5630	1.101	1.119	.1836
.5639	1.086	1.134	.1838
.5852	1.061	1.117	.1891
.5860	1.080	1.121	.1893
.5870	1.079	1.128	.1896
.5880	1.064	1.104	.1898
.5890	1.092	1.122	.1901
.5901	1.092	1.129	.1903
.5911	1.089	1.127	.1906
.5922	1.082	1.117	.1909
.5974	1.086	1.132	.1922
.5984	1.100	1.123	.1924
.5996	1.092	1.122	.1927
.6004	1.088	1.128	.1929
.6133	1.076	1.103	.1961
.6143	1.103	1.115	.1964
.6154	1.098	1.126	.1967
.6161	1.111	1.121	.1969
.6170	1.082	1.117	.1971
.6179	1.096	1.124	.1973
2441260			
.4254	0.965	0.994	.3978
.4262	0.944	0.981	.3980
.4272	0.955	0.983	.3982
.4299	0.939	0.962	.3989
.4306	0.944	0.977	.3991

Table 4 continued

JDH	*V*	*B*	Phase
.4315	0.953	0.995	.3993
.4334	0.942	0.982	.3998
.4344	0.930	0.978	.4000
.4353	0.947	0.994	.4002
.4373	0.947	0.976	.4007
.4381	0.940	0.971	.4009
.4390	0.944	0.984	.4011
.4400	0.936	0.976	.4014
.4792	0.904	0.953	.4112
.4803	0.908	0.946	.4115
.4813	0.913	0.941	.4117
.4835	0.893	0.938	.4123
.4844	0.902	0.946	.4125
.4855	0.898	0.929	.4128
.4863	0.903	0.937	.4130
.4876	0.889	0.951	.4096
.4884	0.891	0.940	.4135
.4907	0.899	0.948	.4141
.4917	0.890	0.936	.4143
.4926	0.893	0.937	.4145
.4935	0.899	0.938	.4148
.4945	0.897	0.934	.4151
.4954	0.893	0.939	.4153
.4965	0.894	0.946	.4156
.4975	0.890	0.933	.4159
.5306	0.846	0.897	.4240
.5317	0.847	0.897	.4243
.5327	0.850	0.895	.4245
.5334	0.862	0.902	.4247
.5345	0.843	0.910	.4250
.5353	0.847	0.901	.4252
.5421	0.846	0.928	.4269
.5431	0.834	0.884	.4272
.5445	0.859	0.916	.4275
.5454	0.825	0.876	.4277
.5462	0.853	0.917	.4279
.5470	0.827	0.876	.4281
.5479	0.844	0.893	.4283
.5486	0.832	0.889	.4285
.5574	0.829	0.872	.4307
.5584	0.826	0.865	.4310
.5607	0.833	0.859	.4316
.5614	0.821	0.870	.4318
.5622	0.817	0.867	.4320

Table 4 continued

JDH	*V*	*B*	Phase
.5633	0.818	0.864	.4322
.5640	0.813	0.859	.4224
.5648	0.806	0.862	.4326
.6233	0.761	0.798	.4472
.6242	0.759	0.794	.4474
.6251	0.753	0.790	.4476
.6259	0.758	0.787	.4478
.6281	0.752	0.783	.4484
.6291	0.746	0.785	.4487
.6304	0.751	0.785	.4490
.6315	0.746	0.786	.4493
.6326	0.735	0.783	.4495
.6336	0.746	0.771	.4498
.6570	0.726	0.773	.4556
.6580	0.723	0.738	.4559
.6588	0.718	0.742	.4561
.6615	0.696	0.738	.4567
.6626	0.698	0.732	.4570
.6633	0.691	0.730	.4572
.6640	0.690	0.738	.4574
.6664	0.700	0.734	.4580
.6673	0.696	0.715	.4582
.6681	0.694	0.732	.4584
.6694	0.697	0.732	.4586
.6862	0.662	0.697	.4629
.6870	0.676	0.727	.4631
.6887	0.669	0.709	.4635
.6897	0.652	0.709	.4638
.6906	0.660	0.707	.4640
.6913	0.662	0.704	.4642
.6933	0.656	0.700	.4647
.6942	0.657	0.690	.4649
.6950	0.652	0.704	.4651
.6959	0.664	0.695	.4653

