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Photometric Elements of the Eclipsing Binary AE Cas

by

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ABSTRACT

The light curves and *U*, *B* and *V* observations of the system AE Cas have been presented. An improved period of $0^{d}.7591215$ is given on the basis of present observations. Photometric elements of the system have been obtained by employing Kopal's method of Fourier analysis of light curves. The spectral types for the primary and secondary components have been found to be G6-7 and G9-K4, respectively.

1. Introduction

The chart and comparison stars for the system AE Cas have been given by Hoffmeister (1929) and Morgenroth (1933), respectively. Later, Hoffmeister and Van Schewick (1938) have reported the epoch, period and magnitude variation. Wood and Forbes (1963) have rediscussed the period but note that their results are of low weight due to very poor distribution in the times of observation.

2. Observations

A total of seventeen nights of observations were obtained during the years 1977 to 1980 with the 104-cm Sampurnanand telescope of the Uttar Pradesh State Observatory. An EMI 6094 S photomultiplier thermoelectrically cooled to $-20°$C, standard *U*, *B*, *V* filters of Johnson and Morgan System and d.c. techniques have been used to record the observations. The standard deviations of observations as determined from the comparison star for randomly chosen four nights range from

Table 1a

Standard differential magnitudes of AE Cas in *U* filter

JD(Hel)	Phase	Δm	JD(Hel)	Phase	Δm
2443					
435.2169	0.8583	$-0^{m}.025$	510.1675	0.5917	$-0^{m}.263$
.2174	.8590	.216	.1716	.5971	.267
.2271	.8718	.231	806.3024	.6938	.193
.2274	.8722	.191	.3401	.7434	.097
.2400	.8888	.279	.3406	.7441	.091
.2404	.8893	.222	.3528	.7602	.263
.2496	.9014	.314	.3532	.7601	.215
.2501	.9021	.328	.3657	.7772	.222
.2587	.9134	.420	.3683	.7806	.143
.2592	.9141	.380	819.2375	.7333	.221
.2696	.9278	.510	.2412	.7382	.203
.2701	.9284	.530	.2485	.7478	.194
.2985	.9658	-0.950	.2638	.7680	.193
.2991	.9666	-1.009	841.2307	.7053	.177
.3125	.9843	.335	.2313	.7061	.170
.3179	.9914	.436	.2506	.7315	.183
