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PHOTOELECTRIC OBSERVATIONS OF CY AQUARII IN AUGUST 1982 AT THE JUNGFRAUJOCH OBSERVATORY

ABSTRACT. PHOTOELECTRIC OBSERVATIONS OF CY AQR IN AUGUST 1982 AT THE JUNGFRAUJOCH OBSERVATORY.

The variable star CY Aqr was observed in two colours (B and V) for more than a period. The reduction of measures was done using Geneva standard stars observed on the same night.
The observed time of maximum is not consistent with the ephemerides published in the GCVS and the Rocznik. The observed drift confirms the trend announced in the GEOS Circ. RR 4.

RESUME. OBSERVATIONS PHOTOELECTRIQUES DE CY AQR EN AOUT 1982 A L'OBSERVATOIRE DU JUNGFRAUJOCH.

La variable CY Aqr a été observée pendant plus d'une période en 2 couleurs (B et V). Le rattachement des mesures est assuré par des étoiles du standard de Genève observées pendant la même nuit.
L'instant du maximum observé n'est pas compatible avec les éphémérides publiées dans le GCVS et le Rocznik. La dérive constatée confirme la tendance annoncée dans la GEOS Circ. RR 4.

RIASSUNTO. OSSERVAZIONI FOTOELETTRICHE DI CY AQR IN AGOSTO 1982 ALL'OSSERVATORIO DEL JUNGFRAUJOCH.

La variabile CY Aqr è stata osservata per più di un periodo in due filtri (B e V). Come riferimento si sono utilizzate stelle standard dell'Osservatorio di Ginevra, osservate durante la stessa notte. L'istante del massimo osservato è incompatibile con l'effemeridi pubblicate dal GCVS e nel Rocznik. La deriva constatata conferma l'andamento annunciato nella GEOS Circ. RR 4.

RESUMEN. OBSERVACIONES FOTOELECTRICAS DE CY AQR EN AGOSTO DE 1982 EN EL OBSERVATORIO DE JUNGFRAUJOCH.

La variable CY Aqr ha sido observada durante más de un periodo en dos colores (B y V). La relación entre las medidas es segura gracias a unas estrellas del standard de Ginebra observadas durante la misma noche.
El instante del máximo observado no es compatible con las efemérides publicadas en el GCVS o el Rocznik. La deriva constatada confirma la tendencia anunciada en la GEOS Circ. RR 4.

1. INTRODUCTION

CY Aqr is an RRs-type variable with a wide amplitude (0.8 magnitude) and a very short period (1h 27m 54s). The star was observed on the night of 1982 August 25/26, during a mission at the Jungfraujoch Observatory sponsored by the Palais de la Découverte. The measures were recorded by a photometer attached at the back of the 76-cm reflector. The observations were carried out by Noël CRAMER (Geneva Observatory), Isabelle BOSC (Ecole de Physique de Marseille) and Michel DUMONT (Palais de la Découverte). The correlation with the standard and reduction of the measures were carried out by Michel DUMONT using a HP-67 calculator.

2. CORRELATION AND REDUCTION OF THE MEASURES

The Bouguer extinction line is given by :

$$m_z = k F_z + m_0$$

where m_0 is the exoatmospheric magnitude, F_z the air-mass, m_z the magnitude measured from the ground with the star at a zenith distance z, and k the atmospheric extinction coefficient. The atmospheric extinction is a function of the wavelength and a useful approximation is given by :

$$k = k_1 + k_2 C$$

where C is a colour index; in this case C = B - V. Let V_0 and B_0 be the magnitudes measured for a standard star of magnitude B and V, as given in photometric catalogues.

$$V_0 = -2{,}5 \log I_V \qquad B_0 = -2{,}5 \log I_B$$

where I_V and I_B are the luminous intensities recorded by the photometer. Bouguer's formula can then be written :

$$V_0 = V + k_{11} + F_z \left[k_{12} + k_{13} (B-V) \right]$$
$$B_0 = B + k'_{21} + F_z \left[k'_{22} + k'_{23} (B-V) \right]$$

$$B_0 - V_0 = B-V + k'_{21} - k_{11} + F_z \left[k'_{22} - k_{12} + (B-V)(k'_{23} - k_{13}) \right]$$

Let $k_{21} = k'_{21} - k_{11}$ $\qquad k_{22} = k'_{22} - k_{12}$

$k_{23} = k'_{23} - k_{13}$ $\qquad (B-V)_0 = B_0 - V_0$

The following equations can then be written :

$$V_0 = V + k_{11} + F_z \left[k_{12} + k_{13} (B-V) \right] \qquad (1)$$

$$(B-V)_0 = (B-V) + k_{21} + F_z \left[k_{22} + k_{23} (B-V) \right] \qquad (2)$$

k_{11} and k_{21} are constants determining the zero of the magnitude scales, k_{12} and k_{22} are atmospheric extinction coefficients, k_{13} and k_{23} are terms correcting the colour according to extinction.

