UBV PHOTOMETRY OF DX AQUARII

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Abstract. *U*, *B*, *V* photometry of the eclipsing binary DX Aqr has been presented for the first time. The period of the system comes out to be nearly half the period given by Strohmeier (1966) and a value of $0\overset{d}{.}472502$ has been determined. The colour of the system has been discussed. The primary eclipse is a total occultation. The orbit seems to be eccentric. The system belongs to Algol type. DX Aqr may be a very complicated system. The present results are considerably different from those of earlier investigations.

1. Introduction

The eclipsing binary DX Aqr (= 29 Aqr = BD − 17°6422 = HD 209278 = HR 8396 = BV 600) was announced to be a variable by Strohmeier *et al.* (1965) from photographic observations. They also declared the system to be an eclipsing binary with an amplitude, Apg = $0\overset{m}{.}8$, of primary minimum having a period of $18\overset{d}{.}25$. However, they could not conclude whether the system was of type EA or EB. Strohmeier (1966) from his subsequent photographic observations gave a revised period of $0\overset{d}{.}945006$ and an amplitude of primary minimum to be $0\overset{m}{.}6$. Popper (1966) has assigned the spectral class *A* to the system. Cowley *et al.* (1969) gave the visual magnitude of the variable as $7\overset{m}{.}15$ and found it to be of spectral type A2V. Wälder (1975) presented photographic observations of the system and indicated the system to be of EB type.

DX Aqr is referred to be the preceding component of the visual binary ADS 15 562. The companion, separated by $3\overset{''}{.}7$ from the main component, had nearly equal brightness and probably belonged to spectral type G2V (Cowley *et al.*, 1969). The late-type companion of the visual binary was classified as K0III by Anderson (Olsen, 1976). Olsen (1976) carried out the *uvby* photometry of the system and derived the standard colour indices and $b - y$, m_1, and C_1 values. He indicated that the ingress starts at about $0\overset{d}{.}83$ phase, and found strong changes in colour indices during eclipse and attributed these to the dominating influence of the visual companion (K0III). Because of this handicap, Olsen (1976) did not carry out the photometry of the system any further. He found $m_v = 6\overset{m}{.}37$, which is considerably different from the value ($m_v = 7\overset{m}{.}15$) given by Cowley *et al.* (1969).

Paffhausen and Seggewiss (1976) presented the spectroscopic orbit of the system and classified the system DX Aqr to be of spectral-type A2V and found no spectral peculiarities on their plates. They indicated that DX Aqr showed pronounced rotation in its radial velocity curve. However, they did not present the spectroscopic data of the individual components. The *U*, *B*, *V* photometry of the system is being presented for the first time. The present results are considerably different from those of earlier

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investigations by Strohmeier *et al.* (1965), Strohmeier (1966), Cowley *et al.* (1969), and Olsen (1976). Details of the observations of these authors have not been available in the literature to the present authors.

2. Observations

The system DX Aqr was put on our observational programme and was observed photo-electrically. The observations were carried out on the 38 cm reflector, using a

TABLE I

Particulars of the variable and the comparison star

Star	α_{1855}	δ_{1855}	m_v	Sp.	Average standard deviation of the individual observation in *U*, *B*, and *V* filters
DX Aqr = BD − 17°6422 = HD 209278 = HR 8396 = BV 600	$21^h54^m29^s.4$	$-17°39'.6$	$6^m.8$	*B*	−
Comparison star = BD − 17°6421	$21^h53^m53^s.6$	$-17°28'.1$	$8^m.5$	−	$\pm 0^m.024$ (*U*) $\pm 0^m.018$ (*B*) $\pm 0^m.015$ (*V*)

1P21 photomultiplier thermo-electrically cooled to − 20 °C and conventional *U*, *B*, and *V* filters of Johnson and Morgan (1953). The photocurrent was recorded using standard d.c. techniques. A total of 10 nights of observations have been secured during the period October 1976–November 1980.

