PHOTOELECTRIC OBSERVATIONS OF LUNAR OCCULTATIONS. X

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ABSTRACT

Photoelectric occultation results for 461 events observed during 15 months are reported. They include 77 reappearances, 4 determinations of angular diameter, 38 analyses of double or multiple stars including two previously unknown bright stars, and 8 previously known bright double or multiple stars.

1. INTRODUCTION

The present paper reports 461 occultations observed almost exclusively with the McDonald 30-in. reflector in essentially the same format as adopted for previous publications in this series (see, e.g., Africano *et al.* 1977). For the first time a considerable number (77) of reappearances is included due mainly to the efforts of one of us (JLA) (Africano and Montemayor 1977). Because of this Table I now includes a column headed "Event" with the designation R for reappearances.

The prediction list used has included the J and K lists of Dunham described in "Extended-Coverage U.S.N.O. Total occultation Predictions" (Dunham 1978). This has presented some problems with designations, which we use preferentially as SAO, DM number, and if neither the Dunham's J or K number.

Of the stars observed 38 have been analysed for duplicity or higher order multiplicity. Newly discovered cases of duplicity of bright stars are 31 Ari (SAO

93022), and 115 Tau (SAO 94554) = ADS 4038A. Previously known bright close double or multiple stars observed are ADS 2101 (SAO 93085), ADS 3135 (SAO 93870), ADS 4681 (SAO 95229), ADS 5885 (SAO 96634, twice, Runs Nos. 4432 and 4666), ADS 7429 (SAO 117767), ADS 7896 (SAO 118443), β Cap (SAO 163481, thrice, Runs Nos. 36/8, 4282, 4507; also 3922, 4059, 4175) and Kui 88 (SAO 161848). Attention is drawn to the possibility (Run No. 4676) of detection of the two components of σ Leo (ADS 7480A) at occultation. Readers are reminded that a single occultation observation of a double star gives the true separation projected in the direction perpendicular to the actual limb (limb slope must be applied if known) and is thus always less than the true separation at the epoch of occultation observation. Separate paragraphs on ADS 3135 and 31 Ari appear below and an extended study of β Cap is in preparation (Evans and Fekel 1978). Angular diameter determinations have been made for β Cap (Run

FIG. 1. Run No. 4441. Bright limb disappearance of α Cnc. Interference filter 5214.

FIG. 2. Run No. 4442. Reappearance of α Cnc. Interference filter 5214 (horizontal scale reversed in reappearance plots).

TABLE I

RUN	SAO/DM	MAG	SP.	U.T. DATE	UTC OBSERVED	DT	P.A.	W.A.	C.A.	DMS	DMB	SLOPE	DS	NOTES	EVENT
36/7	163471	6.1	B9	26 NOV 76	1 43 29.332	1	107.6	121.0	-40.9	3.3	3.4	-11.6	2.6	BC*	
36/8	163481	3.0	K0	26 NOV 76	1 53 27.929	0	113.4	126.8	-46.5	4.1	4.6	-5	1.0	y*	
4247	109699	8.6	F8	22 FEB 77	1 23 49.131	2	142.8	167.1	-72.9	3.7	3.7	3.1	1.0	FB(BC,29)	
4249	109719	8.6	F8	22 FEB 77	2 43 28.663	7	105.8	129.8	-32.2	1.4	1.6			FB(BC,29)*	
4250	7 182	9.4		22 FEB 77	3 3 52.414	6	86.8	110.9	-12.6	1.0	1.1			FR(BC,29)	
4251	93085	7.8	F5	24 FEB 77	1 33 50.120	0	55.7	75.0	19.7	3.8	3.9			FB(BC,29)*	
4252	93087	8.3	A0	24 FEB 77	2 3 12.486	1	144.6	163.8	-67.9	3.8	3.9			FB(BC,29)	
4253	93484	7.0	F5	25 FEB 77	1 14 58.409	1	16.3	31.8	61.2	4.0	4.3			FR(BC,29)*	
4254	93504	7.8	G0	25 FEB 77	3 2 40.549	1	86.0	101.3	-2.5	3.4	3.5			FR(BC,29)*	
4255	93536	6.3	G5	25 FEB 77	5 8 52.780	5	84.5	99.5	2.7	1.0	1.1			FR(BC,29)*	
4256	94422	8.8	F5	27 FEB 77	2 25 14.219	12	101.0	106.9	-11.1	1.0	1.2			FB(BC,29)*	
4257	94431	7.5	B3	27 FEB 77	3 37 14.503	2	159.6	165.1	-66.1	2.9	3.0			FB(BC,29)*	
4258	94431	7.5	B3	27 FEB 77	3 37 37.968	3	159.6	165.1	-66.1	2.4	2.5			FB(42,29)*	
4259	94469	9.0	K7	27 FEB 77	5 35 3.508	2	93.3	98.5	3.4	1.8	1.9			FR(BC,29)	
4260	94510	7.5	K2	27 FEB 77	7 21 4.441	2	69.5	74.5	27.3	2.2	2.3			FR(BC,29)*	
4261	95229	8.3	B9	28 FEB 77	1 34 20.696	4	93.8	94.3	-2.5	2.1	2.4			FB(BC,29)*	
4262	95263	7.6	G5	28 FEB 77	2 50 40.740	1	120.1	120.5	-24.6	3.1	3.2			FR(BC,29)*	
4263	95265	8.8	A0	28 FEB 77	2 55 44.622	22	55.5	55.9	40.2	1.0	1.5			FR(BC,29)*	
4264	95342	8.6	A0	28 FEB 77	5 23 16.064	3	147.1	147.1	-45.9	2.0	2.1			FB(BC,29)*	
4265	95350	8.8	A0	28 FEB 77	5 24 47.068	2	124.9	124.9	-23.6	2.2	2.4			FB(BC,29)	
4266	95337	6.4	K0	28 FEB 77	5 36 3.514	1	170.6	170.6	-69.4	3.7	3.7	23.1	1.2	FR(BC,29)	
4267	95403	9.1	F5	28 FEB 77	6 46 39.403	3	62.2	62.0	39.5	1.8	1.9			FR(BC,29)	
4268	95456	6.8	K0	28 FEB 77	7 49 .572	1	64.4	64.0	37.0	2.3	2.8			FB(BC,29)*	
4269	95469	8.0	A0	28 FEB 77	8 5 6.318	2	91.5	91.0	9.6	2.0	2.1			FB(BC,29)	
4270	96338	8.6	MA	01 MAR 77	1 28 14.091	1	102.3	97.3	-6.8	3.2	3.3			FR(BC,29)	
4271	96347	8.0	G5	01 MAR 77	1 58 40.126	1	83.0	77.9	14.1	2.9	3.0			FR(BC,29)	
4272	96450	8.8		01 MAR 77	6 1 .891	3	128.5	122.9	-22.2	1.8	1.9			FB(BC,29)	
4273	96505	9.0	F8	01 MAR 77	7 37 45.148	2	134.1	128.1	-28.0	2.2	2.4			FB(BC,29)*	
4274	96515	9.0		01 MAR 77	7 44 51.719	6	81.8	75.9	24.2	1.2	1.3			FR(BC,29)*	
4275	96527	9.1	B9	01 MAR 77	8 2 57.661	4	118.3	112.4	-12.6	1.4	1.4			FB(BC,29)*	
4276	96547	7.5	K2	01 MAR 77	8 20 7.665	7	94.4	88.5	11.1	.4	.5			FR(52,89)*	
4277	98143	6.8	M0	03 MAR 77	4 31 58.915	1	70.1	54.7	41.5	3.9	3.9	4.0	1.3	FR(BC,29)*	
4278	98146	8.0	F5	03 MAR 77	5 22 16.179	3	131.1	115.5	-17.7	1.9	2.0			FB(BC,29)*	
4279	98174	7.8	F0	03 MAR 77	6 34 29.723	3	98.0	82.3	16.3	1.7	1.8			FB(BC,29)*	
4280	98235	5.6	K0	03 MAR 77	9 24 44.825	1	102.8	86.6	9.1	3.3	3.4			FR(BC,29)*	
4281	158489	4.5	A2	09 MAR 77	6 35 51.399	1	249.6	229.1	-136.8	2.3	2.4	24.8	14.4	FU	R
4282	163481	3.0	K0	15 MAR 77	12 1 37.878	1	296.6	310.3	143.3	3.7	4.1			B*	R
4283	93371	8.6		24 MAR 77	1 45 41.959	2	117.9	134.8	-35.0	2.4	2.5			FBC	
4284	96965	9.1		29 MAR 77	1 44 31.511	5	74.8	66.5	29.5	1.4	1.5			FB(BC,29)	
4285	96966	9.0		29 MAR 77	2 11 27.725	3	152.3	143.8	-46.7	2.1	2.2			FR(BC,29)	
4286	96977	9.0		29 MAR 77	2 24 51.540	4	75.5	67.3	30.5	1.9	2.0			FB(BC,29)*	
4287	96978	9.0	G0	29 MAR 77	2 25 21.402	4	74.9	66.5	31.2	1.7	1.9			FB(BC,29)*	
4288	96991	8.8	F2	29 MAR 77	2 56 57.725	3	85.1	76.8	22.1	1.5	2.6			FB(BC,29)*	
4289	97008	8.3	A0	29 MAR 77	3 49 37.641	0	118.6	110.0	-10.1	3.6	3.7			FB(BC,29)	
4290	97016	5.0	A2	29 MAR 77	4 24 56.319	0	145.3	136.6	-36.4	4.7	4.9	-1.1	.4	FB(42,29)	
4291	97037	8.1	K0	29 MAR 77	5 26 43.735	2	174.1	165.3	-65.5	2.9	3.1			FR(BC,29)	
4292	97064	9.1		29 MAR 77	6 4 39.609	19	164.1	155.1	-55.9	.8	.9			FR(BC,29)	
4293	97069	9.0	A3	29 MAR 77	6 9 48.593	4	149.6	140.6	-41.4	1.5	1.6			FB(BC,29)*	
4294	97085	9.1		29 MAR 77	6 22 53.061	4	100.8	91.9	7.1	1.2	1.3			FB(BC,29)	
4295	97094	9.1		29 MAR 77	6 45 36.711	6	88.4	79.4	19.2	.6	.7			FB(BC,29)	
4296	97850	8.3	G5	30 MAR 77	6 44 4.318	1	110.0	96.0	1.5	2.5	2.5			FR(BC,29)	
4297	97890	7.5	K0	30 MAR 77	8 19 58.144	3	127.5	113.4	-18.5	1.6	1.7			FR(BC,29)	
4298	98462	8.1	A2	31 MAR 77	2 50 15.674	1	140.0	122.1	-26.6	2.7	2.8			FB(BC,29)*	
4299	118132	8.6	B9	01 APR 77	2 42 17.842	2	91.4	70.1	23.2	2.1	2.2			FB(BC,29)*	
4300	118151	7.8	K0	01 APR 77	4 45 53.080	2	140.8	119.5	-22.7	2.3	2.4			FR(BC,29)*	
4301	138553	7.6	K2	03 APR 77	7 11 28.584	3	146.3	121.8	-28.2	1.9	2.0			FR(BC,29)*	
4302	96738	9.0		25 APR 77	4 58 28.216	3	82.0	75.0	23.8	1.8	1.8			FR(BC,29)	
4303	96746	3.5	A2	25 APR 77	5 10 29.366	1	69.4	62.4	36.4	3.1	3.3			FB(BC,29)*	
4304	97543	8.6	A0	26 APR 77	3 10 15.594	2	55.0	43.2	56.5	2.9	3.0			FB(BC,29)*	
4305	97555	8.3	G0	26 APR 77	4 3 44.776	4	156.0	144.1	-45.0	1.6	1.7			FB(BC,29)*	
4306	97555	8.3	G0	26 APR 77	4 4 3.390	3	156.0	144.1	-45.0	2.0	2.1			FB(BC,29)*	
4307	97564	9.0		26 APR 77	4 21 58.083	3	115.5	103.5	-4.8	1.7	1.8			FR(BC,29)	
4308	97574	9.1	G0	26 APR 77	4 35 37.959	3	97.0	85.0	13.5	1.7	1.8			FB(BC,29)	
4309	97576	8.8	K0	26 APR 77	4 41 23.979	2	96.6	84.8	13.6	2.2	2.2			FR(BC,29)	
4310	97580	8.0	K0	26 APR 77	4 52 44.155	1	92.6	80.8	17.3	3.3	3.4			FR(BC,29)	
4311	97601	8.6	F5	26 APR 77	5 36 30.920	1	135.1	123.0	-26.1	2.3	2.4			FB(BC,29)	
4312	97609	8.6	F5	26 APR 77	5 50 15.235	6	87.4	75.3	21.3	1.2	1.4			FR(BC,29)*	
4313	98235	5.6	K0	27 APR 77	3 3 25.236	0	123.8	107.5	-8.8	3.8	3.9			FR(BC,89)*	
4314	118443	6.5	F5	29 APR 77	5 37 44.282	0	110.0	87.0	7.0	3.9	4.1			FB(BC,29)*	
4315	138298	4.3	K0	30 APR 77	6 29 6.648	0	55.9	31.5	60.2	5.0	5.1	9.6	.4	FR(BC,29)*	

TABLE I (continued)