Table 5

JDH	*V*	*B*	*U*	Phase
2441688				
.4163	1.842	1.900	1.948	.3288
.4253	1.857	1.900	1.945	.3311

Table 5 continued

JDH	*V*	*B*	*U*	Phase
.4538	1.830	1.887	1.947	.3382
.4698	1.838	1.894	1.928	.3422
.4791	1.833	1.896	1.951	.3442
.4830	1.822	1.888	1.952	.3455
.4878	1.838	1.879	1.932	.3467
.5003	1.830	1.876	1.941	.3498
.5055	1.834	1.872	1.930	.3511
.5121	1.841	1.868	1.970	.3527
.5187	1.825	1.859	1.951	.3544
.5253	1.826	1.870	1.937	.3560
.5316	1.807	1.860	1.926	.3576
2441689				
.4537	1.703	1.733	1.782	.5880
.4614	1.699	1.741	1.801	.5899
.4669	1.698	1.760	1.806	.5913
.4850	1.715	1.759	1.820	.5958
.4885	1.721	1.765	1.819	.5967
.4916	1.720	1.760	1.831	.5975
.4965	1.718	1.769	1.827	.5987
.4996	1.721	1.769	1.826	.5995
.5027	1.726	1.765	1.825	.6002
.5059	1.722	1.775	1.818	.6013
.5100	1.732	1.772	1.826	.6031
.5142	1.728	1.775	1.844	.6021
.5194	1.733	1.781	1.837	.6044
.5235	1.742	1.772	1.836	.6054
.5274	1.735	1.784	1.851	.6064
.5315	1.734	1.787	1.851	.6074
.5343	1.739	1.799	1.849	.6081
.5513	1.743	1.792	1.860	.6124
.5544	1.753	1.800	1.847	.6132
.5579	1.759	1.811	1.862	.6140
2441690				
.2395	1.843	1.910	1.962	.7843
.2450	1.867	1.914	1.979	.7857
.2485	1.872	1.913	1.975	.7866
.2634	1.871	1.919	1.966	.7903
.2690	1.871	1.910	1.965	.7917
.2732	1.866	1.905	1.972	.7927
.2773	1.849	1.891	1.962	.7938
.2860	1.862	1.900	1.986	.7959

Table 5 continued

JDH	*V*	*B*	*U*	Phase
.2902	1.866	1.902	1.981	.7970
.2947	1.851	1.899	1.959	.7981
.2985	1.845	1.885	1.970	.7991
.3034	1.854	1.905	1.981	.8003
.3075	1.858	1.900	1.982	.8013
.3113	1.851	1.891	1.972	.8023
.3159	1.858	1.897	1.963	.8034
.3214	1.851	1.897	1.957	.8048
.3256	1.872	1.888	1.983	.8058
.3301	1.854	1.882	1.956	.8070
.3336	1.859	1.892	1.973	.8078
.3374	1.842	1.884	1.952	.8088
.3482	1.857	1.886	1.957	.8115
.3523	1.853	1.881	1.957	.8125
.3732	1.853	1.887	1.955	.8177
.3773	1.857	1.899	1.959	.8187
.3811	1.841	1.888	1.960	.8197
.3850	1.843	1.883	1.954	.8207
.3891	1.842	1.878	1.953	.8217
.3940	1.841	1.880	1.954	.8229
.3982	1.838	1.884	1.958	.8240
.4023	1.848	1.873	1.952	.8250
.4131	1.838	1.878	1.947	.8277
.4179	1.839	1.878	1.929	.8289
.4245	1.843	1.883	1.945	.8305
.4284	1.824	1.877	1.948	.8315
.4322	1.838	1.881	1.954	.8325
.4363	1.826	1.866	1.927	.8335
.4412	1.824	1.870	1.938	.8347
.4454	1.832	1.875	1.943	.8358
.4488	1.828	1.879	1.945	.8366
.4530	1.826	1.863	1.943	.8377
.4572	1.840	1.870	1.940	.8387
.4613	1.832	1.869	1.934	.8397
.4669	1.821	1.865	1.931	.8411
.4711	1.827	1.864	1.935	.8422
.4850	1.828	1.870	1.925	.8457
.4902	1.820	1.872	1.927	.8470
.4954	1.826	1.870	1.945	.8483
.5502	1.798	1.837	1.930	.8619
.5554	1.815	1.828	1.914	.8632
.5593	1.805	1.842	1.924	.8642
.5627	1.784	1.835	1.911	.8651