TABLE II

Minima of DX Aqr

Sl. no.	Epoch of minima, J.D. (Hel.)	Period	O−C based on Strohmeier's (1966) epoch and present period
	Primary minima:		
1	2443073.149 ± $0^d.001$	$0^d.4725016$	$-0^d.007$
2	2444139.159 ± $0^d.001$	$0^d.4724980$	$-0^d.052$
	Mean	$0^d.4724998$	$-0^d.030$
	Secondary minima:		
1	2444531.159 ± $0^d.001$	$0^d.4725029$	$+0^d.015$
2	2444177.217 ± $0^d.001$	$0^d.4725052$	$+0^d.053$
	Mean	$0^d.4725041$	$+0^d.034$

To begin with, two comparison stars BD − 17°6421 and BD − 17°6426 were chosen, but the former was selected finally to reduce the data in view of its better-established constancy. The particulars of the variable and the comparison stars along with the average standard deviations of individual observations, obtained on five nights randomly chosen, are given in Table I.

The ranges of the nightly standard deviations for the comparison star in *U*, *B*, and *V* filters are $0^m.013$ to $0^m.039$, $0^m.011$ to $0^m.033$, and $0^m.011$ to $0^m.023$, respectively.

The data were reduced to the standard system from the observations of three standard stars ζ Cap (G4), ε Cap (B3), and γ Cap (F0) chosen from the Arizona–Tonantzintla catalogue.

The *U*, *B*, and *V* observations are given in Tables VII, VIII, and IX, respectively.

3. Epoch and Period

During the course of our observations two primary and two secondary minima were observed, and their epochs were determined graphically with an accuracy of one minute of time, which is better than $0^d.001$. These are listed in Table II.

The period of the system has been given by various authors, whose results are listed in Table III.

The uncertainty about the period is apparent from Table III. We have tried a number of alternative values for the period to construct integrated light curves in *U*, *B*, and *V* filters, which have satisfied all the observations best. The $\Sigma(\text{O}-\text{C})^2$ vs period diagram

TABLE III

Periods of DX Aqr

Sl. no.	Author	Epoch and period
1	Strohmeier *et al.* (1965)	J.D. 2438618.250 + $18^d.25$
2	Strohmeier (1966)	J.D. 2436814.440 + $0^d.945006$
3	Olsen (1976)	J.D. 2442687.697 + $0^d.9450132$
4	Paffhausen and Seggewiss (1976)	J.D. 2436814.4184 + $0^d.94501435$
5	Srivastava and Sinha (present observations)	J.D. 2436814.440 + $0^d.472502$

TABLE IV

Amplitudes of DX Aqr

Sl. no.	Author	Wavelength	Amplitude of primary minimum	Amplitude of secondary minimum
1	Strohmeier *et al.* (1965)	pg	$0^m.8$	–
2	Strohmeier (1966)	pg	$0^m.6$	$0^m.3$
3	Srivastava and Sinha	*U*	$0^m.39$	$0^m.13$
	(present observations)	*B*	$0^m.37$	$0^m.10$
		V	$0^m.29$	$0^m.17$

TABLE V

Colours of DX Aqr and comparison star

Sl. no.	Phase	$B-V$	$U-B$	Sp.	Tentative *uv*-depression
1	Maximum (combined colour of both the components)	$+0^{m}.96$	$+0^{m}.44$	G8III	$0^{m}.28$
2	Tip of primary minimum (colour of the secondary component)	$+1^{m}.02$	$+0^{m}.46$	K0III	$0^{m}.40$
3	Primary component	$+0^{m}.75$	$+0^{m}.47$	G4III	$0^{m}.09$
4	Tip of secondary minimum (complete colour of primary component and partial colour of secondary component)	$+0^{m}.89$	$+0^{m}.46$	G6III	$0^{m}.16$
5	Comparison star	$+0^{m}.55$	$+0^{m}.40$	F6I	$0^{m}.03$

has also been constructed to find a suitable period. A period of $0^{d}.472502$ is found after trials to produce smooth integrated curves, and the new ephemeris, is:

$$\text{Pr. Min.} = \text{J.D. } 2436\,814.440 + 0^{d}.472\,502E\,.$$

The new period has been obtained by combining the epoch given by Strohmeier (1966) and present epochs of primary and secondary minima. The error in period determination is $\pm 0^{d}.000\,003$.

It is difficult to point out the source of discrepancy in obtaining the period of the system by earlier authors because the only observations of primary minima given by Strohmeier (1966) are available in the literature.