RUN	SAO/DM	MAG	SP.	U.T. DATE	UTC OBSERVED	DT	P.A.	W.A.	C.A.	DMS	DMB	SLOPE	DS	NOTES	EVENT
4316	138303	9.0	G0	30 APR 77	6 36 45.160	12	107.5	83.0	8.5	.3	.4			FB(BC+29)	
4317	138311	8.5	K2	30 APR 77	7 0 9.039	2	106.5	82.0	8.6	2.1	2.2			FR(BC+29)	
4318	138834	8.3	K2	01 MAY 77	6 29 28.566	2	132.6	108.0	-16.7	2.1	2.2			FR(BC+29)	
4320	157984	8.3	K2	02 MAY 77	7 44 59.717	6	88.0	65.0	23.2	1.1	1.2			FR(BC+29)	
4321	139398	8.8	F2	02 MAY 77	8 20 3.690	15	56.0	33.2	53.5	.7	.8			FB(BC+29)*	
4322	158022	8.8	K0	02 MAY 77	9 29 28.157	4	106.5	83.6	.1	1.3	1.4			FR(BC+29)	
4323	159280	5.9	K0	04 MAY 77	5 11 45.027	2	306.2	290.8	162.1	1.5	1.7			Fy	R
4324	161837	8.8	A5	07 MAY 77	10 30 29.509	2	304.7	309.3	136.3	2.4	2.5			FB(BC+29)	R
4325	161847	8.6	B9	07 MAY 77	10 55 42.290	5	237.8	242.6	-157.8	1.3	1.4			FB(BC+29)	R
4326	161848	6.5	A0	07 MAY 77	11 2 49.023	3	258.3	263.1	-178.6	2.6	3.0			FB(BC+29)*	R
4327	161850	7.0	A2	07 MAY 77	11 3 40.027	2	251.6	256.2	-171.8	2.4	2.5			FB(BC+29)	R
4328	161866	8.6	A0	07 MAY 77	11 25 41.422	5	292.2	297.0	146.3	1.3	1.5			FB(BC+29)	R
4329	161883	8.6		07 MAY 77	11 50 55.405	2	279.8	284.7	157.8	2.1	2.2			FR(BC+29)	R
4330	95311	8.3	G5	21 MAY 77	3 3 22.939	4	149.6	149.6	-49.5	1.4	1.5			FB(BC+29)*	
4331	97286	8.1	G5	23 MAY 77	2 47 48.765	0	154.6	144.3	-45.5	3.8	3.9	14.7	2.6	FB(BC+29)	
4333	+15 1675	9.5		23 MAY 77	3 13 43.338	3	55.7	45.5	52.7	1.9	2.0			FR(BC+29)	
4336	+15 1686	9.5		23 MAY 77	4 3 48.382	1	77.0	66.8	30.2	2.4	2.5			FB(BC+29)	
4337	+13 1961	9.1		24 MAY 77	2 57 5.517	0	71.3	56.4	41.4	3.9	4.0			FB(BC+29)	
4339	+13 1962	9.5		24 MAY 77	3 3 20.881	2	63.2	48.4	49.2	2.2	2.4			FB(BC+29)	
4340	+13 1965	9.5		24 MAY 77	3 25 32.815	1	97.5	82.0	14.6	2.3	2.4			FB(BC+29)	
4341	+13 1968	9.3		24 MAY 77	4 0 15.099	1	76.6	61.7	34.4	2.8	2.9			FB(BC+29)	
4342	+13 1970	9.3		24 MAY 77	4 5 16.981	1	70.5	55.5	40.5	2.9	3.0			FR(BC+29)	
4343	117750	8.5	K0	25 MAY 77	4 0 9.012	3	115.8	96.9	-1.7	1.7	1.8			FB(BC+29)*	
4344	117767	8.5	A3	25 MAY 77	4 46 5.254	2	89.0	70.0	23.7	2.4	2.5			FR(BC+29)*	
4345	118224	8.6	F0	26 MAY 77	2 27 17.504	2	57.0	35.0	61.7	2.8	3.0			FB(BC+29)*	
4346	+ 6 2294	9.3		26 MAY 77	2 39 30.097	3	90.6	68.5	27.7	1.9	2.0			FB(BC+29)*	
4347	118242	8.8	G5	26 MAY 77	3 22 37.284	6	154.8	133.0	-37.4	1.3	1.3			FB(BC+29)*	
4349	118289	8.6	K2	26 MAY 77	6 0 38.913	1	75.5	53.5	36.5	3.2	3.4			FB(BC+29)*	
4350	118291	8.5	F5	26 MAY 77	6 3 8.343	1	89.6	67.5	22.3	2.4	2.6			FB(BC+29)*	
4351	118288	8.8	K0	26 MAY 77	6 10 8.665	5	39.0	16.7	72.9	1.9	2.1			FR(BC+29)	
4352	118739	8.3	K2	27 MAY 77	5 4 10.865	1	129.8	105.9	-14.5	2.7	2.8			FB(BC+29)	
4353	118740	8.8	K	27 MAY 77	5 7 .505	4	125.8	101.8	-10.5	1.3	1.4			FR(BC+29)	
4354	118751	8.3	K0	27 MAY 77	6 15 6.698	4	174.1	150.0	-61.5	2.0	2.1			FR(BC+29)	
4355	118767	8.8	K0	27 MAY 77	6 56 41.205	2	71.6	47.5	39.4	3.2	3.2			FB(BC+29)	
4356	138585	6.5	K0	28 MAY 77	4 35 55.619	1	44.5	19.8	72.1	4.8	4.9	1.5	.2	FR(BC+29)	
4357	138589	9.0	F8	28 MAY 77	5 11 43.765	1	133.3	108.6	-18.1	2.6	2.7			FB(BC+29)	
4358	138605	9.0	F0	28 MAY 77	6 2 3.649	1	70.5	45.9	42.7	3.2	3.3			FB(BC+29)	
4359	138610	8.8	G5	28 MAY 77	6 32 45.527	2	147.8	123.1	-36.0	2.2	2.3			FR(BC+29)	
4360	138634	9.3	F5	28 MAY 77	7 34 51.845	3	117.6	93.0	-8.3	1.3	1.4			FR(BC+29)	
4361	138638	6.9	F5	28 MAY 77	7 37 43.541	1	72.0	47.5	37.2	2.3	2.4			FB(BC+29)	
4362	139122	8.8	G0	29 MAY 77	5 59 26.686	2	66.6	42.7	45.7	2.3	2.5			FB(BC+29)	
4363	139126	9.1	F5	29 MAY 77	6 21 19.535	2	140.1	116.3	-28.8	2.0	2.1			FB(BC+29)	
4364	139142	8.6	F5	29 MAY 77	7 19 16.038	1	69.8	46.0	39.0	3.1	3.2			FB(BC+29)	
4365	158267	7.0	G5	30 MAY 77	4 32 10.011	0	107.6	86.0	5.8	3.7	3.8			FR(BC+29)	
4366	158320	8.3	A0	30 MAY 77	8 16 17.965	2	160.0	138.6	-56.0	2.5	2.6			FB(BC+29)	
4367	138897	6.9	K2	25 JUN 77	3 7 14.062	0	138.5	114.0	-22.6	3.8	3.9			FR(42+70)	
4368	138902	8.5	K5	25 JUN 77	3 19 8.318	1	100.9	76.5	14.5	2.7	2.8			FB(BC+29)	
4369	138903	9.1	K2	25 JUN 77	4 12 38.138	4	186.3	162.1	-73.4	2.0	2.1	14.2	2.7	FR(BC+29)	
4370	138919	8.3	K2	25 JUN 77	4 46 18.209	1	153.5	129.1	-42.0	2.7	2.9			FR(BC+29)	
4371	139401	5.4	G5	26 JUN 77	2 20 29.294	0	130.1	107.3	-14.3	5.0	5.1			FB(BC+29)	
4372	158023	8.8	K0	26 JUN 77	3 47 37.802	2	100.6	77.9	11.8	2.2	2.3			FR(BC+29)	
4373	158030	8.6	K0	26 JUN 77	4 4 20.111	1	103.9	81.1	8.0	3.2	3.3			FR(BC+29)	
4374	158035	9.1	F2	26 JUN 77	5 5 32.524	6	183.1	160.3	-74.0	2.1	2.2	6.7	2.3	FR(BC+29)	
4375	158067	8.5	K0	26 JUN 77	6 15 33.922	2	48.5	26.0	57.5	2.3	2.5			FB(BC+29)	
4376	158075	8.8	K0	26 JUN 77	6 31 59.725	5	107.5	84.9	-2.2	1.1	1.3			FB(BC+29)	
4377	160018	7.0	K0	29 JUN 77	5 28 40.926	1	40.2	31.2	56.2	3.4	3.5	6.9	1.4	FR(BC+29)	
4378	139282	8.3	K0	23 JUL 77	3 48 11.830	1	144.1	120.8	-35.7	2.9	3.1			FR(BC+29)	
4379	139277	9.0	F2	23 JUL 77	3 49 57.149	2	182.6	159.3	-74.4	3.3	3.5			FB(BC+29)*	
4380	139284	8.5	G5	23 JUL 77	3 58 44.655	1	123.1	99.8	-15.1	3.1	3.2			FR(BC+29)	
4381	139288	8.8	F2	23 JUL 77	4 18 33.102	2	35.0	11.6	72.3	3.1	3.2			FB(BC+29)	
4382	139298	8.5	G0	23 JUL 77	4 50 8.991	1	96.0	72.8	9.8	2.9	3.0			FB(BC+29)	
4383	158430	9.1	G5	24 JUL 77	2 35 7.984	2	81.8	61.0	27.7	2.5	2.6			FR(BC+29)	
4384	158433	8.8	K2	24 JUL 77	2 36 51.413	1	84.9	64.0	24.7	2.8	2.9			FR(BC+29)	
4387	-12 4002	10.0		24 JUL 77	3 16 27.132	4	129.1	108.3	-22.3	1.6	1.7			FB(BC+29)	
4388	158438	8.8	F8	24 JUL 77	3 29 28.669	2	174.5	153.6	-67.5	2.7	2.8	15.9	4.2	FB(BC+29)	
4389	-12 4008	9.1		24 JUL 77	3 49 27.788	4	134.8	114.0	-28.7	1.8	2.1			FB(BC+29)*	
4390	-12 4009	9.3		24 JUL 77	4 1 8.979	3	154.1	133.3	-48.7	2.1	2.2			FB(BC+29)	
4391	159085	6.8	K0	25 JUL 77	3 47 55.571	1	156.6	139.8	-53.9	4.4	4.6			FB(BC+29)*	
4392	159096	7.8	K2	25 JUL 77	4 0 32.484	1	39.0	22.2	63.2	4.3	4.4	8.3	.5	FR(BC+29)	
4393	159120	8.8	A5	25 JUL 77	4 56 31.454	2	91.0	74.4	8.6	2.5	2.6			FB(BC+29)	

TABLE I (continued)