Table 5 continued

JDH	*V*	*B*	*U*	Phase
2441691				
.2217	1.320	1.362	1.405	.0297
.2259	1.336	1.359	1.414	.0308
.2294	1.327	1.372	1.428	.0316
.2356	1.338	1.395	1.443	.0332
.2391	1.370	1.403	1.444	.0341
.2426	1.369	1.411	1.447	.0349
.2464	1.375	1.393	1.456	.0359
.2499	1.378	1.402	1.473	.0368
.2703	1.421	1.434	1.490	.0419
.2752	1.426	1.465	1.525	.0431
.2808	1.426	1.464	1.539	.0445
.2849	1.441	1.473	1.550	.0455
.2967	1.461	1.486	1.559	.0485
.3012	1.463	1.505	1.566	.0496
.3051	1.472	1.510	1.576	.0506
.3096	1.487	1.511	1.578	.0517
.3134	1.490	1.523	1.598	.0526
.3172	1.492	1.527	1.585	.0536
.3210	1.497	1.527	1.597	.0545
.3249	1.510	1.537	1.597	.0555
.3301	1.498	1.541	1.600	.0568
.3634	1.548	1.589	1.648	.0651
.3676	1.564	1.600	1.661	.0662
.3724	1.569	1.613	1.661	.0674
.3766	1.576	1.610	1.667	.0684
.3811	1.583	1.626	1.661	.0695
.4231	1.621	1.662	1.730	.0800
.4280	1.631	1.665	1.719	.0813
.4335	1.653	1.674	1.734	.0826
.4370	1.649	1.676	1.732	.0835
.4419	1.646	1.685	1.737	.0847
.4457	1.642	1.686	1.752	.0857
.4499	1.648	1.687	1.751	.0867
.4537	1.664	1.695	1.759	.0877
.4585	1.668	1.699	1.760	.0889
.4790	1.669	1.710	1.769	.0940
.4880	1.683	1.726	1.775	.0963
.4981	1.695	1.738	1.769	.0988
.5023	1.708	1.744	1.788	.0998
.5374	1.732	1.763	1.831	.1086
.5419	1.733	1.763	1.819	.1097
.5460	1.735	1.767	1.837	.1107
.5499	1.743	1.762	1.851	.1117
.5537	1.738	1.759	1.828	.1127