In the course of the night, some standard stars are selected, whose magnitude and (B - V) indices are known. The coefficients k_{ij} are then calculated by a least square method. In principle, at least three standard stars with different colours and zenith distances must be used.

When the k_{ij} terms are known, it is then possible to reduce the observations

of any new star by calculating (B - V) with relation (2) and then V with relation (1).

The air-mass was calculated by means of the formula suggested by F. RUFENER :

$$F_z = \sec z \left[1 + \varepsilon - \varepsilon (\sec z)^2\right]$$

where ε is a term depending on the site :
at sea level $\varepsilon = 0{,}00087$
at Jungfraujoch $\varepsilon = 0{,}00056$

3. OBSERVATIONS

On the evening of 1982 August 25, observation began at about 21 h 53 UT. The following stars were successively recorded in two colours B and V: HD 203842, HD 219188, CY Aqr, the star labelled C on the chart figure 1, HD 222935, CY Aqr, star C, GY And, HD 829, HD 1406 and GY And.

The table below gives the data required to correlate the observations with the Geneva standard

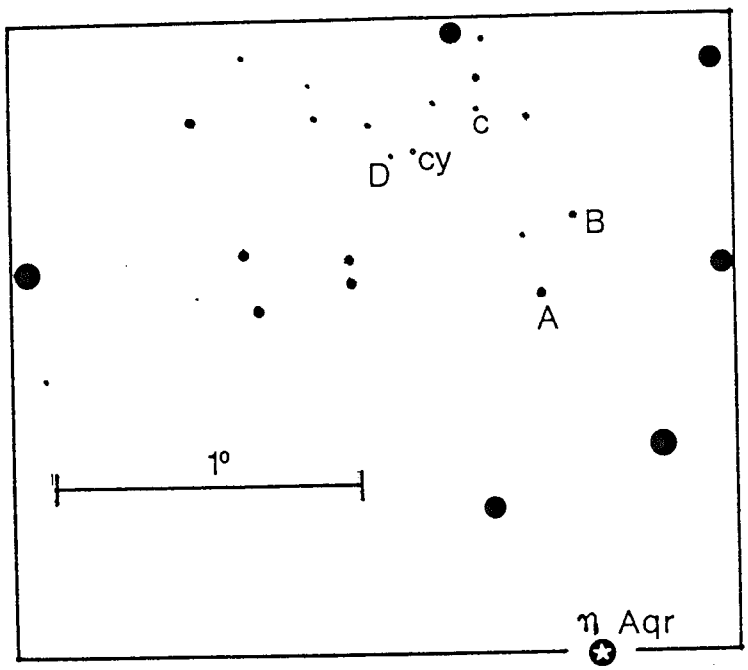
Sidereal Time	Star	F_z	I_B	I_V	M_V	$(B-V)_G$
20 h 46	203842	1,257	3015,9	1902,0	6,322	- 0,382
20 h 56	219188	1,590	2727,0	975,7	7,044	- 1,125
21 h 54	222935	1,124	315,2	290,3	8,400	0,110
23 h 36	829	1,019	4236,1	1455,4	6,702	- 1,105
23 h 47	1406	1,047	737,4	968,2	7,090	0,543

The following values for the k terms are :

$k_{11} = -14{,}7845$ $k_{12} = 0{,}2063$ $k_{13} = 0{,}0305$
$k_{21} = -0{,}1679$ $K_{22} = -0{,}0123$ $k_{23} = -0{,}1120$

and the results for star C are :

Sidereal Time	F_z	I_B	I_V	M_V	$(B-V)_G$
21 h 43	1,449	32,25	20,69	11,212	- 0,354
23 h 12	1,429	32,17	20,61	11,220	- 0,355



CY AQR

α = 22 h 35,2
δ = +01° 17' } 1950

Figure 1

4. REDUCTION OF THE MEASURES OF CY AQR

The method described in this paper supposes that the brightness of the star can be measured in two colours simultaneously, or, to put it in other terms that the magnitude of the star should be constant throughout the measure in two colours. CY Aqr is unfortunately one of the few stars for which such a supposition is not valid (fig.2).