RUN	SAO/DM	MAG	SP.	U.T. DATE	UTC	OBSERVED	DT	P.A.	W.A.	C.A.	DMS	DMB	SLOPE	DS	NOTES	EVENT
4394	159745	6.4	F5	26 JUL 77	2 24	22.303	0	144.0	132.3	-41.5	5.1	5.2	-12.3	.5	FB(BC+29)	
4395	159757	8.3	K5	26 JUL 77	2 57	40.137	0	80.5	69.0	20.2	3.6	3.8			FR(BC+29)	
4396	159759	9.1	F8	26 JUL 77	3 19	13.723	2	47.5	36.0	52.4	2.3	2.5			FB(BC+29)	
4397	159765	7.5	G0	26 JUL 77	3 26	33.064	0	98.0	86.5	1.5	4.1	4.2			FB(BC+29)	
4398	159786	8.3	K0	26 JUL 77	4 24	29.689	0	58.0	46.5	38.5	3.8	4.0			FR(BC+29)*	
4399	159795	9.0	K2	26 JUL 77	4 42	22.983	1	76.8	65.5	18.8	2.8	3.0			FR(BC+29)	
4400	159807	6.4	K0	26 JUL 77	5 24	11.256	0	156.1	144.8	-62.2	4.9	5.0	2.4	.3	FR(BC+29)	
4401	160367	8.8	K2	27 JUL 77	2 55	46.008	2	48.0	42.7	47.9	2.3	2.4			FR(BC+29)	
4402	160379	9.1	F0	27 JUL 77	3 17	2.848	4	128.8	123.5	-33.7	1.6	1.7			FB(BC+29)	
4403	160389	9.0	G5	27 JUL 77	3 28	38.326	4	65.5	60.2	29.1	1.6	1.7			FR(BC+29)	
4404	160399	8.8	A0	27 JUL 77	4 3	9.127	4	122.3	117.0	-29.5	2.0	2.2			FB(BC+29)*	
4405	160447	8.8	F5	27 JUL 77	6 16	5.876	5	60.7	55.9	26.0	1.3	1.4			FR(BC+29)	
4406	160455	8.8	K2	27 JUL 77	6 36	1.636	2	131.3	126.5	-45.2	2.5	2.6			FR(BC+29)	
4407	160474	6.5	G0	27 JUL 77	7 6	45.445	0	84.4	79.6	1.0	4.2	4.3			FR(BC+29)	
4408	160501	8.8	A0	27 JUL 77	8 14	8.812	2	41.2	36.7	43.0	2.1	2.3			FR(BC+29)	
4409	161257	8.1	G5	28 JUL 77	3 33	38.907	0	41.0	42.2	48.0	4.2	4.4			FR(BC+29)	
4410	161286	8.8	B0	28 JUL 77	4 3	39.001	2	54.9	56.4	32.7	2.2	2.3			FR(BC+29)	
4411	161313	9.0	B3	28 JUL 77	4 42	53.970	3	134.0	135.5	-48.2	2.1	2.2			FR(BC+29)	
4412	161378	8.6	F8	28 JUL 77	5 59	23.396	1	103.1	104.9	-21.2	2.7	2.8			FR(BC+29)	
4413	162512	4.0	A5	29 JUL 77	4 37	15.889	0	90.1	98.1	-9.1	4.2	4.3			FB(42+29)	
4414	162559	8.8	G5	29 JUL 77	5 45	59.236	1	109.6	117.9	-32.0	2.9	3.0			FR(BC+29)	
4415	162561	9.0	A0	29 JUL 77	5 57	32.070	2	57.4	65.5	19.7	2.2	2.3			FR(BC+29)*	
4416	162567	8.8	K0	29 JUL 77	6 12	33.821	3	103.0	111.4	-26.6	1.8	1.9			FR(BC+29)*	
4418	162586	8.8	K2	29 JUL 77	6 41	34.063	2	92.5	100.9	-17.2	2.3	2.4			FR(BC+29)*	
4419	162584	9.1	F8	29 JUL 77	6 47	36.720	4	54.4	62.7	20.7	1.5	1.6			FR(BC+29)*	
4420	162593	8.8	G5	29 JUL 77	6 53	10.981	3	87.1	95.5	-12.1	1.8	1.9			FR(BC+29)*	
4421	162708	8.3	G0	29 JUL 77	9 57	39.598	5	83.5	94.1	-12.1	1.2	1.3			FR(BC+29)*	
4422	158918	9.1	G0	21 AUG 77	3 19	58.324	1	122.4	104.5	-22.1	1.6	1.5			FRC	
4423	158923	9.1	F2	21 AUG 77	3 31	2.379	3	87.5	69.6	12.3	1.5	1.6			FRC	
4424	160160	7.4	A2	23 AUG 77	3 12	12.423	1	77.0	0.0	14.8	2.9	3.0			FR(BC+29)	
4426	95601	8.8	A2	07 SEP 77	10 26	16.007	4	241.1	239.3	-154.8	1.4	1.5			FR(BC+29)	R
4427	95621	8.8	G0	07 SEP 77	11 9	.980	1	256.7	254.8	-169.6	2.7	2.8			FR(BC+29)	R
4428	95645	9.0	F5	07 SEP 77	11 47	30.867	2	226.6	224.6	-138.1	2.5	2.6			FR(BC+29)*	R
4429	95654	9.0	F5	07 SEP 77	12 2	49.044	3	313.7	311.7	135.1	2.1	2.2			FR(BC+29)	R
4430	96611	6.6	K5	08 SEP 77	9 29	13.651	1	308.0	301.2	142.0	3.3	3.4			FR(BC+29)*	R
4431	96629	9.1		08 SEP 77	9 55	26.124	4	320.6	313.6	129.6	1.4	1.5			FR(BC+29)*	R
4432	96634	9.0		08 SEP 77	10 16	33.508	2	298.5	291.5	152.1	2.5	2.7			FR(BC+29)*	R
4434	96686	9.1	K0	08 SEP 77	11 31	11.476	1	297.3	290.2	154.8	3.2	3.3			FR(BC+29)*	R
4435	96703	9.1	F0	08 SEP 77	12 0	25.531	1	257.3	250.1	-164.1	2.9	3.0			FR(BC+29)*	R
4436	96704	9.1	F0	08 SEP 77	12 2	1.172	1	256.5	249.1	-163.1	2.7	2.9			FR(BC+29)	R
4437	97543	8.6	A0	09 SEP 77	11 1	35.259	1	241.5	229.3	-145.8	3.4	3.5			FR(BC+29)*	R
4438	+15 1747	9.1		09 SEP 77	11 26	8.887	1	241.1	229.0	-144.8	2.5	2.6			FR(BC+29)	R
4439	97573	8.6	F5	09 SEP 77	12 14	44.630	4	316.7	304.3	141.1	1.5	1.7			FR(BC+29)	R
4440	98244	8.5	K0	10 SEP 77	11 40	9.889	1	289.6	272.8	170.6	2.3	2.4			FR(BC+29)*	R
4441	98267	4.3	A3	10 SEP 77	11 56	14.300	1	183.3	166.6	-82.5	4.2	6.5	2.9	.1	FR(52+29)*	
4442	98267	4.3	A3	10 SEP 77	12 6	8.091	1	198.6	182.0	-97.5	4.6	4.7	1.1	.1	FR(52+29)*	R
4443	158706	8.8	F5	17 SEP 77	2 0	19.488	1	151.1	132.1	-50.7	2.7	2.8			FR(BC+29)*	
4444	158722	7.1	K5	17 SEP 77	2 17	2.504	2	129.6	110.5	-29.7	2.1	2.2			FR(BC+29)*	
4445	158730	8.8	G5	17 SEP 77	2 32	39.301	1	96.6	77.6	2.7	2.7	2.9			FR(BC+29)*	
4446	160010	8.6	A0	19 SEP 77	1 41	40.879	1	67.3	58.2	25.2	3.4	3.5			FR(BC+29)	
4447	160024	8.8	F2	19 SEP 77	2 28	40.095	1	98.4	89.5	-7.6	3.0	3.1			FR(BC+29)*	
4448	160017	6.6	A0	19 SEP 77	2 40	26.925	2	12.3	3.4	78.1	3.8	3.9	6.8	.8	FR(BC+29)*	
4449	-18 4305	9.3		19 SEP 77	3 17	7.518	22	77.0	68.0	12.3	.7	1.1			FR(BC+29)*	
4450	160691	7.3	G5	20 SEP 77	1 10	11.853	1	48.2	45.4	40.9	3.3	3.5			FR(BC+29)	
4451	-19 4673	9.1		20 SEP 77	1 54	37.666	2	150.1	147.3	-63.0	2.7	2.9			FR(BC+29)	
4452	-19 4679	9.5		20 SEP 77	2 25	50.451	5	92.4	89.8	-6.6	1.4	1.5			FR(BC+29)	
4453	160752	9.1	B2	20 SEP 77	3 56	54.956	5	130.0	127.5	-47.0	1.4	1.5			FR(BC+29)	
4454	-18 5021	11.1		21 SEP 77	1 26	55.260	2	76.4	80.0	7.0	2.4	2.5			FR(BC+29)	
4455	-18 5024	9.3	A3	21 SEP 77	1 56	31.726	5	117.3	121.0	-35.2	1.6	1.7			FR(BC+29)	
4456	161726	9.1	M0	21 SEP 77	3 54	5.155	2	138.5	142.3	-60.7	2.7	2.8			FR(BC+29)*	
4457	162899	9.3	G0	22 SEP 77	4 28	48.107	4	64.3	74.4	8.0	1.2	1.3			FR(BC+29)	
4458	162924	9.1	K0	22 SEP 77	5 18	25.282	1	65.0	75.1	6.9	2.5	2.6			FR(BC+29)	
4459	163688	9.1	G0	23 SEP 77	1 19	28.520	2	117.0	132.1	-41.4	2.4	2.5			FR(BC+29)	
4460	163724	9.0	K0	23 SEP 77	3 3	.301	1	44.0	59.2	26.7	3.0	3.1			FR(BC+29)	
4461	163780	7.8	M3	23 SEP 77	5 13	16.618	1	92.4	107.8	-24.7	2.9	3.0			FR(BC+29)*	
4462	164464	8.6	F8	24 SEP 77	3 51	4.444	2	18.5	38.2	47.5	2.3	2.4			FR(BC+29)*	
4463	146062	6.0	K0	25 SEP 77	1 44	6.380	0	84.9	107.5	-15.1	4.5	4.7			FR(52,70)*	
4464	146624	9.0	F5	26 SEP 77	3 40	11.157	5	77.4	102.0	-13.3	1.4	1.6			FR(BC+29)	
4465	146638	9.1	K8	26 SEP 77	4 25	42.740	2	89.3	113.9	-26.7	2.4	2.5			FR(BC+29)	
4467	93022	5.6	F5	30 SEP 77	5 4	29.785	1	265.7	285.2	162.3	3.3	3.8			FR(BC+29)*	R

TABLE I (continued)

RUN	SAO/DM	MAG	SP.	U.T. DATE	UTC OBSERVED	DT	P.A.	W.A.	C.A.	DMS	DMB	SLOPE	DS	NOTES	EVENT
4468	93029	7.6	G5	30 SEP 77	5 20 52.725	2	198.6	218.1	-130.6	3.1	3.1	-6.4	1.6	FR(BC+29)*	R
4469	93040	8.6		30 SEP 77	7 38 29.070	4	283.3	302.7	143.1	1.5	1.6			FB(BC+29)	R
4470	+12 369	9.1		30 SEP 77	7 43 2.832	5	246.8	266.1	179.8	1.2	1.3			FR(BC+29)	R
4471	93045	9.3	F2	30 SEP 77	7 55 26.074	7	249.8	268.7	177.3	.8	.9			FB(BC+29)	R
4472	93068	8.6		30 SEP 77	8 49 14.407	4	186.3	205.6	-118.4	2.3	2.4			FB(BC+29)	R
4473	93064	8.1	F5	30 SEP 77	9 5 36.058	2	226.8	246.1	-158.3	2.5	2.6			FB(BC+29)	R
4474	93061	9.0		30 SEP 77	9 13 23.604	4	260.1	279.2	168.8	1.5	1.6			FB(BC+29)	R
4475	93070	9.1	F5	30 SEP 77	9 23 34.967	15	327.7	346.8	101.6	1.5	2.4			FB(BC+29)*	R
4476	93075	8.1	K0	30 SEP 77	10 22 54.693	3	301.8	321.1	130.1	2.1	2.3			FR(BC+29)	R
4477	93086	8.1	K2	30 SEP 77	11 29 49.984	1	248.3	267.3	-172.8	3.6	3.7			FR(BC+29)*	R
4478	93449	7.3	A0	01 OCT 77	6 44 9.516	2	224.8	240.5	-154.6	2.8	2.9	-14.3	5.0	FB(BC+29)	R
4479	93453	8.8		01 OCT 77	7 13 35.752	2	269.2	284.7	160.6	2.4	2.5			FB(BC+29)	R
4480	93483	8.5	G0	01 OCT 77	9 59 25.598	1	276.7	292.0	157.3	2.8	2.9			FB(BC+29)*	R
4481	93486	8.6		01 OCT 77	10 21 11.015	1	267.2	282.3	167.8	2.8	2.9			FB(BC+29)	R
4482	93843	8.3	G0	02 OCT 77	5 49 43.617	2	210.8	222.1	-135.8	2.1	2.2	14.8	8.5	FR(BC+29)	R
4483	93886	8.8		02 OCT 77	8 57 .261	1	269.6	280.3	165.8	3.1	3.2			FR(BC+29)	R
4484	161376	5.4	F5P	18 OCT 77	0 52 32.839	0	84.0	85.9	-2.4	4.6	4.7			FB(BC+29)*	
4485		10.8		18 OCT 77	1 4 3.532	3	122.8	124.6	-41.5	2.1	2.2			FB(BC+29)*	
4486	-18 4939	10.3		18 OCT 77	1 15 44.257	2	85.5	87.4	-4.6	2.3	2.5			FB(BC+29)	
4488	161399	8.8	A0	18 OCT 77	1 45 50.496	1	65.9	67.9	14.1	3.4	3.6			FB(BC+29)*	
4489		9.8		18 OCT 77	1 59 6.717	1	128.3	130.3	-48.7	2.8	2.9			FB(BC+29)*	
4490		10.8		18 OCT 77	2 31 8.410	3	91.8	93.9	-12.8	1.8	1.9			FB(BC+29)*	
4491	161442	9.0	B	18 OCT 77	2 46 50.248	1	87.5	89.6	-8.6	2.6	2.7			FB(BC+29)	
4492	161449	7.9	M2	18 OCT 77	3 4 40.022	1	47.7	50.0	31.0	3.4	3.5			FR(BC+29)	
4493	-18 4956	11.0		18 OCT 77	3 8 38.747	3	90.0	92.4	-11.3	1.6	1.7			FR(BC+29)	
4494		10.3		18 OCT 77	3 16 52.553	4	108.6	111.0	-30.1	1.3	1.4			FB(BC+29)*	
4496	-18 4958	9.8		18 OCT 77	3 25 45.532	1	124.4	126.5	-45.7	2.6	2.7			FB(BC+29)*	
4497	161463	8.8	H8	18 OCT 77	3 36 3.077	1	60.7	63.0	17.8	3.0	3.2			FB(BC+29)*	
4498	-18 4961	10.7		18 OCT 77	3 48 28.895	6	34.0	36.5	44.7	1.1	1.2			FB(BC+29)*	
4499		10.1		18 OCT 77	3 54 1.084	3	84.4	86.6	-5.6	1.2	1.3			FB(BC+29)*	
4501	162584	9.1	F8	19 OCT 77	3 18 .663	2	139.8	148.1	-66.4	3.1	3.2			FB(BC+29)*	
4502	162611	9.0	B8	19 OCT 77	3 53 9.539	1	70.5	79.0	2.9	3.2	3.3			FB(BC+29)	
4503	163446	9.1	G0	20 OCT 77	0 56 13.553	1	62.4	76.0	10.1	2.5	2.6			FB(BC+29)	
4504	163453	8.3	F8	20 OCT 77	1 19 35.290	0	58.5	72.3	13.1	3.6	3.7			FB(BC+29)	
4505	163458	9.3	F5	20 OCT 77	1 23 56.171	1	76.5	90.4	-5.1	2.6	2.7			FB(BC+29)	
4506	163471	6.1	B9	20 OCT 77	2 19 31.543	1	21.7	35.5	48.0	4.2	4.3	-14.6	.2	FB(bay)*	
4507	163481	3.0	K0	20 OCT 77	2 25 28.266	0	26.7	40.5	42.9	4.3	5.1	-2.7	.4	FB(bay)*	
4508	163504	8.8	F2	20 OCT 77	3 34 15.671	1	18.3	32.4	50.4	2.9	3.1			FB(BC+29)*	
4509	163551	9.0	G5	20 OCT 77	4 52 46.666	2	127.5	141.8	-58.5	3.0	3.1	3.5	2.7	FB(BC+29)*	
4510	163563	9.1	G5	20 OCT 77	5 10 57.306	1	112.6	127.0	-43.2	2.6	2.7			FB(BC+29)*	
4511	163556	9.3	K2	20 OCT 77	5 15 22.292	2	26.3	40.5	43.2	2.1	2.2			FR(BC+29)	
4512	163565	9.1	G0	20 OCT 77	5 34 37.167	2	19.1	33.4	51.0	2.1	2.2			FR(BC+29)	
4513	164353	8.6	F5	21 OCT 77	6 30 29.847	3	103.4	122.4	-35.9	1.9	2.0			FB(BC+29)	
4514	145990	8.6	F8	22 OCT 77	7 16 33.712	1	60.5	82.9	5.8	2.5	2.6			FB(BC+29)*	
4515	128449	8.0	MA	24 OCT 77	4 42 37.145	0	54.4	79.5	5.9	3.7	3.8			FR(BC+29)	
4516	128452	9.0	G0	24 OCT 77	4 49 7.346	4	101.4	126.5	-41.4	1.6	1.7			FB(BC+29)	
4517	128460	8.8	G0	24 OCT 77	5 29 32.660	5	41.7	66.9	19.0	1.6	1.7			FR(BC+29)	
4518	128470	8.8	K0	24 OCT 77	5 58 20.479	5	82.4	107.5	-21.0	1.2	1.4			FR(BC+29)	
4519	128522	9.0	F5	24 OCT 77	9 5 16.622	5	112.3	137.5	-43.7	1.2	1.3			FB(BC+29)	
4520	109365	8.1	G5	25 OCT 77	3 15 31.462	1	21.5	46.4	40.7	2.6	2.7			FB(BC+29)	
4521	109450	9.1	G5	25 OCT 77	7 27 45.989	11	97.1	122.0	-32.5	.5	.6			FR(BC+29)	
4522	109455	8.6	G5	25 OCT 77	7 41 40.873	6	119.3	144.0	-54.0	1.4	1.5			FB(BC+29)	
4523	109464	8.8	K2	25 OCT 77	8 28 46.032	4	84.6	109.4	-17.2	1.6	1.7			FR(BC+29)	
4524	109471	5.8	G5	25 OCT 77	8 50 23.452	1	52.7	77.5	15.6	3.4	3.5			FB(BC+29)*	
4525	+18 929	9.5	A2	31 OCT 77	7 35 7.961	6	242.3	244.6	-158.8	1.2	1.3			FB(BC+29)	R
4526	94802	8.6	B9	31 OCT 77	7 40 35.083	2	255.8	258.1	-172.1	2.4	2.5			FB(BC+29)	R
4527		10.0		31 OCT 77	8 1 11.622	6	250.6	253.0	-166.3	1.1	1.2			FB(BC+29)*	R
4528	+18 956	8.6		31 OCT 77	9 20 56.878	3	291.1	293.2	156.8	1.8	1.9			FB(BC+29)	R
4529	+18 964	9.5		31 OCT 77	10 40 36.553	2	270.0	272.0	-177.6	2.2	2.3			FR(BC+29)	R
4530		9.6		31 OCT 77	12 32 16.078	14	285.2	287.1	172.0	.1	.2			FB(BC+29)*	R
4531	95730	7.5	G0	01 NOV 77	5 0 10.741	1	279.8	277.3	166.3	2.5	2.7			FB(BC+29)	R
4532	95748	7.5	A0	01 NOV 77	5 17 37.061	9	322.1	319.5	124.0	.5	.6			FR(BC+29)	R
4533	95745	7.9	A2	31 NOV 77	5 21 55.642	5	248.6	246.1	-162.3	1.1	1.2			FR(BC+29)	R
4534	95750	9.1	K2	01 NOV 77	5 31 24.465	3	277.2	274.7	168.8	1.3	1.3			FR(BC+29)	R
4535	95775	9.1	K0	01 NOV 77	6 16 36.383	6	235.1	232.5	-148.6	1.0	1.1			FR(BC+29)	R
4536		9.6	G5	01 NOV 77	6 30 43.293	5	252.0	249.3	-165.3	1.1	1.2			FR(BC+29)*	R
4537	95791	8.1	K0	01 NOV 77	6 35 52.341	1	251.0	248.1	-164.1	3.0	3.1			FR(BC+29)	R
4538	95794	7.8	F8	01 NOV 77	6 46 52.795	1	276.8	274.0	170.0	3.5	3.6			FB(BC+29)*	R
4539	95795	7.1	F8	01 NOV 77	6 47 14.864	0	278.0	275.1	168.8	3.4	3.6			FB(BC+29)*	R
4540	95804	8.5	A0	01 NOV 77	6 51 44.730	1	245.5	242.6	-158.5	2.8	2.9			FB(BC+29)	R

