PHOTOELECTRIC STUDY OF AW UMa

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Abstract. *UBV* photoelectric photometry of the eclipsing binary system AW UMa has been presented. A slightly improved period of $0\overset{\mathrm{d}}{.}4387304$ has been given. The colour of the system has been discussed. Eccentricity is present in the system. Light and colour curves show that intrinsic light variations may be present in the system. The presence of mass transfer is a possibility.

1. Introduction

The variability of the eclipsing binary system AW UMa (= BD + 30°2163 = = HD 099946) was discovered by Paczynski (1963) and preliminary details were given by Paczynski (1964). Kalish (1965) confirmed the variability of the system from his *V* observations. Eggen (1967) also observed the system but his results were not conclusive. Mauder (1972) obtained orbital elements and absolute dimensions. Mochnacki and Doughty (1972) presented a model for W UMa systems having total eclipses. Rucinski (1973) also presented a method for deriving elements of W UMa systems including AW UMa. Wilson and Devinney (1973) obtained complete elements of the system AW UMa. Oschepkov (1974) searched for polarization in the system. Piirola (1975, 1977) also searched for intrinsic polarization in AW UMa. Dworak and Kurpinska (1975) presented *V* photoelectric observations of AW UMa. Ferland and McMillan (1976) attempted differential photometry of the system. Al-Naimiy (1978) obtained the elements of the system. Hart *et al.* (1979) presented the minima of AW UMa. Mikolajewska and Mikolajewski (1980) presented *B* and *V* light curves of the system. Istomin *et al.* (1980) gave orbital elements of AW UMa.

Recently, Woodward *et al.* (1980) secured four-colour observations of AW UMa and Hrivnak (1982) obtained green and red observations of the system. Woodward *et al.* (1980) found small changes in the colour indices. Hrivnak (1982) suspected some intrinsic variability in the system, but could not ascertain the source of the variability. Anderson *et al.* (1983) obtained spectrographic observations of AW UMa and used rotational broadening of spectral lines in deriving the shape and surface brightness distribution of the system. Our present photometric observations were carried out to see whether intrinsic light variations are present in the system and to analyse its light curves further.

2. Observations

The system was observed photoelectrically on the 38-cm reflector of the Uttar Pradesh State Observatory, using a cooled (− 20 °C) 1P21 photomultiplier tube and *UBV* filters

