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UBV Light Curves of AR Lacertae During 1980–'81 and 1981–'82[1),2)]

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Abstract

The *UBV* observations of the brightest RS CVn-type eclipsing binary star AR Lac were made at four observatories, two in Korea and two in the U.S. in the 1980-81 and 1981-82 seasons. As a result of the cooperation, two light curves in the yellow and in the blue were completed for each observing seasons. Ultraviolet observations were also made at three of the four observatories.

The orbital period of AR Lac apparantly decreased around 1977. An analysis of our yellow light curves together with five other yellow curves available in the literature since 1975 shows that there seems no periodicity in the migration of the distortion waves. There is a gradual decrease of at least $0.^{m}1$ between 1976 and 1982 in the brightness of the cooler component if one assumes that the hotter component is constant.

1) Yonsei University Observatory Contribution No. 11.
2) Contributions of the Department of Astronomy of the University of Florida No. 47
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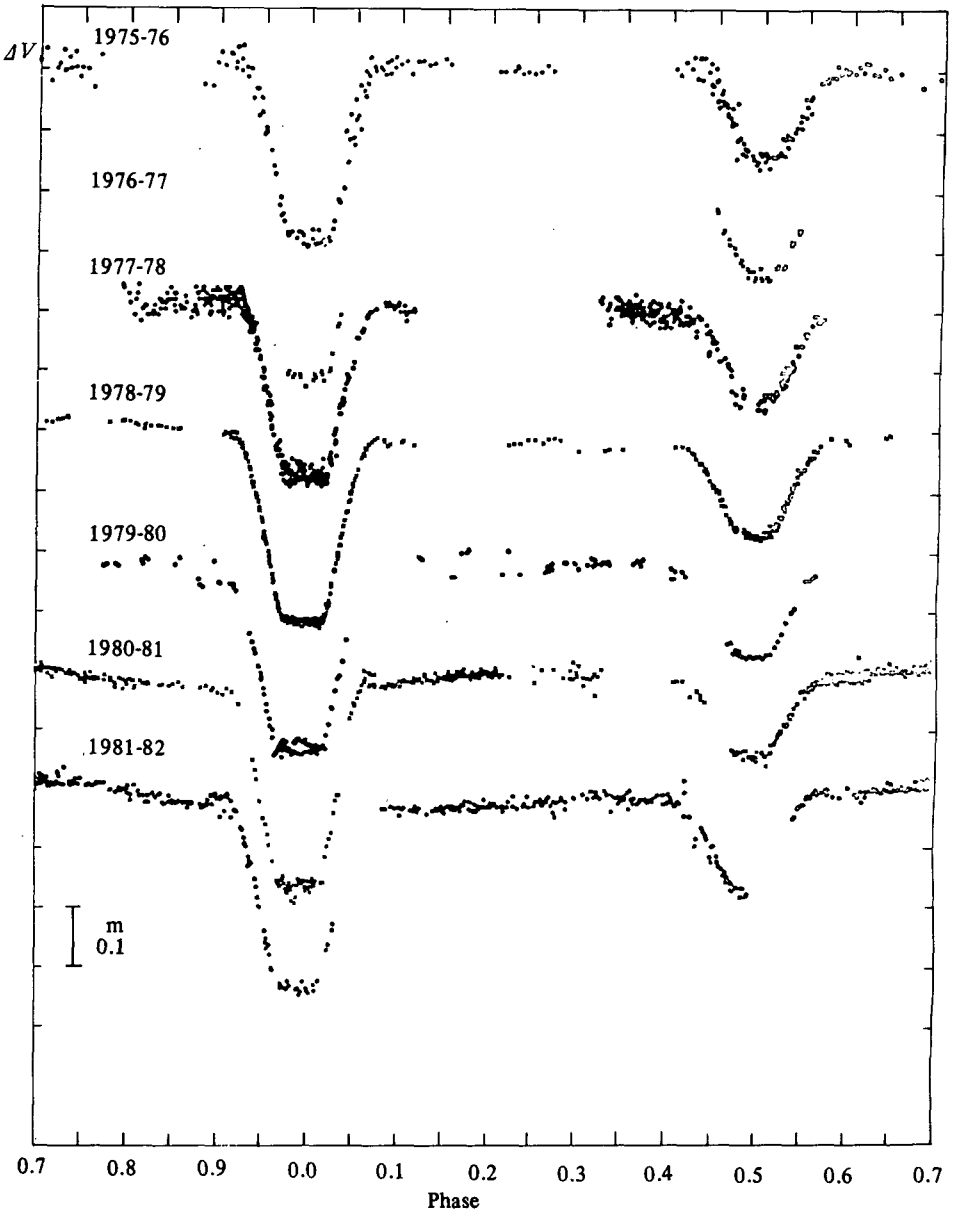

Figure 1. The yellow light curves since 1975. Open rectangles and is are used alternatively in order to differentiate seasons. The light curve for 1976-77 covers only eclipsed parts.

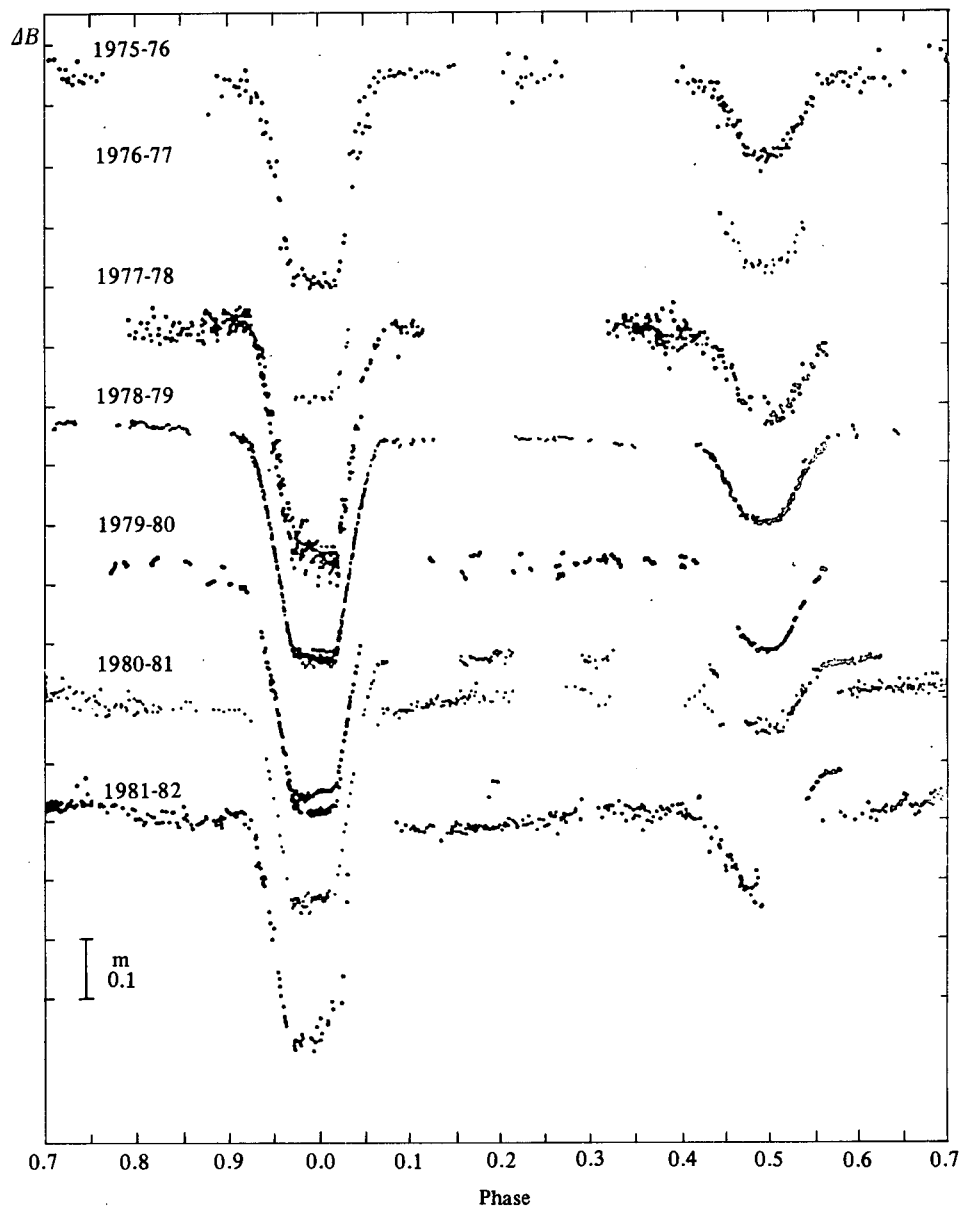

Figure 2. The blue light curves since 1975. Symbols used are the same as given in Fig. 1.