TABLE I (continued)

RUN	SAO/DM	MAG	SP.	U.T. DATE	UTC OBSERVED	DT	P.A.	W.A.	C.A.	DMS	DMB	SLOPE	DS	NOTES	EVENT
4541	95880	9.1	A2	01 NOV 77	9 6 30.850	3	302.0	298.8	149.3	2.1	2.2			FB(BC,29)	R
4542	95883	7.4	K0	01 NOV 77	9 14 30.885	1	253.3	250.1	-161.5	3.4	3.6			FR(BC,29)	R
4543	95886	9.1	A2	01 NOV 77	9 15 55.745	2	293.5	290.2	158.3	2.1	2.2			FB(BC,29)	R
4544		8.8	A2	01 NOV 77	9 27 19.126	2	260.7	257.5	-168.1	2.2	2.3			FB(BC,29)*	R
4545		9.5		01 NOV 77	9 48 27.707	4	216.8	213.5	-123.0	2.0	2.1			FB(BC,29)*	R
4546		9.6		01 NOV 77	10 52 33.134	5	274.8	271.5	-177.6	1.2	1.2			FB(BC,29)*	R
4547	95927	9.1	G5	01 NOV 77	10 58 40.882	8	282.3	279.0	175.3	.8	.9			FR(BC,29)	R
4548		10.0		01 NOV 77	11 4 24.548	5	291.7	288.2	166.3	1.3	1.4			FB(BC,29)*	R
4549		8.5		01 NOV 77	11 24 39.921	5	226.8	223.3	-127.8	1.8	2.0			FB(BC,29)*	R
4550	95941	8.6	G5	01 NOV 77	11 42 36.683	2	292.7	289.2	167.1	2.0	2.1			FR(BC,29)*	R
4551	96825	8.3	B9	02 NOV 77	6 35 53.365	1	328.7	320.7	122.3	3.2	3.3			FB(BC,29)*	R
4552	96817	9.1	A	02 NOV 77	6 37 16.650	2	306.2	298.2	144.8	2.3	2.4			FB(BC,29)*	R
4553	97649	8.6	A5	03 NOV 77	7 29 31.999	1	283.8	271.0	172.3	2.7	2.8			FB(BC,29)	R
4554	97655	8.3	F8	03 NOV 77	7 40 52.458	1	288.2	275.2	168.1	2.6	2.7			FB(BC,29)	R
4555		9.5		03 NOV 77	7 46 8.087	1	286.3	273.5	170.1	2.3	2.4			FR(BC,29)*	R
4556	97722	8.6	F8	03 NOV 77	11 44 29.166	1	277.8	264.5	-170.5	2.8	3.0			FB(BC,29)	R
4557	117991	8.6	F2	05 NOV 77	10 3 53.492	4	227.6	206.8	-120.1	1.9	2.0			FB(BC,29)*	R
4558	117991	8.6	F2	05 NOV 77	10 4 2.285	3	227.6	206.8	-120.1	2.1	2.3			FB(BC,29)*	R
4559	118023	6.3	K0	05 NOV 77	11 34 30.021	0	335.1	314.1	136.5	5.6	5.7	-14.8	.1	FR(BC,29)	R
4561	118044	4.9	M0	05 NOV 77	13 19 42.209	1	325.1	304.0	151.0	3.9	4.1			FR(52,87)*	R
4562	-16 5484	9.6		16 NOV 77	0 51 1.229	2	76.0	88.3	-5.0	2.3	2.4			FB(BC,29)	
4563	163200	8.3	K0	16 NOV 77	0 57 37.088	1	58.5	70.6	12.3	2.9	3.0			FB(BC,29)	
4564	163207	9.0	A0	16 NOV 77	1 1 36.219	1	102.0	114.1	-31.2	2.9	3.0			FR(BC,29)	
4565	163226	9.0	G5	16 NOV 77	1 56 57.687	1	98.0	110.3	-27.7	2.9	3.0			FR(BC,29)	
4566	163225	9.0		16 NOV 77	2 3 14.470	1	55.5	67.8	14.8	3.0	3.1			FB(BC,29)	
4567	163227	9.0	B9	16 NOV 77	2 6 28.640	0	48.2	60.5	22.2	3.5	3.7			FB(BC,29)	
4568	163235	8.8	G5	16 NOV 77	2 23 5.568	2	141.8	154.1	-71.5	3.3	3.4	2.9	1.4	FB(BC,29)	
4569	163251	9.0	A0	16 NOV 77	2 36 14.672	2	64.4	76.8	6.1	2.0	2.1			FB(BC,29)	
4570	163258	8.8	G0	16 NOV 77	2 45 30.879	1	90.5	103.0	-20.0	2.7	2.8			FB(BC,29)	
4571	163255	8.6	K0	16 NOV 77	3 10 23.550	2	13.3	25.8	57.5	2.5	2.6			FR(BC,29)	
4572	164046	6.5	A3	17 NOV 77	0 49 6.988	0	94.0	111.3	-27.2	4.4	4.5	-8.6	.6	FB(42,29)	
4573	-13 5820	9.8		17 NOV 77	1 29 38.382	2	73.5	90.6	-7.0	2.0	2.1			FR(BC,29)	
4574	-13 5823	9.6		17 NOV 77	1 45 55.608	2	54.0	71.3	12.3	2.1	2.2			FB(BC,29)	
4575	-13 5819	9.0		17 NOV 77	1 51 33.590	3	26.2	43.5	40.0	1.8	1.9			FR(BC,29)	
4576	-13 5824	9.3		17 NOV 77	1 57 44.630	2	49.0	66.4	17.1	2.3	2.4			FR(BC,29)	
4577	164063	9.1	G5	17 NOV 77	2 8 27.761	2	16.0	33.2	50.2	2.4	2.5			FR(BC,29)	
4578	164068	8.6	K0	17 NOV 77	2 20 41.616	2	21.5	38.9	44.7	3.3	3.4	-12.8	1.3	FR(BC,29)	
4579	164075	9.3	K5	17 NOV 77	2 44 2.201	4	19.8	37.2	46.5	1.5	1.6			FB(BC,29)	
4580	164084	8.8	F2	17 NOV 77	2 49 12.687	1	42.5	59.9	24.0	2.5	2.6			FB(BC,29)*	
4581	164080	7.3	K2	17 NOV 77	2 55 35.795	1	24.1	41.5	42.4	3.8	3.9	15.5	2.3	FR(BC,29)*	
4582	145770	8.8	B9	18 NOV 77	4 2 50.327	1	352.2	13.6	72.3	4.1	4.2	3.2	.7	FB(BC,29)	
4583	145788	8.6	MB	18 NOV 77	4 32 5.238	1	144.6	165.8	-79.4	3.9	4.0	13.8	.5	FR(BC,29)	
4584	145783	8.8	K0	18 NOV 77	4 36 46.110	2	356.0	17.3	69.5	3.1	3.2	8.5	1.2	FR(BC,29)	
4585	145800	8.6	G5	18 NOV 77	5 7 42.991	1	64.0	85.4	2.4	2.5	2.6			FR(BC,29)	
4586	146806	9.0	K0	20 NOV 77	1 32 14.768	3	67.3	92.3	-6.4	1.8	1.9			FB(BC,)*	
4587	146817	8.8	G5	20 NOV 77	2 24 48.979	1	59.5	84.5	.6	2.6	2.8			FR(BC,29)	
4588	146816	9.0	G5	20 NOV 77	2 26 27.198	2	49.5	74.5	10.6	2.0	2.1			FR(BC,29)	
4589	146828	9.0	K0	20 NOV 77	3 27 23.248	2	127.4	152.5	-67.0	2.8	2.9	19.8	2.7	FR(BC,29)	
4590	146832	8.8	F0	20 NOV 77	3 33 8.557	1	75.9	100.9	-15.5	2.9	3.0			FB(BC,29)	
4591	146835	9.0	F5	20 NOV 77	3 43 29.226	1	84.9	109.9	-24.2	3.1	3.2			FB(BC,29)	
4592	146841	8.1	F0	20 NOV 77	4 41 42.131	4	30.6	55.5	31.7	1.6	1.7			FB(BC,29)*	
4593	146863	9.3	K0	20 NOV 77	6 17 3.982	4	67.1	92.1	-1.2	1.2	1.3			FR(BC,29)	
4594	146860	8.3	A0	20 NOV 77	6 20 6.006	0	49.5	74.5	16.5	3.5	3.6			FB(BC,29)*	
4595	109244	9.0	F2	21 NOV 77	5 57 1.879	6	16.0	41.0	49.0	1.8	2.1			FB(BC,29)*	
4596	109253	8.3	A3	21 NOV 77	6 2 53.686	1	69.6	94.6	-4.5	2.7	2.8			FB(BC,29)	
4597	109257	8.5	F5	21 NOV 77	6 19 44.073	2	53.7	78.6	12.3	2.6	2.7			FB(BC,29)	
4598	109281	8.8	K2	21 NOV 77	7 42 13.336	2	116.3	141.1	-46.5	2.6	2.7	11.0	4.6	FR(BC,29)	
4599	109742	8.6	K0	22 NOV 77	1 7 17.440	2	46.2	70.1	17.6	2.1	2.3			FB(BC,29)	
4600	109747	8.8	F8	22 NOV 77	1 22 50.164	2	60.0	84.0	3.4	2.0	2.1			FB(BC,29)	
4601	109753	6.1	K0	22 NOV 77	1 48 18.615	0	46.7	70.8	16.0	4.5	4.6			FR(BC,29)	
4602	109790	8.8	G5	22 NOV 77	3 55 30.082	3	92.8	116.6	-30.8	2.4	2.6			FB(BC,29)*	
4603	92804	8.3	K5	23 NOV 77	6 23 57.708	2	4.0	25.5	64.9	3.7	3.7	5.2	.8	FR(BC,29)	
4604	93145	8.6	K0	24 NOV 77	1 52 1.749	4	18.7	37.4	49.5	1.8	1.9			FR(BC,29)	
4605	93181	8.3	F5	24 NOV 77	3 51 23.880	3	91.5	110.0	-24.3	1.9	2.0			FB(BC,29)	
4606	93191	8.3	G5	24 NOV 77	4 48 .041	2	85.0	103.4	-17.1	2.3	2.4			FR(BC,29)	
4607	93193	8.6	K0	24 NOV 77	5 12 38.290	4	33.7	52.0	34.9	1.8	1.9			FR(BC,29)	
4608	162842	8.8	A0	13 DEC 77	1 8 4.910	1	104.1	114.0	-31.0	2.5	2.6			FB(BC,29)	
4609	162853	7.5	A2	13 DEC 77	1 22 19.992	1	73.1	83.0	.3	2.9	3.0			FB(BC,29)*	
4610	162853	7.0	A2	13 DEC 77	1 22 37.615	1	73.0	82.9	.4	2.9	3.0			FB(BC,29)*	
4611	163780	7.8	M3	14 DEC 77	1 41 37.649	0	51.5	67.0	17.5	3.3	3.5			FR(BC,29)*	