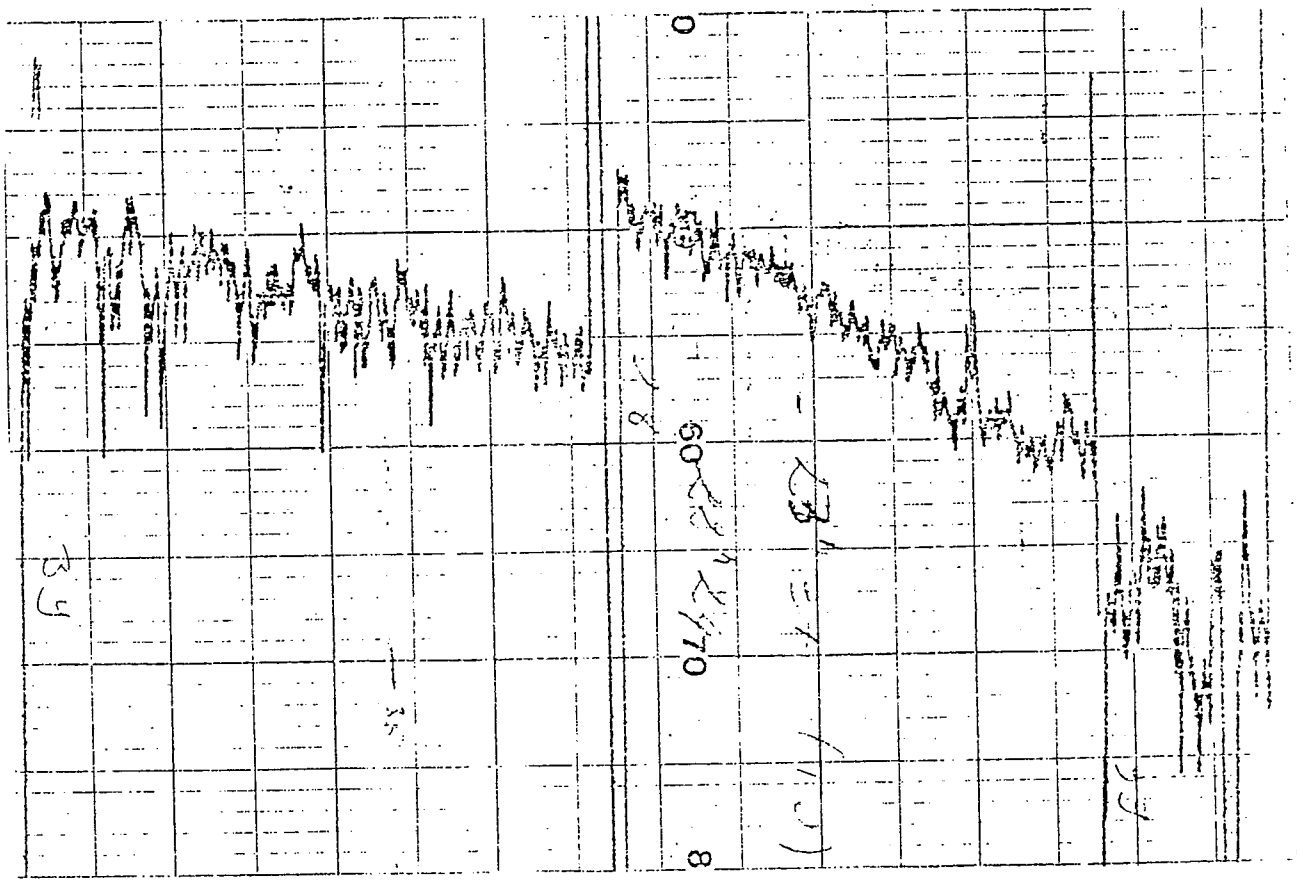


figure 2

The photoelectric recording of CY Aqr was carried out in two stages : from 21 h 21 to 21 h 40 (Sidereal Time) and from 22 h 02 to 22 h 58 (ST). 35 points were then taken from these 75 minutes of observation. For each of these points, a V (resp.B) curve was extrapolated so as to estimate its position relative to the B (resp.V) curve at the time corresponding to the chosen point. It is plain that such a procedure introduces inaccuracies; a one-colour photometry would however have been too doubtful.

