BV OBSERVATIONS OF THE ECLIPSING BINARY WX ERIDANI

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Abstract. Photoelectric observations of WX Eridani in B and V filters have been discussed. The maximum magnitudes of the system are $B = 9^m.70$ and $V = 9^m.46$. The $B - V$ colours of the components are $0^m.16$ and $0^m.80$ for the primary and the secondary, respectively, while their spectral types are A5 + K0. The period has been found to be constant and its revised value is $0^d.823\,270\,76$.

1. Introduction

Variability of the system WX Eridani = BD − 1°484 was discovered by Miss Leavitt (Pickering, 1908) from Harvard plates. Hoffmeister (1934) found it to be a variable while examining the Sonneberg plates for new variable stars. Rügemer (1934) confirmed its Algol nature. The period, range of variation, duration of eclipse and light curve have been given by Jensch (1934). Roman (1956) has reported the spectral type of the system as A7 + F6V. *UBV* magnitudes and colours have been reported by Drilling (1971). Also, Drilling and Pesch (1973) have done *ubvy* and Hβ photometry while Hilditch and Hill (1975) have reported the *uvby* magnitudes at two phases only.

Sarma and Abhyankar (1979) have given complete light curves in B and V filters along with orbital elements for WX Eri by use of the Russell and Merrill method. The normal points given by them have been used by Giuricin and Mardirossian (1981) and also by Russo and Milano (1983) for determining the elements of the system by light-curve synthesis techniques. Sarma and Abhyankar have found WX Eri to be a detached system with the primary components as a δ Scuti variable pulsating with periods equal to one-fifth and one-sixth of the orbital period, the pulsations being locked to the orbital motion. Giuricin and Mardirossian have also found the system to be detached but not very far from contact configuration. On the other hand, Russo and Milano have reported it to be a semi-detached system. As mentioned by earlier authors, no spectroscopic study of the system exists in the literature. Observations taken during the period October–November 1974 and October–November 1975 are being reported here.

2. Observations

Observations of WX Eri were secured on the 56-cm reflector of the Uttar Pradesh State Observatory through standard U, B, and V filters, using an unrefrigerated 1P21 photomultiplier and employing standard d.c. technique. BD − 1°488 and BD − 1°490

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have been observed as comparisons along with the variable. BD – 1°488 has been observed only on nine nights; BD – 1°490 on all the ten nights.

The comparison and the variable stars were also observed on two nights during 1984 with standard stars through the 104-cm telescope of the Observatory using an EMI 6094 S photomultiplier, cooled to – 20 °C in order to find their standard magnitudes and colours. These magnitudes and colours are listed in Table I. The last column of the table gives the spectral type as given in the *HD Catalogue*.

TABLE I

Particulars of comparison and variable stars

Name	HD	V	$B-V$	$U-B$	Sp.
WX Eri = BD – 1°484 (Phase 0.47)	21102	$9^m.56$	$0^m.35$	$0^m.04$	A5
BD – 1°488	21230	10.33	0.51	0.02	G
BD – 1°490	21262	9.36	1.12	1.02	K0

The differential standard magnitudes of the system in the sense variable minus comparison (BD – 1°490) are listed in Table II. The standard errors of observations lie in the range $0^m.006$ to $0^m.048$ for B and V filters. The U observations have been taken only on four nights but have not been reported here owing to a large scatter.

3. Light Curve and Period

The light and colour curves are shown in Figure 1. The coverage of the light curve is fairly good except for the phase between 0.44 and 0.54. The depths of primary minima in B and V filters are $0^m.85$ and $0^m.96$, respectively. The primary minimum in the V filter shows a constant phase of eclipse for about 24 min. Our light curves also show the kind of stand-stills as found by Sarma and Abhyankar (1979) but only around phase 0.18.

Only on one night were both the ascending and the descending branches of the primary minimum covered, and these have been used to determine the time of primary minimum by the method of Kwee and Van Woerden (1956). The time of primary minimum is found to be J.D. (Hel.) 2442337.3794 ± 0.0001.