TABLE I (continued)

RUN	SAO/DM	MAG	SP.	U.T. DATE	UTC	OBSERVED	DT	P.A.	W.A.	C.A.	DMS	DMB	SLOPE	DS	NOTES	EVEN
4612	163804	9.1	F5	14 DEC 77	2 30	9.699	2	60.9	76.6	8.8	2.2	2.3			FB(BC+29)	
4613	164537	8.8	F0	15 DEC 77	2 5	47.288	3	61.4	81.4	4.1	1.5	1.6			FB(BC+29)	
4614	164556	8.6	K5	15 DEC 77	2 50	14.916	0	68.4	88.5	-1.7	3.4	3.5			FR(BC+29)	
4615	164555	6.1	K0	15 DEC 77	2 54	22.443	1	127.4	147.5	-60.7	3.9	4.0	2.3	.5	FR(52+89)	
4616	164570	8.8	A0	15 DEC 77	3 25	7.229	1	67.3	87.4	.4	2.6	2.7			FB(BC+29)	
4617	164573	9.0	A2	15 DEC 77	3 34	38.890	2	73.6	93.9	-5.8	1.9	2.0			FB(BC+29)	
4618	164574	8.6	G5	15 DEC 77	3 38	27.356	3	74.5	94.8	-6.5	1.6	1.7			FR(BC+29)	
4619	164565	8.3	K0	15 DEC 77	3 44	6.634	1	13.3	33.7	54.9	2.9	3.0	3.3	1.0	FR(BC+29)	
4620	146135	6.1	F8	16 DEC 77	1 25	43.964	0	61.5	84.5	.5	3.9	4.0			FR(52+70)	
4621	146142	7.0	G0	16 DEC 77	2 14	16.663	0	76.1	99.3	-13.1	4.1	4.2			FB(BC+29)	
4622	146154	9.1	K0	16 DEC 77	2 48	31.522	1	67.1	90.3	-3.2	2.4	2.5			FR(BC+29)	
4623	146695	9.0	K2	17 DEC 77	2 58	5.771	1	124.6	73.0	14.3	2.7	2.8			FR(BC+29)*	
4624	146733	6.5	K0	17 DEC 77	5 39	46.057	1	109.1	134.1	-40.5	2.7	2.8	9.0	6.2	FR(BC+29)	
4625	109106	8.6	K2	18 DEC 77	4 36	56.504	1	61.5	86.6	4.4	3.3	3.4			FB(BC+29)	
4626	109109	8.8	K5	18 DEC 77	4 54	53.577	1	45.9	71.0	20.8	2.6	2.7			FR(BC+29)	
4627	109662	8.6	M0	19 DEC 77	4 29	39.227	1	111.4	135.6	-45.2	3.8	3.9	-1.3	1.1	FR(BC+29)	
4628	93022	5.6	F5	21 DEC 77	0 9	13.509	3	41.5	61.2	25.3	2.0	2.1			FR(BC+29)*	
4629	93029	7.6	G5	21 DEC 77	0 44	6.986	2	108.3	127.9	-41.9	2.3	2.5			FB(BC+29)*	
4630	93086	8.1	K2	21 DEC 77	6 39	58.006	0	60.0	79.1	16.5	3.6	3.8			FR(BC+29)*	
4631	93907	4.8	A5	23 DEC 77	7 4	49.947	1	37.7	48.5	47.0	4.5	4.6	-4.6	.8	FB(BC+29)	
4632	145895	9.1	G0	12 JAN 78	1 21	13.919	1	32.2	54.0	33.7	3.3	3.4			FB(BC+29)	
4633	146973	6.0	M3	14 JAN 78	0 51	52.734	0	60.2	85.5	1.5	5.1	5.3			FR(BC+70)*	
4634	128481	8.8	F0	14 JAN 78	2 21	38.381	1	26.2	51.4	39.9	3.3	3.4			FB(BC+29)*	
4635	93362	8.1	F8	18 JAN 78	2 47	54.164	2	100.6	117.5	-28.8	2.5	2.7			FB(BC+29)	
4636	95866	8.3	G0	22 JAN 78	2 43	13.612	2	61.0	58.0	26.8	2.2	2.6			FR(BC+29)*	
4637	95941	8.6	G5	22 JAN 78	5 39	11.046	2	121.8	118.3	-25.0	2.5	2.6			FR(BC+29)*	
4638	95955	8.6	B9	22 JAN 78	6 16	25.051	1	137.8	134.3	-39.0	3.0	3.1			FB(BC+29)*	
4640	95985	7.9	F8	22 JAN 78	7 7	11.487	2	144.1	140.5	-43.4	2.6	2.7			FR(BC+29)*	
4641	96002	8.0	B9	22 JAN 78	7 38	56.108	1	110.8	107.1	-9.1	3.4	3.5			FB(BC+29)	
4642	96054	8.1	K0	22 JAN 78	9 26	3.069	1	115.0	111.0	-12.1	2.3	2.4			FR(BC+29)	
4643	93192	8.5	K2	14 FEB 78	1 9	49.244	1	125.6	143.8	-54.5	3.3	3.4	13.3	2.1	FR(BC+29)	
4644	+12 414	10.5	F0	14 FEB 78	1 51	36.491	3	63.2	81.4	10.0	1.8	1.9			FB(BC+29)	
4646	94047	8.3	F0	16 FEB 78	3 12	59.105	1	45.5	54.7	39.0	4.0	4.1	-3.7	1.7	FB(BC+29)	
4647	+16 634	9.3	A2	16 FEB 78	3 18	29.215	2	103.0	112.1	-18.2	2.2	2.3			FB(BC+29)	
4649	94059	8.0	K0	16 FEB 78	4 24	.266	2	21.2	30.2	66.6	3.7	3.8	-5.7	.8	FB(BC+29)	
4650	94065	8.8	K0	16 FEB 78	4 30	22.398	1	58.2	67.3	30.0	3.0	3.1			FR(BC+29)	
4651	94070	8.6	A2	16 FEB 78	5 14	13.223	1	52.5	61.5	37.2	3.2	3.3	-6.8	3.3	FR(BC+29)	
4652	94080	8.1	K5	16 FEB 78	6 0	44.608	1	77.9	86.6	13.0	3.2	3.4			FB(BC+29)	
4653	94554	5.3	B3	17 FEB 78	1 33	33.256	0	98.0	102.1	-14.6	4.7	4.9			FB(42+29)*	
4654	+17 932	9.5	G0	17 FEB 78	2 33	52.151	4	71.8	75.8	14.6	1.6	1.7			FB(BC+29)	
4655	94621	9.0	K7	17 FEB 78	5 37	44.339	3	25.0	28.6	70.0	3.1	3.2	3.5	1.1	FR(BC+29)	
4656	94633	8.6	F0	17 FEB 78	6 4	14.019	3	166.8	170.5	-71.5	3.6	3.7	-5.3	.7	FR(BC+29)	
4657	95645	9.0	F5	18 FEB 78	7 11	57.410	1	100.4	98.5	.5	2.5	2.6			FB(BC+29)*	
4658	95660	9.1	A0	18 FEB 78	7 32	46.909	1	88.6	86.6	12.3	2.2	2.3			FB(BC+29)	
4659	95683	9.0	A0	18 FEB 78	8 8	52.039	1	72.6	70.5	28.2	2.3	2.5			FB(BC+29)	
4660	96515	9.0		19 FEB 78	1 39	43.907	3	131.6	125.0	-39.2	2.0	2.1			FB(BC+29)*	
4661	96529	8.6		19 FEB 78	1 59	26.600	2	55.5	49.0	37.5	2.4	2.5			FR(BC+29)	
4662	96541	8.5	A5	19 FEB 78	2 21	29.855	1	49.2	42.7	44.7	3.5	3.6	-5.8	2.2	FR(BC+29)	
4663	96554	9.0	A5	19 FEB 78	2 52	36.490	11	157.1	150.3	-61.2	1.0	1.1			FR(BC+29)	
4664	96611	6.6	K5	19 FEB 78	4 45	38.864	0	116.8	109.9	-15.0	4.0	4.1			FR(BC+70)*	
4665	96629	9.1		19 FEB 78	5 28	32.170	4	96.0	89.0	7.5	1.4	1.5			FB(BC+29)*	
4666	96634	9.0		19 FEB 78	5 49	13.751	2	107.5	100.5	-3.4	2.2	2.2			FB(BC+29)*	
4667	96686	9.1	K0	19 FEB 78	7 18	48.944	2	80.6	73.5	24.7	2.1	2.2			FR(BC+29)*	
4668	96681	8.1	A0	19 FEB 78	7 26	43.338	1	141.3	134.1	-35.9	3.3	3.4	1.7	3.7	FB(BC+29)	
4669	96703	9.1	F0	19 FEB 78	7 47	11.393	1	111.6	104.4	-6.3	2.4	2.5			FB(BC+29)*	
4671	96728	9.3		19 FEB 78	8 52	44.342	4	140.1	132.8	-35.5	1.3	1.4			FR(BC+29)	
4672	97560	8.3	G5	20 FEB 78	8 38	28.560	2	50.5	38.2	58.7	2.6	2.7			FR(BC+29)	
4673	97586	8.5	F0	20 FEB 78	9 21	47.624	2	100.5	88.1	7.8	2.1	2.2			FB(BC+29)	
4674	98240	8.3	F8	21 FEB 78	8 32	53.008	2	116.1	99.5	67.5	2.1	2.3			FB(BC+29)	
4675	98244	8.5	K0	21 FEB 78	9 12	3.731	3	152.3	135.6	-40.2	1.7	1.8			FB(BC+29)*	
4676	98709	3.7	F5	22 FEB 78	4 39	41.327	0	113.0	93.1	-2.2	4.0	4.1			FB(52+89)*	
4678	+14 568	9.5		14 MAR 78	3 31	36.131	5	85.0	100.5	-1.2	1.1	1.2			FR(BC+29)	
4679	93475	8.8	F8	14 MAR 78	3 54	12.825	2	98.6	114.1	-14.3	1.8	1.9			FR(BC+29)	
4680	93870	6.9	G0	15 MAR 78	2 45	6.541	0	102.0	113.0	-15.5	4.9	5.0			FB(BC+29)*	
4681	93884	9.0		15 MAR 78	4 3	15.301	2	33.2	44.0	55.5	3.0	3.1	-2	2.8	FB(BC+29)	
4682	93895	7.8	G5	15 MAR 78	4 40	27.656	1	39.5	50.2	49.9	2.9	3.0	2.7	1.9	FR(BC+29)	
4683	93901	7.8	A0	15 MAR 78	4 51	16.933	1	82.8	93.5	6.6	2.9	3.0			FR(BC+29)	
4684	93900	5.6	A2	15 MAR 78	4 59	48.593	2	44.4	55.0	45.2	2.6	2.7	-17.5	3.2	FB(BC+29)	
4685	93911	8.8	G	15 MAR 78	5 28	7.931	3	142.6	153.1	-53.0	2.6	2.6	-12.1	2.9	FB(BC+29)	
4686	94358	9.3	A0	16 MAR 78	2 29	36.416	5	29.1	35.0	61.0	2.0	2.8			FB(BC+29)*	

TABLE I (continued)