The table below gives the results of the reduction for CY Aqr :

T S	U T	F_Z	I_B	I_V	M_V	$(B-V)_G$	$(B-V)_J$
21 h 22	22 h 35,5	1, 493	58, 46	29, 73	10, 823	- 0, 658	0, 245
21 h 25	22 h 38	1, 487	54, 45	28, 96	10, 850	- 0, 599	0, 294
21 h 27	22 h 40	1, 483	51, 99	28, 28	10, 876	- 0, 570	0, 319
21 h 30	22 h 43	1, 477	49, 45	26, 82	10, 934	- 0, 573	0, 316
21 h 32	22 h 45	1, 473	49, 09	26, 18	10, 962	- 0, 595	0, 298
21 h 37	22 h 50	1, 464	43, 17	23, 99	11, 056	- 0, 541	0, 343
22 h 04	23 h 17	1, 430	39, 18	21, 47	11, 184	- 0, 557	0, 330
22 h 12	23 h 25	1, 424	40, 38	22, 61	11, 128	- 0, 529	0, 353
22 h 19	23 h 32	1, 420	46, 86	24, 65	11, 038	- 0, 609	0, 286
22 h 20	23 h 33	1, 420	46, 99	25, 66	10, 993	- 0, 561	0, 326
22 h 22	23 h 35	1, 419	50, 19	27, 77	10, 906	- 0, 544	0, 341
22 h 23	23 h 36	1, 418	54, 36	28, 63	10, 876	- 0, 607	0, 288
22 h 24,5	23 h 37	1, 418	62, 25	31, 23	10, 785	- 0, 670	0, 235
22 h 26	23 h 38,5	1, 417	70, 38	34, 17	10, 689	- 0, 712	0, 199
22 h 29	23 h 42	1, 417	87, 92	41, 83	10, 470	- 0, 738	0, 177
22 h 30	23 h 43	1, 417	89, 70	42, 36	10, 457	- 0, 748	0, 169
22 h 31	23 h 44	1, 416	90, 15	42, 46	10, 455	- 0, 751	0, 166
22 h 32	23 h 45	1, 416	89, 88	42, 67	10, 449	- 0, 741	0, 175
22 h 33	23 h 46	1, 416	89, 08	42, 47	10, 454	- 0, 736	0, 179
22 h 34	23 h 47	1, 416	88, 23	41, 58	10, 478	- 0, 751	0, 166
22 h 36	23 h 49	1, 416	84, 30	39, 84	10, 524	- 0, 747	0, 170
22 h 37	23 h 50	1, 416	81, 76	39, 29	10, 538	- 0, 725	0, 188
22 h 38	23 h 51	1, 416	79, 21	38, 75	10, 552	- 0, 702	0, 208
22 h 39	23 h 52	1, 416	77, 83	37, 14	10, 600	- 0, 734	0, 181
22 h 41	23 h 54	1, 416	74, 53	36, 27	10, 624	- 0, 709	0, 202
22 h 42	23 h 55	1, 416	72, 88	35, 86	10, 636	- 0, 695	0, 214
22 h 43	23 h 56	1, 416	70, 51	35, 36	10, 650	- 0, 670	0, 235
22 h 44	23 h 57	1, 417	68, 28	34, 81	10, 666	- 0, 649	0, 252
22 h 45	23 h 58	1, 417	66, 49	33, 69	10, 702	- 0, 657	0, 246
22 h 46	23 h 59	1, 417	64, 13	32, 76	10, 732	- 0, 647	0, 254
22 h 47	0 h 00	1, 417	61, 59	31, 52	10, 774	- 0, 644	0, 257
22 h 48	0 h 01,5	1, 417	59, 67	30, 88	10, 795	- 0, 630	0, 268
22 h 54	0 h 07	1, 420	51, 10	28, 01	10, 897	- 0, 556	0, 330
22 h 56	0 h 09	1, 421	50, 06	26, 73	10, 949	- 0, 590	0, 302
22 h 57	0 h 10	1, 421	49, 44	25, 85	10, 987	- 0, 617	0, 279