.3307	.0082	.384	.2511	.7322	.196
.3362	.0155	.041	.2667	.7527	.290
.3396	.0200	.047	.2673	.7535	.298
.3509	.0349	-1.031	.2804	.7707	.310
.3552	.0405	-0.667	.2812	.7718	.288
.3616	.0490	.619	.3357	.8436	.364
.3645	.0528	.598	.3396	.8487	.211
454.1090	.7451	.152	2444		
.1121	.7492	.068	144.2539	.8814	.284
.1199	.7595	.313	.2545	.8822	.240
.1228	.7633	.242	.2694	.9018	.335
.2153	.8852	.232	.2701	.9028	.304
.2158	.8858	.245	.2866	.9245	.475
.2248	.8977	.237	.2893	.9280	.517
.2254	.8985	.283	.2954	.9361	.553
.2340	.9098	.348	.2988	.9406	.610
.2345	.9105	.301	.3063	.9504	.762
.2423	.9207	.374	.3095	.9547	-0.747
.2429	.9215	.388	.3402	.9951	-1.463
.2501	.9310	.422	.3475	.0047	.314
.2506	.9317	.479	.3502	.0083	.133
.2594	.9433	.492	.3561	.0160	.074
.2598	.9438	.487	.3589	.0197	-1.037
.2748	.9635	.898	.3637	.0261	-0.863
.2778	.9675	.938	.3664	.0296	.856
.2832	.9746	-0.999	.3704	.0349	.858
.2862	.9786	-1.165	.3726	.0378	.733
.2928	.9873	.260	.3769	.0434	.708
.2954	.9907	.379	.3796	.0470	.637
.3018	.9991	-1.384	.3851	.0542	.563
.3097	.0095	-0.999	.3880	.0581	.508
.3126	.0133	-1.199	.3988	.0723	.429
.3178	.0202	-1.011	145.3112	.2742	.068
.3204	.0236	-0.988	.3217	.2880	.143
.3259	.0309	.895	.3278	.2961	.203
.3284	.0341	.759	.3379	.3094	.187
.3330	.0402	.707	511.2452	.3235	.183
.3357	.0438	.695	.2574	.3396	.208
.3414	.0513	.607	.2695	.3555	.266
.3443	.0551	.572	.2811	.3708	.206
.3489	.0612	.477	.2863	.3777	.212
.3516	.0647	.481	.2948	.3889	.233
.3565	.0712	.380	.3007	.3966	.186
.3597	.0754	.374	.3051	.4024	.259
.3698	.0887	.372	.3111	.4103	.257
.3730	.0929	.298	.3184	.4200	.288
490.0659	.1116	.215	.3270	.4313	.309
.0696	.1165	.221	.3326	.4387	.349
.0878	.1404	.241	.3353	.4422	.386
.0884	.1412	.271	.3725	.4912	.344
.1557	.2299	.209	.3795	.5004	.385
.1563	.2307	.201	.3844	.5074	.329
.1734	.2532	.202	.3923	.5173	.347
.1769	.2578	.172	.4001	.5276	.338
.1839	.2670	.198	.4045	.5334	.292
.1869	.2710	.229	.4116	.5427	.252
.2079	.2986	.250	.4161	.5487	.340
510.1215	.5311	.281	512.2478	.6443	.225
.1223	.5321	.319	.2483	.6449	.165
.1370	.5515	.324	.2608	.6614	.231
.1423	.5585	.320	.2613	.6620	.230
.1541	.5749	.275	.2737	.6784	.278
510.1582	0.5794	-0.277	512.2742	0.6790	-0.278