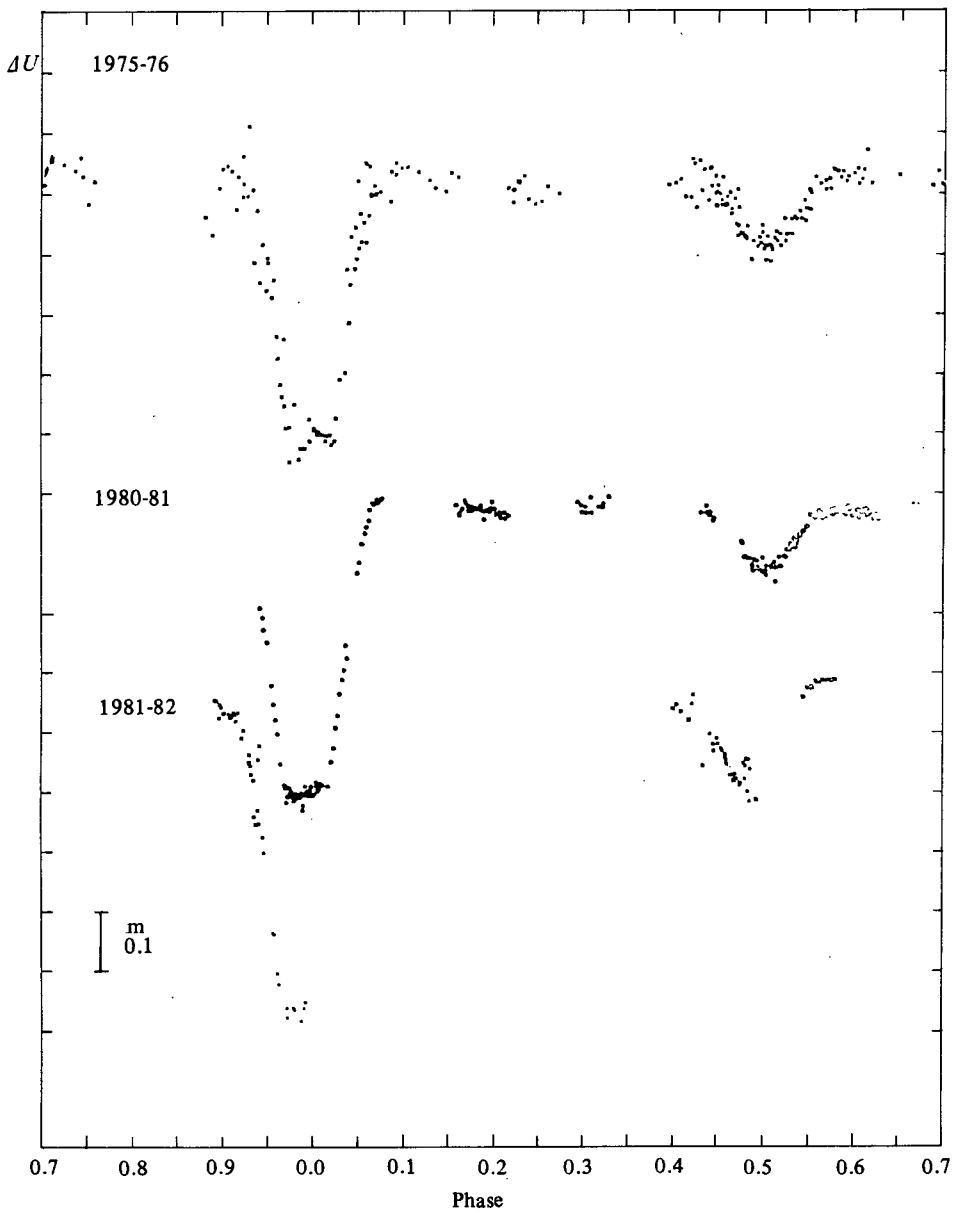

Figure 3. Three ultraviolet light curves. Symbols used are the same as given in Fig. 1.

either to the intrinsic light variation of one of the components or to the different photometric systems of the observatories. To check either possibility the check star (BD+44°4041) observations were used and plotted in Figure 4 for the yellow and in Figure 5 for the blue during two seasons. A total of 359 check star observations (177 in *V* and 182 in *B*, Table VII a and b). shows a straight line distribution in which no systematic difference exists between observatories. Therefore, the cause of the blue light variation remains in question, but it seems likely that it is in one of the components.

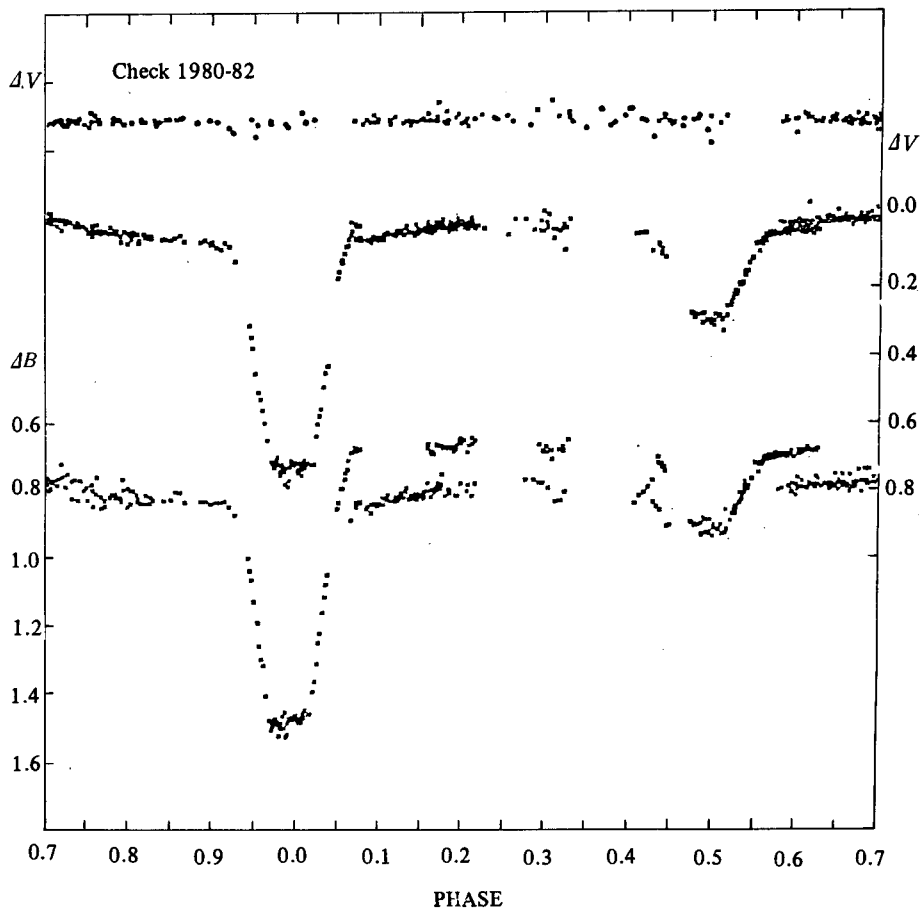

Figure 4. The light curves of AR Lac made in 1980-81. X represents 1980-81 observations and the open rectangle represents 1981-82 observations in the light curve of check stor, BD+44°4041.

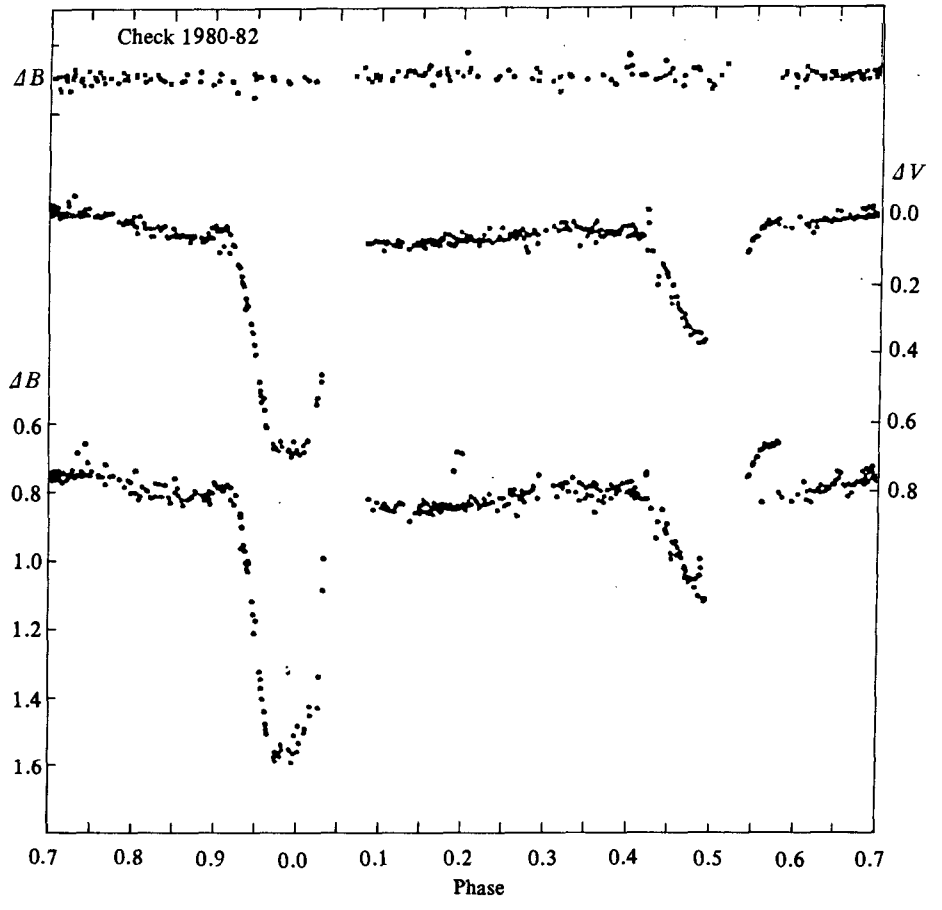

Figure 5. The light curves of AR Lac and made in 1981-82. Symbols used are given in Fig. 4.

III. Discussion

We would like to restrict ourselves here to discussion of the light variations of AR Lac with yellow light curves of the recent seven years as given in Figure 1. The variation in orbital period of AR Lac was first noticed by Wood (1946). Recent observations indicate that it has decreased steadily since 1977 as is clear in Figures 1 and 2. This shortening of the period occured about 1977. Kurutac *et al.* (1981) suggested that the orbital period of AR Lac changed in a quadratic form from 1961 to 1979, which Nha and Kang (1982) reported that the period remained constant for ten years during 1967-77. Kurutac *et al.* of course could not include in their study 6 times of minima by Srivastava (1981) and 9 times of minima by Nha and Kang (1982).

It is, therefore, desireable to see whether the period change including the 15 times of minima above with an additional two we made in 1980 and 1982 is of a quadratic nature for the extended

1961-1982 period. To do this the O-C diagram, which is based on Eq. (1), is made in Figure 6 using the data of our new collection of the times of minimum light which are listed in Table III for 1960-1982. It is difficult to bring any conclusion about the nature of the period variation of AR Lac because the O-C diagram may fit both the quadratic form and the constant period for about 10 years followed by an abrupt change in 1977 (see an arrow in Figure 6). One thing, however, we can say definitely is that the orbital period has been decreased by January 1982, from its value before 1977. The difference in O-C amounts to about $0.^{d}0144$ ($\sim$20 min.).