All the times of primary minima that we could locate in the literature have been listed in Table III, column 1. These times have been analysed by the method of least squares to find a period for the system. The analysis also indicates that there is no variation in the period. Now an improved ephemeris can be given as

$$\text{Primary Min.} = \text{J.D. (Hel.) } 2427531.6807 + 0^d.82327076E\,,$$
$$\pm 0.0016 \pm 0.00000010\,.$$

TABLE II

Standard differential magnitudes of WX Eri

J.D. (Hel.) 2442000+	Phase	ΔB	ΔV	J.D. (Hel.) 2442000+	Phase	ΔB	ΔV
337.2938	0.8928	−0.ᵐ627	0.ᵐ212	339.2462	0.2643	−0.ᵐ756	0.ᵐ106
.3065	0.9082	−0.630	0.251	.2521	0.2715	−0.742	0.094
.3147	0.9182	−0.569	0.296	.2552	0.2753	−0.745	0.104
.3564	0.9688	−0.025	0.811	.2604	0.2816	−0.783	0.114
.3620	0.9756	0.056	0.895	.2688	0.2918	−0.765	0.117
.3662	0.9808	0.121	0.918	.2739	0.2980	−0.780	0.118
.3703	0.9857	0.155	0.963	.2823	0.3082	−0.780	0.135
.3723	0.9882	0.177	0.953	.2885	0.3157	−0.755	0.111
.3766	0.9934	0.220	0.949	.3137	0.3463	−0.741	0.153
.3794	0.9968	0.245	0.933	.3201	0.3541	−0.767	0.113
.3878	0.0070	0.181	0.981	.3270	0.3625	−0.754	0.126
.3906	0.0104	0.148	0.970	.3334	0.3702	−0.755	0.128
.3952	0.0160	0.073	0.885	356.1963	0.8531	−0.589	0.139
.3981	0.0195	0.027	0.870	.2267	0.8900	−0.659	0.204
.4036	0.0262	−0.025	0.800	.2534	0.9224	−0.509	0.308
.4060	0.0291	−0.084	0.732	.2729	0.9461	−0.339	0.524
.4113	0.0355	−0.211	0.681	.3043	0.9842	−0.083	0.929
.4162	0.0415	−0.273	0.615	376.3010	0.2736	−0.801	0.017
.4220	0.0485	−0.340	0.542	.3035	0.2766	−0.850	0.022
.4254	0.0527	−0.373	0.519	.3108	0.2855	−0.804	0.144
.4281	0.0559	−0.403	0.472	.3197	0.2963	−0.807	0.059
.4340	0.0631	−0.471	0.404	.3288	0.3073	−0.872	0.089
338.2341	0.0350	−0.174	0.691	.3367	0.3169	−0.877	0.058
.2403	0.0425	−0.265	0.641	.3439	0.3257	−0.849	0.100
.2466	0.0501	−0.339	0.578	.3516	0.3350	−0.814	0.109
.2520	0.0567	−0.430	0.535	.3597	0.3449	−0.773	0.067
.2577	0.0636	−0.472	0.443	378.1564	0.5273	−0.658	0.223
.2643	0.0716	−0.533	0.329	.1690	0.5426	−0.647	0.250
.2671	0.0750	−0.547	0.281	.2064	0.5880	−0.702	0.119
.2748	0.0844	−0.598	0.251	.2173	0.6012	−0.724	0.177
.2803	0.0911	−0.634	0.311	.2253	0.6110	−0.739	0.166
.2872	0.0995	−0.680	0.285	.2367	0.6248	−0.757	0.125
.2934	0.1070	−0.684	0.170	.2433	0.6328	−0.776	0.148
.3006	0.1157	−0.681	0.163	.2774	0.6742	−0.747	0.131
.3026	0.1182	−0.691	0.161	.2843	0.6826	−0.787	0.087
.3090	0.1259	−0.718	0.156	.2914	0.6912	−0.841	0.102
.3140	0.1320	−0.719	0.177	.3198	0.7257	−0.813	0.115
.3337	0.1559	−0.735	0.147	.3283	0.7361	−0.823	0.085
.3382	0.1614	−0.740	0.119	.3355	0.7448	−0.872	0.017
.3448	0.1694	−0.749	0.129	721.3122	0.3474	−0.800	0.134
.3512	0.1772	−0.751	0.127	.3204	0.3573	−0.772	0.119
.3576	0.1850	−0.751	0.113	.3325	0.3720	−0.792	0.022
.3628	0.1913	−0.757	0.126	.3426	0.3843	−0.727	0.138
.3709	0.2011	−0.778	0.114	.3554	0.3998	−0.754	0.065
.3763	0.2077	−0.775	0.096	.3658	0.4125	−0.734	0.147
.3822	0.2149	−0.770	0.115	.3759	0.4247	−0.744	0.094
.3865	0.2201	−0.769	0.110	727.2682	0.5819	−0.778	0.204
339.2408	0.2578	−0.692	0.088	.2826	0.5994	−0.803	0.147

Table II (continued)