Table 1a — concluded

JD(Hel)	Phase	Δm	JD(Hel)	Phase	Δm
512.2812	0.6883	-0$^{\rm m}$.137	561.1867	0.1121	-0$^{\rm m}$.256
.2816	.6888	.193	.1899	.1163	.258
.2921	.7026	.235	.1951	.1231	.212
.2924	.7030	.283	.1983	.1274	.253
.2995	.7124	.083	.2081	.1403	.194
.3001	.7132	.119	.2133	.1471	.207
.3112	.7278	.113	.2194	.1551	.185
.3115	.7282	.082	.2235	.1605	.195
.3355	.7598	.110	.2324	.1723	.192
.3358	.7602	.088	.2370	.1783	.168
.3441	.7711	.163	.2435	.1869	.189
.3465	.7743	.222	.2469	.1914	.214
.3540	.7842	.201	.2780	.2323	.196
.3544	.7847	.221	.2814	.2368	.262
526.3118	.1709	.209	.2871	.2443	.172
.3150	.1752	.219	.2905	.2488	.179
.3238	.1867	.269	.3013	.2630	.142
.3243	.1874	.206	.3054	.2684	.192
.3411	.2095	.180	.3105	.2752	.224
.3417	.2103	.205	.3140	.2798	.216
.3520	.2239	.186	.3217	.2899	.171
.3550	.2278	.207	601.0964	.6856	.241
.4024	.2903	.141	.1070	.6996	.203
.4117	.3125	.108	.1156	.7109	.249
.4143	.3060	.107	.1216	.7188	.263
560.1960	.8070	.285	.1316	.7320	.215
.1975	.8090	.235	.1415	.7450	.223
.2015	.8143	.256	.1546	.7623	.233
.2120	.8281	.187	.1588	.7678	.271
.2182	.8363	.210	.1673	.7790	.210
.2267	.8474	.205	.1766	.7913	.245
.2790	.9163	.405	.1825	.7990	-0.353
.2855	.9249	.474	605.1372	.0086	-1.437
.2933	.9352	.482	.1409	.0135	.261
.2978	.9411	.611	.1471	.0216	.127
.3057	.9515	.788	.1506	.0263	-1.038
.3115	.9592	-0.901	.1606	.0394	-0.786
.3196	.9698	-1.069	.1652	.0455	.733
561.1752	.0969	-0.289	605.1686	0.0500	-0.687
561.1787	0.1015	-0.256			