Table 5 continued

JDH	*V*	*B*	*U*	Phase
.5592	1.729	1.774	1.843	.1140
.5672	1.746	1.772	1.838	.1160
.5710	1.736	1.766	1.821	.1170
.5752	1.740	1.788	1.853	.1180
.5804	1.747	1.787	1.847	.1193
2441692				
.2203	1.878	1.917	1.978	.2792
.2241	1.876	1.923	1.979	.2802
.2279	1.881	1.913	1.991	.2811
.2328	1.882	1.915	1.980	.2823
.2377	1.880	1.922	1.998	.2836
.2425	1.884	1.921	1.989	.2848
.2463	1.880	1.919	1.989	.2857
.2502	1.882	1.917	1.993	.2867
.2640	1.881	1.921	1.996	.2901
.2675	1.886	1.919	1.988	.2910
.2717	1.879	1.915	1.987	.2921
.2762	1.864	1.916	1.987	.2932
.2845	1.877	1.920	1.988	.2953
.2901	1.876	1.921	1.986	.2967
.2939	1.866	1.912	1.985	.2976
.2984	1.870	1.916	1.985	.2987
.3043	1.871	1.909	1.982	.3002
.3081	1.882	1.919	1.979	.3011
.3120	1.868	1.917	1.969	.3021
.3161	1.870	1.914	1.980	.3031
.3203	1.873	1.913	1.987	.3042
.3248	1.865	1.905	1.973	.3053
.3297	1.868	1.898	1.969	.3065
.3338	1.869	1.909	1.976	.3076
.3387	1.878	1.919	1.998	.3088
.3482	1.869	1.926	1.993	.3099
.3488	1.871	1.923	1.991	.3113
.3529	1.859	1.909	1.985	.3123
.3568	1.866	1.908	1.977	.3133
.3616	1.869	1.911	1.986	.3145
.3658	1.870	1.902	1.984	.3156
.3696	1.882	1.911	1.980	.3165
.3870	1.867	1.912	1.975	.3209
.3918	1.860	1.905	1.975	.3221
.3960	1.867	1.907	1.980	.3231
.4002	1.866	1.904	1.970	.3242
.4057	1.871	1.897	1.965	.3255
.4095	1.866	1.879	1.941	.3265

Table 5 continued

JDH	*V*	*B*	*U*	Phase
.4137	1.865	1.892	1.965	.3275
.4175	1.845	1.896	1.968	.3285
.4231	1.851	1.892	1.969	.3299
.4269	1.847	1.893	1.962	.3308
.4314	1.845	1.891	1.962	.3320
.4356	1.846	1.893	1.958	.3330
.4394	1.850	1.890	1.969	.3340
.4432	1.846	1.894	1.974	.3349
.4502	1.854	1.892	1.949	.3367
.4543	1.858	1.906	1.952	.3377
.4606	1.840	1.882	1.940	.3392
.4658	1.840	1.876	1.935	.3405
.4706	1.852	1.889	1.959	.3417
.4755	1.831	1.885	1.946	.3430
.4793	1.836	1.883	1.941	.3439
.4932	1.840	1.876	1.959	.3474
.4970	1.829	1.860	1.951	.3483
.5019	1.830	1.896	1.944	.3496
.5088	1.831	1.868	1.947	.3513
.5127	1.823	1.850	1.937	.3523
.5255	1.835	1.865	1.956	.3555
.5307	1.831	1.870	1.936	.3568
.5377	1.827	1.867	1.925	.3585
.5415	1.827	1.856	1.911	.3595
.5453	1.820	1.854	1.924	.3604
.5495	1.809	1.855	1.913	.3615
2441693				
.2196	1.394	1.456	1.518	.5289
.2241	1.404	1.440	1.503	.5300
.2275	1.405	1.446	1.520	.5308
.2345	1.401	1.438	1.493	.5326
.2383	1.429	1.464	1.514	.5336
.2425	1.431	1.479	1.515	.5346
.2459	1.416	1.468	1.521	.5354
.2494	1.438	1.476	1.533	.5363
.2536	1.436	1.480	1.543	.5374
.2682	1.460	1.496	1.563	.5410
.2734	1.468	1.512	1.573	.5423
.2814	1.479	1.533	1.598	.5443
.2855	1.498	1.552	1.608	.5453
.2970	1.494	1.537	1.595	.5482
.3029	1.517	1.555	1.619	.5497
.3064	1.515	1.549	1.625	.5506
.3105	1.516	1.550	1.631	.5516