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TABLE I

Standard U magnitudes of AW UMa

J.D. (Hel.)	Phase	ΔU	J.D. (Hel.)	Phase	ΔU	J.D. (Hel.)	Phase	ΔU
2445767.1718	0.6197	$-0^m.449$	2445782.2029	0.8800	$-0^m.252$	2445821.2604	0.9036	$-0^m.278$
1857	0.6513	−0.448	2127	0.9023	−0.270	2704	0.9264	−0.290
1932	0.6684	−0.491	2233	0.9265	−0.211	2757	0.9385	−0.238
2008	0.6858	−0.471	783.0890	0.8997	−0.243	2767	0.9408	−0.242
2085	0.7033	−0.482	0995	0.9236	−0.205	2775	0.9426	−0.246
2309	0.7544	−0.437	1109	0.9496	−0.220	2910	0.9734	−0.247
2397	0.7744	−0.409	1185	0.9669	−0.298	2921	0.9759	−0.259
2481	0.7936	−0.367	1255	0.9829	−0.274	2934	0.9789	−0.268
2593	0.8191	−0.385	1330	0.0000	−0.300	2944	0.9811	−0.268
768.0930	0.7194	−0.459	1397	0.0152	−0.275	3070	0.0099	−0.279
1022	0.7403	−0.527	1471	0.0321	−0.323	3111	0.0192	−0.289
1098	0.7576	−0.488	1562	0.0529	−0.366	825.1264	0.7154	−0.532
1434	0.8342	−0.366	1642	0.0711	−0.411	1361	0.7375	−0.513
1535	0.8572	−0.323	1722	0.0893	−0.464	1427	0.7526	−0.523
1672	0.8885	−0.255	1798	0.1066	−0.473	1453	0.7585	−0.503
1776	0.9122	−0.254	1873	0.1237	−0.498	1539	0.7781	−0.451
1932	0.9477	−0.199	1968	0.1454	−0.486	1640	0.8011	−0.442
2018	0.9673	−0.241	2041	0.1620	−0.455	1718	0.8189	−0.449
2150	0.9974	−0.248	2121	0.1803	−0.489	1741	0.8241	−0.416
2181	0.0045	−0.211	2195	0.1971	−0.495	1759	0.8282	−0.407
2198	0.0084	−0.272	2262	0.2124	−0.533	1837	0.8460	−0.360
2223	0.0141	−0.301	795.1155	0.3117	−0.409	1888	0.8576	−0.389
2242	0.0184	−0.308	1239	0.3308	−0.323	1918	0.8645	−0.325
2278	0.0266	−0.314	1308	0.3465	−0.324	1945	0.8607	−0.309
2411	0.0569	−0.355	1388	0.3648	−0.333	1962	0.8745	−0.307
2451	0.0660	−0.379	1464	0.3821	−0.314	2018	0.8873	−0.314
2478	0.0722	−0.421	1544	0.4003	−0.276	2079	0.9012	−0.290
2509	0.0793	−0.425	1623	0.4183	−0.255	2096	0.9050	−0.288
2527	0.0834	−0.435	1756	0.4486	−0.282	2159	0.9194	−0.282
2620	0.1046	−0.458	1828	0.4650	−0.272	840.1109	0.8695	−0.390
2675	0.1171	−0.491	821.1827	0.7265	−0.506	1419	0.9402	−0.238
769.1971	0.2359	−0.471	1939	0.7521	−0.518	1487	0.9557	−0.240
2107	0.2669	−0.441	2033	0.7735	−0.491	1545	0.9689	−0.203
2227	0.2943	−0.422	2114	0.7920	−0.453	1621	0.9862	−0.214
2250	0.2995	−0.415	2189	0.8090	−0.421	1673	0.9981	−0.151
2321	0.3157	−0.395	2241	0.8209	−0.424	1713	0.0072	−0.271
2327	0.3171	−0.381	2296	0.8334	−0.395	1757	0.0172	−0.188
2357	0.3239	−0.403	2312	0.8371	−0.366	1802	0.0275	−0.312
2367	0.3262	−0.396	2352	0.8462	−0.377	1850	0.0384	−0.320
2414	0.3369	−0.358	2406	0.8585	−0.347	1894	0.0484	−0.163
2442	0.3411	−0.342	2469	0.8729	−0.343	1926	0.0557	−0.419
2507	0.3581	−0.326	2504	0.8808	−0.310	1950	0.0612	−0.346
2524	0.3620	−0.332	2564	0.8945	−0.263			
782.1926	0.8565	−0.295	2579	0.8979	−0.271			

Table I (continued)