0$^{\rm m}$.01 to 0$^{\rm m}$.06. The large deviation or scatter in the observations may be mainly due to the faintness of the program stars. The standard differential magnitudes are listed in Tables 1a, 1b and 1c. We had selected two comparison stars C_1 and C_2 for the study of this system. However, all the observations were finally reduced by taking only C_2 as comparison, for it was found to be better than C_1 in respect of magnitude and colour. The coordinates, magnitudes and colours of the variable and comparison stars are given in Table 2.

3. Light curve and period

The time of minimum was determined by the method of Kwee and Van Woerden (1956) from the observations on one night (JD 2443454.302) when both ascending and descending branches were well covered. The standard deviations for the time of minima in U, B, and V filters were not more than 0$^{\rm d}$.0002. The other two minima have been found graphically. The times of minima thus obtained are as follows:

JD(Hel) 244 3435.326
3454.302
4144.340

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Table 1b

Standard differential magnitudes of AE Cas in *B* filter

JD(Hel)	Phase	Δm
2443		
423.3273	0.1960	$+0^{m}.026$
.3372	.2991	.008
.3454	.2199	+0.066
435.2154	.8564	-0.041
.2180	.8598	.039
.2266	.8711	.039
.2282	.8732	.028
.2391	.8876	.047
.2410	.8901	.049
.2488	.9004	.092
.2507	.9029	.107
.2581	.9126	.149
.2598	.9148	.174
.2688	.9267	.210
.2707	.9292	.229
.2978	.9648	.642
.2998	.9675	.687
.3114	.9828	-0.904
.3185	.9922	-1.048
.3301	.0075	-1.021
.3370	.0165	-0.955
.3388	.0189	.923
.3519	.0362	.660
.3544	.0395	.599
.3624	.0500	.415
.3640	.0521	-0.385
454.1099	.7463	+0.011
.1116	.7486	.014
.1205	.7603	.026
.1220	.7623	+0.017
.2145	.8552	-0.057
.2165	.8578	.052
.2240	.8677	.052
.2260	.8703	.076
.2334	.9090	.116
.2353	.9115	.132
.2416	.9198	.174
.2435	.9223	.184
.2494	.9301	.220
.2513	.9326	.275
.2587	.9423	.355
.2604	.9446	.407
.2755	.9645	.658
.2777	.9674	.694
.2838	.9754	.851
.2855	.9776	-0.900
.2934	.9880	-1.056
.2948	.9899	.066
.3120	.0125	-1.012
.3184	.0210	-0.876
.3198	.0228	.824
.3264	.0315	.684
.3278	.0334	.662
.3335	.0409	.539
.3350	.0428	.534
.3419	.0519	.405
.3436	0542	.397
.3495	.0619	.308
.3510	.0639	.296
.3571	.0720	.221
.3590	.0745	.201
.3706	.0897	.099
.3723	.0920	.072
490.0667	.1126	.025
.0688	.1154	.013
.0842	.1357	.016
.0895	.1427	-0.017
.1548	.2287	+0.001
.1572	.2319	.036
.1743	.2544	.022
.1761	.2568	.015
.1846	.2680	.004
.1936	.2798	.053
.1956	.2824	.055
510.1191	.5279	-0.108
.1227	.5327	.120
.1362	.5504	.084
.1416	.5576	.059
510.1552	0.5755	-0.054
510.1592	0.5807	$-0^{m}.055$
.1670	.5910	.049
.1708	.5960	.042
806.2818	.6666	.153
.2839	.6694	.134
.3002	.6909	.060
.3018	.6930	-0.055
.3393	.7424	+0.029
.3419	.7458	+0.059
.3518	.7589	-0.011
.3540	.7618	.010
.3661	.7777	.020
.3676	.7797	-0.009
819.2382	.6896	+0.018
.2420	.7393	.005
.2496	.7493	.015
.2648	.7693	+0.018
841.2301	.7045	-0.002
.2321	.7071	+0.013
.2498	.7304	.002
.2517	.7329	.012
.2662	.7520	.056
.2679	.7543	.032
.2796	.7697	.015
.2820	.7728	.016
.3366	.8448	.063
.3388	.8477	+0.078
2444		
144.2533	.8806	-0.105
.2551	.8830	.074
.2688	.9010	.129
.2708	.9037	.141
.2871	.9251	.278
.2887	.9273	.291
.2960	.9365	.363
.2982	.9398	.409
.3071	.9515	.544
.3089	.9539	-0.561
.3481	.0055	-1.088
.3496	.0075	-1.026
.3567	.0168	-0.917
.3582	.0188	.886
.3642	.0267	.817
.3657	.0287	.780
.3710	.0357	.672
.3721	.0371	.610
.3775	.0442	.471
.3791	.0463	.454
.3856	.0549	.372
.3870	.0567	-0.356
145.2897	.2459	+0.007
.3104	.2732	+0.022
.3209	.2870	-0.010
.3284	.2969	.001
.3386	.3103	.014
511.2425	.3200	.007
.2552	.3367	.050
.2670	.3522	.001
.2777	.3663	.032
.2842	.3749	.031
.2921	.3853	.021
.2997	.3953	.070
.3055	.4030	.084
.3107	.4098	.056
.3189	.4206	.064
.3266	.4308	.107
.3330	.4392	.103
.3359	.4430	.100
.3459	.4562	.103
.3600	.4748	.150
.3661	.4828	.126
.3732	.4921	.125
.3790	.4998	.132
.3853	.5081	.124
.3913	.5160	.136
.3995	.5268	.075
.4049	.5339	.100
.4109	.5418	.146
.4166	.5493	-0.126
512.2464	0.6424	+0.017