J.D. (Hel.) 2442000+	Phase	ΔB	ΔV	J.D. (Hel.) 2442000+	Phase	ΔB	ΔV
727.3062	0.6281	$-0^m.820$	$0^m.132$	728.2453	0.7688	$-0^m.825$	$0^m.125$
.3660	0.7007	−0.825	0.133	.2566	0.7825	−0.805	0.139
.3840	0.7226	−0.823	0.105	.3025	0.8383	−0.795	0.141
.4021	0.7446	−0.853	0.123	.3196	0.8590	−0.805	0.139
728.1535	0.6573	−0.828	0.091	729.1583	0.8778	−0.785	0.166
.1688	0.6759	−0.804	0.128	.1721	0.8945	−0.773	0.142
.1812	0.6909	−0.822	0.109	.1760	0.8993	−0.758	0.178
.2197	0.7377	−0.843	0.108	.2764	0.0212	−0.151	0.765
.2331	0.7540	−0.832	0.103	.2870	0.0341	−0.028	0.839

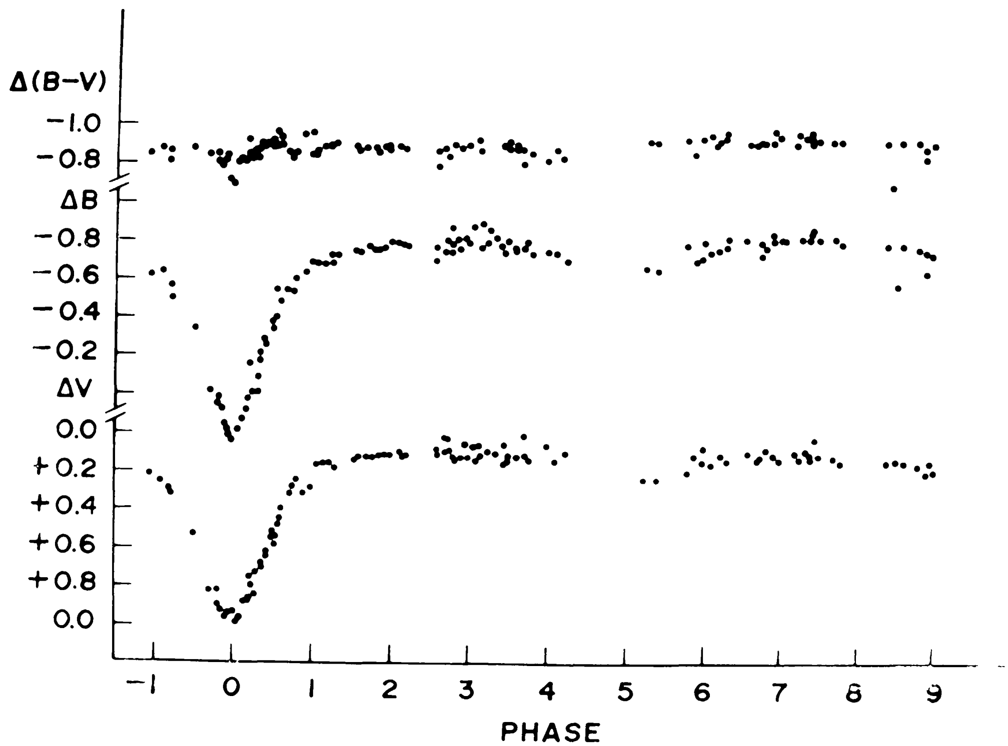

Fig. 1. Light and colour curves of WX Eridani.

The various values of O–C obtained from the above ephemeris are listed in column 2 of Table III, with their sources in column 3. These values have been plotted in Figure 2.

4. Discussion

From the magnitudes of WX Eri at maximum ($V = 9^m.46$ and $B = 9^m.70$) and depths of primary minima in B and V filters quoted earlier, the colour of the primary component is found to be $B - V = 0^m.16$. Assuming it to be a Main-Sequence star, the corre-