Standard *B* magnitudes of AW UMa

J.D. (Hel.)	Phase	ΔB	J.D. (Hel.)	Phase	ΔB	J.D. (Hel.)	Phase	ΔB
2445767.1701	0.6158	$-0^{\mathrm{m}}.433$	2445768.2187	0.0059	$-0^{\mathrm{m}}.248$	2445795.1242	0.3315	$-0^{\mathrm{m}}.318$
1851	0.6500	−0.430	2207	0.0104	−0.284	1311	0.3472	−0.346
1945	0.6714	−0.473	2229	0.0151	−0.284	1389	0.3650	−0.311
2013	0.6869	−0.445	2251	0.0204	−0.285	1469	0.3832	−0.289
2089	0.7042	−0.452	2282	0.0275	−0.289	1550	0.4017	−0.262
2206	0.7309	−0.455	2417	0.0583	−0.338	1628	0.4195	−0.246
2234	0.7373	−0.459	2459	0.0679	−0.355	1759	0.4493	−0.289
2252	0.7414	−0.460	2491	0.0752	−0.409	1831	0.4657	−0.281
2267	0.7448	−0.442	2514	0.0804	−0.407	821.1849	0.7316	−0.490
2280	0.7478	−0.434	2532	0.0845	−0.411	1944	0.7532	−0.482
2293	0.7507	−0.440	2633	0.1075	−0.444	2039	0.7749	−0.480
2314	0.7555	−0.424	2679	0.1180	−0.474	2120	0.7933	−0.432
2324	0.7578	−0.409	769.1980	0.2380	−0.429	2193	0.8100	−0.416
2333	0.7598	−0.408	2112	0.2681	−0.405	2245	0.8218	−0.411
2348	0.7633	−0.407	2233	0.2956	−0.394	2301	0.8346	−0.374
2372	0.7687	−0.413	2245	0.2984	−0.393	2316	0.8380	−0.348
2421	0.7799	−0.358	2317	0.3148	−0.379	2357	0.8473	−0.364
2452	0.7870	−0.357	2333	0.3184	−0.363	2409	0.8592	−0.331
2593	0.8191	−0.360	2349	0.3221	−0.384	2474	0.8740	−0.301
2628	0.8271	−0.355	2373	0.3276	−0.373	2510	0.8822	−0.267
2651	0.8323	−0.354	2420	0.3383	−0.331	2568	0.8954	−0.235
2679	0.8387	−0.337	2434	0.3415	−0.325	2584	0.8991	−0.247
2788	0.8635	−0.334	2512	0.3592	−0.312	2607	0.9043	−0.255
2798	0.8658	−0.326	2522	0.3615	−0.313	2710	0.9278	−0.238
2809	0.8683	−0.318	782.1930	0.8574	−0.320	2790	0.9460	−0.244
2818	0.8704	−0.309	2032	0.8807	−0.234	2802	0.9488	−0.246
2827	0.8724	−0.309	2133	0.9037	−0.260	2814	0.9515	−0.235
2833	0.8738	−0.301	2238	0.9276	−0.170	2825	0.9540	−0.235
2841	0.8756	−0.308	2032	0.8807	−0.234	2832	0.9556	−0.247
2850	0.8777	−0.281	2133	0.9037	−0.260	2954	0.9834	−0.247
2863	0.8806	−0.325	2238	0.9276	−0.170	2966	0.9861	−0.248
2878	0.8841	−0.274	783.0898	0.9015	−0.237	2972	0.9875	−0.248
2910	0.8914	−0.260	0999	0.9245	−0.202	2981	0.9896	−0.251
2926	0.8950	−0.253	1113	0.9505	−0.193	2991	0.9918	−0.242
2946	0.8996	−0.251	1190	0.9681	−0.265	3000	0.9939	−0.254
2962	0.9032	−0.262	1261	0.9842	−0.251	3075	0.0110	−0.250
2982	0.9078	−0.271	1334	0.0009	−0.273	3114	0.0199	−0.251
3005	0.9130	−0.279	1400	0.0159	−0.257	825.1274	0.7177	−0.533
3046	0.9224	−0.263	1476	0.0333	−0.283	1367	0.7389	−0.517
3056	0.9246	−0.254	1562	0.0538	−0.344	1432	0.7537	−0.502
3073	0.9285	−0.254	1647	0.0722	−0.396	1459	0.7598	−0.483
768.0936	0.7207	−0.425	1727	0.0905	−0.443	1543	0.7790	−0.428
1440	0.8356	−0.337	1803	0.1078	−0.456	1646	0.8025	−0.436
1543	0.8591	−0.270	1877	0.1247	−0.502	1726	0.8207	−0.385
1678	0.8898	−0.288	1973	0.1465	−0.480	1749	0.8259	−0.398
1782	0.9135	−0.235	2126	0.1814	−0.468	1767	0.8300	−0.385
1937	0.9489	−0.167	2198	0.1978	−0.489	1842	0.8471	−0.340
2023	0.9685	−0.204	2266	0.2133	−0.533	1894	0.8590	−0.351
2157	0.9990	−0.222	795.1158	0.3123	−0.353	1928	0.8667	−0.295

Table I (continued)

Standard B magnitudes of AW UMa

J.D. (Hel.)	Phase	ΔB	J.D. (Hel.)	Phase	ΔB	J.D. (Hel.)	Phase	ΔB
2445825.1948	0.8713	$-0^m.275$	2445825.2184	0.9251	$-0^m.253$	2445840.1715	0.0076	$-0^m.239$
1968	0.8759	−0.277	840.1112	0.8702	−0.325	1759	0.0177	−0.221
2023	0.8884	−0.308	1422	0.9409	−0.180	1803	0.0277	−0.272
2085	0.9025	−0.279	1489	0.9561	−0.200	1852	0.0389	−0.303
2120	0.9105	−0.278	1547	0.9694	−0.188	1927	0.0560	−0.376
2127	0.9121	−0.271	1622	0.9865	−0.171	1951	0.0614	−0.356
2137	0.9144	−0.269	1675	0.9985	−0.199	1952	0.0617	−0.347