Table III. Times of minimum light of AR Lac since 1960

JD Hel. 2400 000+	Meth.	E	O-C	Ref	JD Hel. 2440 000+	Meth.	E	O-C	Ref
37 569.7977	Pe	-1696	-0.0173	Ka	2701.314	Pe	891.5	-0.010	Sr
39 376.4926	Pe	-785	-0.0100	Ce	2715.167	Pe	898.5	-0.039	Sr
39 383.4386	Pe	-781.5	-0.0052	Ce	2716.199	PE	899	+0.002	Sr
876.268	Pe	-533	+0.001	PK	2717.187	Pe	899.5	-0.002	Sr
40 546.5834	Pe	-195	-0.0023	NK	2730.095	Pe	906	+0.015	Sr
561.4705	Pe	-187.5	+0.0108	NK	3084.077	Pe	1084.5	-0.002	NK
932.3168	Pe	-0.5	+0.0003	NK	3420.229:	Pe	1254	-0.001:	NK
932.3168	Pe	-0.5	+0.0003	Ba	3427.170	Pe	1257.5	-0.002	NK
41 268.461	Vi	169	-0.007	Pi	3428.163	Pe	1258	0.0	NK
270.435	Vi	170	+0.002	Pi	3739.5194	Pe	1415	-0.0050	Ku
274.417	Vi	172	0.0	Pi	3740.5104	Pe	1415.5	-0.0056	Ku
506.443	Vi	289	-0.008	Pe	3745.4701	Pe	1418	-0.0038	Ku
513.391:	Pe	292.5	-0.001:	KP	3747.4535	Pe	1419	-0.0036	Ku
513.393:	Pe	292.5	+0.001:	KP	3750.4274	Pe	1420.5	-0.0045	Ku
592.7219	Pe	332.5	+0.0026	Ch	3751.4182	Pe	1421	-0.0053	Ku
593.7124	Pe	333	+0.0015	Ch	3752.4108	Pe	1421.5	-0.0043	Ku
604.6224	Pe	338.5	+0.0039	Ch	3755.3858	Pe	1423	-0.0041	Ku
608.5951	Pe	340.5	+0.0102	NK	4113.3584	Pe	1603.5	+0.0024	Ku
610.5796	Pe	341.5	+0.0115	NK	4114.3380	Pe	1604	-0.0096	Ku
936.8022	Pe	506	-0.0009	Ch	4550.6398	Pe	1824	-0.0100	T
938.7874	Pe	507	+0.0012	Ch	4977.0216	Pe	2039	-0.0144	T
42 700.304	Pe	891	-0.028	Sr					

References: Ka = Karle (1961), Ce = Cester (1967), PK = Pohl and Kizilirmak (1970), NK = Nha and Kang (1982), Ba = Battistini *et al.* (1973), Pi = Pickup (1972), Pe = Peter (1972), KP = Kizilirmak and Pohl (1974), Ch = Chambliss (1976), Sr = Srivastava (1981), Ku = Kurutac *et al.* (1981), T = this paper.

The distortion wave, so called by many observers for the RS CVn-type stars, may be another interesting subject to discuss with the yellow light curves of AR Lac. Glancing at those light curves in Figure 1, it is clear that the shapes of the light curves are different from one another. It is difficult to point out the wave minimum or maximum in each light curves, most of which are lack of phase coverage outside eclipses.

A Fourier analysis was made for the best six light curves and is given in Table VIII. This follows the conventional form,

Table IV. *V* observations of AR Lac

JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v
ROSEMARY H OB.		550.6165	0.737	549.6558	0.309
505.6223	0.034	550.6186	0.723	549.6639	0.299
505.6280	0.037	550.6207	0.738	549.6759	0.287
505.6298	0.037	550.6227	0.747	549.6771	0.283
505.6373	0.013	550.6248	0.782	549.6840	0.298
505.6389	0.027	550.6290	0.730	549.6933	0.287
505.6516	0.031	550.6311	0.790	549.6959	0.282
505.6535	0.057	550.6311	0.790	549.7035	0.256
505.6683	0.036	550.6331	0.771	549.7060	0.245
505.6777	0.017	550.6352	0.733	549.7141	0.210
505.6794	0.090	550.6373	0.711	549.7162	0.219
505.6912	0.003	550.6397	0.716	549.7242	0.188
545.5532	0.094	550.6419	0.724	549.7271	0.193
545.5672	0.073	550.6436	0.723	549.7354	0.157
545.5686	0.078	550.6456	0.716	549.7381	0.152
545.5742	0.102	550.6477	0.718	573.5073	0.233
545.5754	0.088	550.6498	0.718	573.5097	0.220
545.5839	0.113	550.6519	0.736	573.5149	0.218
545.6504	0.290	550.6540	0.750	573.5164	0.210
545.6523	0.287	550.6561	0.717	573.5216	0.193
545.6617	0.281	550.6582	0.742	573.5233	0.192
545.6696	0.279	550.6603	0.739	573.5284	0.189
545.6751	0.277	550.6623	0.720	573.5302	0.185
545.6922	0.300	550.6644	0.756	573.5344	0.165
545.6983	0.315	550.6665	0.736	573.5361	0.167
545.6998	0.281	550.6690	0.709	573.5425	0.153
545.7153	0.295	550.6707	0.720	573.5442	0.131
545.7186	0.329	550.6728	0.732	573.5512	0.117
545.7281	0.258	550.6751	0.717	573.5529	0.114
550.5383	0.311	550.6876	0.723	573.5595	0.076
550.5435	0.344	550.6935	0.723	573.5612	0.074
550.5467	0.376	550.6985	0.637	573.5670	0.070
550.5536	0.450	550.7029	0.600	573.5693	0.074
550.5623	0.506	550.7067	0.577	573.5748	0.062
550.5667	0.527	550.7108	0.556	573.5770	0.063
550.5712	0.560	550.7172	0.490	573.5830	0.047
550.5758	0.596	550.7210	0.449	573.5854	0.049
550.5826	0.650	550.7249	0.430	573.5910	0.040
550.5915	0.714	550.7282	0.429	573.5934	0.042
550.5936	0.718			573.5994	0.041
550.5956	0.724	FERNBANK OB.		573.6016	0.050
550.5977	0.733	549.6103	0.277	573.6075	0.044
550.5998	0.732	549.6125	0.277	573.6095	0.046
550.6019	0.715	549.6194	0.280	573.6161	0.044
550.6040	0.710	549.6218	0.288	573.6181	0.049
550.6061	0.701	549.6350	0.304	573.6247	0.042
550.6081	0.725	549.6370	0.309	573.6347	0.047
550.6103	0.743	549.6469	0.294	573.6371	0.048
550.6123	0.753	549.6484	0.300	573.6452	0.037
550.6144	0.756	549.6544	0.295	573.6661	0.041

Table IV. Continued

JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v
573.6682	0.044	608.4870	0.041	532.0482	0.019
573.6744	0.043	608.4901	0.032	532.0593	0.0
573.6765	0.044	608.4916	0.033	532.0874	0.003
573.6832	0.035	608.4981	0.008	532.1065	-0.022
573.6855	0.038	608.5000	0.023	532.1225	-0.009
573.6937	0.046	608.5046	0.020	532.1417	0.002
573.6972	0.031	608.5059	0.019	532.1610	-0.012
573.7043	0.035	608.5131	0.018	532.1755	-0.012
573.7080	0.037	608.5143	0.027	532.1853	-0.016
577.5345	0.096	608.5196	0.026	532.2011	-0.028
577.5425	0.076	608.5213	0.024	532.1853	-0.016
577.5447	0.061	608.5261	0.026	532.2116	-0.019
577.5519	0.067	608.5276	0.036	532.9439	0.061
577.5560	0.052	608.5329	0.019	532.9572	0.063
577.5633	0.044	608.5342	0.018	532.9709	0.062
577.5656	0.047	608.5389	0.025	532.9815	0.068
577.5721	0.032	608.5404	0.031	532.9935	0.052
577.5741	0.040	608.5451	0.013	533.0093	0.043
577.5810	0.031	608.5473	0.031	533.0187	0.044
577.5831	0.031	608.5516	0.019	533.0295	0.044
577.5901	0.032	608.5534	0.010	533.0414	0.048
577.5936	0.040	608.5577	0.006	533.0527	0.032
577.5997	0.033	608.5594	0.017	533.0660	0.025
577.6017	0.048	608.5639	0.008	533.0660	0.025
577.6085	0.029	608.5670	0.014	533.0886	0.014
577.6109	0.028	608.5752	0.031	533.1018	0.031
577.6178	0.039	608.5776	0.010	533.1182	0.020
577.6284	0.033	608.5843	-0.002	533.1254	0.025
577.6307	0.027	608.5868	0.009	533.1415	0.026
577.6390	0.030	608.5928	0.029	533.1516	0.0
577.6421	0.029	916.6356	0.107	533.1706	0.008
577.6481	0.032	916.6387	0.100	533.1897	-0.002
577.6506	0.026	916.6458	0.073	533.2050	0.026
582.4811	0.170	916.6490	0.066	533.2157	0.026
582.4841	0.153	916.6557	0.060	533.9512	0.017
582.4903	0.119	916.6588	0.060	533.9617	0.015
582.4924	0.127	916.6646	0.040	533.9756	0.019
582.4984	0.101	916.6677	0.032	533.9827	0.018
582.5004	0.080	916.6740	0.037	533.9956	0.008
582.5056	0.076	916.6775	0.022	534.0108	0.008
582.5076	0.058	916.6840	0.012	534.0283	0.011
582.5134	0.045	916.6877	0.026	534.0471	0.015
582.5155	0.035	916.6982	0.018	534.0592	0.014
582.5235	0.014	916.7057	0.010	534.0751	0.012
582.5257	0.021	916.7091	0.009	534.0864	0.011
582.5323	0.020			534.0959	0.008
582.5345	0.021	YONSEI U. OB.		534.1102	0.008
608.4772	0.018	532.0122	0.004	534.1412	-0.002
608.4789	0.008	532.0252	0.039	534.1506	0.002
608.4835	0.027	532.0391	-0.043	534.1645	0.007

Table IV. Continued

JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v
534.1777	0.0	540.1937	0.002	546.9475	0.018
534.1914	0.005	540.2103	0.018	546.9576	0.039
534.2052	-0.001	540.9189	0.050	546.9761	0.029
534.2138	0.0	540.9302	0.060	546.9910	0.032
534.2250	0.0	540.9346	0.055	546.9991	0.031
534.2355	0.0	540.9450	0.060	547.0091	0.027
534.9165	0.008	540.9532	0.039	547.0169	0.021
534.9290	0.054	540.9708	0.046	547.0282	0.012
534.9388	0.052	540.9798	0.040	547.0521	0.017
534.9576	0.059	540.9922	0.047	547.0650	0.022
534.9639	0.060	541.0039	0.039	547.0805	0.012
534.9734	0.056	541.0147	0.038	547.1043	0.021
534.9835	0.060	541.0264	0.043	547.1206	0.021
535.9373	0.012	541.0397	0.035	547.1361	0.029
535.9608	0.012	541.0483	0.039	573.9304	0.018
535.9775	0.036	541.0547	0.033	573.9445	0.018
538.9912	0.033	541.0667	0.033	573.9561	0.039
539.0341	0.048	541.9148	0.013	573.9561	0.039
539.0423	0.036	541.9293	0.005	573.9681	0.029
539.0590	0.025	541.9420	0.012	573.9758	0.034
539.0727	0.022	541.9570	0.013	573.9858	0.033
539.0876	0.015	541.9691	0.003	573.9948	0.035
539.0982	0.008	541.9992	-0.005	574.0099	0.022
539.1114	0.027	542.0106	-0.002	574.0232	0.042
539.1191	0.018	542.0191	0.009	574.0421	0.034
539.1445	0.014	542.0262	0.013	574.0563	0.044
539.1636	0.016	542.0371	0.007	574.0742	0.042
539.1742	0.019	542.0478	0.011	574.0879	0.042
539.1824	0.021	542.0611	0.009	574.1047	0.048
539.9335	0.014	542.0716	0.009	575.9163	0.009
539.9457	0.021	542.0859	0.0	575.9485	0.036
539.9552	0.029	542.0961	0.008	575.9632	0.036
539.9643	0.014	542.1396	-0.017	575.9786	0.037
539.9786	0.015	542.1637	0.031	575.9917	0.040
539.9880	0.018	546.0131	0.011	576.0045	0.037
539.9965	0.010	546.0234	0.023	576.0162	0.049
540.0125	-0.001	546.0522	0.017	576.0334	0.038
540.0218	0.012	546.0635	0.009	576.9826	0.003
540.0340	0.006	546.0812	0.009	577.0029	0.032
540.0441	0.003	546.0976	0.009	577.0191	0.006
540.0555	0.001	546.1067	0.013	577.0257	-0.022
540.0687	0.002	546.1196	0.019	577.0379	-0.011
540.0822	0.008	546.1383	0.012	577.0544	0.033
540.0996	0.007	546.1510	0.007	577.0686	0.028
540.1138	0.002	546.1710	0.023	577.0784	0.026
540.1273	0.009	546.1867	0.027	581.9991	0.049
540.1416	0.001	546.2013	0.017	581.9189	0.040
540.1536	-0.002	546.2134	0.014	581.9559	0.032
540.1653	-0.001	546.9279	0.039	581.9891	0.043
540.1796	0.002	546.9363	0.037	581.9966	0.037