RUN	SAO/DM	MAG	SP.	U.T. DATE	UTC OBSERVED	DT	P.A.	W.A.	C.A.	DMS	DMB	SLOPE	DS	NOTES	EVENT
4687	+17 860	10.0		16 MAR 78	2 35 33.030	4	56.2	62.0	34.2	1.7	1.9			FB(BC,29)	
4688	+17 863	9.5		16 MAR 78	3 4 7.267	2	86.1	92.0	5.4	2.1	2.2			FB(BC,29)	
4689	94366	8.1	B8	16 MAR 78	3 25 34.222	1	164.8	170.6	-72.6	4.6	4.7	.9	.3	FB(BC,29)	
4690	+17 866	10.5		16 MAR 78	3 55 22.377	3	63.7	69.5	29.3	1.8	2.0			FB(BC,29)	
4691	+17 871	10.5		16 MAR 78	4 26 16.600	4	134.6	140.3	-41.0	1.6	1.7			FB(BC,29)	
4692	94402	9.0	M0	16 MAR 78	5 10 8.518	2	138.6	144.1	-44.5	3.0	3.1	-16.4	1.4	FR(BC,29)	
4693	+18 1052	9.1		17 MAR 78	2 5 31.566	1	79.1	79.9	14.1	2.5	2.7			FB(BC,29)	
4694		10.5		17 MAR 78	3 22 17.287	8	26.2	26.7	70.5	1.8	1.9			FB(BC,29)*	
4695	+17 1096	10.0		17 MAR 78	3 35 4.292	2	101.6	102.1	-4.5	1.9	2.1			FR(BC,29)	
4696		10.0		17 MAR 78	3 47 36.888	4	91.4	91.8	6.0	1.3	1.4			FB(BC,29)*	
4697	95146	8.6	A0	17 MAR 78	3 48 55.674	1	70.5	71.0	26.8	3.5	3.6	-13.2	2.9	FB(BC,29)	
4698	95145	9.0	G	17 MAR 78	3 54 20.206	3	55.0	55.4	42.7	2.7	2.8	-10.9	2.4	FB(BC,29)	
4699		10.0		17 MAR 78	4 4 15.153	9	103.1	103.5	-5.3	.2	.3			FB(BC,29)*	
4700	+17 1099	9.1		17 MAR 78	4 9 23.298	2	109.5	109.8	-11.5	2.1	2.2			FB(BC,29)	
4701	95158	8.1	G5	17 MAR 78	4 16 5.425	1	69.4	69.8	28.7	3.3	3.3	-5.8	3.0	FR(BC,29)	
4702	+18 1066	9.1		17 MAR 78	4 20 55.629	3	53.7	54.0	44.5	2.4	2.4	-9.3	6.0	FB(BC,29)	
4703	95157	8.1	K0	17 MAR 78	4 39 43.716	2	159.8	159.8	-61.2	3.6	3.7	.4	.9	FR(BC,29)	
4704	95195	8.6	B9	17 MAR 78	5 21 45.586	1	107.3	107.3	-8.3	3.0	3.1			FB(BC,29)	
4705	+17 1115	9.6	A7	17 MAR 78	5 37 28.221	2	69.8	70.0	29.2	2.0	2.2			FB(BC,29)	
4706	95200	9.1	A0	17 MAR 78	5 41 11.417	1	143.3	143.5	-44.5	3.2	3.3	-8.2	2.4	FB(BC,29)	
4707	+17 1117	9.6		17 MAR 78	5 47 39.475	3	127.3	127.4	-28.3	1.5	1.6			FB(BC,29)	
4708	+17 1119	10.0		17 MAR 78	5 58 33.258	3	109.6	109.8	-10.8	1.4	1.5			FB(BC,29)	
4709	+17 1120	9.1		17 MAR 78	6 13 18.746	3	36.2	36.4	62.5	2.2	2.3			FB(BC,29)	
4710	+17 1124	10.0		17 MAR 78	6 15 26.189	3	84.5	84.5	14.3	1.4	1.5			FB(BC,29)	
4711	+17 1126	9.0		17 MAR 78	6 33 21.252	4	123.4	123.3	-24.6	1.5	1.6			FB(BC,29)	
4712	+17 1133	9.1		17 MAR 78	7 1 42.718	6	91.5	91.5	7.0	1.0	1.1			FR(BC,29)	
4713	96167	8.1	K0	18 MAR 78	1 52 2.945	1	65.8	61.2	30.8	3.7	3.8	8.1	2.6	FR(BC,29)	
4715	+17 1411	10.1		18 MAR 78	1 59 32.032	3	111.5	106.8	-14.3	1.7	1.8			FB(BC,29)	
4716		10.0		18 MAR 78	2 1 24.606	3	83.5	78.8	13.6	2.0	2.1			FB(BC,29)*	
4717	+17 1413	9.5		18 MAR 78	2 22 50.408	2	133.1	128.5	-34.7	2.2	2.3			FB(BC,29)	
4718	+17 1416	9.5		18 MAR 78	2 28 28.171	5	96.0	91.4	2.5	1.8	2.1			FB(BC,29)*	
4719		10.5		18 MAR 78	3 55 12.903	3	116.3	111.4	-14.1	1.6	1.8			FR(BC,29)*	
4720	+17 1429	11.3	M0	18 MAR 78	4 32 59.521	3	133.3	128.3	-30.2	1.8	2.0			FR(BC,29)	
4721		9.6		18 MAR 78	5 46 16.641	4	102.9	97.8	.6	1.2	1.3			FB(BC,29)*	
4722	96267	8.6	K2	18 MAR 78	5 55 50.687	2	166.8	161.6	-63.4	2.8	3.0			FB(BC,29)	
4724	+17 1448	9.0		18 MAR 78	6 24 51.659	1	105.0	99.6	-1.6	2.4	2.5			FB(BC,29)	
4725	+17 1452	10.1		18 MAR 78	6 55 21.891	7	72.5	67.0	30.6	.8	.9			FB(BC,29)	
4726	+17 1453	9.6		18 MAR 78	7 18 32.161	4	164.5	159.1	-61.9	1.7	1.8			FB(BC,29)	
4727	97124	8.5	K0	19 MAR 78	1 39 30.199	2	130.3	120.5	-30.3	2.8	2.9	-5.3	2.4	FR(BC,29)*	
4728	97140	9.1		19 MAR 78	2 39 48.594	5	106.5	96.5	-3.2	1.3	1.4			FB(BC,29)	
4729	118209	8.3	F8	22 MAR 78	9 35 34.029	8	170.1	148.1	-57.5	.9	1.0			FB(BC,29)	

At the suggestion of a referee the following items are included:

Explanation of Table:

The headings are self explanatory save for

DT = timing error in milliseconds.

DMS = magnitude difference from primary of brightest companion which could be lost in the noise while primary present.

DMB = magnitude difference from primary of brightest companion which could be lost in the noise while primary occulted (i.e., larger values of DMS, DMB indicate better discrimination).

DS = error of limb slope determination.

F = 30-in. reflector.

B, R = before parentheses, channel of record chosen for reduction.

Filters = within parentheses, filters used, e.g., Blue Clear, Wratten 29, Stromgren y, interference 52, etc.

Asterisk = remark.

Event: R = Reappearance

List of references to previous papers in the series "Photoelectric Measurement of Lunar Occultations" (all in *Astronomical Journal*)

I: The Process. R. E. Nather and David S. Evans, **75**, 575, 1970.

II: Instrumentation. R. E. Nather, **75**, 583, 1970.

III: Lunar Limb Effects. David S. Evans, **75**, 589, 1970.

IV: Data Analysis. R. E. Nather and M. M. McCants, **75**, 963, 1970.

V: Observations. David S. Evans, **76**, 1107, 1971.

VI: Observations. David W. Dunham, David S. Evans, John T. McGraw, William H. Sandmann, and Donald C. Wells, **78**, 482, 1973.

VII: Observations. John L. Africano, Charles L. Cobb, David W. Dunham, David S. Evans, Francis C. Fekel and Steven S. Vogt **80**, 689, 1975.

VIII: Observations. John L. Africano, David S. Evans, Francis C. Fekel and Gary J. Ferland **81**, 650, 1976.

IX: Observations. John L. Africano, David S. Evans, Francis C. Fekel and Thomas Montemayor, **82**, 631, 1977.

NOTES TO TABLE I

36/7: SAO 163471 ADS 13717. Observation made with 36-in. telescope. Same as Run No. 4174. Other Run Nos. are 3921, 4058, and 4506. Visual $\Delta m \approx 4.0$.

Based on the last visual separation and position angle (0.8, 89°) given in the *Index Catalogue of Visual Double Stars* (IDS) (Jeffers *et al.* 1963) occultation

- of the secondary occurred after the primary and outside our observing range.
- 36/8: SAO 163481: β Cap, HR 7776, Double. 36-in. telescope used. Same event as Run No. 4175; other Run Nos. 3922, 4059, 4282, 4507. The secondary disappeared at UTC $1^{\text{h}}53^{\text{m}}27^{\text{s}}981 \pm 0^{\text{s}}001$, giving a separation $0^{\circ}0155 \pm 0^{\circ}0004$ in direction $113^{\circ}9$ (slope -0.5 ± 1.0) $\Delta m = 1.8 \pm 0.1$ in Stromgren y. Analysis yields a diameter for the KO II-III star of 3.2 ± 0.5 milliarcsec for a disk fully darkened at the limb. This is an excellent agreement with Ridgeway *et al.* (1977) who obtained 3.45 ± 0.12 milliarcsec for a disk fully darkened at the limb. β Cap is the subject of a separate contribution (Evans and Fekel 1978).
- 4249: SAO 109719: Possible double. The secondary disappeared at UTC $2^{\text{h}}43^{\text{m}}28^{\text{s}}594 \pm 0^{\text{s}}017$, giving a separation $0^{\circ}026 \pm 0^{\circ}007$ in direction $285^{\circ}8$ (no slope determined) with $\Delta m = 0.7 \pm 0.8$ in blue channel. In red $\Delta m = 0.7 \pm 0.7$.
- 4251: SAO 93085: ADS 2101, Double. The secondary disappeared at UTC $1^{\text{h}}33^{\text{m}}51^{\text{s}}358 \pm 0^{\text{s}}011$, giving a separation $0^{\circ}379 \pm 0^{\circ}003$ in direction $55^{\circ}7$ (no slope determined) with $\Delta m = 3.1 \pm 0.5$ in the blue. In red $\Delta m = 2.3 \pm 0.6$. The separation and position angle ($0^{\circ}6, 118^{\circ}0$) extrapolated from positions listed in the IDS give a separation of $0^{\circ}28$ when projected in our observed direction in fair agreement with our value. The IDS gives $\Delta m = 3.7$ in rough agreement with our values.
- 4253: SAO 93484: Possible double. The secondary disappeared at UTC $1^{\text{h}}14^{\text{m}}58^{\text{s}}683 \pm 0^{\text{s}}026$, giving a separation $0^{\circ}035 \pm 0^{\circ}003$ in direction $13^{\circ}0$ (slope -3.4 ± 0.7) with $\Delta m = 3.5 \pm 0.6$.
- 4255: SAO 93536: ADS 2661. Based on visual separation and position angle ($36^{\circ}2, 152^{\circ}6$) from the IDS, the secondary occurred outside our observing range. Severe interference by clouds.
- 4256: SAO 94422: Possible double. The secondary disappeared at UTC $2^{\text{h}}25^{\text{m}}14^{\text{s}}099 \pm 0^{\text{s}}019$, giving a separation $0^{\circ}036 \pm 0^{\circ}007$ in direction $281^{\circ}1$ (no slope determined) with $\Delta m = 0.9 \pm 1.1$ in blue channel. No trace of secondary in very noisy red channel.
- 4257, 4258: SAO 94431: A and B components respectively of ADS 3854. The time difference between the occultations gives a separation $3^{\circ}07$ in direction $159^{\circ}6$. The separation and position angle ($2^{\circ}5, 162^{\circ}7$) from the IDS give a separation of 2.5 when projected in our direction. In the blue $\Delta m = 0.6$ and in the red $\Delta m = 0.65$. This is in good agreement with $\Delta m = 0.5$ from the IDS.
- 4260: SAO 94510: Severe interference from clouds.
- 4261: SAO 95229: ADS 4681. Double. The secondary disappeared at UTC $1^{\text{h}}34^{\text{m}}20^{\text{s}}573 \pm 0^{\text{s}}006$, giving a separation $0^{\circ}038 \pm 0^{\circ}002$ in direction $273^{\circ}8$ (no slope determined) with $\Delta m = 0.9 \pm 0.4$ in the blue. In red $\Delta m = 0.3 \pm 1.0$. Our observation is in good agreement with the current separation and position angle ($0^{\circ}4, 181^{\circ}0$) from the IDS which gives a separation of $0^{\circ}02$ in direction $93^{\circ}8$. The order of the disappearances is probably reversed because our observed angle is nearly 90° different from the actual position angle. The $\Delta m = 0.7$ from the IDS is in reasonable agreement with our observations.
- 4262: SAO 95263: This occultation occurred 19.7 s after the predicted time. This difference was due to an error in the SAO Catalog proper motion in RA and the RA (Herald 1977).
- 4263: SAO 95265: Possibly double. The secondary disappeared at UTC $2^{\text{h}}55^{\text{m}}44^{\text{s}}552 \pm 0^{\text{s}}015$, giving a separation $0^{\circ}016 \pm 0^{\circ}006$ in direction $235^{\circ}6$ (no slope determined) with $\Delta m = 0.1 \pm 1.2$ in red. No duplicity in good blue trace.
- 4268: SAO 95456: Double. The secondary disappeared at UTC $7^{\text{h}}49^{\text{m}}0^{\text{s}}610 \pm 0^{\text{s}}005$, giving a separation $0^{\circ}014 \pm 0^{\circ}002$ in direction $64^{\circ}4$ (no slope determined) with $\Delta m = 1.3 \pm 0.5$ in blue channel. Duplicity in red channel uncertain.
- 4273: SAO 96505: ADS 5794. Based on visual separation and position angle ($12^{\circ}3, 254^{\circ}$) from the IDS, the secondary occurred far outside our observing range. No features corresponding to alleged composite nature of primary's spectrum.
- 4274: SAO 96515: Just possibly double. If so the secondary disappeared at UTC $7^{\text{h}}44^{\text{m}}51^{\text{s}}581 \pm 0^{\text{s}}010$, giving a separation $0^{\circ}057 \pm 0^{\circ}005$ in direction $261^{\circ}8$ (no slope determined) with $\Delta m = 0.6 \pm 0.8$ in red channel. No duplicity in blue channel or in Run No. 4660 of same star.
- 4276: SAO 96547: ADS 5816. Based on visual separation and position angle ($6^{\circ}9, 355^{\circ}0$) and $\Delta m = 0.1$ from the IDS, both stars probably disappeared within our trace. However the trace shows severe cloud interference and only one star is apparent.
- 4277: SAO 98143: Same star as Run No. 3707.
- 4278: SAO 98146: Same star as Run No. 3709. This star is listed by the USNO predictions as being a possible close double. Both of our observations are noisy but there is some indication of possible duplicity in each although not definite enough to analyze.
- 4279: SAO 98174: ADS 7049AB. Same star as Runs Nos. 3710 and 3740. Based on separation and position angle ($2^{\circ}0, 88^{\circ}6$) from the IDS, the secondary occurred outside our observing range.
- 4280: SAO 98235: Same star as Runs Nos. 3742 and 4313. Analysis of Run No. 3742 suggested a possible small diameter but the trace was not good enough for an accurate analysis. The same holds true for these two new observations.
- 4282: SAO 163481: β Cap, HR 7776, double. The secondary disappeared at UTC $12^{\text{h}}13^{\text{m}}37^{\text{s}}929 \pm 0^{\text{s}}001$, giving a separation $0^{\circ}0192 \pm 0^{\circ}0005$ in direction $110^{\circ}0$ (slope 6.6 ± 3.4) with $\Delta m = 1.1 \pm 0.1$ in Johnson B. See Run No. 36/8 for comments.
- 4286, 4287: SAO 96977, 96978: Components of ADS 6146. The time difference between occultations gives a separation $8^{\circ}24$ in direction $75^{\circ}2$. The separation and position angle ($10^{\circ}6, 32^{\circ}0$) from the IDS give a separation of 7.7 when projected in our direction. From our observations SAO 96978 is fainter in the blue, $\Delta m = 0.14$ and brighter in the red, $\Delta m = -0.23$. The IDS gives $\Delta m = 0.0$.
- 4288: SAO 96991: Probably double. The secondary disappeared at UTC $2^{\text{h}}56^{\text{m}}57^{\text{s}}744 \pm 0^{\text{s}}005$, giving a separation $0^{\circ}006 \pm 0^{\circ}001$ in direction $85^{\circ}2$ (no slope determined) with $\Delta m = 1.2 \pm 1.0$ in blue channel. Duplicity in red channel uncertain.
- 4293: SAO 97069: Severe interference from clouds.
- 4298: SAO 98462: Same star as Runs Nos. 3559 and 3730.
- 4299: SAO 118132: Same star as Run No. 2780 and Eitter and Beavers (1977) No. 286.
- 4300: SAO 118151: Same star as Run No. 2781 and Eitter and Beavers (1977) No. 289.
- 4301: SAO 138553: Severe interference from clouds.
- 4303: SAO 96746: ADS 5961, HR 2763 λ Gem, $V = 3.6$, spectral type A3. Based on visual separation and position angle ($9^{\circ}6, 33^{\circ}0$) from the IDS, the secondary occurred outside our observing range. There is a level change in both blue and red which occurs just before primary disappearance, but large variations due to seeing reach about the same amplitudes. Therefore we have not attempted to solve for possible duplicity reported by some visual graze observers (Dunham 1977).
- 4304: SAO 97543: Same star as Run No. 4437.
- 4305, 4306: SAO 97555: double. Components B and A, respectively. The star is not listed as double in the IDS, however, the image on the Palomar Sky Survey is double. This pair is listed separately in the AGK3 as $+14^{\circ}868, m = 8.8$ and $+14^{\circ}869, m = 9.4$. Dunham (1977) gives a separation and position angle ($10^{\circ}9, 32^{\circ}8$) calculated from AGK3 coordinates.
- 4312: SAO 97609: Probably double. The secondary disappeared at UTC $5^{\text{h}}50^{\text{m}}15^{\text{s}}322 \pm 0^{\text{s}}011$, giving a separation $0^{\circ}039 \pm 0^{\circ}006$ in direction $87^{\circ}4$ (no slope determined) with $\Delta m = 0.6 \pm 1.1$ in the red. In the blue $\Delta m = 1.0 \pm 1.2$.