Olsen (1976) has given only four observations out side the eclipse and five observations during the total eclipse phase, but did not publish the detailed observations of each filter. However, he stated that the primary minimum was followed for five hours. No mention about the observations of the secondary minimum was made. Also, the spectroscopic observations of DX Aqr, given by Paffhausen and Seggewiss (1976), are scanty. Only the photographic times of minima given by Strohmeier (1966) are available in the literature, which show large, fluctuations in O–C values ranging from $-0^{d}.059$ to $+0^{d}.083$. However, neither complete light-time observations of Strohmeier *et al.* (1965) or of Strohmeier (1966) are available in the literature, nor are their light curves traceable.

4. Amplitudes and Durations of Minima

From present observations, the average amplitudes of primary and secondary minima come out to be $0^{m}.35$ and $0^{m}.13$, respectively. These amplitudes are nearly half the amplitudes given earlier by Strohmeier *et al.* (1965) and by Strohmeier (1966). The amplitudes given by various authors are given in Table IV.

The durations of primary eclipses are $0^d.25$, $0^d.25$, and $0^d.21$ in *U*, *B*, and *V* filters, respectively, while the durations of secondary eclipses are $0^d.14$, $0^d.15$, and $0^d.16$ in these respective filters. The average durations of primary and secondary eclipses are $0^d.24$ and $0^d.15$, respectively.

5. Duration of Totality

There are indications that the primary eclipse is total occultation and the secondary eclipse is an annular one. From our observations the durations of totality in *U*, *B*, *V* filters come out to be $0^d.05$, $0^d.06$, and $0^d.05$, respectively. Olsen (1976) has also indicated that the primary eclipse is total and he has given a duration of totality of twenty minutes (or $0^d.014$), which is about one-third the duration of totality derived by us (seventy two minutes or $0^d.05$).

6. Colour and Luminosity Classification

The colour indices ($B - V$ and $U - B$) of the comparison star were obtained on four nights randomly chosen, the average colour being, $B - V = +0^m.547$ ($\pm 0^m.169$) and $U - B = +0^m.396$ ($\pm 0^m.106$). These values of the colour indices agree fairly well with those of a star of spectral type F6 and of luminosity class I (Arp, 1958). The colours of the system have been determined by reading $\Delta(B - V)$ and $\Delta(U - B)$ values from the integrated light curves and adding the colours of the comparison star to these values.

The colour indices of the individual components have been derived assuming the primary eclipse to be a total occultation. The values of ΔU, ΔB, and ΔV have been read out at the maximum phase (outside the eclipse), where the combined light of both the components is observed, and also at the tip of the primary minimum (during the phase of totality), where the light of the fainter and bigger secondary component is recorded. These are then converted into respective intensities. The respective intensities of the fainter component, thus obtained, are subtracted from the respective intensities at maximum, thereby yielding the intensities of the brighter and smaller component. The respective intensities of the smaller component are then converted to magnitudes to find ΔU, ΔB, and ΔV values. Thus $\Delta(B - V)$ and $\Delta(U - B)$ values for the primary and the secondary components are derived. To these ($\Delta B - V$ and $\Delta U - B$) values, the $B - V$ and $U - B$ values of the comparison star are added, thereby yielding the colour indices ($B - V$, $U - B$) of the primary and the secondary components. The colour indices at different phases have been obtained and are listed in Table V.

The mean tentative ultraviolet depression, estimated from the colour of various phases of the system (Table V), comes out to be of the order of $0^m.2$ on the basis of a comparison of the observed colours with the colour sequences given by Arp (1958). However, these colour indices are tentative, because of large scatter in *U* observations, and due to absence of spectroscopic data of individual components, and also owing to