Table IV. Continued

JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v
582.0085	0.069	889.1094	-0.002	891.9769	0.079
582.0262	0.050	889.1193	0.010	892.0715	0.072
582.0338	0.055	889.1259	0.004	892.0871	0.067
582.8889	0.047	889.1390	-0.020	892.0976	0.073
582.9058	0.002	889.1503	-0.018	892.1056	0.062
587.9163	0.065	889.1592	-0.020	892.1124	0.064
587.9331	0.071	889.1694	-0.008	892.1259	0.053
587.9411	0.056	889.1845	-0.029	892.1365	0.061
587.9531	0.043	889.1943	-0.042	892.1460	0.067
587.9600	0.061	889.2020	-0.033	892.1560	0.045
587.9754	0.052	889.2110	-0.028	892.1701	0.057
587.9881	0.055	889.2351	-0.046	892.1792	0.060
588.0135	0.058	889.2490	-0.062	892.1869	0.070
588.0209	0.057	890.9896	0.025	892.1984	0.067
588.0349	0.060	890.9963	0.035	897.1956	-0.012
588.0429	0.054	891.0059	0.050	897.2064	-0.023
588.0546	0.047	891.0144	0.034	897.2176	-0.025
588.0654	0.064	891.0210	0.015	897.2358	-0.005
609.9198	0.067	891.0295	0.014	897.2525	-0.011
609.9307	0.061	891.0411	0.017	897.9204	0.098
609.9427	0.075	891.0489	0.020	897.9302	0.073
609.9471	0.067	891.0615	0.012	897.9448	0.083
609.9563	0.082	891.0674	0.014	897.9536	0.069
609.9677	0.089	891.0748	0.008	897.9632	0.074
609.9769	0.068	891.0813	0.008	898.2228	0.053
609.9883	0.081	891.0951	0.006	898.2328	0.045
610.0019	0.122	891.1014	0.008	898.2460	0.042
610.0019	0.122	891.1085	0.0	898.2554	0.066
616.9086	0.045	891.1138	0.002	898.2687	0.056
616.9183	0.043	891.1245	0.005	898.2789	0.041
616.9306	0.041	891.1321	0.007	898.2888	0.055
616.9404	0.052	891.1407	-0.003	899.9317	0.084
616.9507	0.073	891.1460	0.005	899.9418	0.087
616.9592	0.087	891.1531	0.0	900.0120	0.067
616.9678	0.107	891.1599	-0.001	900.0284	0.071
616.9819	0.149	891.1654	-0.010	900.0366	0.085
616.9911	0.164	891.1727	-0.003	900.0565	0.078
888.9445	0.027	891.1780	-0.005	900.0662	0.085
888.9575	0.034	891.1908	-0.012	900.0711	0.085
888.9733	0.036	891.1997	-0.009	900.0791	0.066
888.9915	0.003	891.2060	-0.010	900.0871	0.068
889.0121	0.027	891.2146	-0.013	900.0921	0.071
889.0189	0.016	891.2310	-0.003	900.1027	0.072
889.0303	0.017	891.2436	-0.013	900.1128	0.058
889.0480	0.006	891.2520	-0.005	900.1294	0.071
889.0549	0.009	891.9326	0.076	900.1326	0.085
889.0713	0.009	891.9410	0.077	900.1426	0.071
889.0795	-0.014	891.9524	0.069	900.1544	0.068
889.0870	-0.013	891.9610	0.074	900.1774	0.067
889.1014	0.006	891.9703	0.072	900.1894	0.071

Table IV. Continued

JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v
900.2020	0.067	914.9309	-0.002	941.0790	0.055
900.2169	0.059	914.9397	0.0	941.0881	0.055
900.2256	0.054	914.9462	-0.002	941.0953	0.059
900.2285	0.053	914.9544	-0.003	941.1163	0.072
900.2349	0.038	914.9716	-0.004	941.1272	0.064
900.2439	0.088	914.9787	-0.009	945.9228	0.029
900.2476	0.104	914.9874	-0.022	945.9335	0.042
900.2715	0.079	914.9941	0.003	945.9419	0.019
900.2896	0.040	915.0095	-0.003	945.9504	0.021
901.9676	0.078	915.0175	-0.006	945.9598	0.042
901.9771	0.078	915.0247	-0.004	945.9847	0.086
901.9855	0.091	915.0440	-0.002	945.9940	0.041
902.0086	0.080	915.0518	-0.012	946.0011	0.039
903.9291	0.095	915.0617	-0.005	946.0112	0.039
903.9516	0.083	915.0796	0.0	946.0191	0.022
903.9608	0.066	915.0921	0.001	946.0288	0.044
904.0043	0.069	915.1009	-0.004	946.0357	0.040
904.0133	0.050	915.1094	-0.009	946.0607	0.044
904.0257	0.080	915.1186	-0.011	946.1071	0.059
904.1104	0.053	915.1327	0.013	946.1245	0.066
904.1218	0.034	915.1450	0.021	948.9090	0.016
904.1307	0.076	915.1519	0.007	948.9208	0.033
904.1463	0.058	915.1601	0.011	948.9307	0.032
904.1541	0.034	915.1698	-0.001	948.9424	0.025
904.1700	0.053	934.9893	0.017	948.9582	0.025
904.1787	0.051	935.0030	0.024	948.9668	0.061
904.1865	0.065	935.0110	0.047	948.9776	0.032
904.2005	0.037	939.9890	0.019	948.9856	0.048
904.2112	0.053	939.9978	0.038	948.9992	0.051
904.2272	0.049	940.0054	0.035	949.0084	0.056
906.9915	-0.020	940.0195	0.017	949.0184	0.072
907.0016	-0.025	940.0262	0.031	949.0276	0.054
907.0145	-0.028	940.0360	0.035	949.0457	0.061
907.0337	-0.004	940.0569	0.048	949.0543	0.069
907.0439	-0.022	940.0656	0.047	949.0614	0.046
907.0514	-0.010	940.0760	0.015	949.0723	0.061
907.0665	0.0	940.0982	0.052	949.0894	0.102
907.0856	-0.033	940.1282	0.042	949.0995	0.084
907.9089	0.082	940.9492	0.010	949.1137	0.104
907.9161	0.074	940.9599	0.029	953.9345	0.058
907.9298	0.086	940.9670	-0.002	953.9464	0.036
907.9406	0.067	940.9800	0.032	953.9565	0.076
907.9506	0.078	940.9928	0.055	953.9657	0.059
907.9665	0.077	940.9999	0.055	953.9742	0.061
907.9734	0.062	941.0138	0.039	953.9992	0.055
907.9910	0.076	941.0231	0.029	954.0100	0.052
908.0018	0.081	941.0310	0.055	954.0193	0.031
908.0093	0.077	941.0445	0.053	955.9669	0.044
908.0288	0.068	941.0526	0.056	955.9775	0.050
908.0427	0.065	941.0605	0.056	955.9876	0.049

Table IV. Continued

JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v
955.9982	0.041	965.9674	0.057	978.9713	0.669
956.0158	0.061	965.9781	-0.019	978.9850	0.653
956.0244	0.054	965.9790	0.021	978.9883	0.668
		966.0017	0.200	979.0097	0.698
956.0338	0.055	966.0038	0.176		
956.0429	0.066	966.0244	0.164	979.0131	0.688
956.0623	0.100	966.0264	0.178	979.0265	0.685
956.0747	0.103	976.9118	0.200	979.0300	0.693
		976.9296	0.311	979.8979	0.141
KONGJU C OB				979.9026	0.154
962.9435	0.058	976.9321	0.336	979.9058	0.167
962.9555	0.031	976.9521	0.520	979.9208	0.202
962.9578	0.031	976.9551	0.540	979.9231	0.200
962.9746	0.041	976.9663	0.607	979.9328	0.255
		976.9683	0.612	979.9351	0.268
962.9879	0.037	976.9852	0.674	979.9507	0.321
962.9958	0.051	976.9875	0.672	979.9528	0.312
963.0235	0.173	976.9964	0.676	979.9601	0.324
963.0258	0.191	976.9986	0.679		
963.0350	0.236	977.0204	0.681	979.9629	0.323
963.0389	0.258	977.0231	0.676	979.9825	0.369
964.9342	0.031	977.0343	0.655	979.9856	0.368
964.9452	0.024	977.0420	0.676	979.9942	0.366
964.9472	0.041			979.9974	0.359
964.9549	0.043	977.0576	0.665	981.9003	0.236
964.9575	0.035	977.0593	0.684	981.9024	0.255
964.9685	0.030	977.0668	0.652	981.9137	0.234
964.9710	0.027	977.0685	0.651	981.9158	0.252
		977.0876	0.547	981.9332	0.301
964.9872	0.081	977.0897	0.528		
964.9910	0.085	977.0991	0.480	981.9369	0.311
965.0000	0.139	977.1008	0.460	981.9448	0.347
965.0036	0.146	978.9022	0.253	981.9479	0.347
965.0154	0.268	978.9195	0.371	983.9078	0.276
965.0180	0.264			983.9100	0.298
965.9310	0.031	978.9223	0.400	983.9163	0.286
965.9418	0.026	978.9336	0.481	983.9195	0.305
965.9473	0.039	978.9361	0.506	983.9388	0.336
965.9497	0.048	978.9436	0.529	983.9414	0.338
		978.9464	0.563	983.9511	0.338
965.9647	0.055	978.9680	0.660		
				983.9538	0.340