- 4313: SAO 95235: Same star as Runs Nos. 3742, and 4280. See note for Run No. 4280.
- 4314: SAO 118443: ADS 7896. Double. The secondary disappeared at UTC $5^{\text{h}}37^{\text{m}}44^{\text{s}}570 \pm 0^{\text{s}}002$, giving a separation $0''.1182 \pm 0''.0008$ in direction 110.0 (no slope determined) with $\Delta m = 1.6 \pm 0.2$ in the blue. In the red $\Delta m = 1.5 \pm 0.2$. This double star has now covered over half of its orbit since its discovery. It is currently moving rapidly near minimum separation and difficult to observe visually. The orbit of Dommanget (1972) appears to have been premature (Heintz, private communication). White (private communication) obtained an occultation observation on the same night.
- 4315: SAO 138298: HR 4471, 91° Leo, $V = 4.3$, $B - V = 0.99$, spectral type G9III. Analysis yields a diameter of 2.9 ± 0.4 milliarcsec for a disk fully darkened to the limb. Diameter determined from a plot of rms error values versus assumed diameter as before (e.g., Dunham *et al.*, 1973). Jacoby and Price (1978) obtained a fully darkened diameter of 2.4 ± 0.7 milliarcsec in good agreement with our value.
- 4321: SAO 139398: Severe interference from clouds.
- 4326: SAO 161848: HR 7072, Kui 88. Double. The secondary disappeared at UTC $11^{\text{h}}2^{\text{m}}49^{\text{s}}074 \pm 0^{\text{s}}003$, giving a separation $0''.0120 \pm 0''.002$ in direction 78.4 (no slope determined) with $\Delta m = 0.1 \pm 0.3$ in the blue channel. In the red $\Delta m = 1.7 \pm 0.4$. This compares with a visual $\Delta m = 0.7$. Hoffleit (1964) lists a composite spectrum of K0 + A1 for this star which is in accord with our magnitude differences. Our observed direction is nearly perpendicular to the actual position angle. A list of observations provided by Charles Worley from the Naval Observatory's unpublished Catalogue of Observations shows little orbital motion with separation and position angle ($0.37, 179.6$) in 1965 giving a separation of 0.07 in our observed direction and in rough agreement with our observation.
- 4330: SAO 95311: Trace poor due to bad seeing.
- 4343: SAO 117750: Heavy cirrus.
- 4344: SAO 117767: ADS 7429, Double. The secondary disappeared at UTC $4^{\text{h}}46^{\text{m}}53^{\text{s}}52 \pm 0^{\text{s}}018$, giving a separation $0''.041 \pm 0''.008$ in direction 89.0 (no slope determined) with $\Delta m = 2.4 \pm 1.1$ in the red. No sign of duplicity in a good blue trace. Solution for the secondary was suggested by the visual duplicity. Based on separation and position angle ($1.2, 358^\circ$) and $\Delta m = 3$ from the IDS, the secondary was predicted to occur 0.05 s before the primary. Our magnitude difference is in agreement with that of visual observers. With a spectral type of A3 and $V = 8.5$ for the primary, it is not surprising that we do not see the secondary in our blue trace. Thus we believe we have correctly identified the secondary although our observation shows the secondary occurring 0.1 s after the primary. This is understandable since our observed direction is nearly 90° different than the true position angle and a small change in the true position angle would reverse the order of the components.
- 4345: SAO 118224: Probably double. The secondary disappeared at UTC $2^{\text{h}}27^{\text{m}}18^{\text{s}}625 \pm 0^{\text{s}}018$, giving a separation $0''.1954 \pm 0''.0032$ in direction 57.0 (no slope determined) with $\Delta m = 2.4 \pm 0.8$ in blue channel. In the red $\Delta m = 0.2 \pm 0.8$. This star was also observed in Run No. 2765 where no duplicity was found. The position angle for Run No. 2765 differs by 100° from Run No. 4345. Since the actual separation of the stars is greater than that found in Run No. 4345, it is reasonable to suppose that the secondary occurred outside our observing range in Run No. 2765 due to the large difference in position angles.
- 4346: BD +6°2294: Unpredicted. Severe interference from cirrus.
- 4347: SAO 118242: Severe interference from cirrus.
- 4349: SAO 118289: Just possibly double. The secondary disappeared at UTC $6^{\text{h}}0^{\text{m}}40^{\text{s}}088 \pm 0^{\text{s}}007$, giving a separation $0''.470 \pm 0''.003$ in direction 75.6 (no slope determined) with $\Delta m = 3.2 \pm 1.0$ in blue. No duplicity seen in the red.
- 4350: SAO 118291: Same star as Run No. 2768.
- 4379: SAO 139277: Severe interference from clouds.
- 4389: BD -12°4008: Unpredicted, double. The secondary disappeared at UTC $3^{\text{h}}49^{\text{m}}27^{\text{s}}848 \pm 0^{\text{s}}008$, giving a separation $0''.022 \pm 0''.003$ in direction 134.8 (no slope determined) with $\Delta m = 0.6 \pm 0.6$ in the blue. In red $\Delta m = 0.9 \pm 1.1$.
- 4391: SAO 159085: Possible double. The secondary disappeared at UTC $3^{\text{h}}47^{\text{m}}55^{\text{s}}329 \pm 0^{\text{s}}004$, giving a separation $0''.0541 \pm 0''.0008$ in direction 338.7 (slope -2.1 ± 0.8) with $\Delta m = 2.6 \pm 0.1$ in blue. In red $\Delta m = 2.6 \pm 0.1$.
- 4398: SAO 159786: Double. The secondary disappeared at UTC $4^{\text{h}}24^{\text{m}}29^{\text{s}}359 \pm 0^{\text{s}}004$, giving separation $0''.103 \pm 0''.001$ in direction 238.0 (no slope determined) with $\Delta m = 2.5 \pm 0.2$ in the red. Blue channel too noisy to see duplicity.
- 4404: SAO 160399: Double. The secondary disappeared at UTC $4^{\text{h}}3^{\text{m}}9^{\text{s}}037 \pm 0^{\text{s}}009$, giving a separation $0''.030 \pm 0''.003$ in direction 302.3 (no slope determined) with $\Delta m = 1.3 \pm 0.5$ in the blue. In the red $\Delta m = 0.9 \pm 0.9$.
- 4415: SAO 162561: Same star as Run No. 4142.
- 4416: SAO 162567: ADS 12391. Same star as Run No. 4143. Based on visual separation and position angle ($2.0, 130^\circ$) from the IDS, the occultation of the secondary occurred outside our observing range.
- 4418: SAO 162586: Same star as Run No. 4144.
- 4419: SAO 162584: Same star as Runs Nos. 4146 and 4501.
- 4420: SAO 162593: Same star as Run No. 4145.
- 4421: SAO 162708: Same star as Run No. 4147.
- 4428: SAO 95645: Same star as Run No. 4657.
- 4430: SAO 96611: Same star as Run No. 4664.
- 4431: SAO 96629: Same star as Run No. 4665.
- 4432: SAO 96634: ADS 5885, possible double. The secondary disappeared at UTC $10^{\text{h}}16^{\text{m}}34^{\text{s}}306 \pm 0^{\text{s}}005$, giving a separation $0''.308 \pm 0''.002$ in direction 118.5 (no slope determined) with $\Delta m = 1.2 \pm 0.3$ in the blue channel. In the red $\Delta m = 1.3 \pm 0.4$. The separation and position angle ($0.6, 45^\circ$) from the IDS give a separation of 0.17 when projected in our observed direction in poor agreement with our value. The IDS gives $\Delta m = 2$ in rough agreement with our values.
- 4434: The trace of this reappearance was noisy perhaps leading to spurious duplicity. This star was also observed in Run No. 4666 where much better agreement was obtained with the IDS projected separation.
- 4434: SAO 96686: Same star as Run No. 4667.
- 4435: SAO 96703: Same star as Run No. 4669.
- 4437: SAO 97543: Same star as Run No. 4304.
- 4440: SAO 98244: Same star as Run No. 4675.
- 4441: SAO 98267: α Cancri, ADS 7115, $V = 4.3$, spectral type A5m (Cowley and Cowley 1969). Bright limb disappearance. Our traces show no significant close duplicity. The visual secondary was too faint to be observed. Same star as Run No. 4442. (Fig. 1)
- 4442: SAO 98267: α Cancri, ADS 7115. Same star as Run No. 4441. (Fig. 2)
- 4443: SAO 158706: Severe interference from clouds.
- 4444: SAO 158722: Severe interference from clouds.
- 4445: SAO 158730: Severe interference from clouds.
- 4447: SAO 160024: Severe interference from clouds.
- 4448: SAO 160017: Severe interference from clouds.
- 4449: BD -18°4305: Unpredicted, possibly double. The secondary disappeared at UTC $3^{\text{h}}17^{\text{m}}7^{\text{s}}474 \pm 0^{\text{s}}011$,

