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FLARES OF UV CETI, 1967

Continuous U-band photoelectric photometry of flare activity of UV Ceti was obtained late in 1967 with the 16-inch and 36-inch reflectors of the Cerro Tololo Inter-american Observatory as part of the co-operative monitoring program by the working group on flare stars of I.A.U. Commission 27. The observations consist of 256 flares observed in 78.4 hours of monitoring.

The data here presented depart from the common format in two respects. First, monitoring was done in the U-band to take advantage of the more favorable detection of flare events afforded by this band (Kunkel, 1967). Flare light was reduced to U-magnitudes by an equation of the form

$$U = u - k_u \cdot X + \text{const.}$$

where u is the raw magnitude, k_u is an ultraviolet extinction coefficient (equal, on the average, to $k_u = 0.58$), and X is the airmass. For each night the constant and the extinction coefficient were determined from standard stars. Residuals from a best fit were 0.05 magnitudes, r.m.s., or better. Errors in estimating statistical parameters will generally exceed this amount until the number of recorded flare events exceeds several hundred, thus justifying the present procedure for all but the most extravagant observing programs. The exclusion of a color term was maintained because the value of the term is not a simple function of color, and is further completely unknown for flare light. This problem is likely to be more severe in the B-band where line emission will occasionally account for a major fraction of the recorded signal. Calibration was achieved by comparing flare light to a nearby star of moderately early type, thus avoiding complications associated with the red-leak of the instrumental system, as well as any reference to quiescent photospheric light, which is known to be variable in many instances (Roques 1958, Petit 1955, Oskanian 1964, Bateson and Kohler 1968).

The second departure from common practice is to express flare duration as a time interval during which flare light is brighter than a specified fraction of peak light. This estimator is less likely to be biased than an estimator that depends on a search from a noisy record for the beginning and end of a change in light. Complete free-

dom from bias cannot be assured even so, since the electrometer time constant of one second will affect estimates of peak light in the faster flares.

Tabulated for each night (columns 1,2, and 3) are the event U.T., airmass of the observation, and U-magnitude of peak light. Columns 4 and 5 list flare durations in minutes at 0.5 peak light and 0.1 peak light, respectively. A colon is used to denote uncertainty greater than 10 per cent, r.m.s., in the presence of low level signals, and the letter "c" indicates a complex time history, often with several peaks, so that meaningful measurement could not be made. Flare decay rates are offered at 1,2, and 3 magnitudes below peak light in columns 6,7, and 8, respectively. They are expressed as the \log_{10} of the decay in magnitudes per minute; the r.m.s. error is about 0.1 unless a colon is used to indicate greater uncertainty. No estimates of flare rise characteristics are offered since the rise rate is at times strongly influenced by instrumental limitations of the one second pen movement. There is evidence that loss of extremely rapid events due to instrumental limitations is not negligible in these observations. A more complete discussion of this matter will appear in another paper.

Completeness of the record may be bounded by two lines: (1) the listing is at least 90 per cent complete for flares brighter than $U = 14.5$. (2) Flare parameters are not significantly biased by instrumental response characteristics for all events with durations at half peak light greater than 0.08 minutes. (Electrical noise "spikes" generally had durations at half power of 0.03 minutes.) The 53 events beginning with those of 1967 Sept.7 and ending with the eight event of 1967 Sept.26 were observed on a sampling scheme of successive 5 second integrations. Flare parameters for these events are likely to be biased unless the duration at half peak light is greater than 0.3 minutes. (Peak light will be underestimated, flare durations will be overestimated, and decay rate parameters may be slightly too negative.)

In perhaps 10 per cent of the cases event times are in error by more than 0.1 minutes. This is due to a slight variability in the frequency of the observatory power source, and was not recognized until after the observing season had ended.

A graphical summary of the observations is presented in figure 1, showing the flare rate in events per hour brighter than some magnitude U . The data fit an expression of the form