Table V. *B* observations of AR Lac

JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b
ROSEMARY H OB		550.6125	1.522	549.6565	0.933
505.6214	0.664	550.6146	1.527	549.6646	0.938
505.6285	0.682	550.6167	1.502	549.6761	0.919
505.6303	0.686	550.6188	1.486	549.6774	0.918
505.6378	0.670	550.6209	1.506	549.6846	0.930
505.6395	0.688	550.6229	1.468	549.6940	0.930
505.6510	0.683	550.6271	1.503	549.6964	0.917
505.6528	0.709	550.6292	1.456	549.7041	0.892
505.6678	0.680	550.6313	1.528	549.7067	0.873
505.6771	0.670	550.6334	1.521	549.7147	0.848
505.6789	0.684	550.6354	1.489	549.7167	0.873
505.6907	0.650	550.6375	1.475	549.7251	0.810
545.5537	0.772	550.6399	1.475	549.7279	0.832
545.5677	0.703	550.6421	1.480	549.7362	0.790
545.5691	0.720	550.6438	1.477	549.7388	0.776
545.5746	0.733	550.6459	1.471	573.5082	0.873
545.5758	0.722	550.6479	1.475	573.5102	0.863
545.5826	0.732	550.6500	1.472	573.5153	0.858
545.5843	0.744	550.6521	1.479	573.5170	0.852
545.6509	0.907	550.6542	1.465	573.5222	0.841
545.6530	0.902	550.6563	1.467	573.5238	0.839
545.6624	0.905	550.6605	1.485	573.5290	0.829
545.6693	0.901	550.6625	1.475	573.5306	0.824
545.6747	0.885	550.6646	1.489	573.5350	0.810
545.6790	0.890	550.6667	1.484	573.5367	0.803
545.6917	0.891	550.6688	1.474	573.5431	0.798
545.6978	0.914	550.6709	1.460	573.5447	0.788
545.6993	0.905	550.6731	1.473	573.5517	0.770
545.7160	0.905	550.6753	1.450	573.5534	0.766
545.7191	0.932	550.6878	1.463	573.5600	0.722
545.7277	0.861	550.6940	1.396	573.5619	0.720
550.5386	1.002	550.6988	1.367	573.5677	0.722
550.5438	1.042	550.7031	1.314	573.5700	0.726
550.5469	1.069	550.7070	1.253	573.5755	0.720
550.5538	1.135	550.7111	1.225	573.5779	0.716
550.5626	1.195	550.7175	1.164	573.5837	0.701
550.5671	1.263	550.7213	1.121	573.5861	0.707
550.5716	1.301	550.7251	1.083	573.5919	0.696
550.5760	1.318	550.7288	1.054	573.5941	0.700
550.5831	1.409			573.6001	0.697
550.5917	1.480	FERNBANK OB		573.6024	0.709
550.5938	1.480	549.6109	0.895	573.6080	0.702
550.5958	1.509	549.6133	0.898	573.6104	0.702
550.5979	1.495	549.6201	0.906	573.6168	0.701
550.6000	1.499	549.6222	0.907	573.6187	0.702
550.6021	1.479	549.6356	0.931	573.6255	0.700
550.6042	1.476	549.6375	0.936	573.6354	0.696
550.6063	1.474	549.6474	0.926	573.6378	0.704
550.6084	1.484	549.6488	0.928	573.6459	0.682
550.6105	1.492	549.6548	0.926	573.6667	0.692

Table V. Continued

JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b
573.6690	0.682	608.4873	0.693	532.0474	0.787
573.6722	0.690	608.4905	0.689	532.0584	0.761
573.6772	0.679	608.4926	0.695	532.1039	0.753
573.6838	0.670	608.4986	0.662	532.1232	0.755
573.6862	0.681	608.5006	0.669	532.1417	0.757
573.6950	0.687	608.5050	0.668	532.1608	0.740
573.6978	0.680	608.5063	0.670	532.1757	0.738
573.7057	0.685	608.5134	0.674	532.1859	0.738
573.7088	0.677	608.5147	0.677	532.2103	0.738
577.5354	0.748	608.5202	0.673	532.2108	0.716
577.5432	0.727	608.5217	0.672	532.9473	0.853
577.5455	0.707	608.5265	0.673	532.9561	0.841
577.5535	0.712	608.5282	0.677	532.9702	0.858
577.5568	0.711	608.5333	0.671	532.9824	0.870
577.5641	0.696	608.5346	0.670	532.9926	0.840
577.5663	0.707	608.5393	0.675	533.0083	0.824
577.5727	0.688	608.5409	0.686	533.0197	0.830
577.5749	0.704	608.5462	0.665	533.0309	0.834
577.5817	0.694	608.5477	0.679	533.0423	0.821
577.5839	0.692	608.5521	0.654	533.0519	0.808
577.5909	0.693	608.5538	0.650	533.0664	0.795
577.5950	0.692	608.5583	0.644	533.0900	0.811
577.6002	0.692	608.5599	0.662	533.1018	0.821
577.6023	0.699	608.5645	0.653	533.1171	0.780
577.6091	0.694	608.5675	0.651	533.1263	0.823
577.6119	0.692	608.5757	0.688	533.1406	0.780
577.6185	0.705	608.5780	0.668	533.1503	0.755
577.6289	0.697	608.5850	0.644	533.1696	0.805
577.6315	0.681	608.5873	0.662	533.1887	0.818
577.6398	0.687	608.5934	0.653	533.2123	0.805
577.6428	0.684	916.6362	0.759	533.9519	0.801
577.6488	0.683	916.6393	0.755	533.9604	0.796
577.6513	0.673	916.6465	0.726	533.9756	0.789
582.4818	0.857	916.6494	0.718	533.9824	0.806
582.4848	0.838	916.6562	0.702	533.9950	0.784
582.4908	0.796	916.6593	0.700	534.0095	0.792
582.4931	0.796	916.6652	0.682	534.0282	0.786
582.4989	0.769	916.6683	0.681	534.0444	0.785
582.5009	0.751	916.6745	0.676	534.0609	0.785
582.5062	0.740	916.6774	0.665	534.0738	0.796
582.5081	0.713	916.6847	0.669	534.0876	0.786
582.5142	0.686	916.6884	0.672	534.0960	0.771
582.5162	0.690	916.6956	0.663	534.1094	0.778
582.5242	0.675	916.6989	0.669	534.1310	0.778
582.5264	0.686	916.7062	0.656	534.1403	0.775
582.5330	0.680	916.7096	0.660	534.1515	0.774
582.5351	0.679			534.1627	0.776
608.4776	0.677	YONSEI U OB		534.1784	0.762
608.4795	0.663	532.0132	0.762	534.1915	0.758
608.4850	0.685	532.0394	0.798	534.2042	0.772

Table V. Continued

JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b
534.2238	0.766	540.9442	0.845	547.0178	0.794
534.9169	0.891	540.9540	0.815	547.0292	0.798
534.9286	0.836	540.9718	0.835	547.0395	0.818
534.9393	0.835	540.9794	0.829	547.0520	0.813
534.9566	0.850	540.9927	0.825	547.0647	0.817
534.9656	0.842	541.0054	0.831	573.9165	0.825
534.9727	0.844	541.0139	0.829	573.9313	0.831
534.9827	0.843	541.0256	0.831	573.9457	0.800
535.9354	0.800	541.0405	0.805	573.9671	0.802
535.9620	0.793	541.0657	0.809	573.9750	0.813
535.9771	0.817	541.9158	0.809	573.9867	0.820
538.9922	0.824	541.9305	0.801	573.9949	0.832
539.0336	0.814	541.9419	0.774	574.0110	0.813
539.0435	0.815	541.9580	0.781	574.0219	0.824
539.0596	0.814	541.9681	0.785	574.0397	0.800
539.0737	0.802	542.0003	0.782	574.0563	0.841
539.0863	0.803	542.0102	0.780	574.0729	0.834
539.0990	0.784	542.0181	0.792	574.1034	0.823
539.1160	0.799	542.0269	0.800	575.9786	0.849
539.1464	0.782	542.0379	0.791		
539.1646	0.787	542.0470	0.785	575.9907	0.823
539.1733	0.819	542.0600	0.792	576.0047	0.812
539.1811	0.783	542.0717	0.787	576.0157	0.823
539.9350	0.783	542.0849	0.772	576.0333	0.795
539.9466	0.792	542.0972	0.785	576.9818	0.771
539.9542	0.792	542.1212	0.789	577.0021	0.771
539.9646	0.795	542.1615	0.722	577.0143	0.780
539.9776	0.786	546.0144	0.792	577.0230	0.781
539.9891	0.795	546.0223	0.806	577.0367	0.795
539.9968	0.768	546.0371	0.795	577.0533	0.835
540.0046	0.790	546.0500	0.807	577.0678	0.832
540.0132	0.783	546.0661	0.787	577.0776	0.806
540.0228	0.799	546.0823	0.780	581.9004	0.848
540.0347	0.790	546.0939	0.783	581.9215	0.855
540.0432	0.780	546.1083	0.779	581.9709	0.769
540.0547	0.780	546.1184	0.787	581.9884	0.804
540.0671	0.784	546.1372	0.790	581.9958	0.803
540.0842	0.779	546.1527	0.775	582.0074	0.828
540.1020	0.777	546.1722	0.773	582.0252	0.817
540.1150	0.774	546.1880	0.792	582.0346	0.841
540.1285	0.781	546.1996	0.784	587.9168	0.835
540.1426	0.773	546.2126	0.762	587.9322	0.850
540.1524	0.794	546.9278	0.834	587.9402	0.843
540.1644	0.771	546.9353	0.820	587.9523	0.814
540.1807	0.760	546.9467	0.806	587.9609	0.841
540.1925	0.753	546.9587	0.815	587.9733	0.841
540.2080	0.769	546.9751	0.819	587.9903	0.831
540.9193	0.845	546.9901	0.827	588.0170	0.833
540.9307	0.851	546.9997	0.805	588.0338	0.829
540.9356	0.843	547.0082	0.798	588.0439	0.806