Table 1b — concluded

JD(Hel)	Phase	Δm	JD(Hel)	Phase	Δm
512.2494	0.6464	$+0^m.009$	560.3044	0.9498	$-0^m.525$
.2603	.6607	+0.003	.3120	.9598	.672
.2621	.6631	-0.014	.3190	.9690	.870
.2733	.6779	+0.022	561.1792	.1022	.046
.2746	.6796	+0.016	.1861	.1113	.015
.2811	.6881	-0.000	.1893	.1155	.047
.2820	.6893	.010	.1957	.1239	.063
.2915	.7018	.036	.1989	.1281	.064
.2930	.7038	.034	.2074	.1393	.036
.2991	.7118	.015	.2127	.1463	.021
.3005	.7137	.030	.2201	.1561	.043
.3099	.7261	.005	.2242	.1615	.033
.3122	.7291	-0.001	.2317	.1713	.007
.3348	.7589	+0.023	.2362	.1773	-0.015
.3363	.7608	.046	.2242	.1878	+0.027
.3447	.7719	.013	.2473	.1919	.048
.3458	.7734	+0.012	.2774	.2315	.031
.3535	.7835	-0.054	.2807	.2359	.011
.3551	.7856	.068	.2877	.2451	.000
526.2900	.1422	.042	.2911	.2496	+0.003
.2916	.1443	.035	.3007	.2622	-0.002
.3123	.1716	.033	.3049	.2678	.034
.3143	.1742	-0.024	.3111	.2759	.019
.3229	.1856	+0.007	.3145	.2804	.031
.3249	.1882	+0.002	.3211	.2891	.028
.3404	.2086	-0.003	601.0954	.6822	.021
.3422	.2110	-0.020	.1078	.7006	-0.042
.3529	.2251	+0.003	.1153	.7105	+0.001
.3542	.2268	+0.004	.1223	.7197	.010
.3979	.2244	-0.014	.1307	.7308	.013
.3998	.2869	-0.005	.1421	.7458	+0.037
.4016	.2892	+0.010	.1532	.7604	-0.007
.4125	.3036	-0.012	.1584	.7673	-0.010
.4137	.3052	.029	.1662	.7776	+0.006
560.1946	.8052	.079	.1759	.7903	+0.006
.1984	.8102	.058	.1834	.8002	-0.057
.2035	.8169	.013	605.1312	.0007	-1.130
.2111	.8269	.019	.1381	.0098	-0.978
.2187	.8369	.036	.1418	.0147	.896
.2260	.8465	.036	.1478	.0226	.749
.2340	.8571	.138	.1500	.0255	.685
.2783	.9154	.183	.1616	.0407	.508
.2862	.9256	.257	.1659	.0464	.463
.2927	.9344	.371	.1680	.0492	.453
560.2985	0.9420	-0.486	605.1851	0.0717	-0.226