TABLE III

Times of primary minima of WX Eri

J.D. (Hel.) 2400000 +	*E*	O–C	Reference
25543.50	−2415	0ᵈ0182	*Astron. Nachr.* **251**, 318, 1934.
25543.504	−2415	0.0222	*ibid*, 327.
25585.44	−2364	−0.0286	*ibid*, 318.
25585.446	−2364	−0.0226	*ibid*, 327.
26406.276	−1367	0.0064	*ibid.*
26406.28	−1367	0.0104	*ibid*, 318.
27313.51	−265	−0.0040	*ibid.*
27313.513	−265	−0.0010	*ibid*, 327
27396.669	−164	0.0047	*ibid.*
27397.493	−163	0.0054	*ibid.*
27398.310	−162	0.0009	*ibid.*
27416.40	−140	−0.0228	*ibid*, 318.
27416.427	−140	0.0042	*ibid*, 327.
27421.354	−134	−0.0084	*ibid.*
27421.36	−134	−0.0024	*ibid*, 318.
27531.687	0	0.0063	*Astrophys. Space Sci.* **65**, 443, 1979
28521.252	1202	−0.0002	*Astron. Nachr.* **277**, 41, 1949.
28535.254	1219	0.0062	*ibid.*
28544.303	1230	−0.0038	*ibid.*
28837.387	1586	−0.0012	*ibid.*
28889.257	1649	0.0029	*ibid.*
28917.247	1683	0.0016	*Astron. Nachr.* **277**, 41, 1949.
28921.362	1688	0.0002	*ibid.*
28931.243	1700	0.0020	*ibid.*
28935.359	1705	0.0016	*ibid.*
28954.294	1728	0.0014	*ibid.*
28963.347	1739	0.0016	*ibid.*
28977.338	1756	−0.0062	*ibid.*
37320.373	11890	0.0029	*ibid.* **288**, 171, 1965.
37320.374	11890	0.0039	*ibid.*
42021.2452	17600	−0.0010	*Astrophys. Space Sci.* **65**, 443, 1979.
42035.2405	17617	−0.0013	*ibid.*
42063.2337	17651	0.0007	*ibid.*
42100.283	17696	0.0028	*BBSAG Bull.* **14**, 1974.
42266.583	17898	0.0021	*ibid.* **17**, 1974.
42289.634	17926	0.0016	*ibid.*
42289.637	17926	0.0046	*ibid.*
42318.458	17961	0.0111	*ibid.*
42337.3794	17984	−0.0027	Present study.
42356.3196	18007	0.0022	*Astrophys. Space Sci.* **65**, 443, 1979.
42360.44	18012	0.0063	*BBSAG Bull.* **18**, 1974.
42365.381	18018	0.0077	*ibid.*
42370.3095	18024	−0.0035	*Astrophys. Space Sci.* **65**, 443, 1979.
42389.247	18047	0.0012	*BBSAG Bull.* **19**, 1975.
42403.239	18064	−0.0048	*BBSAG Bull.* **19**, 1975.
42403.248	18064	0.0042	*ibid.*
42416.404	18080	−0.0121	*ibid.* **20**, 1975.
42416.407	18080	−0.0091	*ibid.*

Table III (continued)

J.D. (Hel.) 2400000 +	*E*	O–C	Reference
42417.239	18081	– 0.0004	*ibid.*
42417.252	18081	0.0126	*ibid.*
42426.292	18092	– 0.0034	*ibid.*
42468.29	18143	0.0078	*ibid.* **21**, 1975.
42626.592	18328	0.0047	*ibid.* **23**, 1975.
42634.581	18345	– 0.0019	*ibid.*
42780.304	18522	0.0022	*ibid.* **26**, 1976.
43463.608	19352	– 0.0085	*ibid.* **35**, 1977.
43762.468	19715	0.0042	*ibid.* **39**, 1978.
43776.457	19732	– 0.0024	*ibid.*
43813.502	19777	– 0.0046	*ibid.*
43832.439	19800	– 0.0029	*ibid.* **40**, 1978.
43837.387	19806	0.0055	*ibid.*
43837.388	19806	0.0065	*ibid.*
43888.442	19868	0.0177	*ibid.* **41**, 1979.
44134.593	20167	0.0108	*ibid.* **45**, 1979.
44266.304	20327	– 0.0015	*ibid.* **46**, 1980.
44512.467	20626	0.0035	*ibid.* **50**, 1980.
44582.447	20711	0.0055	*ibid.* **52**, 1981.
44601.386	20734	0.0093	*ibid.*
44606.308	20740	– 0.0084	*ibid.*
44643.358	20785	0.0056	*ibid.* **53**, 1981.
44662.291	20808	– 0.0078	*ibid.*
44847.535	21033	0.0003	*ibid.* **56**, 1981.
44913.393	21113	– 0.0034	*ibid.* **57**, 1981.
44988.316	21204	0.0020	*ibid.* **58**, 1982.
45611.517	21961	– 0.0130	*ibid.* **69**, 1983.
45611.527	21961	– 0.0030	*ibid.*
45625.527	21978	0.0014	*ibid.*
45649.387	22007	– 0.0134	*ibid.*
45705.367	22075	– 0.0158	*ibid.* **70**, 1984.
45705.384	22075	0.0012	*ibid.*
46049.508	22493	– 0.0020	*ibid.* **75**, 1985.
46120.310	22579	– 0.0013	*ibid.* **76**, 1985.

sponding spectral type, without taking into consideration the reddening, is about A5. This is quite close to A7 (Roman, 1956). To determine the spectral type of the secondary component, we have taken into account the depth at the same phase during secondary minimum in both *B* and *V* filters. This gives the colour of the secondary component as $B - V = 0\overset{m}{.}80$, which corresponds to spectral type K0.