Table V. Continued

JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b
588.0555	0.809	891.0288	0.783	897.9217	0.853
588.0666	0.837	891.0419	0.788	897.9315	0.856
609.9208	0.834	891.0483	0.793	897.9421	0.859
609.9319	0.834	891.0606	0.781	897.9546	0.833
609.9428	0.842	891.0682	0.742	897.9621	0.837
609.9552	0.836	891.0740	0.746	898.2213	0.796
609.9668	0.837	891.0822	0.781	898.2339	0.794
609.9760	0.834	891.0940	0.778	898.2449	0.823
609.9873	0.850	891.1022	0.784	898.2560	0.830
610.0008	0.875	891.1077	0.783	898.2673	0.803
616.9079	0.841	891.1144	0.771	898.2779	0.785
616.9174	0.819	891.1252	0.775	898.2907	0.752
616.9296	0.809	891.1314	0.781	899.9308	0.842
616.9397	0.793	891.1399	0.771	900.0145	0.849
616.9499	0.837	891.1524	0.763	900.0275	0.849
616.9584	0.851	891.1592	0.770	900.0381	0.859
616.9669	0.861	891.1661	0.768	900.0576	0.841
616.9834	0.908	891.1720	0.767	900.0661	0.848
616.9912	0.905	891.1788	0.764	900.0775	0.843
888.9455	0.804	891.1917	0.764	900.0863	0.846
888.9543	0.818	891.1988	0.768	900.0914	0.837
888.9761	0.830	891.2069	0.765	900.1036	0.841
888.9925	0.810	891.2136	0.749	900.1121	0.839
889.0110	0.825	891.2325	0.750	900.1268	0.831
889.0196	0.798	891.2422	0.738	900.1317	0.842
889.0295	0.802	891.2531	0.659	900.1438	0.839
889.0441	0.805	891.9316	0.823	900.1528	0.836
889.0567	0.800	891.9423	0.852	900.1754	0.855
889.0786	0.768	891.9514	0.832	900.1921	0.843
889.0880	0.762	891.9619	0.846	900.1985	0.839
889.1025	0.786	891.9693	0.836	900.2022	0.836
889.1095	0.814	891.9778	0.848	900.2154	0.811
889.1183	0.804	892.0723	0.834	900.2283	0.814
889.1271	0.776	892.0881	0.833	900.2349	0.814
889.1399	0.769	892.0964	0.841	900.2712	0.820
889.1491	0.763	892.1048	0.836	901.9686	0.841
889.1601	0.745	892.1133	0.838	901.9761	0.839
889.1687	0.760	892.1272	0.838	901.9862	0.858
889.1855	0.745	892.1353	0.740	902.0076	0.849
889.1935	0.755	892.1451	0.685	903.9283	0.887
889.2131	0.773	892.1550	0.689	903.9510	0.852
889.2101	0.746	892.1709	0.830	903.9617	0.825
889.2334	0.752	892.1782	0.814	904.0032	0.836
889.2506	0.684	892.1879	0.822	994.0143	0.833
890.9887	0.773	892.1971	0.848	904.0234	0.851
890.9964	0.800	897.1942	0.739	904.1096	0.821
891.0066	0.833	897.2074	0.713	904.1226	0.807
891.0132	0.803	897.2163	0.738	904.1296	0.831
891.0221	0.792	897.2499	0.719	904.1455	0.818
				904.1556	0.821

Table V. Continued

JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b
904.1710	0.807	934.9917	0.803	948.9573	0.779
904.1780	0.811	935.0026	0.803	948.9676	0.831
904.1874	0.871	935.0137	0.813	948.9783	0.801
904.2014	0.799	939.9898	0.780	948.9849	0.788
904.2103	0.805	939.9968	0.790	948.9982	0.839
904.2260	0.794	940.0063	0.775	949.0093	0.823
906.9923	0.742	940.0195	0.760	949.0192	0.815
907.0025	0.734	940.0273	0.802	949.0270	0.797
907.0153	0.729	940.0351	0.774	949.0444	0.810
907.0345	0.757	940.0557	0.809	949.0538	0.808
907.0424	0.736	940.0664	0.786	949.0622	0.835
907.0524	0.758	940.0748	0.779	949.1118	0.823
907.0642	0.742	940.0957	0.814	953.9339	0.821
907.0864	0.735	940.1290	0.788	953.9479	0.812
907.9078	0.863	940.9483	0.801	953.9556	0.861
907.9177	0.865	940.9592	0.822	953.9645	0.826
907.9288	0.858	940.9678	0.785	953.9752	0.833
907.9414	0.865	940.9811	0.796	953.9951	0.791
907.9656	0.853	940.9913	0.816	954.0087	0.786
907.9746	0.848	941.0008	0.813	954.0204	0.777
907.9910	0.847	941.0147	0.813	955.9681	0.796
908.0010	0.853	941.0221	0.781	955.9766	0.821
908.0102	0.851	941.0319	0.814	955.9885	0.807
908.0297	0.855	941.0454	0.761	955.9974	0.797
908.0410	0.836	941.0534	0.808	956.0149	0.805
914.9316	0.757	941.0621	0.822	956.0253	0.813
914.9382	0.772	941.0798	0.820	956.0328	0.822
914.9473	0.743	941.0872	0.812	956.0444	0.819
914.9535	0.757	941.0965	0.803	956.0634	0.822
914.9709	0.751	941.1170	0.824	956.0735	0.850
914.9793	0.744	941.1287	0.821		
914.9860	0.736	945.9245	0.782	KONGJU C OB	
914.9948	0.746	945.9327	0.815	962.9427	0.796
915.0101	0.753	945.9428	0.777	962.9442	0.803
915.0160	0.747	945.9497	0.774	962.9548	0.773
915.0254	0.759	945.9590	0.800	962.9571	0.779
915.0431	0.755	945.9855	0.827	962.9753	0.797
915.0514	0.750	945.9931	0.781	962.9776	0.796
915.0627	0.752	946.0100	0.785	962.9871	0.779
915.0813	0.757	946.0201	0.774	962.9950	0.787
915.0915	0.756	946.0276	0.793	963.0200	0.965
915.0988	0.777	946.0367	0.799	963.0252	0.955
915.1105	0.755	946.0615	0.781	963.0365	1.000
915.1177	0.752	946.1061	0.799	963.0396	1.008
915.1320	0.762	946.1237	0.808	964.9348	0.802
915.1442	0.785	948.9103	0.795	964.9446	0.783
915.1528	0.766	948.9197	0.814	964.9466	0.788
915.1590	0.770	948.9318	0.774	964.9555	0.791
915.1698	0.738	948.9416	0.777	964.9585	0.782

Table V. Continued

JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b
964.9677	0.782	976.9867	1.590	979.0287	1.535
964.9703	0.781	976.9971	1.565	979.8974	0.854
964.9865	0.837	976.9996	1.577	979.9033	0.912
964.9903	0.809	977.0213	1.550	979.9049	0.916
965.0012	0.873	977.0242	1.556	979.9216	0.949
965.0019	0.863	977.0336	1.513	979.9238	0.952
965.0043	0.902	977.0418	1.484	979.9320	0.988
965.0145	1.007	977.0576	1.505	979.9343	0.986
965.0171	1.024	977.0584	1.493	979.9499	1.053
965.9318	0.774	977.0677	1.428	979.9521	1.048
965.9404	0.772	977.0698	1.454	979.9591	1.066
965.9484	0.790	977.0887	1.433	979.9636	1.060
965.9503	0.807	977.0907	1.340	979.9813	1.107
965.9655	0.824	977.0999	1.091	979.9845	1.109
965.9681	0.824	977.1016	0.996	979.9953	1.122
965.9759	0.753	978.9032	1.033	979.9985	1.116
965.9782	0.746	978.9203	1.213	981.9010	0.983
966.0002	0.937	978.9231	1.177	981.9029	0.999
966.0031	0.890	978.9329	1.326	981.9130	0.947
966.0237	0.923	978.9352	1.348	981.9151	0.964
966.0257	0.896	978.9445	1.444	981.9325	1.025
976.9113	0.972	978.9474	1.479	981.9350	1.026
976.9304	1.121	978.9691	1.560	981.9458	1.054
976.9326	1.158	978.9724	1.559	981.9490	1.058
976.9528	1.374	978.9840	1.539	981.9693	0.998
976.9556	1.406	978.9872	1.553	981.9726	0.102
976.9657	1.495	979.0107	1.595	983.9068	0.978
976.9676	1.510	979.0145	1.567	983.9092	0.994
976.9845	1.576	979.0256	1.559	983.9178	1.018
				983.9203	1.035
				983.9399	1.082
				983.9422	1.059
				981.9726	1.025
				983.9501	1.049
				983.9529	1.046

Table VI. *U* observations of AR Lac

JD Hel 2444000+	Δm_u	JD Hel 2444000+	Δm_u	JD Hel 2444000+	Δm_u
ROSEMARY H OB		550.6127	1.831	549.6479	1.055
505.6210	0.835	550.6148	1.828	549.6492	1.064
505.6291	0.847	550.6169	1.824	549.6553	1.066
505.6312	0.868	550.6190	1.809	549.6574	1.071
505.6383	0.850	550.6211	1.812	549.6653	1.079
505.6400	0.871	550.6232	1.818	549.6765	1.056
505.6505	0.818	550.6273	1.821	549.6777	1.048
505.6522	0.870	550.6294	1.805	549.6853	1.057
505.6673	0.851	550.6315	1.863	549.6947	1.052
505.6765	0.853	550.6336	1.846	549.6972	1.052
505.6783	0.839	550.6357	1.813	549.7047	1.019
505.6902	0.816	550.6377	1.783	549.7076	1.022
545.5557	0.870	550.6401	1.803	549.7153	0.999
545.5683	0.848	550.6423	1.799	549.7153	0.999
545.5695	0.870	550.6441	1.814	549.7180	0.975
545.5750	0.879	550.6460	1.800	549.7259	0.957
545.5762	0.869	550.6481	1.796	549.7290	0.989
545.5830	0.896			549.7369	0.946
545.5847	0.888			549.7396	0.948
545.6514	1.022			573.5090	0.996
545.6537	1.022	550.6502	1.783	573.5107	0.995
545.6630	1.026	550.6523	1.815	573.5159	0.989
545.6685	1.047	550.6545	1.814	573.5174	0.985
545.6742	1.031	550.6565	1.811	573.5227	0.977
545.6796	1.034	550.6607	1.768	573.5243	0.973
545.6912	1.024	550.6627	1.781	573.5296	0.975
545.6972	1.066	550.6649	1.799	573.5310	0.964
545.6989	1.050	550.6669	1.792	573.5355	0.945
545.7165	1.039	550.6685	1.793	573.5373	0.948
545.7196	1.100	550.6711	1.774	573.5436	0.934
545.7273	1.022	550.6733	1.777	573.5454	0.933
550.5388	1.185	550.6755	1.779	573.5524	0.919
550.5443	1.216	550.6880	1.783	573.5541	0.916
550.5470	1.256	550.6943	1.701	573.5606	0.879
550.5540	1.299	550.6991	1.654	573.5624	0.878
550.5674	1.506	550.7034	1.586	573.5683	0.882
550.5629	1.444	550.7073	1.547	573.5706	0.889
550.5718	1.560	550.7114	1.473		
550.5764	1.606	550.7178	1.425		
550.5837	1.707	550.7215	1.392		
550.5919	1.778	550.7254	1.310	573.5761	0.883
550.5940	1.789	550.7286	1.353	573.5785	0.878
550.5960	1.837			573.5846	0.876
550.5981	1.816	FERNBANK OB		573.5867	0.891
550.6002	1.818	549.6117	0.966	573.5927	0.884
550.6023	1.787	549.6141	0.973	573.5948	0.885
550.6044	1.804	549.6203	1.020	573.6008	0.877
550.6065	1.800	549.6227	1.024	573.6031	0.875
550.6107	1.820	549.6363	1.063	573.6086	0.869
550.6085	1.804	549.6383	1.067	573.6110	0.879