The period of $0^d.75911650$ given by Wood and Forbes (1963) has been revised to $0^d.7591215$ on the basis of our times of minima. The phases have been computed from the ephemeris:

$$\text{JD } 2433282.8335 + 0^d.7591215\, E.$$
$$\pm 0.0000002$$

The light curves are given in Figure 1.

4. Elements

The light curves in U, B and V filters have been analysed by Kopal's method in the frequency-domain. It has been assumed that the relative orbit of the two stars in the system is circular and there is no proximity effect as the secondary minimum falls at phase 0.5 and the portions of the light curve between eclipses appear to be fairly constant. The magnitudes were changed to intensity l and phases to phase angle θ. A graph was plotted between $\sin^2\theta$ and intensity l for the primary and secondary minima. A smooth curve was drawn through the observed points and inten-

Table 1c

Standard differential magnitudes of AE Cas in *V* filter

JD(Hel)	Phase	Δm	JD(Hel)	Phase	Δm
2443			510.1411	0.5569	$-0^{m}.049$
423.3268	0.1954	$+0^{m}.106$	.1560	.5765	.026
.3364	.2080	.035	.1600	.5818	.046
.3448	.2191	+0.095	.1660	.5897	.045
435.2139	.8544	-0.018	.1700	.5950	.028
.2186	.8606	+0.018	806.2806	.6651	.087
.2262	.8706	-0.007	.2844	.6701	.037
.2292	.8745	+0.009	.3007	.6915	.003
.2385	.8868	-0.027	.3013	.6923	-0.000
.2418	.8911	.044	.3388	.7417	+0.048
.2481	.8994	.032	.3425	.7466	.052
.2513	.9037	.064	.3511	.7579	.010
.2575	.9118	.089	.3544	.7623	.013
.2603	.9155	.086	.3664	.7781	.043
.2681	.9258	.174	.3671	.7790	.071
.2713	.9300	.196	819.2388	.6080	.082
.2969	.9637	.543	.2426	.7351	.060
.3004	.9683	.581	.2513	.7515	.097
.3106	.9818	.787	.2656	.7703	.080
.3191	.9930	.876	841.2291	.7032	.043
.3376	.0173	.832	.2326	.7078	.094
.3382	.0181	.846	.2495	.7300	.085
.3530	.0376	.543	.2523	.7337	+0.058
.3538	.0387	.532	.2655	.7511	-0.004
.3630	.0580	.391	.2685	.7551	+0.046
.3634	.0513	-0.352	.2792	.7691	.061
454.1104	.7470	+0.021	.2825	.7735	.086
.1111	.7479	.033	.3374	.8458	.112
.1209	.7608	.047	.3381	.8467	+0.140
.1215	.7616	.051	2444		
.2139	.8833	.013	144.2527	.8798	-0.030
.2171	.8875	+0.018	.2557	.8838	.038
.2234	.8958	-0.016	.2682	.9003	.054
.2266	.9000	.031	.2714	.9045	.090
.2328	.9082	.101	.2876	.9258	.204
.2357	.9120	.099	.2882	.9266	.247
.2410	.9190	.151	.2966	.9377	.295
.2440	.9230	.161	.2973	.9386	.325
.2489	.9294	.163	.3078	.9524	.494
.2523	.9339	.272	.3084	.9532	.491
.2581	.9415	.266	.3486	.0062	.864
.2610	.9454	.294	.3492	.0070	.860
.2761	.9653	.584	.3572	.0175	.780
.2766	.9659	.572	.3577	.0181	.735
.2844	.9762	.742	.3716	.0365	.489
.2849	.9768	.758	.3718	.0367	.535
.2939	.9887	.964	.3781	.0450	.401
.2943	.9892	.960	.3786	.0457	.389
.3030	.0007	.980	.3861	.0556	.278
.3035	.0013	.993	.3866	.0562	.279
.3108	.0110	.989	145.2891	.2451	+0.017
.3115	.0119	.910	.3096	.2721	+0.048
.3189	.0216	.743	.3203	.2862	-0.005
.3194	.0223	.740	.3288	.2974	.067
.3269	.0322	.585	.3389	.3107	.028
.3274	.0328	.617	511.2425	.3200	+0.071
.3339	.0414	.462	.2552	.3367	.048
.3346	.0423	.504	.2670	.3522	.068
.3425	.0527	.329	.2777	.3663	.073
.3430	.0534	.333	.2842	.3749	+0.047
.3501	.0627	.236	.2925	.3858	-0.005
.3505	.0633	.219	.3000	.3957	+0.004
.3578	.0729	.128	.3063	.4040	-0.009
.3585	.0738	.165	.3102	.4091	-0.021
.3712	.0905	.065	.3195	.4214	+0.011
.3717	.0912	-0.049	.3261	.4301	-0.066
490.0675	.1137	+0.028	.3336	.4400	.082
.0682	.1146	.023	.3362	.4434	.045
.0834	.1346	.024	.3466	.4571	.052
.0904	.1439	.023	.3605	.4754	.083
.1540	.2276	.033	.3657	.4823	.069
.1579	.2328	.047	.3735	.4925	.087
.1750	.2553	.061	.3785	.4991	.122
.1756	.2561	.052	.3858	.5087	.104
.1852	.2687	.017	.3912	.5159	.082
.1857	.2694	.064	.3991	.5263	.081
.1942	.2806	+0.160	.4053	.5344	.089
510.1175	.5258	-0.039	.4106	.5414	.095
.1231	.5332	.064	511.4170	0.5498	-0.058
510.1356	0.5497	-0.066			