Table 5 continued

JDH	*V*	*B*	*U*	Phase
.3140	1.522	1.548	1.625	.5525
.3178	1.524	1.544	1.631	.5534
.3227	1.552	1.596	1.670	.5546
.3265	1.525	1.571	1.642	.5556
.3314	1.540	1.584	1.665	.5568
.3352	1.546	1.598	1.676	.5578
.3387	1.556	1.586	1.682	.5586
.3435	1.553	1.598	1.680	.5598
.3466	1.554	1.597	1.664	.5606
.3515	1.572	1.617	1.695	.5616
.3557	1.573	1.629	1.704	.5629
.3716	1.600	1.629	1.698	.5668
.3779	1.606	1.644	1.714	.5684
.3824	1.618	1.654	1.718	.5696
.3862	1.614	1.653	1.730	.5705
.3897	1.625	1.653	1.731	.5714
.3935	1.615	1.654	1.741	.5723
.3973	1.620	1.662	1.745	.5733
.4022	1.633	1.667	1.736	.5745
.4064	1.644	1.679	1.745	.5756
.4109	1.640	1.685	1.753	.5767
.4147	1.634	1.688	1.778	.5776
.4185	1.643	1.686	1.772	.5786
.4223	1.658	1.684	1.753	.5795
.4262	1.651	1.697	1.770	.5805
.4300	1.650	1.697	1.770	.5814
.9338	1.663	1.700	1.766	.5824
.4380	1.664	1.701	1.769	.5834
.4421	1.676	1.718	1.784	.5845
.4459	1.677	1.714	1.786	.5854
.4508	1.683	1.722	1.793	.5866
.4546	1.677	1.715	1.788	.5876
.4640	1.688	1.739	1.802	.5899
.4685	1.685	1.736	1.794	.5911
.4727	1.698	1.744	1.814	.5921
.4775	1.718	1.759	1.816	.5933
.4814	1.711	1.747	1.818	.5943
.4852	1.703	1.749	1.811	.5952
.4890	1.712	1.754	1.824	.5962
.4932	1.710	1.754	1.820	.5972
.4970	1.733	1.770	1.825	.5982
.5012	1.727	1.779	1.830	.5992
.5060	1.737	1.761	1.828	.6004
.5105	1.731	1.770	1.836	.6016

Table 5 continued

JDH	*V*	*B*	*U*	Phase
.5147	1.729	1.778	1.847	.6026
.5216	1.735	1.792	1.855	.6043
.5258	1.740	1.775	1.839	.6054
.5314	1.748	1.787	1.849	.6068
.5355	1.748	1.787	1.862	.6078
2441695				
.2209	1.307	1.377	1.413	.0289
.2254	1.324	1.379	1.424	.0300
.2292	1.321	1.384	1.435	.0310
.2327	1.341	1.388	1.437	.0318
.2379	1.359	1.406	1.453	.0331
.2417	1.368	1.406	1.453	.0341
.2459	1.372	1.412	1.482	.0351
.2497	1.382	1.416	1.468	.0361
.2552	1.389	1.417	1.477	.0375
.2591	1.411	1.437	1.494	.0384
.2643	1.415	1.439	1.496	.0397
.2702	1.442	1.483	1.539	.0412
.2747	1.427	1.470	1.526	.0423
.2788	1.426	1.466	1.521	.0434
.2827	1.436	1.473	1.529	.0443
.2875	1.444	1.481	1.537	.0455
.2913	1.446	1.485	1.548	.0465
.2952	1.450	1.493	1.549	.0475
.3004	1.465	1.495	1.538	.0488
.3045	1.463	1.499	1.538	.0498
.3104	1.482	1.518	1.554	.0513
.3243	1.512	1.551	1.601	.0547
.3299	1.506	1.544	1.574	.0561
.3337	1.506	1.558	1.603	.0571
.3375	1.521	1.562	1.607	.0580
.3431	1.523	1.565	1.602	.0594
.3625	1.564	1.596	1.660	.0643
.3667	1.570	1.613	1.669	.0653
.3705	1.566	1.609	1.674	.0663
.3875	1.582	1.618	1.676	.0705
.3910	1.591	1.634	1.679	.0714
.3966	1.595	1.627	1.695	.0728
.4108	1.613	1.654	1.721	.0763
.4163	1.612	1.655	1.699	.0777
.4299	1.637	1.673	1.725	.0811
.4365	1.656	1.683	1.741	.0828
.4500	1.661	1.703	1.752	.0861