Standard V magnitudes of AW UMa

J.D. (Hel.)	Phase	ΔV	J.D. (Hel.)	Phase	ΔV	J.D. (Hel.)	Phase	ΔV
2445767.1693	0.6140	$-0^m.329$	2445768.2683	0.1189	$-0^m.372$	2445795.1316	0.3483	$-0^m.218$
1857	0.6513	−0.343	769.1971	0.2359	−0.380	1393	0.3659	−0.197
1950	0.6725	−0.391	2117	0.2692	−0.330	1472	0.3839	−0.179
2018	0.6880	−0.399	2236	0.2963	−0.293	1555	0.4028	−0.173
2095	0.7056	−0.369	2242	0.2977	−0.303	1635	0.4211	−0.153
2211	0.7320	−0.356	2314	0.3141	−0.286	1762	0.4500	−0.168
2301	0.7525	−0.353	2338	0.3196	−0.274	1835	0.4666	−0.165
2390	0.7728	−0.331	2357	0.3239	−0.275	821.1854	0.7327	−0.401
2471	0.7913	−0.263	2379	0.3289	−0.265	1950	0.7546	−0.382
2689	0.8410	−0.233	2426	0.3396	−0.240	2044	0.7760	−0.388
2891	0.8870	−0.135	2430	0.3405	−0.242	2124	0.7942	−0.348
3028	0.9183	−0.126	2516	0.3601	−0.209	2197	0.8109	−0.315
768.0942	0.7221	−0.347	782.1933	0.8581	−0.202	2253	0.8236	−0.326
1030	0.7421	−0.351	2036	0.8816	−0.151	2305	0.8355	−0.281
1107	0.7597	−0.361	2138	0.9048	−0.143	2322	0.8394	−0.270
1213	0.7839	−0.354	783.0902	0.9024	−0.154	2362	0.8485	−0.262
1294	0.8023	−0.314	1004	0.9257	−0.129	2411	0.8596	−0.227
1446	0.8370	−0.249	1117	0.9514	−0.105	2477	0.8747	−0.196
1546	0.8598	−0.139	1193	0.9688	−0.153	2516	0.8836	−0.185
1684	0.8912	−0.168	1264	0.9849	−0.139	2572	0.8963	−0.178
1788	0.9149	−0.146	1337	0.0016	−0.167	2589	0.9002	−0.166
1948	0.9514	−0.176	1403	0.0166	−0.161	2613	0.9057	−0.177
2035	0.9712	−0.180	1481	0.0344	−0.200	2713	0.9285	−0.139
2162	0.0002	−0.180	1570	0.0547	−0.245	2835	0.9563	−0.160
2192	0.0070	−0.216	1650	0.0729	−0.286	2845	0.9586	−0.157
2215	0.0122	−0.230	1730	0.0911	−0.332	2862	0.9624	−0.163
2232	0.0161	−0.227	1805	0.1082	−0.355	3010	0.9962	−0.147
2256	0.0216	−0.233	1883	0.1260	−0.389	3021	0.9987	−0.156
2288	0.0289	−0.257	1976	0.1472	−0.357	3029	0.0005	−0.145
2423	0.0597	−0.237	2051	0.1643	−0.315	3036	0.0021	−0.158
2465	0.0692	−0.269	2131	0.1825	−0.372	3080	0.0121	−0.184
2500	0.0772	−0.286	2203	0.1990	−0.362	3118	0.0208	−0.149
2518	0.0813	−0.295	2268	0.2138	−0.392	825.1284	0.7200	−0.398
2537	0.0856	−0.295	795.1161	0.3130	−0.298	1371	0.7398	−0.405
2646	0.1105	−0.365	1245	0.3322	−0.254	1438	0.7551	−0.399

Table I (continued)