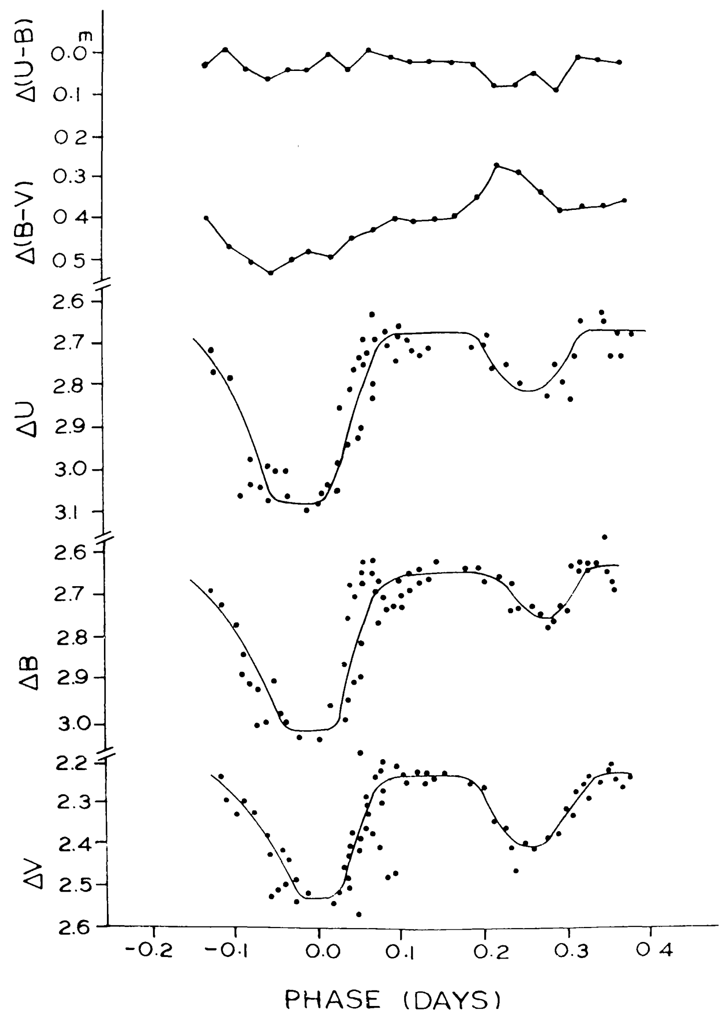

Fig. 1. Light and colour curves of DX Aqr. The solid lines indicate the smoothed light curves in U, B, and V filters.

TABLE VI

Spectral types of DX Aqr given by various authors

Star	Strohmeier *et al.* (1965) and Strohmeier (1966)	Popper (1966)	Cowley *et al.* (1969)	Olsen (1976)	Paffhausen and Seggewiss (1976)	Srivastava and Sinha (present observations)
Primary component	–	–	–	A8	–	G4
Secondary component	–	–	–	G1	–	K0
System (primary and secondary components	A2	A	A2	F4	A2	G8

contamination from the light of the visual companion. The colour indices ($\Delta(B-V)$ and $\Delta(U-B)$) have been obtained (at $0^d.025$ interval) from ΔU, ΔB, and ΔV light curves throughout the cycle and are listed in Table X and are plotted on the top of Figure 1. These colour indices show variation throughout the cycle, and this finding of ours is in agreement with the finding of Olsen (1976), that strong colour changes are present during the eclipse phase. Present spectral classes, presented in Table VI, are considerably different from those given by earlier authors.

Olsen (1976) has not assigned any spectral class either to the system or to either of the components. However, he pointed out that the primary may be a total eclipse and gave $b-y$ and m_1 and C_1 values of colour indices at maximum phase (outside eclipse), which indicate that the system belongs to spectral type F4 (vide the standard $b-y$ and m_1 relation given by Strömgren, 1963). Olsen has also given the colours at the time of totality of primary eclipse. Considering the primary eclipse to be a total occultation, the spectral classes of the primary and the secondary components from Olsen's (1976) observations, come out to be A8 and G1, respectively.

Paffhausen and Seggewiss (1976) deduced the spectroscopic orbit of the system. However, they did not present $a \sin i$ and $m \sin^3 i$ values of the individual components, hence it is difficult to confirm the luminosity classes of the individual components.

7. Nature of the Variability of DX Aqr

No definite type of the variability of the system (Algol, Beta Lyrae, W UMa type) is available in the literature. However, Strohmeier *et al.* (1965) indicated that the system may belong either to Algol or to Beta Lyrae type. Our observations between primary and secondary minima (i.e., outside eclipses) show no detectable variation. Considering this fact, and looking at the various light curve characteristics given by Strohmeier (1972), we infer that DX Aqr is an Algol-type system.

8. Interesting Features of DX Aqr

The following interesting features are evident from the light curves of DX Aqr obtained by us:

(i) Looking at the integrated light curves in different filters around the primary eclipse, we find that the primary minimum appears to be asymmetric, the descending branch being less steep than the ascending one (Figure 1).

(ii) The secondary minimum also appears to be asymmetric. The descending branch is steeper than the ascending branch.