Table 6

JDH	*V*	*B*	*U*	Phase
2443811				
.4045	1.871	1.944	1.989	.7451
.4087	1.871	1.939	2.002	.7461
.4129	1.885	1.940	2.001	.7472
.4157	1.878	1.952	2.001	.7479
.4191	1.872	1.942	1.989	.7487
.4233	1.877	1.933	1.999	.7498
.4268	1.894	1.940	2.001	.7507
.4299	1.888	1.941	2.003	.7514
.4330	1.881	1.940	1.994	.7522
.4358	1.879	1.934	2.003	.7529
.4420	1.870	1.937	1.995	.7545
.4452	1.885	1.939	2.010	.7553
.4490	1.885	1.942	2.005	.7562
.4518	1.879	1.935	2.011	.7569
.4594	1.878	1.940	1.998	.7588
.4632	1.875	1.934	1.991	.7598
.4660	1.879	1.938	1.991	.7605
.4691	1.890	1.935	1.995	.7612
.4729	1.874	1.929	1.999	.7622
.4771	1.864	1.927	2.011	.7632
.4813	1.870	1.993	2.007	.7643
.4879	1.871	1.931	2.006	.7659
.4941	1.876	1.939	2.007	.7675
.4997	1.878	1.933	2.014	.7689
.5049	1.882	1.939	2.007	.7702
.5091	1.868	1.932	2.010	.7712
.5170	1.882	1.941	2.001	.7732
.5229	1.882	1.934	1.995	.7747
.5275	1.864	1.950	1.985	.7758
.5341	1.887	1.947	1.999	.7775
.5386	1.874	1.937	1.988	.7786
.5490	1.869	1.941	2.013	.7812
.5552	1.867	1.925	1.984	.7828
.5636	1.879	1.931	1.995	.7849
.5712	1.869	1.943	1.989	.7867
.5782	1.870	1.926	1.982	.7885
.5837	1.872	1.946	2.001	.7899
.6000	1.860	1.923	2.011	.7939
.6101	1.869	1.929	2.003	.7965
.6236	1.854	1.924	1.985	.7998
.6330	1.851	1.928	1.987	.8022
.6479	1.868	1.911	1.989	.8059
.6601	1.856	1.919	1.976	.8090

Table 6 continued

JDH	*V*	*B*	*U*	Phase
2443812				
.3870	1.226	1.284	1.312	.9906
.3940	1.218	1.275	1.309	.9923
.3972	1.221	1.281	1.314	.9931
.3997	1.229	1.277	1.318	.9937
.4023	1.226	1.270	1.311	.9944
.4059	1.223	1.264	1.308	.9953
.4085	1.227	1.272	1.316	.9959
.4110	1.224	1.269	1.309	.9966
.4147	1.215	1.255	1.229	.9975
.4178	1.227	1.273	1.316	.9983
.4217	1.232	1.262	1.320	.9992
.4243	1.207	1.265	1.318	.9999
.4272	1.217	1.269	1.306	.0006
.4301	1.221	1.264	1.324	.0013
.4335	1.238	1.278	1.316	.0022
.4366	1.227	1.259	1.325	.0030
.4395	1.216	1.263	1.315	.0037
.4439	1.229	1.270	1.329	.0048
.4466	1.227	1.275	1.312	.0055
.4494	1.224	1.277	1.323	.0062
.4525	1.225	1.281	1.314	.0069
.4551	1.229	1.276	1.317	.0076
.4582	1.227	1.274	1.317	.0084
.4610	1.227	1.279	1.318	.0091
.4651	1.228	1.292	1.339	.0101
.4681	1.238	1.287	1.345	.0108
.4709	1.227	1.301	1.341	.0115
.4754	1.241	1.295	1.347	.0127
.4795	1.250	1.293	1.350	.0137
.4855	1.262	1.313	1.358	.0152
.4896	1.269	1.316	1.364	.0162
.4952	1.275	1.311	1.368	.0176
.5026	1.284	1.336	1.380	.0195
.5125	1.300	1.345	1.398	.0219
.5193	1.325	1.359	1.414	.0236
.5245	1.321	1.363	1.419	.0249
.5295	1.328	1.391	1.440	.0262
.5347	1.342	1.394	1.445	.0275
.5405	1.342	1.398	1.445	.0289
.5453	1.349	1.407	1.462	.0301
.5514	1.353	1.417	1.461	.0316
.5634	1.380	1.440	1.499	.0346
.5731	1.400	1.467	1.507	.0371