$$\text{Rate}(U) = \exp[1.04 (U - 13.58)] \text{ events/hour}$$

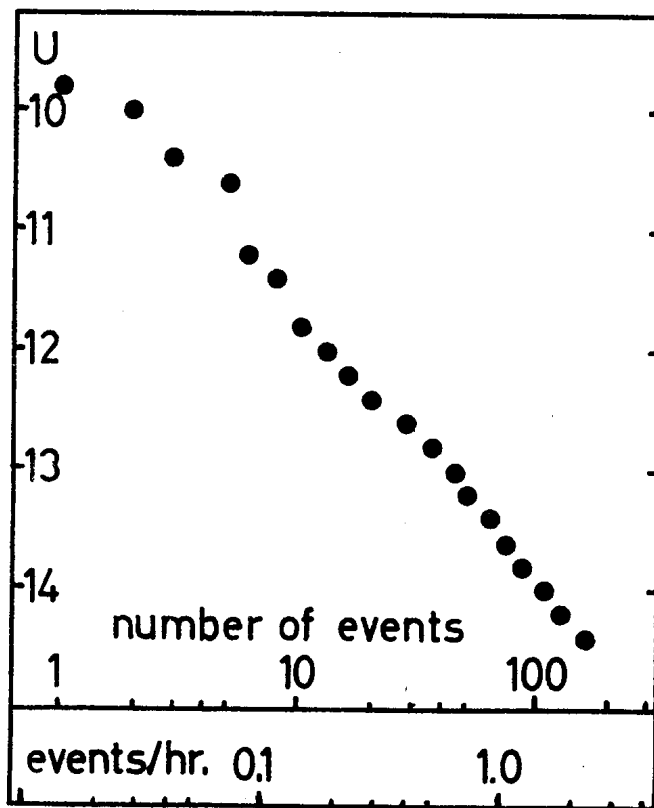


fig1. Flare Incidence of UV Cet

Flare Abstract

Event U.T.	Air- mass	U _{peak}	T _{0.5}	T _{0.1}	τ_1	τ_2	τ_3
1967 Sep 05, 05 ^h 44 ^m .2 - 9 ^h 05 ^m .0 U.T. 29 events; 3 ^h .346							
05 ^h 51 ^m .0	1.09	15.76	0.48		-		
6 15.1	1.06	14.38	.50	2.8:	-.09	0.0	
6 01.4	1.07	15.87	.74		-		
6 18.5	1.05	14.71	.05		-		
6 24.9	1.05	13.84	.10	.55	1.02	+.43	+.03:
6 32.1	1.04	15.09	.8		+.46		
6 39.8	1.04	14.84	.62		-.21		
6 43.1	1.03	15.23	.63		-		
6 45.5	1.03	15.36	.7:		-		
6 54.8	1.03	15.9	.14		-		
7 10.4	1.02	16.5	.7:		-		
7 13.3	1.02	15.80	.28		-		
7 14.2	1.02	14.58	.23	2.5:	+.59	-.63:	
7 21.6	1.02	15.80	.28		-		
7 23.1	1.02	16.1	.26		-		
7 23.7	1.02	15.35	.20		-		
7 38.5	1.03	16.00	.26:		-		
8 9.7	1.05	15.29	.48		-.13		
8 15.6	1.05	13.81	.29	2.1	+.39	-.13:	
8 24.3	1.06	15.50	3.2		c		
8 29.6	1.07	15.38	.52		-		
8 32.5	1.07	15.57	.45		-		
8 46.3	1.09	15.41	.26		-		
8 47.6	1.09	13.01	.20	c	+.21	c	
8 48.0	1.09	13.44:	c	c	c	c	
8 48.9	1.09	13.06:	c	c	-.22c	-.43c	
8 53.8	1.10	14.02	.55	1.14	+.31		
8 56.6	1.11	15.05	.09		+.82		
9 1.1	1.11	15.75	.35		-		
1967 Sep 07, 4 ^h 26 ^m .2 - 9 ^h 15 ^m .0 U.T. 24 events 4 ^h .813							
4 ^h 54 ^m .4	1.20	15.20	.23		+.25		
5 11.9	1.16	14.45	1.05	5.:	+.04		
5 31.5	1.11	13.72	.40	2.22	+.23		
5 35.5	1.11	13.33	.51	2.38	+.04	-.02	-.40:
5 47.0	1.09	15.17	.36		-		
6 3.2	1.06	14.46	.15	1.:	+.52	+.25	
6 29.0	1.04	14.39	.42	1.88	+.50	+.16	
6 15.7	1.05	16.19	.52		+.25		
6 35.6	1.04	15.49	.34		+.41		
6 36.6	1.04	15.82	.85		-.03		