(iii) The secondary minima do not fall half a period apart, but occur subsequently (shifted toward the right-hand side) by nearly $0^d.03$ (vide Table II).

(iv) The primary minima are shifted earlier by nearly $0^d.03$ (vide Table II).

(v) The durations of the primary and the secondary minima are unequal (vide Figure 1 and Table IV). These are, respectively, $0^d.24$ and $0^d.15$.

(vi) The variation in differential colour indices is considerable (vide Figure 1). The

TABLE VII

Standard U magnitudes of DX Aqr

J.D. (Hel.)	Phase	Δm	J.D. (Hel.)	Phase	Δm
2443072.1479	$-0\overset{d}{.}1116$	$2\overset{m}{.}714$	.2169	$0\overset{d}{.}2481$	$2\overset{m}{.}719$
.1607	−0.0976	2.759	.2202	0.2613	2.782
.1722	−0.0856	2.756	192.1043	0.0181	3.043
073.1225	−0.0790	3.041	.1126	0.0264	2.988
.1369	−0.0646	3.045	.1222	0.0360	2.922
.1476	−0.0539	2.992	.1310	0.0447	2.766
.1584	−0.0431	3.007	.1391	0.0529	2.733
.1688	−0.0327	3.004	.1461	0.0599	2.736
.1862	+0.0262	2.855	.1620	0.0758	2.622
.1952	0.0352	2.846	.1782	0.0920	2.688
.2051	0.0451	2.818	.1857	0.0995	2.688
.2155	0.0564	2.687	.1929	0.1067	2.658
.2255	0.0664	2.602	.2010	0.1149	2.702
2444139.0751	−0.0909	3.056	.2088	0.1226	2.736
.0908	−0.0752	2.980	215.0896	0.3233	2.763
.1064	−0.0596	3.083	.0992	0.3328	2.507
.1239	−0.0421	3.075	.1098	0.3435	2.466
.1381	−0.0279	3.072	.1198	0.3534	2.638
.1562	−0.0098	3.121	.1310	0.3646	2.777
.1808	+0.0158	3.054	.1408	0.3745	2.789
.2014	0.0372	3.062	6.1505	0.3842	2.697
.2163	0.0521	2.919	525.2390	0.0389	3.134
.2298	0.0656	2.926	.2604	0.0602	2.927
.2424	0.0782	2.806	.2781	0.0783	2.949
.2551	0.0909	2.711	.2863	0.0865	3.054
175.1827	0.0984	2.765	526.2053	0.0602	2.758
.1920	0.1077	2.707	.2151	0.0701	2.731
.2105	0.1262	$2\overset{m}{.}767$	.2256	0.0805	2.703
.2195	0.1353	2.735	531.1493	0.2791	2.854
177.1607	0.1945	2.730	.1594	0.2892	2.772
.1686	0.1993	2.725	.1685	0.2983	2.818
.1814	0.2125	2.778	.1878	0.3176	2.639
.1896	0.2207	2.699	.2189	0.3487	2.662
.2085	0.2397	2.733	.2307	0.3605	2.827

variation in $\Delta(B - V)$ is of the order of $0\overset{m}{.}10$, while the variation in $\Delta(U - B)$ is nearly $0\overset{m}{.}05$ from the maximum level. Considering primary eclipse to be a total occultation, the colour curves (Figure 1) show that the star which is in front at the primary eclipse (i.e., the fainter star) is fainter visually but brighter photographically (and also indicating ultraviolet contribution).

(vii) Large scatter is present during the primary eclipse phase.

9. Discussion

Due to scanty observations, it is premature to attempt the interpretation of the above mentioned features definitely, however, the following can be anticipated:

TABLE VIII

Standard *B* magnitudes of DX Aqr

J.D. (Hel.)	Phase	Δm	J.D. (Hel.)	Phase	Δm
2443072.1483	$-0\overset{d}{.}1112$	$2\overset{m}{.}676$	.2089	$0\overset{d}{.}2400$	$2\overset{m}{.}683$
.1613	−0.0982	2.719	.2175	0.2486	2.726
.1729	−0.0861	2.732	.2206	0.2617	2.740
073.1231	−0.0784	2.921	192.1047	0.0185	2.963
.1373	−0.0646	2.923	.1131	0.0268	2.864
.1481	−0.0539	2.902	.1227	0.0365	2.760
.1588	−0.0427	2.887	.1315	0.0452	2.701
.1694	−0.0321	2.892	.1465	0.0603	2.671
.1867	+0.0267	2.755	.1625	0.0763	2.585
.1953	0.0353	2.727	.1703	0.0840	2.666
.2055	0.0455	2.683	.1787	0.0924	2.713
.2155	0.0564	2.687	.1861	0.0999	2.744
.2161	0.0570	2.606	.1932	0.1070	2.732
.2261	0.0670	2.527	.2013	0.1152	2.717
2444139.0757	−0.0903	2.887	.2092	0.1231	2.688
.0914	−0.0746	2.838	215.0795	0.3132	2.640
.1069	−0.0591	2.998	.0903	0.3240	2.648
.1243	−0.0417	2.983	.0997	0.3334	2.625
.1387	−0.0289	2.996	.1103	0.3440	2.635
.1814	+0.0162	3.059	.1202	0.3538	2.655
.2018	0.0376	2.953	.1315	0.3651	2.710
.2167	0.0525	2.914	525.2390	0.0389	3.006
.2302	0.0660	2.809	.2608	0.0607	2.902
.2433	0.0791	2.778	.2784	0.0786	2.893
.2556	0.0914	2.735	.2869	0.0872	2.904
175.1749	0.0906	2.659	526.1927	0.0476	2.621
.1831	0.0994	2.672	.2057	0.0607	2.652
.1924	0.1081	2.654	.2154	0.0703	2.639
.2039	0.1196	2.667	.2260	0.0810	2.684
.2110	0.1267	2.640	531.1498	0.2796	2.794
.2198	0.1356	2.665	.1598	0.2896	2.759
.2293	0.1452	2.602	.1689	0.2987	2.736
177.1613	0.1950	2.652	.1785	0.3083	2.745
.1691	0.1999	2.644	.1982	0.3280	2.653
.1818	0.2129	2.670	.2195	0.3493	2.574
.1900	0.2211	2.670	.2312	0.3610	2.708
.1993	0.2304	2.759			

(a) About (i), (ii), (vi), and (vii), we make reference to Strohmeier *et al.* (1965), who suspected that the system may also be of Beta Lyrae type. However, our present observations rule out this possibility.

(b) Discordances in the branches of the primary and the secondary minima and colour variation during totality do indicate that one of the components of the system may itself be an intrinsic variable. Although, our present observations are scanty and it may be difficult to reach a conclusion in this regard, yet further work is being carried out to find the reality.

(c) Regarding (iii), (iv), and (v), no definite conclusion can be drawn until and unless the period of the system is finally established, and more and more observations are compiled. However, we may make a comment that the eccentricity may be present in the system. Our observations show that the primary minimum falls at $-0^{d}.03$ (or $0^{P}.937$) and the secondary minimum falls at $0^{d}.2663$ (or $0^{P}.563$), showing a shift of nearly $0^{d}.03$ (vide Table II) towards right-hand side from its mean position ($0^{P}.5$). Also the durations of primary and secondary minima are $0^{d}.24$ and $0^{d}.15$, respectively. These features show that the system may belong to third category of eccentric orbits (vide Binnendijk, 1960a),