J.D. (Hel.)	Phase	ΔV	J.D. (Hel.)	Phase	ΔV	J.D. (Hel.)	Phase	ΔV
2445825.1465	0.7612	$-0^m.397$	2445825.1970	0.8763	$-0^m.183$	2445840.1677	0.9990	$-0^m.129$
1549	0.7804	−0.374	2029	0.8898	−0.183	1716	0.0079	−0.126
1649	0.8032	−0.348	2089	0.9034	−0.160	1761	0.0181	−0.116
1732	0.8221	−0.314	2096	0.9050	−0.160	1805	0.0282	−0.112
1754	0.8271	−0.327	2107	0.9075	−0.160	1853	0.0391	−0.204
1774	0.8316	−0.290	840.1113	0.9028	−0.220	1899	0.0496	−0.362
1845	0.8478	−0.263	1423	0.9411	−0.102	1928	0.0562	−0.262
1901	0.8606	−0.257	1490	0.9564	−0.131	1953	0.0619	−0.245
1933	0.8679	−0.216	1548	0.9696	−0.104			
1956	0.8731	−0.191	1624	0.9869	−0.115			

TABLE II

Differential colours of AW UMa

Phase	$\Delta(B-V)$	$\Delta(U-B)$	Phase	$\Delta(B-V)$	$\Delta(U-B)$	Phase	$\Delta(B-V)$	$\Delta(U-B)$
0.000	$-0^m.090$	$-0^m.025$	0.275	$-0^m.075$	$-0^m.030$	0.725	$-0^m.090$	$-0^m.020$
0.025	−0.060	−0.025	0.300	−0.090	−0.025	0.750	−0.124	0.000
0.050	−0.090	−0.020	0.325	−0.100	−0.030	0.775	−0.075	−0.025
0.075	−0.115	0.000	0.350	−0.105	−0.015	0.800	−0.060	−0.050
0.100	−0.095	−0.015	0.375	−0.114	−0.020	0.825	−0.060	0.000
0.125	−0.094	−0.025	0.400	−0.085	−0.015	0.850	−0.110	−0.020
0.150	−0.125	0.000	0.425	−0.090	−0.010	0.875	−0.135	+0.015
0.175	−0.110	−0.005	0.450	−0.110	0.000	0.900	−0.125	0.000
0.200	−0.110	−0.010	0.650	−0.075	−0.015	0.925	−0.100	−0.015
0.225	−0.065	−0.030	0.675	−0.060	−0.025	0.950	−0.110	−0.005
0.250	−0.051	−0.035	0.700	−0.090	−0.020	0.975	−0.100	0.000

of the Johnson and Morgan system, and a dc amplifier. A total of nine nights of observations were secured during the period February 1984 to May 1984. Two comparison stars BD + 30°2162 and BD + 31°2270 were used to begin with. However, the latter comparison star was finally chosen to obtain differential magnitudes because it is more constant than the former. Four standard stars were observed to reduce the data to the standard system. The average standard deviations (on four nights chosen randomly) for the comparison star are $\pm 0^m.016$, $\pm 0^m.021$, and $\pm 0^m.016$ in U, B, and V filters, respectively.

The standard differential magnitudes ΔU, ΔB, and ΔV and differential colour indices $\Delta(U-B)$, $\Delta(B-V)$ are in the sense 'variable minus comparison' and are given in Tables I and II, respectively. The photoelectric observations of the variable star listed in Table I are plotted against phase in Figure 1.