Event U.T.	Air- mass	U_{peak}	$T_{0.5}$	$T_{0.1}$	τ_1	τ_2	τ_3
1967 Sep 07, continued							
7 ^h 0 ^m .8	1.02	14.97	1.54		-		
7 2.1	1.02	14.92	.88		-		
7 16.3	1.02	14.78	.35		-		
7 18.8	1.02	11.48	.44	3.25	+ .16:	-0.08	-.36
7 44.3	1.03	15.18	8.5:		-		
7 56.4	1.04	16.07	.55		-		
8 18.6	1.06	14.76	2.25	5.7	-.22	-.51:	
8 37.3	1.09	15.12	.32		+ .56:		
8 48.5	1.10	14.43	.22	1.85	-.01	+ .06	
8 53.9	1.11	12.25	.4		+ .52		
8 55.4	1.12	12.82	.65		c	c	} -.83
9 05.9	1.14	15.42	.22		c	c	
9 09.1	1.15	15.97	.6:		-		
9 10.4	1.15	15.73	.6:		-		
1967 Sep 20, 6 ^h 36 ^m .7 - 8 ^h 58 ^m .1 10 events 2 ^h .368							
6 ^h 54 ^m .4	1.03	13.95	.18:		+ .62		
6 55.9	1.03	15.12	.76		-		
7 02.5	1.03	12.60	.63	2.25	+ .27	+ .09	-.43
7 13.9	1.04	13.02	.29:	2.:	+ .5:	+ .07	
7 31.7	1.06	15.31	.7		-		
7 34.6	1.06	15.46	.35		-		
7 56.3	1.09	15.20	1.2		~ .0		
8 19.0	1.14	12.81	.75	3.0	-.09	-.19	-.29:
8 33.5	1.17	15.25	.4:		-		
8 41.3	1.19	14.85	2.1		-		
1967 Sep 21, 6 ^h 28 ^m .2 - 7 ^h 23 ^m .2 5 events 0 ^h .917							
6 ^h 42 ^m .0	1.03	15.35	.82		-		
6 46.0	1.03	15.43	.95		-		
6 56.1	1.03	13.56	.49	1.4:	+ .42	+ .39	
7 16.7	1.05	12.53	.2:	1.25:	+ .17:	+ .26	-.32
7 26.9:	1.06	*14.53			-		
1967 Sep 23, 4 ^h 21 ^m .2 - 9 ^h 19 ^m .7 16 events 4 ^h .982							
4 ^h 30 ^m .2	1.18	15.41	.34	1.9	+ .4:		
4 36.2	1.11	14.90	.14:	.55	+ .9:		
4 41.9	1.10	15.56	1.15		-		
4 47.1	1.09	14.20	.19:		+ .62		

* Brightest observed value; peak lost while checking sky

Event U.T.	Air- mass	U _{peak}	T _{0.5}	T _{0.1}	τ_1	τ_2	τ_3
1967 Sep 23, continued							
4 ^h 50 ^m .2	1.09	*13.14			-		
5 17.3	1.05	15.23	2.3		-.32		
5 51.9	1.03	14.74	.54		+.16		
6 53.9	1.04	15.19	1.15		+.02:		
7 12.4	1.05	13.72	.84	8.:	-.02	-.65	
7 30.0	1.07	15.49	.52		-		
7 53.3	1.11	14.99	.92		-.02		
8 12.4	1.14	14.15	.25		.00		
8 18.2	1.16	14.53	8.4		-.85		
8 36.8	1.21	14.44	.19		+.62:		
8 48.6	1.25	14.75	.17:		+.62:		
9 10.2	1.33	15.25	.65		-		
1967 Sep 26, 4 ^h 09 ^m .4-5 ^h 30 ^m .5 & 6 ^h 17 ^m .0-8 ^h 47 ^m .0 18 events 3 ^h .852							
4 ^h 15 ^m .5	1.13	15.32	.34		-		
4 19.9	1.12	16.05	1.04		-		
4 39.7	1.08	10.34	.16:	.57	+.63	+.53	+.05
4 55.1	1.06	16.44	1.5:		-		
5 01.0	1.06	15.09	.25		+.85		
5 02.6	1.05	15.69	1.4		-		
5 17.8	1.04	15.45	.3		-		
5 26.4	1.03	15.80	6.6		-		
6 24.4	1.03	12.27	.12	.7	+.78	+.10	-.95
6 32.5	1.03	16.08	.15		-		
6 39.3	1.03	15.70	.24		-		
6 40.9	1.04	13.39	.19	.6	+.76	+.59	+.25
6 44.6	1.04	14.46	.09	.42	+.93	+.55	
6 45.9	1.12	15.70			-		
6 48.3	1.12	15.37	.17		-		
6 48.8	1.12	15.21	.44		-		
6 56.2	1.14	15.97	1.6		-		
8 04.1	1.36	15.46	.2:		-		
1967 Oct 03, 3 ^h 35 ^m .0-5 ^h 08 ^m .3 & 5 ^h 19 ^m .1-9 ^h 01 ^m .5 16 events 5 ^h .262							
3 ^h 41 ^m .5	1.14	14.96	.3		-		
3 51.3	1.12	13.36	.07	.24	+1.25	+.92	
3 55.9	1.11	12.82	.20	.8	+.71	+.46	+.24
4 15.8	1.07	14.13	.53	1.6	-		
4 26.4	1.06	11.10	.13	.37	+1.22	+1.11	-.23
4 29.0	1.06	10.62	.12	.31	1.17	1.06	+.38

* Brightest observed value; peak lost while checking sky.