Table 1c — concluded

JD(Hel)	Phase	Δm	JD(Hel)	Phase	Δm
512.2458	0.6416	$-0^{m}.010$	560.2990	0.9427	$-0^{m}.377$
.2501	.6473	-0.042	.3038	.9490	.487
.2594	.6595	+0.057	.3125	.9605	.502
.2624	.6635	+0.017	.3185	.9684	.737
.2727	.6771	-0.060	561.1765	.0986	.046
.2751	.6802	-0.056	.1798	.1030	.049
.2804	.6872	+0.046	.1856	.1106	-0.012
.2824	.6898	+0.075	.1886	.1146	+0.027
.2908	.7009	-0.005	.1962	.1246	.035
.2933	.7042	+0.021	.1994	.1288	.010
.2985	.7110	.096	.2060	.1375	.052
.3009	.7142	.091	.2120	.1454	.033
.3095	.7255	.091	.2207	.1569	.024
.3128	.7299	.111	.2249	.1624	.048
.3344	.7583	.129	.2311	.1706	.035
.3367	.7614	.140	.2356	.1765	.043
.3451	.7724	.036	.2447	.1885	.082
.3454	.7728	+0.032	.2477	.1924	.099
.3531	.7830	-0.054	.2769	.2309	.077
.3558	.7865	.013	.2800	.2350	.099
526.2905	.1429	.050	.2882	.2458	.070
.2911	.1437	.066	.2917	.2504	.095
.3127	.1721	.016	.3002	.2616	.079
.3136	.1733	.007	.3044	.2671	.056
.3225	.1850	-0.014	.3116	.2766	.022
.3254	.1889	+0.002	.3151	.2812	.058
.3399	.2080	.014	.3205	.2883	.070
.3429	.2119	.021	601.0948	.6835	.034
.3532	.2255	.030	.1084	.7014	.063
.3537	.2261	+0.045	.1146	.7096	.062
.3670	.2437	-0.095	.1229	.7205	.030
.3673	.2440	-0.070	.1303	.7303	.034
.3974	.2837	+0.028	.1428	.7467	.036
.4009	.2883	.058	.1530	.7602	.057
.4013	.2888	.027	.1579	.7666	.088
.4128	.3040	.135	.1653	.7764	.061
.4132	.3045	.146	.1750	.7891	+0.040
560.1937	.8040	.025	605.1319	.0016	-0.907
.1984	.8102	.023	.1388	.0107	.937
.2046	.8183	.017	.1425	.0156	.746
.2104	.8260	.060	.1485	.0235	.611
.2193	.8377	.034	.1491	.0243	.626
.2252	.8455	+0.025	.1626	.0421	.392
.2343	.8575	-0.044	.1668	.0476	.398
.2776	.9145	.120	.1675	.0485	.418
.2867	.9265	.240	605.1736	0.0565	-0.161
560.2921	0.9336	-0.292			

Table 2

Coordinates, magnitudes and colours of variable and comparison stars

Star	α_{1950}	δ_{1950}	V	$B-V$	$U-B$
Variable (Max)	$1^{h}22^{m}43^{s}.5$	$+69°51'.8$	$11^{m}.90$	$+0^{m}.77$	$+0^{m}.42$
C_1	1 23 08.5	+69 52.9	12.80	+0.85	+0.54
C_2	1 23 19.5	+69 53.3	11.95	+0.72	+0.22

sities were read from this plot for equidistant values of $\sin^2\theta$. This was necessitated by the large scatter present in our observations. Then using the method given by Al-Naimiy (1977) the moments were derived for all the three U, B and V light curves. These were found only for primary minima, the secondary minima being shallow. The moments have been listed in Table 3.

For determining the elements, we started with the initial value of $k = 1$ and $Y = 1$ and determined the elements following iteration pro-