Table 6 continued

JDH	*V*	*B*	*U*	Phase
.5820	1.421	1.470	1.526	.0393
.5904	1.445	1.448	1.543	.0414
.6020	1.456	1.506	1.564	.0443
.6108	1.456	1.517	1.569	.0465
.6200	1.476	1.530	1.586	.0488
.6291	1.499	1.556	1.614	.0511
.6414	1.501	1.556	1.617	.0541
.6505	1.532	1.575	1.654	.0564
.6593	1.528	1.587	1.644	.0586
.6687	1.549	1.603	1.658	.0610
.6766	1.562	1.620	1.663	.0629
2443813				
.4372	1.893	1.940	2.011	.2530
.4415	1.893	1.950	2.033	.2540
.4493	1.881	1.951	2.023	.2560
.4542	1.886	1.966	2.009	.2572
.4594	1.902	1.967	2.023	.2585
.4766	1.892	1.941	2.012	.2628
.4848	1.891	1.947	2.021	.2649
.4901	1.896	1.946	2.013	.2662
.5105	1.891	1.948	2.020	.2713
.5188	1.888	1.941	2.009	.2733
.5346	1.884	1.942	2.013	.2773
.5578	1.889	1.938	2.012	.2831

Table 7. BV measurements made at the Hvar Observatory 1978

JDH	*V*	*B*	Phase	JDH	*V*	*B*	Phase
2443820				.4498	.422	.458	.0050
.3700	.457	.490	.9851	.4536	.431	.458	.0060
.3741	.444	.482	.9861	.4578	.424	.459	.0070
.3783	.442	.481	.9872	.4614	.429	.467	.0079
.3819	.441	.475	.9881	.4654	.425	.470	.0089
.3859	.446	.473	.9891	.4690	.435	.468	.0098
.3906	.438	.471	.9902	.4730	.447	.476	.0108
.3952	.436	.464	.9914	.4772	.448	.479	.0119
.3990	.428	.464	.9923	.4812	.443	.481	.0129
.4034	.437	.465	.9936	.4849	.450	.483	.0138
.4083	.429	.458	.9946	.4886	.456	.491	.0147

Table 7 continued

JDH	*V*	*B*	Phase	JDH	*V*	*B*	Phase
.4143	.429	.462	.9961	.4923	.472	.497	.0156
.4198	.423	.465	.9975	.4961	.467	.503	.0166
.4239	.427	.461	.9985	.5003	.475	.507	.0176
.4286	.423	.455	.9997	.5057	.481	.518	.0190
.4327	.433	.453	.0007	.5093	.488	.523	.0199
.4375	.432	.454	.0019	.5131	.491	.531	.0208
.4415	.426	.458	.0029	.5168	.501	.537	.0218
.4453	.422	.461	.0039				

Table 8. UBV measurements made at Ondřejov 1983

JDH				
2445635				
.5359	.583	.602	.854	.4938
.5444	.562	.597	.854	.4959
.5486	.570	.605	.852	.4970
.5535	.565	.598	.842	.4982
.5594	.548	.586	.843	.4997
.5656	.542	.587	.829	.5012
.5734	.556	.593	.838	.5031
.5809	.562	.612	.836	.5050
.5877	.563	.609	.843	.5067
.5932	.572	.606	.855	.5081
.5992	.558	.602	.841	.5096
.6040	.566	.604	.850	.5108
.6088	.571	.606	.849	.5120
.6137	.568	.602	.856	.5132