Table VI. Continued

JD Hel 2444000+	Δm_u	JD Hel 2444000+	Δm_u	JD Hel 2444000+	Δm_u
573.6174	0.866	582.5248	0.824	916.6854	0.831
573.6193	0.869	582.5274	0.834	916.6889	0.832
573.6263	0.870	582.5337	0.825	916.6961	0.829
573.6362	0.874	582.5360	0.820	916.7000	0.833
573.6388	0.878	608.4782	0.842	916.7068	0.827
573.6466	0.862	608.4800	0.842	916.7103	0.828
573.6673	0.888	608.4863	0.871		
573.6696	0.869			KONG JU C OB	
573.6759	0.871			962.9416	0.894
573.6781	0.860			962.9451	0.896
573.6845	0.882	608.4875	0.876	962.9540	0.909
573.6869	0.880	608.4911	0.859	962.9563	0.919
573.6963	0.879	608.4938	0.855	962.9761	0.949
573.6988	0.893	608.4992	0.827	962.9784	0.949
573.7067	0.877	608.5011	0.835	962.9862	0.943
573.7097	0.893	608.5055	0.845	962.9888	0.964
577.5364	0.881	608.5069	0.863	962.9939	0.936
577.5439	0.866	608.5138	0.847	963.0188	1.104
577.5462	0.865	608.5151	0.862	963.0243	1.142
577.5551	0.875	608.5208	0.853	963.0380	1.263
577.5578	0.873	608.5221	0.853	963.0406	1.308
577.5649	0.869	608.5271	0.857	964.9356	0.955
577.5673	0.870	608.5286	0.857	964.9439	0.938
577.5734	0.860	608.5338	0.845	964.9460	0.938
577.5757	0.861	608.5352	0.860	964.9562	0.941
577.5824	0.856	608.5398	0.864	964.9593	0.954
577.5846	0.870	608.5415	0.891	964.9669	0.935
577.5920	0.858	608.5467	0.861		
577.5955	0.861	608.5481	0.863		
577.6008	0.855	608.5527	0.867		
577.6030	0.868	608.5542	0.854	964.9857	1.020
577.6099	0.848	608.5586	0.832	964.9894	0.995
577.6128	0.859	608.5606	0.855	965.0025	1.077
577.6193	0.882	608.5655	0.857	965.0050	1.114
577.6299	0.864	608.5680	0.875	965.0136	1.285
577.6326	0.863	608.5768	0.869	965.0164	1.311
577.6409	0.873	608.5785	0.885	965.9327	0.925
577.6436	0.866	608.5857	0.868	965.9398	0.911
577.6497	0.859	608.5879	0.888	965.9490	0.932
577.6521	0.861	608.5949	0.878	965.9509	0.936
582.4827	1.070	916.6368	0.887	965.9664	0.965
582.4856	1.037	916.6399	0.888	965.9689	0.963
582.4913	0.973	916.6470	0.857	965.9752	0.909
582.4936	0.972	916.6499	0.859	965.9774	0.879
582.4996	0.937	916.6569	0.850	965.9995	1.116
582.5014	0.916	916.6599	0.858	965.0024	1.101
582.5069	0.894	916.6659	0.833	965.0229	1.092
582.5088	0.859	916.6687	0.839	965.0251	1.046
582.5148	0.836	916.6750	0.839	976.9107	1.163
582.5174	0.840	916.6787	0.828	976.9311	1.352

Table VI. Continued

JD Hel 2444000+	Δm_u	JD Hel 2444000+	Δm_u	JD Hel 2444000+	Δm_u
976.9334	1.403	979.9514	1.167	983.9429	1.095
976.9540	1.671	979.9622	1.182	983.9491	1.096
976.9564	1.677	979.9646	1.174	983.9518	1.129
976.9642	1.806	979.9804	1.204		
976.9670	1.845	979.9834	1.237		
976.9837	1.924	979.9964	1.228		
976.9859	1.956	979.9996	1.233		
976.9978	1.923	979.9124	1.024		
977.0007	1.931	979.9151	1.043		
977.0161	1.968	979.9317	1.091		
977.0222	1.924	979.9340	1.112		
977.0250	1.904	979.9468	1.146		
979.8970	1.009	979.9501	1.163		
979.9040	1.044	979.9705	1.109		
979.9065	1.067	979.9736	1.161		
979.9223	1.058	983.9061	1.125		
979.9246	1.066	983.9084	1.149		
979.9312	1.078	983.9186	1.144		
979.9335	1.101	983.9210	1.160		
979.9492	1.168	983.9405	1.118		

Table VIIa. *V* observations of check star (BD+44°4041)

JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v
ROSEMARY H OB		540.0587	0.326	587.9657	0.317
505.6174	0.282	540.0886	0.320	587.9961	0.311
505.6642	0.322	540.1370	0.317	588.0248	0.309
505.6878	0.306	540.1680	0.311	588.0483	0.310
545.5645	0.318	540.1979	0.318	588.0584	0.307
545.5881	0.317	540.9286	0.308	616.9717	0.306
545.5881	0.317	540.9582	0.312	616.9959	0.320
545.6854	0.305	540.9970	0.315	888.9994	0.297
545.7093	0.325	541.0220	0.317	889.0635	0.309
545.7242	0.303	541.9200	0.314	889.0950	0.315
YONSEI U CB		541.9472	0.301	889.1328	0.331
532.0312	0.309	541.9659	0.322	889.1787	0.300
532.0645	0.323	542.0302	0.321	889.2186	0.313
532.1357	0.330	542.0508	0.320	891.0548	0.318
532.1716	0.301	542.0768	0.314	891.0878	0.309
532.1934	0.328	542.1123	0.345	891.1195	0.315
532.9610	0.325	542.1494	0.313	891.1506	0.313
532.9790	0.318	546.0335	0.297	891.1854	0.320
532.9856	0.297	546.0460	0.327	891.2225	0.308
533.0273	0.325	546.0595	0.329	892.0793	0.313
533.0392	0.303	546.0770	0.320	892.1202	0.312
533.0789	0.315	546.1030	0.318	892.1633	0.317
533.1112	0.315	546.1304	0.322	897.2239	0.289
533.1410	0.260	546.1675	0.318	900.0463	0.320
533.1598	0.286	546.1829	0.323	900.1194	0.309
533.1824	0.305	546.2084	0.297	900.1646	0.307
533.9558	0.323	546.9397	0.321	900.2080	0.316
533.9695	0.319	546.9804	0.311	903.9724	0.293
533.9889	0.312	547.0208	0.302	904.1380	0.310
534.0227	0.309	547.0437	0.322	904.1623	0.300
534.0683	0.324	547.0710	0.295	904.2178	0.328
534.1266	0.316	547.0961	0.331	907.0772	0.327
534.1724	0.309	547.1280	0.296	907.9585	0.315
534.1954	0.324	573.9364	0.305	908.0202	0.322
534.2448	0.326	573.9594	0.331	915.0033	0.308
534.9250	0.314	573.9830	0.321	915.0346	0.312
534.9524	0.311	574.0275	0.313	915.0731	0.314
534.9690	0.319	574.0611	0.320	915.1250	0.304
534.9790	0.317	574.0929	0.316	915.1388	0.311
535.9471	0.307	575.9678	0.319	940.0138	0.319
535.9731	0.353	575.9979	0.321	940.0469	0.337
539.0244	0.327	576.0225	0.322	940.0838	0.282
539.0547	0.306	577.0068	0.284	940.1159	0.320
539.1039	0.317	577.0417	0.257	940.9733	0.308
539.1607	0.307	577.0584	0.303	941.0077	0.326
539.9426	0.311	577.0819	0.291	941.0386	0.309
539.9848	0.318	581.9127	0.308	941.0702	0.304
540.0014	0.312	581.9147	0.308	941.1066	0.319
540.0312	0.300	587.9244	0.325	948.9490	0.316
540.0472	0.320	587.9433	0.317	949.0361	0.320

Table VIIa. Continued

JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v	JD Hel 2444000+	Δm_v
953.9869	0.330	965.9359	0.280	978.9984	0.332
954.0315	0.283	965.9586	0.312	979.0397	0.320
956.0059	0.301	965.9892	0.362	979.0419	0.317
956.0538	0.317	966.0143	0.299	979.9138	0.326
		976.9443	0.326	979.9415	0.311
KONGJU C OB		976.9759	0.315	979.9740	0.311
962.9676	0.318	977.0107	0.324	980.0051	0.381
963.0049	0.348	977.0482	0.291	981.9221	0.333
963.0571	0.361	977.0781	0.311	981.9608	0.301
964.9333	0.312	978.9127	0.310	983.9298	0.314
964.9781	0.334	978.9587	0.322	983.9632	0.345

Table VIIb. *B* observations of check star (BD+44°4041)

JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b
ROSEMARY H OB		534.0235	0.182	541.9191	0.192
505.6166	0.185	534.0696	0.204	541.9455	0.170
505.6635	0.196	534.1252	0.137	541.9841	0.207
505.6874	0.190	534.1713	0.181	541.9882	0.202
545.5649	0.202	534.1963	0.195	542.0293	0.206
545.5886	0.189	534.2457	0.200	542.0518	0.190
545.6865	0.234	534.9242	0.194	546.0779	0.191
545.7087	0.195	534.9518	0.200	546.1134	0.225
545.7247	0.160	534.9699	0.197	546.1147	0.234
		534.9797	0.194	546.1482	0.171
YONSEI U OB		535.9479	0.185	546.0343	0.183
532.0308	0.197	535.9702	0.229	546.0467	0.206
532.0522	0.189	539.0254	0.178	546.0603	0.204
532.0630	0.197	539.0531	0.185	546.0760	0.194
532.1345	0.209	539.1032	0.173	546.1021	0.197
532.1722	0.183	539.1598	0.182	546.1310	0.204
532.1949	0.203	539.9417	0.202	546.1654	0.196
532.9602	0.169	539.9833	0.184	546.1820	0.175
532.9782	0.211	540.0021	0.195	546.2091	0.179
532.9850	0.189	540.0303	0.183	546.9406	0.194
533.0266	0.200	540.0460	0.190	546.9821	0.192
533.0385	0.181	540.0599	0.197	547.0201	0.183
533.0799	0.185	540.0877	0.189	547.0965	0.171
533.1105	0.173	540.1361	0.188	573.9350	0.216
533.1333	0.187	540.1692	0.189	573.9605	0.193
533.1589	0.198	540.1990	0.185	573.9822	0.195
533.1805	0.183	540.9276	0.206	573.9999	0.196
533.9546	0.202	540.9571	0.208	574.0293	0.181
533.9633	0.193	540.9963	0.179	574.0624	0.195
533.9905	0.197	541.0229	0.192	574.0941	0.199

Table VIIb. Continued

JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b	JD Hel 2444000+	Δm_b
575.9687	0.211	897.2250	0.203	956.0068	0.172
576.0225	0.188	900.0456	0.189	956.0512	0.193
577.0091	0.209	900.1202	0.194		
577.0430	0.208	900.1661	0.204	KONGJU C OB	
577.0594	0.238	900.2089	0.196	962.9665	0.185
582.9518	0.172	903.9713	0.162	963.0064	0.238
587.9236	0.202	904.1394	0.196	963.0502	0.201
587.9441	0.187	904.1616	0.179	964.9328	0.216
587.9638	0.187	904.2187	0.203	964.9787	0.207
587.9937	0.186	907.0764	0.233	965.0279	0.254
588.0255	0.213	907.9594	0.190	965.9343	0.192
588.0486	0.0	908.0179	0.194	965.9351	0.166
588.0577	0.202	915.0026	0.186	965.9579	0.194
616.9727	0.196	915.0351	0.204	965.9902	0.206
616.9953	0.210	915.0721	0.198	966.0150	0.152
889.0007	0.208	915.1258	0.210	976.9443	0.195
889.0628	0.185	915.1394	0.200	976.9766	0.203
889.0942	0.200	940.0096	0.196	977.0099	0.207
889.1320	0.203	940.0478	0.204	977.0494	0.195
889.1773	0.177	940.0848	0.193	977.0772	0.208
889.2194	0.200	940.1151	0.219	978.9133	0.185
891.0556	0.196	940.9726	0.207	978.9578	0.195
891.0887	0.190	941.0070	0.199	978.9963	0.212
891.1188	0.195	941.0379	0.100	979.0410	0.204
891.1513	0.192	941.0694	0.185	979.9131	0.175
891.1467	0.768	941.1053	0.178	979.9423	0.197
891.1840	0.191	948.9498	0.205	979.9731	0.173
891.2214	0.190	948.9923	0.206	980.0111	0.223
891.2630	0.216	949.0368	0.206	981.9230	0.225
892.0784	0.219	949.0809	0.205	981.9597	0.181
892.1193	0.207	953.9851	0.206	983.9288	0.174
892.1624	0.126	954.0298	0.134	983.9649	0.211

Table VIII. Coefficients for Yellow Light Outside Eclipses of AR Lacertae

Year	A_0 A	A_1 B	B_1	A_2	B_2
1975	.9854	.0033	−.0002	−.0045	.0034
	± 40	± 50	± 44	± 46	± 51
1976	.9637	.0304	.0110	−.0141	−.0172
	± 42	± 56	± 53	± 43	± 46
1978	.9692	.0071	−.0302	−.0259	.0022
	± 13	± 20	± 14	± 20	± 16
1979	.9600	−.0068	.0013	−.0159	.0051
	± 47	± 62	± 41	± 51	± 49
1980	.9681	−.0145	.0017	−.0211	.0132
	± 12	± 15	± 11	± 16	± 13
1981	.9486	−.0230	−.0252	−.0201	.0006
	± 12	± 16	± 9	± 18	± 10

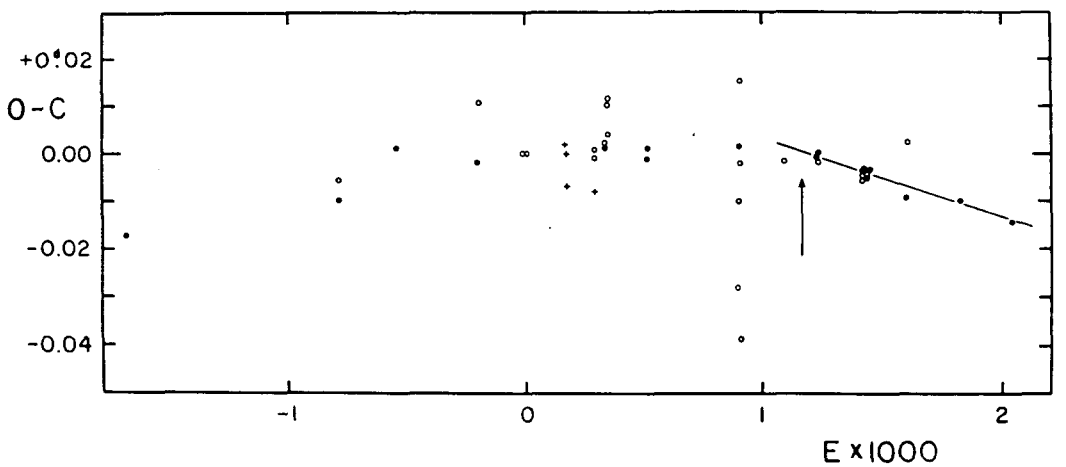

Figure 6. O-C diagram of AR Lac for 1960-1982 period. Symbols used are dots and open circles for the photoelectric primary and secondary minima, spearately. Crosses represent the primary minima determined visually.

$$I = A_0 + A_1 \cos\theta + B_1 \sin\theta + A_2 \cos 2\theta + B_2 \sin 2\theta \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

used in rectification of the light curve in the classical Russell-Merrill treatment. However, in a

system such as this, we refrain from giving the conventional interpretation of ellipticity or reflection effects and we then solely attempt to describe the light changes between eclipses without attempting to force any theoretical model on them. Any meaningful interpretation is difficult. The scatter in A_1 from year to year is perhaps unusually large. This could be interpreted as changes in brightness (spot groups, plages, or other changes) on the side of the cooler star which faces the companion.

This same interpretation could explain the intrinsic brightness changes reported by Wood (1946) which did not occur during primary eclipse and which he suggested might be caused by the variability of the hotter component.

However, the only firm conclusion we draw is that further observation, obtaining whenever possible a complete light curve in as short an interval as possible, will be necessary to reach an understanding of these changes.

Further study of the light curves of the different years produces interesting results, although their exact function in interpreting the system is not entirely clear.

In Figure 7, (A) shows a plot of the depth of the unrectified minima (defined as the difference between the brightness of the system at maximum light and the brightness at the bottom of

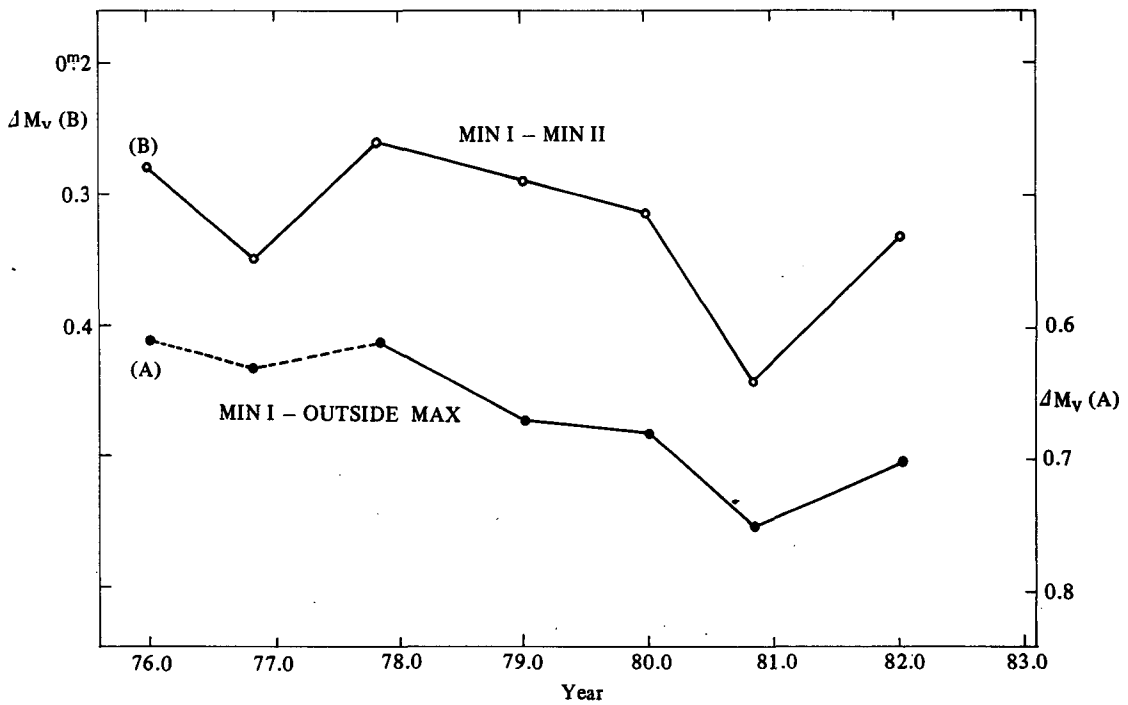

Figure 7. Depth variation of the primary minimum light of AR Lac. Dashed part are the estimation.

primary) as a function of time. For this purpose only the observations in yellow light are used. Even allowing for observational uncertainties, a decrease of at least 0.1 magnitude between 1976 and 1982 has occured. The observations in the later part of 1980 suggest that this may not be a uniform decrease, but show a sudden drop of 0.07 magnitude from the preceding one with a partial decrease by 1982. Only continual observation will clarify the behavior of the system in this respect.

On the same figure is also shown, in (B), the difference between the brightness of the system at the bottom of secondary for the given year. In the first case we are seeing only the cooler side of the cooler component; in the second we are seeing the hotter component plus a smaller amount of light from the cooler. Again there is a decrease with time; whether this is steady over the interval or whether the sudden drop in 1977 and in the later part of 1980 are meaningful. A meaningful interpretation demands continued observation, although one possible interpretation is a gradual decrease in brightness of the cooler component while the hotter component is constant.

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