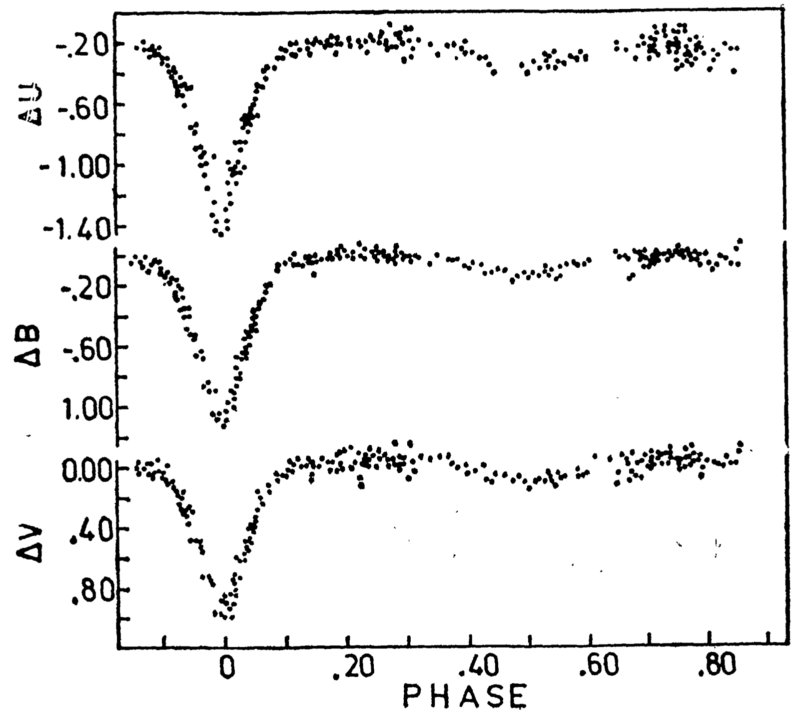

Fig. 1. Light curves of AE Cas in U, B and V filters.

Table 3

Moments of the primary eclipse in U, B and V filters

	U	B	V
A_0	0.6447	0.6486	0.6085
A_2	0.08028	0.08429	0.08244
A_4	0.01785	0.01975	0.02005
A_6	0.00499	0.00581	0.00613

cess described in detail by Kopal (1982). Tsesevich (1939, 1940) tables have been used for finding the successive values of Y. The equations used are:

$$A_0 = L_1 \alpha_0,$$

$$A_2 = L\{\bar{C}_3 + (1-\alpha_0)\cot^2 i\} - L_1 \beta_2 \cot^2 i,$$

$$A_4 = L_1\{\bar{C}_3^2 + \bar{C}_2^2 - (1-\alpha_0)\cot^4 i\} + L_1 \beta_4 \cot^4 i, \text{ and}$$

$$A_6 = L_1\{\bar{C}_3^3 + 3\bar{C}_2^2\bar{C}_3 + \bar{C}_1\bar{C}_2^2 + (1-\alpha_0)\cot^6 i\} - 4\beta_6 \cot^6 i,$$

where the symbols have the same meanings as given by Kopal (1982). After the iteration the value of k was found to be more than one and α_0 less than one meaning thereby that the primary eclipse is partial transit.

From the derived elements, light curves were computed which were found to be in fair agreement with the observations. The elements have been listed in Table 4.

Table 4

Photometric elements of AE Cas

	U	B	V	Average
$\varkappa$ (assumed)	0.8	0.6	0.6	
$(1-\lambda)_{sec}$	0.120	0.104	0.126	
k	1.046	1.015	1.038	1.03 $\pm$0.02
i	81°.1	81°.1	80°.1	80°.4 $\pm$0°.6
r_1	0.3539	0.3524	0.3631	0.356 $\pm$0.006
r_2	0.3382	0.3471	0.3499	0.345 $\pm$0.006
L_1	0.8353	0.8591	0.8202	
L_2	0.1647	0.1401	0.1798	
θ'	43°.1	43°.5	44°.6	43°.7 $\pm$0°.8

5. Discussion

Magnitude of the variable at maximum light was obtained from the differential magnitude of the variable at maximum and the magnitude of the comparison star. Using this magnitude and fractional luminosities L_1 and L_2, colours of the primary and secondary components were derived as under:

	Primary	Secondary
V	$12^m.12$	$13^m.76$
$B-V$	0.72	1.04
$U-B$	0.42	0.24

Colours obtained from the depths of the two minima are $(B-V) = 0^m.70$; $(U-B) = 0^m.38$ for the primary and $(B-V) = 0^m.77$; $(U-B) = 0^m.27$ for the secondary component. The standard deviation in $\Delta(U-B)$ and $\Delta(B-V)$ is $\pm 0^m.04$. Assuming that both the components belong to main-sequence and there is no space reddening, the spectral type of the components based on $(B-V)$ values are G6-7 and G9-K4 for primary and secondary components, respectively.

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