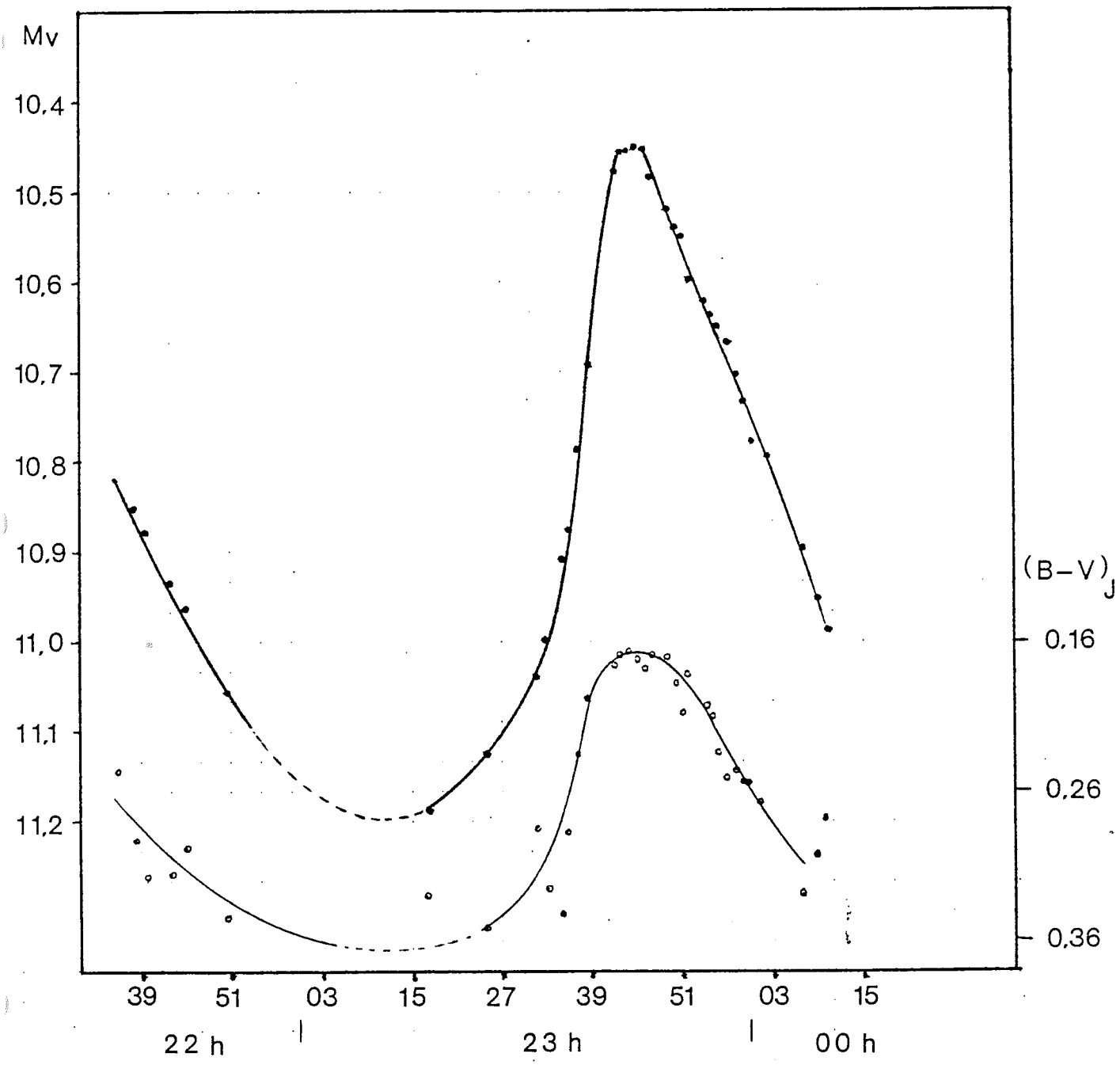


Figure 3 shows the curves thus obtained for V magnitude and the (B-V) index. An excellent fit between both curves can immediately be noticed. The apparent spectrum of CY Aqr ranges from A7 et F3 and one will note that the spectral class derived from the photometric measures is generally shifted owing to interstellar reddening.

5. HELIOCENTRIC OBSERVED TIME OF MAXIMUM

The observed maximum occurred on 1982 August 25 at 23 h 44 UT $\pm$ 2 m. The heliocentric correction is 8m 10s. The maximum therefore occurred at 23 h 52 UT (Hel.) $\pm$ 2 m, that is to say at :

J D (Hel.) = 2 445 207. 4944 ($\pm$ 0.0014)

6. COMPARISON WITH EPHEMERIDES

The table below compares the observed time of maximum with several ephemerides :

SOURCE	CALCULATED TIME OF MAXIMUM	O - C
KUKARKIN. GCVS,1976	... 207, 4968	- 3,4 min.
J.R.PERCY, 1975	... 207, 4991	- 6,8 min.
ROCZNIK, 1983	... 207, 4975	- 4,5 min.

As can immediately be seen, the maximum occurred earlier than predicted by the different ephemerides. This trend had already been pointed at in the GEOS CIRCULAR RR4 which gave for August 1980 a mean maximum with an O-C of -1.3m relative to the GCVS ephemeris.

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