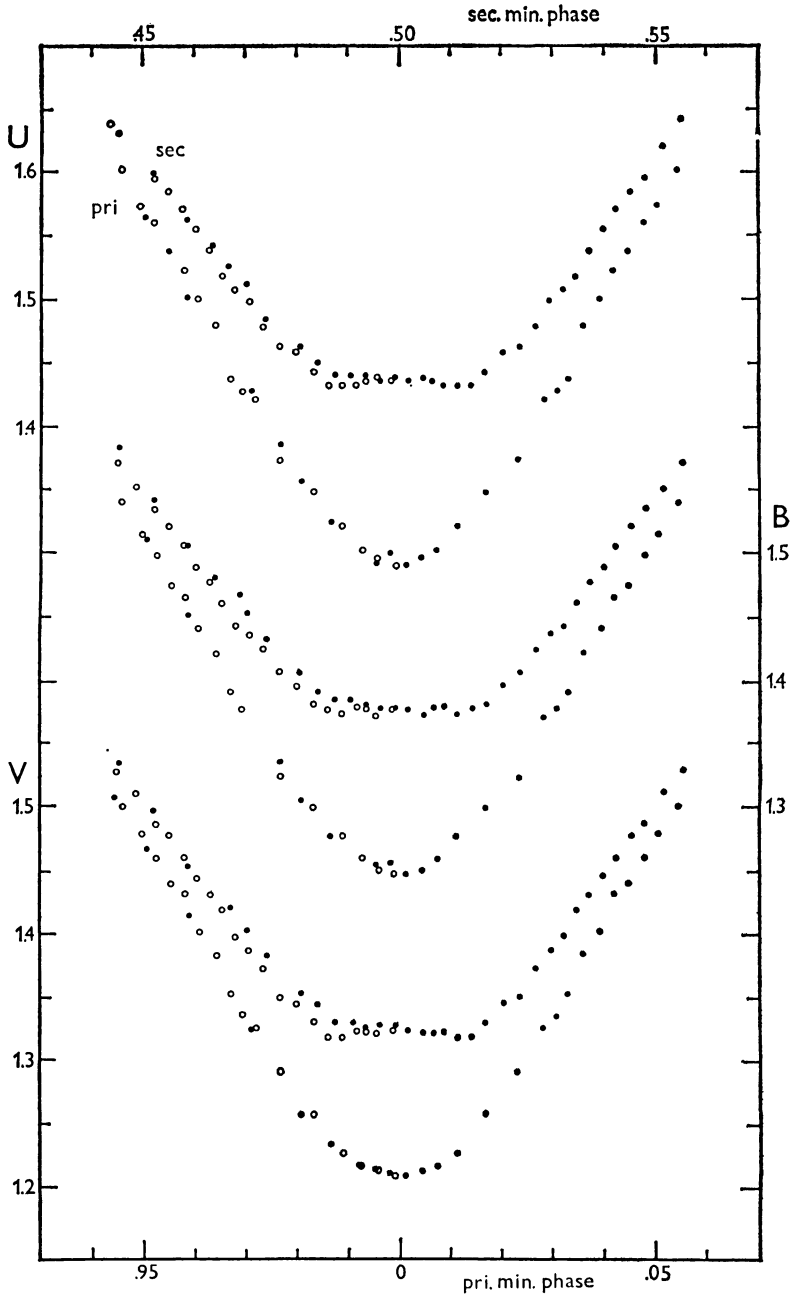

Fig. 1. The *U*, *B* and *V* normal points for the primary and secondary minima are given as magnitude difference "HD 35619 minus LY Aur" (black dots). The rising parts of both minima are plotted also with reversed phases (white dots), in order to show the symmetric or asymmetric shapes of the minima.