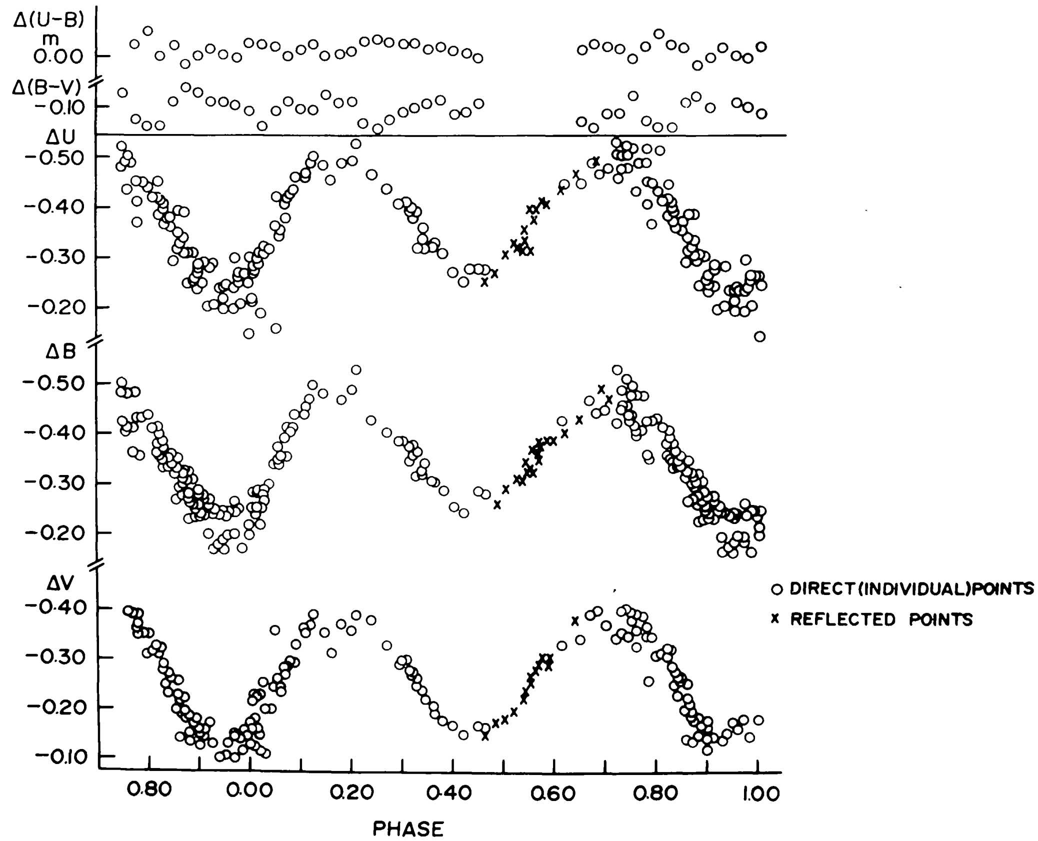

Fig. 1. Light and colour curves of AW UMa.

3. Epoch and Period

During the course of our observations the times of minima shown below have been determined by a graphical method with an accuracy of $0\overset{d}{.}0007$.

Primary minima J.D. (Hel.)	Secondary minimum J.D. (Hel.)
2445768.1950	2445795.1712
783.1060	
821.2742	

Using the epoch given by Kalish (1965), viz.,

$$\text{Pr. Min.} = \text{J.D. } 2438044.7815 + 0\overset{d}{.}4387318E\,,$$

it is found that the primary and secondary minima are shifted earlier by $0\overset{p}{.}05$ from the expected positions as shown in Figure 1. Using the primary minima observed by us, an improved period of $0^{\rm d}\!.438\,7304$ has been obtained. The period seems to have decreased slightly since Dworak and Kurpinska's (1975) observations.

4. Analysis of the Light Curves

The *UBV* light curves (Figure 1) of the system under study are fairly well covered except between the phases 0.47 and 0.60, which is no limitation in discussing the light curve features. The mean depths of primary and secondary minima differ by $0^{\rm m}\!.05$. The shoulder at phase 0.715 is higher than the shoulder at phase 0.175. Kalish (1965) pointed out that the maximum at phase 0.75 is somewhat brighter than the maximum at phase 0.25. Ferland and McMillan (1976) also reported that the maximum in the *V* filter at phase 0.75 is brighter by $0^{\rm m}\!.0.15$ compared to Dworak and Kurpinska' observations.

The observed light curves (Figure 1) also reveal that the average durations of primary and secondary minima are $0^{\rm p}\!.45$ and $0^{\rm p}\!.55$, respectively. The branches of the minima are asymmetric. In addition, the primary and secondary minima are shifted earlier in phase by $0^{\rm p}\!.05$. Paczynski's (1964) observations show that the primary and the secondary minima fall at phases $0^{\rm p}\!.05$ and $0^{\rm p}\!.55$, respectively, with the two maxima falling at phases $0^{\rm p}\!.30$ and $0^{\rm p}\!.80$, while in our observations the two maxima fall nearly at phases $0^{\rm p}\!.18$ and $0^{\rm p}\!.72$. These results indicate not only that the durations of minima are different but also that their positions of maximum are also changing. Also, the scatter is more around the primary minimum phase.