The magnitudes of the variable reported by various investigators are listed in Table IV. An examination of Table IV reveals that the values given by Sarma and Abhyankar appear to be a little too high.

We have determined the colour and spectral type of both the components from the fractional luminosities reported in the three available analyses of the light curves. The

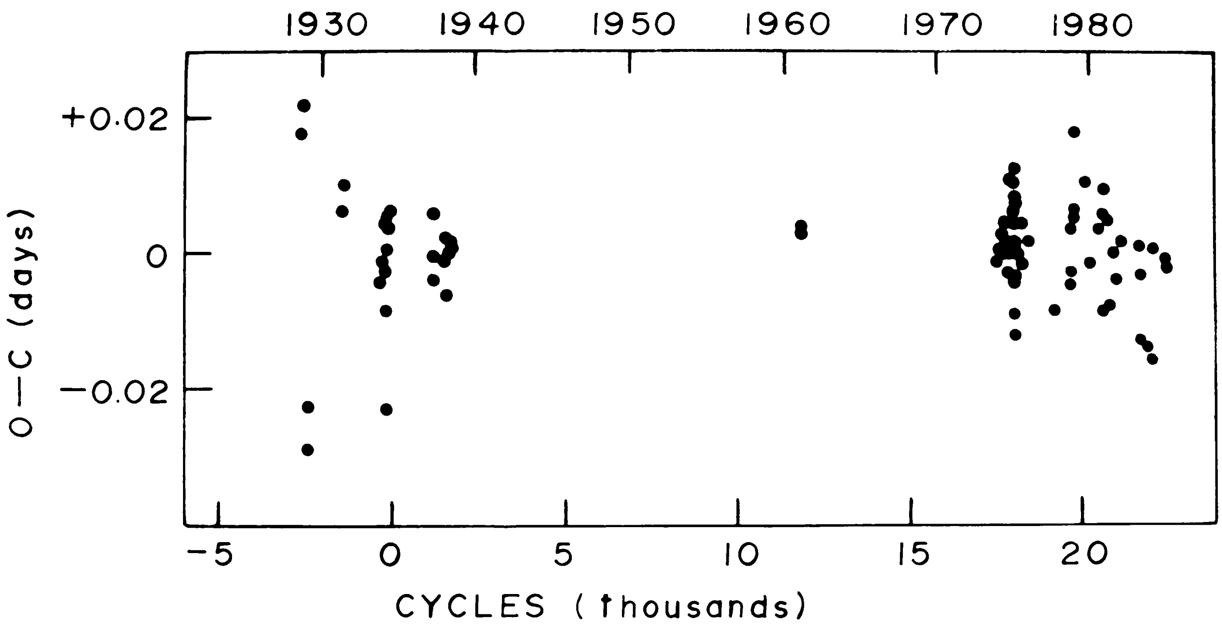

Fig. 2. (O–C) diagram for WX Eridani.

TABLE IV

Magnitude and spectral type of WX Eri

Magnitude		Sp. type	Reference
(photographic)			
9.9		–	Pickering (1908)
9.4		–	Jensch (1934)
9.3		–	Pickering (1949)
9.53		A5	Gaposchkin (1952)
(photoelectric)			
V	*B*		
9.41	–	A7	Drilling (1971)
9.52	–	F0V	Drilling and Pesch (1973)
9.38	–		Hilditch and Hill (1975)
(at phase 0.2789)			
9.6	–		*ibid.*
(at phase 0.4981)			
8.471	8.846	F3 + G8V	Sarma and Abhyankar (1979)
9.46	9.70	A5 + K0	Present study

spectral type of the primary component was found to be about A7 while that of the secondary component ranged between F3 and K5, none being near to our value of K0. In the above spectral type determinations we have assumed the components of WX Eri to be Main-Sequence stars. The reported spectral types of the secondary component are K0 (Giuricin and Mardirossian, 1981) and G8 (Sarma and Abhyankar, 1979).

Observations of two individual nights have been examined near the maximum phase but the δ Scuti type light variations were not noticed. Perhaps more observations are needed to further ascertain the nature of the primary component.

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