- giving a separation $0''.02 \pm 0''.01$ in direction $257^\circ 0$ (no slope determined) with $\Delta m = 0.5 \pm 1.4$ in the red. In the blue $\Delta m = 0.8 \pm 1.1$.
- 4456: SAO 161726: Apparent duplicity probably spurious due to noise.
- 4461: SAO 163780: Severe interference from clouds. Same star as Run No. 4611.
- 4462: SAO 164464: Same star as Run No. 3035. Severe interference from clouds.
- 4463: SAO 146062: Observed by de Vegt and Gehlich (1976) on 18 Oct. 1972.
- 4467: SAO 93022: 31 Ari, HR 763, $V = 5.64$, spectral type F7V. Same star as Run No. 4628. Double. The secondary disappeared at UTC $5^h 4^m 29^s 732 \pm 0^s 001$, giving a separation $0''.0213 \pm 0''.0006$ in direction $265^\circ 7$ (no slope determined) with $\Delta m = 0.1 \pm 0.1$ in the blue. In red $\Delta m = 0.3 \pm 0.1$. See separate paragraph for discussion (Fig. 3).
- 4468: SAO 93029: Same star as Run No. 4629.
- 4475: SAO 93070: Possible double. The secondary disappeared at UTC $9^h 23^m 34^s 871 \pm 0^s 024$, giving a separation $0''.006 \pm 0''.002$ in direction $327^\circ 7$ (no slope determined) with $\Delta m = 0.6 \pm 0.8$ in the blue. No trace of secondary in very noisy red channel.
- 4477: SAO 93086: Same star as Run No. 4630.
- 4480: SAO 93483: ADS 2602. Based on visual separation and position angle ($2^\circ 9$, $51^\circ 0$) from the IDS, the secondary occurred outside our observing range.
- 4484: SAO 161376: HR 6863, Y Sgr. Our traces of this Cepheid show no duplicity out to $0''.16$. (Fig. 4).
- 4485: AC-19°50797, J5271.
- 4488: SAO 161399: double. The secondary disappeared at UTC $1^h 45^m 50^s 717 \pm 0^s 003$, giving a separation $0''.090 \pm 0''.001$ in direction $65^\circ 9$ (no slope determined) with $\Delta m = 1.4 \pm 0.2$ in blue channel. In the red $\Delta m = 0.4 \pm 0.3$.
- 4489: AC-19°50782, J5364.
- 4490: AC-19°50755, J5404.
- 4494: AC-19° 50756, J5448.
- 4497: SAO 161463: Probably double. The secondary disappeared at UTC $3^h 36^m 3^s 241 \pm 0^s 009$, giving a separation $0''.077 \pm 0''.004$ in direction $60^\circ 8$ (no slope determined) with $\Delta m = 2.7 \pm 0.8$ in blue channel. In the red $\Delta m = 0.4 \pm 0.6$.
- 4499: AC-19°50724, J5487.
- 4501: SAO 162584: Same star as Runs Nos. 4146 and 4419.
- 4506: SAO 163471: ADS 13717. See note for Run No. 36/7.
- 4507: SAO 163481: β Capricorni double. The secondary disappeared at UTC $2^h 25^m 28^s 291 \pm 0^s 001$, giving a separation $0''.0068 \pm 0''.001$ in direction $24^\circ 0$ (slope -2.7 ± 0.4) with $\Delta m = 1.02 \pm 0.07$ in Stromgren b. In Stromgren y, $\Delta m = 2.2 \pm 0.2$. See Run No. 36/8 for discussion. (Fig. 5)
- 4508: SAO 163504: Same star as Run No. 4179.
- 4509: SAO 163551: Same star as Run No. 3846.
- 4510: SAO 163563: Same star as Run No. 3849 which was double with vector separation $0''.088$ in direction 190° . For Run No. 4510 the position angle is $112^\circ 7$, differing from the previous one by $77^\circ 3$. Thus, the previously observed secondary may be out of our observing range.
- 4514: SAO 145990: Same star as Run No. 2644.
- 4527: AC +18°43163, J1332.
- 4530: AC +18°44213, J1532.
- 4538, 4539: SAO 95794, 95795: Components B and A of the wide binary ADS 5166. The time difference between occultations gives a separation of $8''.51$ in direction $277^\circ 5$. The separation and position angle from the IDS give a separation of $7''.65$ when projected in our direction. The IDS gives $\Delta m = 0.9$ while our observation gives $\Delta m = 0.44$ in the blue and $\Delta m = 0.7$ in the red.
- 4546: AC +18 50405, J2957.
- 4548: AC +18 50417, J2992.
- 4550: SAO 95941: Same star as Run Nos. 4242 and 4637.
- 4551: SAO 96825: Same star as Run Nos. 4065 and 4245.
- 4552: SAO 96817: Same star as Run No. 4064.
- 4557, 4558: SAO 117991: Components of ADS 7579. Same stars as Runs Nos. 2786 and 2787. The time difference between occultations gives a separation of $1''.83$ in direction $227^\circ 7$. The separation and position angle ($1''.7$, $39^\circ 0$) from the IDS gives $1''.68$ when projected in our direction. IDS gives $\Delta m = 0.0$ from visual observers. In the blue the brighter star is that of Run No. 4558 with $\Delta m = 0.3$. In the red the brighter star is that of Run No. 4557 with $\Delta m = 0.7$.
- 4561: SAO 118044: π Leo, HR 3950 $V = 4.7$, $B - V = 1.60$, spectral type M2III. Analysis yields a diameter of 3.9 ± 1.0 milliarcsec for a disk fully darkened at the limb. Diameter determined from a plot of rms error values versus assumed diameter, as before (e.g., Dunham *et al.* 1973). Limb slope near zero affected by large observational error. The result is in unusually poor agreement with that of Vilas and Lasker (1977) who found 5.9 milliarcsec for a disk fully darkened to the limb.
- 4580: SAO 164084: Same star as Run No. 3625.
- 4581: SAO 164080: Same star as Run No. 3624.
- 4586: SAO 146806: Red channel inoperative.
- 4592: SAO 146841: ADS 16920. Based on the position angle and separation ($2''.5$, $220^\circ 0$) from the IDS projected in our direction, the secondary occurred 7.8 s before the primary. Since our event occurred about 7 s before the USNO predicted time we have probably observed the secondary rather than the primary.
- 4594: SAO 146860: Same star as Run No. 1522.
- 4595: SAO 109244: Possible double. The secondary disappeared at UTC $5^h 57^m 2^s 017 \pm 0^s 008$, giving a separation $0''.034 \pm 0''.002$ in direction $16^\circ 0$ (no slope determined) with $\Delta m = 0.2 \pm 0.5$ in the red. No trace of secondary in the blue.
- 4602: SAO 109790: Just possibly double. The secondary disappeared at UTC $3^h 55^m 29^s 870 \pm 0^s 004$, giving a separation $0''.060 \pm 0''.001$ in direction $272^\circ 8$ (no slope determined) with $\Delta m = 0.6 \pm 0.3$ in the blue. In the red $\Delta m = 0.6 \pm 0.4$.
- 4609, 4610: SAO 162852, 162853: Components B and A of ADS 12728. The time difference between occultations gives a separation of $9''.49$ in direction $73^\circ 1$ in agreement with the value of $9''.75$ found by projecting in our observed direction the separation and position angle ($10''.2$, $236^\circ 0$) given in the IDS. The IDS gives $\Delta m = 0.5$ compared with our $\Delta m = -0.02$ in the blue. Variable seeing in both observations.
- 4611: SAO 163780: Same star as Run No. 4461.
- 4623: SAO 146695: Same star as Run No. 1617.
- 4628: SAO 93022: 31 Ari, HR 763. Same star as Run No. 4467 which showed definite duplicity. Unfortunately large seeing variations preclude detection of a second star before the primary occultation event. There is no evidence of the secondary in the 1.8 s after the event which corresponds to $0''.6$. See separate paragraph for discussion.
- 4629: SAO 93029: Same star as Run No. 4468.
- 4630: SAO 93086: Same star as Run No. 4477.
- 4633: SAO 146973: HR 9047, $V = 5.98$ spectral type M5III. Analysis yields a diameter of 6.3 ± 0.5 milliarcsec for a disk fully darkened at the limb. Diameter determined from a plot of rms error versus assumed diameter, as before (e.g., Dunham *et al.* 1973). At contact angle $1''.5$ limb slope has no effect and is assumed zero.
- 4634: SAO 128481: RST 5177N: The secondary is 4.0 mag fainter and not visible on our trace.
- 4636: SAO 95866: Possibly double. Same star as Run No. 4241 which showed no duplicity but position angles differ by 52° . The secondary disappeared at UTC $2^h 43^m 13^s 674 \pm 0^s 012$, giving a separation $0''.019 \pm 0''.004$ in direction $61^\circ 1$ (no slope determined) with $\Delta m = 1.8 \pm 0.8$ in red channel. No trace of secondary in blue channel.
- 4637: SAO 95941: Same star as Runs Nos. 4242 and 4550.
- 4638: SAO 95955: Same star as Run No. 4243.
- 4640: SAO 95985: BRT 1208: Based on separation and

- position angle ($5^{\circ}3, 175^{\circ}0$) from the IDS. The secondary was outside our observing range.
- 4653: SAO 94554: Double. HR 1808, 115 Tau, ADS 4038A. The secondary disappeared at UTC $1^{\text{h}}33^{\text{m}}33^{\text{s}}595 \pm 0^{\text{s}}001$, giving a separation $0''.0987 \pm 0''.0002$ in direction $98^{\circ}1$ (no slope determined) with $\Delta m = 1.13 \pm 0.06$ using interference filter 4230 in blue channel. WR 29 filter in red channel gives $\Delta m = 0.90 \pm 0.06$. This observed duplicity is of a new component rather than ADS components *B* or *C* which are much fainter and well outside our observing range according to the IDS. (Fig. 6)
- 4657: SAO 95645: Same star as Run No. 4428.
- 4660: SAO 96515: Same star as Run No. 4274.
- 4664: SAO 96611: Same star as Run No. 4430.
- 4665: SAO 96629: Same star as Run No. 4431.
- 4666: SAO 96634: Probably double. ADS 5885. The secondary disappeared at UTC $5^{\text{h}}49^{\text{m}}14^{\text{s}}494 \pm 0^{\text{s}}020$, giving a separation $0''.238 \pm 0''.006$ in direction $107^{\circ}6$ (no slope determined) with $\Delta m = 1.9 \pm 0.9$ in the blue. Red trace too noisy to analyze. This appears to be the secondary of ADS 5885. The separation and position angle ($0^{\circ}6, 45^{\circ}0$) from the IDS projected in our direction give a separation of $0''.276$. The IDS gives $\Delta m = 2.0$ in agreement with our value. This star was also observed in Run No. 4432 where spurious duplicity may have been seen
- 4467: SAO 96686: Same star as Run No. 4434.
- 4469: SAO 96703: Same star as Run No. 4435.
- 4675: SAO 98244: Same star as Run No. 4440.
- 4676: SAO 98709: HR 3852, α Leo, ADS 7480, $V = 3.5$, $B - V = 0.5$, spectral type A2 + F6II-III (Iriarte *et al.* 1965). Component *B* is apparently optical and outside our observing range. However, component *A*, which we observed here, is a double lined spectro-

- scopic binary with a period of 14.5 days (Plummer 1908). The maximum separation of the spectroscopic pair is $0''.008$ calculated from the nominal angular diameter formula (McGraw *et al.* 1974). This separation is similar to that that observed for β Cap in Run No. 4507. Thus, there is a possibility of detecting the components of the spectroscopic binary at certain phases. Only two observations of the actual position angle and separation at appropriate phases are needed to determine the masses of the system. Unfortunately, our observation shows no duplicity.
- 4680: SAO 93870: ADS 3135, double. The secondary disappeared at UTC $2^{\text{h}}45^{\text{m}}7^{\text{s}}688 \pm 0^{\text{s}}001$, giving a separation $0''.3955 \pm 0''.0003$ in direction $102^{\circ}0$ (no slope determined) with $\Delta m = 1.61 \pm 0.06$ in the blue. In the red $\Delta m = 1.16 \pm 0.09$. See separate paragraph for discussion (Fig. 7).
- 4686: SAO 94358: This star has $V = 9.3$ and spectral type A3. Possible multiple components are seen in the blue. The reality of these components cannot be confirmed by the red trace which is of poor quality because of the early spectral type of the star. The time given is that of the first drop in signal.
- 4694: AC +18°45323, J 1942.
- 4696: AC +18°46261, J 1981.
- 4699: AC +18°46266, J 1990.
- 4716: AC +18°52537, J 3383.
- 4718: BD +17°1416: Double. The secondary disappeared at UTC $2^{\text{h}}28^{\text{m}}27^{\text{s}}965 \pm 0^{\text{s}}006$, giving a separation $0''.061 \pm 0''.002$ in direction $276^{\circ}1$ (no slope determined) with $\Delta m = 0.4 \pm 0.5$ in the blue. Red channel too noisy to determine duplicity.
- 4719: AC +17°51321, J 3450.
- 4721: AC +17°52080, J 3508.
- 4727: SAO 97124: Same star as Run No. 4053.

No. 36/8), ν Leo (Run No. 4315), π Leo (Run No. 4561), and HR 9047 (Run No. 4633).

II. DISCUSSION

a) 31 Ari, HR 763

The star 31 Ari is a previously unknown double with combined $m_p = 5.64$ and a spectral type F7V (Cowley 1976). The magnitude difference is 0.1 ± 0.1 in the blue and 0.3 ± 0.1 in the red suggesting that the stars have similar spectral types. The star has a trigonometrical parallax of $0''.033$. From Run No. 4467 (Fig. 3) our observed separation of $0''.021$ in direction $265^{\circ}7$ is a minimum value. The star was also observed in Run No. 4628 but clouds and poor seeing precluded any certain de-

tection of duplicity before occultation of the primary. No secondary was seen after this event out to about $0''.6$ from the primary. Visual observers would probably have previously detected the system as double if the separation were as large as $0''.2$. This inferred small separation combined with the trigonometrical parallax and assumed masses for each component of $1.2 M_{\odot}$ give orbital periods ranging from 0.56 to 9.6 years for semi-major axes $0''.03$ to $0''.2$. At certain epochs double lines might be visible in a high dispersion spectrogram. One of us (F.C.F.) obtained a $3.0 \text{ \AA/mm}$ spectrogram on 3 Nov. 1977 at McDonald Observatory but found no line doubling at that epoch. Visual and speckle observers are urged to search for duplicity.

b) ADS 3135, 55 Tau

The star 55 Tau, ADS 3135 is one of three Hyades visual binaries, ADS 3135, 3210, and 3475, with well-determined orbital elements. Its combined magnitude and colors are $V = 6.88$, $B - V = 0.56$, and $U - B = 0.09$ (Johnson and Knuckles 1955) and spectral type F9V. The orbit of St. Wierzbinski (1958) is rated reliable by Finsen and Worley (1970) even though observations cover less than one full period. Batten and Wallerstein (1972) have suggested that independent interferometric observations would provide a check on the accuracy of these three orbits. An interferometric observation by Wickes (1975) is in excellent agreement with the orbit of ADS 3135.

FIG. 3. Run No. 4467. Blue channel reappearance of 31 Ari. Separation $0''.0213$.

FIG. 4. Run No. 4484. Blue channel disappearance of Cepheid Y Sgr. No duplicity seen.

FIG. 5. Run No. 4507. Disappearance of β Cap (Stromgren b). Separation of components, 6.8 arcmin.

FIG. 6. Run No. 4653. Discovery of duplicity in ADS 4038 A (115 Tau A). Interference filter 4230. Separation $0''.0987$.

FIG. 7. Run No. 4680. Observation of the known Hyades visual binary 55 Tau (ADS 3135). Blue channel. Separation $0''.3955$.

Our occultation observation of ADS 3135, Run No. 4680 (Fig. 7), on 15 March 1978 gives a vector separation of $0''.3955 \pm 0''.0003$ at position angle $102^\circ.0$. The separation and position angle for 1978.2 computed from the orbit of St. Wierzbinski (1958) are $0''.457$ and $75^\circ.1$ respectively, giving a calculated vector separation of $0''.408$, in excellent agreement with our value.

Finsen and Worley (1970) list a visual magnitude difference of 1.0. Our magnitude differences are 1.61 ± 0.06 in the blue channel with no filter and 1.16 ± 0.09 in the red channel with the Wratten 29 filter.

Additional occultation events of ADS 3135 will occur in the United States, those at McDonald Observatory on U.T. 29 July and 13 December 1978 according to the USNO predictions. Of the other two visual binaries ADS 3210 can also be occulted. Other observatories are strongly urged to observe these events. Combining ob-

servations will permit a true position angle and separation to be obtained. More importantly, observations made in Johnson *U*, *B*, *V* and perhaps Stromgren colors will permit the colors of the individual stars to be obtained as well as an estimate of their spectral types. These stars can then be more accurately compared with the mass-luminosity relation (Harris *et al.* 1963).

Note added in proof: Run No. 4561: Discrepancy possibly explained by Vilas and Lasker smoothing procedure, which would tend to increase the deduced diameter.

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