TABLE IX

Standard V magnitudes of DX Aqr

J.D. (Hel.)	Phase	Δm	J.D. (Hel.)	Phase	Δm
2443072.1488	$-0^{d}.1107$	$2^{m}.242$	.2210	$0^{d}.2621$	$2^{m}.434$
.1619	−0.0988	2.294	192.1137	0.0274	2.533
.1729	−0.0861	2.333	.1230	0.0367	2.523
073.1243	−0.0772	2.554	.1319	0.0456	2.498
.1379	−0.0636	2.540	.1399	0.0536	2.383
.1484	−0.0531	2.515	.1469	0.0607	2.295
.1593	−0.0422	2.516	.1549	0.0687	2.386
.1699	−0.0316	2.491	.1629	0.0767	2.422
.1872	+0.0272	2.458	.1708	0.0846	2.442
.1960	0.0360	2.404	.1791	0.0929	2.491
.2059	0.0460	2.376	.1865	0.1002	2.481
.2167	0.0576	2.303	.1936	0.1074	2.523
2444139.0762	−0.0898	2.304	.2017	0.1156	2.538
.0918	−0.0742	2.335	.2095	0.1233	2.523
.1073	−0.0587	2.432	215.0801	0.3138	2.289
.1248	−0.0412	2.419	.0907	0.3244	2.268
.1391	−0.0269	2.443	.1004	0.3341	2.261
.1572	−0.0078	2.534	.1107	0.3443	2.261
.1819	+0.0167	2.556	.1205	0.3541	2.244
.2023	0.0381	2.405	.1319	0.3656	2.263
.2173	0.0531	2.385	.1416	0.3753	2.276
.2307	0.0665	2.300	.1515	0.3851	2.263
.2437	0.0795	2.278	525.2399	0.0398	2.430
.2560	0.0918	2.245	.2519	0.0518	2.426
175.1753	0.0910	2.251	.2612	0.0611	2.344
.1836	0.0995	2.256	.2787	0.0790	2.313
.1928	0.1085	2.235	.2872	0.0875	2.366
.2043	0.1200	2.257	526.2062	0.0611	2.379
.2113	0.1271	2.243	.2160	0.0710	2.239
.2203	0.1361	2.247	.2264	0.0814	2.265
.2299	0.1457	2.239	531.1501	0.2799	2.393
177.1618	0.1955	2.271	.1602	0.2900	2.391
.1695	0.2006	2.286	.1694	0.2992	2.326
.1821	0.2132	2.367	.1789	0.3087	2.347
.1905	0.2216	2.377	.1887	0.3185	2.296
.1998	0.2310	2.427	.1986	0.3284	2.313
.2093	0.2405	2.483	.2205	0.3403	2.229
.2179	0.2490	2.421	.2317	0.3615	2.250

TABLE X

Colour indices of DX Aqr

Phase	$\Delta(B-V)$	$\Delta(U-B)$
$-0^d.125$	$0^m.410$	$0^m.040$
-0.100	0.480	0.000
-0.075	0.510	0.050
-0.050	0.540	0.080
-0.025	0.510	0.060
0.000	0.510	0.060
$+0.025$	0.500	0.020
0.050	0.460	0.060
0.075	0.440	0.010
0.100	0.410	0.030
0.125	0.420	0.040
0.150	0.420	0.040
0.175	0.410	0.040
0.200	0.370	0.050
0.225	0.290	0.100
0.250	0.310	0.100
0.275	0.360	0.070
0.300	0.410	0.120
0.325	0.400	0.030
0.350	0.400	0.040
0.375	0.380	0.050

where $i = 90°$ and the orientation of the major axis is in some general direction. One should then find a phase shift (i.e., the minima are not separated $\frac{1}{2}P$ apart) and unequal durations of minima. It is pertinent to mention that Paffhausen and Seggewiss (1976) neglected the small eccentricity present in their spectroscopic observations.

In this context, we may also expect a different feature present in the system. The primary is shifted earlier ($-0^d.03$) from its mean position, while the secondary is shifted latter ($+0^d.03$) from its mean position, hence, one may also expect the presence of rotation of line of apsides (vide Binnendijk, 1960b). More observations are needed over a span of long time to confirm it.

(d) As regards (vi), we may add the reference of Olsen (1976), who pointed out that the strong change in the colour indices during the eclipse reflects the dominating influence of the visual companion. Also, we may make mention of Wood (1946), who during the study of AR Lac, pointed out that the G5 star is the one eclipsed at primary minimum is borne out by colour measures. These show a large positive colour index (and hence later spectral type) at primary than at normal light. The reverse is true at secondary. Wood (1946) had suspected that one of the components may be intrinsically variable. Although, we have used the smallest diaphragm, yet the contamination of the light from the visual companion can not be separated. But the significant thing is that our observations show a definite change from later to earlier spectral type as the star emerges from the eclipse at primary minimum. This shows that the star eclipsed at primary minimum is of earlier spectral type. Visual companion acting as the third body of the system can also cause colour changes.

Further photoelectric observations of DX Aqr are in progress for better understanding of the system.

10. Conclusions

Although, the present results are tentative, yet they reflect some of the gross features of the system. In our opinion, the system seems to be very complicated, and the uncertainty hangs over every feature present in the system. Further observations of DX Aqr are needed to throw a definite light on the intrinsic light variations, the eccentricity, the rotation of line of apsides, the presence of a third body, and also to establish a suitable period of the system.

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