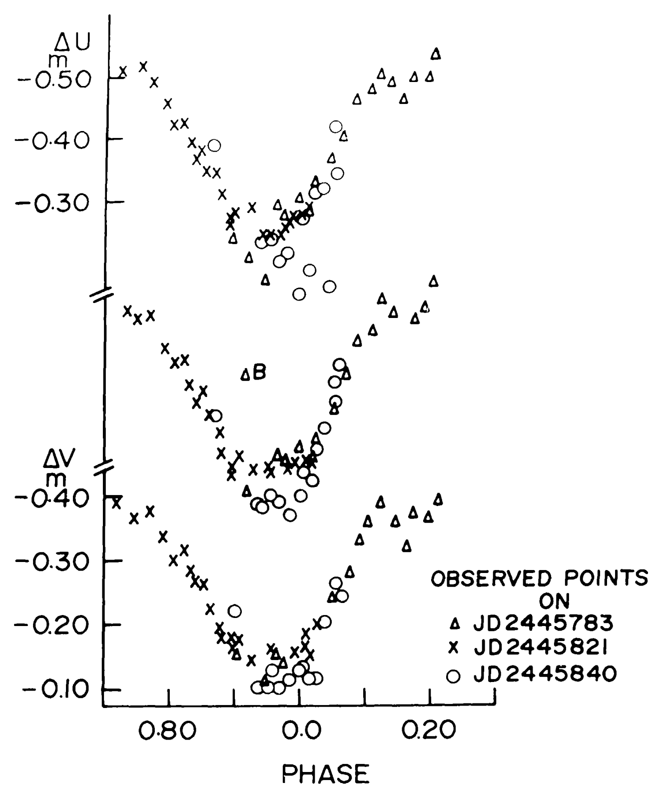

Fig. 2. Primary minima of AW UMa, showing variation of the depths and the dip at phase 0.165.

Figure 2 reveals that an appreciable change in the amplitude of the primary minimum is found on some individual nights. The depths of observed primary minima on three individual nights (Figure 2) are given below:

Primary minima J.D. (Hel.)	U	B	V	Mean
2445783	$0\overset{m}{.}28$	$0\overset{m}{.}28$	$0\overset{m}{.}27$	$0\overset{m}{.}28$
821	0.26	0.26	0.27	0.26
840	0.30	0.31	0.29	0.30

It is clear that the mean amplitude difference is about $0\overset{m}{.}04$ on the nights of J.D. 2445821 and J.D. 2445840. Also, a definite dip of $0\overset{m}{.}03$ is seen at phase 0.165 in all the filters.

Similarly, on two different individual nights (Figure 3) there is a gradual variation of light from phase 0.9 to 0.7, with a maximum variation occurring at phase 0.75. These variations can be attributed either to intrinsic light variations of one of the components – probably having multiple periods – or owing to a gaseous stream emerging from the

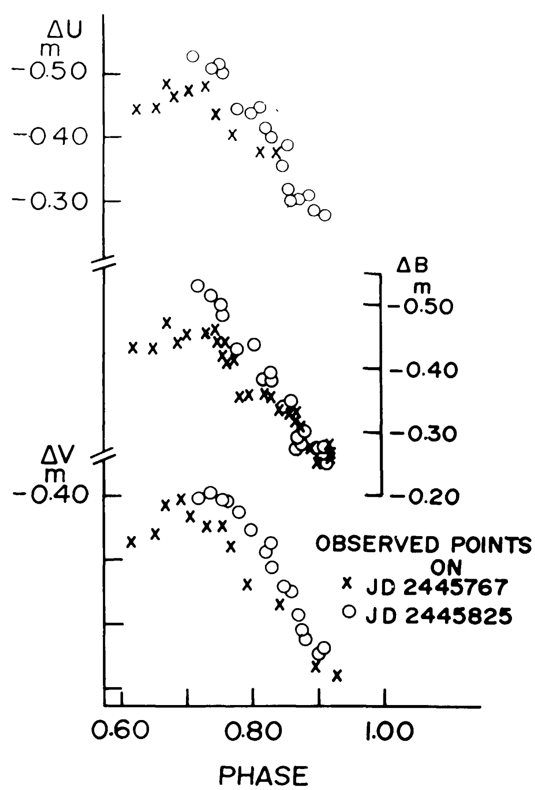

Fig. 3. Observed light curves on two individual nights showing relative variation of the light from phase 0.9 to 0.7. The magnitude difference of the two light curves is maximum at phase 0.75.

secondary component on to the primary. Hrivnak (1982) did not find an exact fit in the observed light curves and he therefore suspected the presence of intrinsic light variability.

5. Colour and Luminosity Classification

The colours ($U - B$ and $B - V$) of the comparison star have been obtained on three nights. These turn out to be $B - V = +0\overset{m}{.}416$ and $U - B = +0\overset{m}{.}111$, values which place the star in the F5III spectral-luminosity class. The colours of both the components of the system AW UMa have been obtained by the usual method from differential $\Delta(U - B)$ and $\Delta(B - V)$ magnitudes and using the colours of the comparison star. The differential (variable *minus* comparison) colours at phase interval 0.025 have been determined and are given in Table II. The colours are plotted at the top of Figure 1. The colours of the system and the individual components are given below:

	$B - V$	$U - B$	Spectral type
System (at maximum)	$0\overset{m}{.}326$	$0\overset{m}{.}091$	F2III
Primary component (bigger and brighter)	0.316	0.101	F1III
Secondary component	0.406	0.121	F5II

Eggen (1967) gave the combined colour (at maximum) of the system as $B - V = +0\overset{m}{.}36$ and $U - B = -0\overset{m}{.}01$. Our colour indices are more consistent than those of Eggen (1967) and match well with the standard colour sequences given by Golay (1974). Dworak and Kurpinska (1975) also gave the colour of the system as $B - V = +0\overset{m}{.}355$. The colour curves (at the top of Figure 1) show that the colour of the system is varying; some sort of intrinsic variation of the light is reflected. Paczynski (1964) did not find any variation in the colours.

6. Discussions and Conclusions

Our observations show a dip of $0\overset{m}{.}03$ at phase 0.165 and an elevation of $0\overset{m}{.}03$ at phase 0.715. These facts are indicative of a mass transfer process, and the mass is being transferred from the secondary component to the primary. This finding contradicts the speculation of Hrivnak (1982) that the mass is being transferred from the primary component to the secondary. The difference emerges from the fact that Hrivnak (1982) found the first maximum higher than the second by $0\overset{m}{.}005$, while our observations show that the second maximum is higher than the first by $0\overset{m}{.}03$. Our present findings indicate that the mass transfer between the components has reversed its direction. Also, we have found more scatter near the tip of the primary minimum, which suggests that star in front at the time of primary eclipse is responsible for some physical change, e.g., mass transfer.

Asymmetries present in the branches of both minima further support the idea that the mass transfer between the components is taking place. In addition, Oschepkov (1974) detected variable polarization in this system, and found a polarization maximum centred at phase 0.26. The dip in our observations near phase 0.17 is further supported by the fact that matter is centred around phase 0.2, and the same may be giving rise to the polarization.

The possibility of intrinsic light variations can not be ruled out, as the colour variations are of the order of $0^m.03$. The colour variations are present in the system throughout the cycle, suggesting that both the components have intrinsic variability. Since the tip of the primary minimum shows a larger scatter than the tip of the secondary minimum, it is possible that the intrinsic variability may be associated with the fainter component, which is more evolved (F5II) in comparison to the primary (F1III). The $\Delta(U - B)$ index shows no systematic variation in the colour, hence we infer that the variable mass transfer can create a hot spot of varying brightness, and such a spot can cause non-systematic colour changes. This possibility seems more likely, as large scatter is seen around the phase of the second maximum.

Hrivnak (1982) found small changes in the colour of the system and did not find a satisfactory fit of the computed points with the observed ones. Thus he suspected variations in the light, due either to intrinsic light changes or to mass transfer from the primary component to the secondary component or owing to prominence activity, but he could not give evidence to support any of these possibilities.

None of the earlier photometric works were satisfactory, and investigators called for further observations of the system. The period of the system does not appear to be constant. Changing depths and varying colour indices point to the possibility of intrinsic light variations present in the system. Shift of minima from their expected positions and unequal durations of minima indicate the presence of eccentricity. The maximum at phase 0.715 appears about $0^m.03$ brighter than maximum at phase 0.175 which may be due to transfer of mass from the secondary (fainter) component to the primary. The overall picture of the system suggests that the light curve is changing.

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