Event U.T.	Air- mass	U _{peak}	T _{0.5}	T _{0.1}	τ_1	τ_2	τ_3
1967 Oct 03, continued							
5 ^h 22 ^m .1	1.02	14.41	.13		-		
5 34.6	1.02	14.23	.05		-		
5 35.8	1.02	12.55	.12	2.0:	+1.08	- .19	
5 41.1	1.02	13.13	.46	1.14	+ .58	+ .30	
5 42.5	1.02	13.36	.09	.35	+ .85		
5 52.4	1.03	14.13	.25c		-		
5 59.0	1.03	12.84	.08	.46	1.24	+ .26	
7 42.1	1.17	12.65	.23	2.48	+ .80	+ .20	
7 43.5	1.17	14.33	.14		-		
7 46.3	1.18	14.38	.35		-		

1967 Oct 04, 1^h38^m.2-2^h43^m.8 & 4^h51^m.6-6^h52^m.8 3 events 3^h.113

2 ^h 13 ^m .7	1.45	14.98	.12		-		
4 56.3	1.03	14.43	1.35		-		
6 17.6	1.03	15.13	.95:		-		

1967 Oct 05, 1^h28^m.0 - 9^h00^m.4 15 events 7^h.365

1 ^h 55 ^m .5	1.70	13.36	.20	.92	.76	+ .15	
2 27.4	1.61	14.03	.20		.64		
2 40.6	1.52	11.95	.11	.67	.76	+ .60	+ .22
4 04.2	1.12	13.65	.50	6.5:	- .13		
4 13.7	1.10	15.26	.27		-		
4 29.3	1.08	14.86	.14		-		
4 39.8	1.06	14.80	.74		-		
5 35.9	1.02	13.06	.09	.32	+ .91	+ .82	- .11
5 50.4	1.02	15.40	.13		-		
6 01.3	1.02	14.30	.06		-		
7 18.9	1.09	14.51	.92		- .04		
7 43.8	1.14	14.52	.16		+ .17		
7 54.2	1.17	13.99	.19		+ .94:		
8 02.4	1.19	14.71	.7:		-		
5 00.7	1.04	14.18	.13		+1.03	+ .12	

1967 Oct 06, 1^h17^m.4-4^h11^m.0 & 4^h28^m.5-9^h00^m.2 26 events 7^h.422

1 ^h 49 ^m .4	1.55	13.00	.26	1.12	+ .74	+ .02	
1 58.2	1.49	13.97	.91		+ .05		
2 10.5	1.42	12.78	.19c	.4	+ .87	+ .87	
2 23.8	1.35	14.67	1.4		-		

Event U.T.	Air- mass	U _{peak}	T _{0.5}	T _{0.1}	τ ₁	τ ₂	τ ₃
1967 Oct 06, continued							
2 ^h 56 ^m .7	1.22	14.74	.19		-		
3 01.1	1.21	14.95	1?		-		
3 24.1	1.15	15.58	.3		-		
3 25.8	1.15	15.14	.45		-		
3 36.9	1.12	13.82	.38 or	1.1c	0:?		
4 42.3	1.04	14.80	.10		-		
5 14.3	1.02	14.02	.06	.26	1.43	+ .82:	
5 28.0	1.02	14.07	.12		1.06		
5 28.2	1.02	14.66	.08		-		
5 32.6	1.02	14.16	.14	1.5?	1.18	+ .18:	
5 59.5	1.04	13.21	.32c	1.7	+ .55	+ .30	- .11:
6 36.8	1.07	14.49	.07		-		
6 40.6	1.08	15.43	.17		-		
6 41.9	1.08	13.43	.07		1.40		
6 43.0	1.08	11.46	.30	2.0c	.84	} - .01	- .10
6 43.4	1.08	12.62	.09		1.18:		
6 46.8	1.09	13.02	.13	1.7:c	.62:e		
7 30.5	1.17	13.90	.26		- .23		
7 39.5	1.20	14.06	.27	1.7:	+ .53		
7 42.1	1.21	14.06	.31	2.4	+ .04		
8 15.1	1.33	14.83	.47		-		
8 56.5	1.55	13.35	.83	4.25	- .26	- .13	

1967 Oct 07, 1^h 35^m.2 - 3^h 32^m.1 & 3^h 49^m.5 - 9^h 04^m.5 23 events 7^h.313

1 ^h 53 ^m .8	1.50	14.27	.07		+ .32		
2 28.9	1.31	14.03	.05	.47	1.53		
2 32.2	1.30	13.83	.11	1.4	1.22	+ .05:	
2 41.2	1.26	13.11	.21	1.26	+ .66	+ .07	- .11:
3 08.2	1.18	14.24	.10		-		
3 44.8	1.10	14.45	.82		+ .28		
3 47.0	1.10	14.48	.22		+ .45		
4 19.4	1.06	13.36	.11	.74	+ .79	+ .20	
5 10.7	1.02	12.09	.13	.63	1.05	+ .52	+ .32
5 12.2	1.02	14.30	.38		c		
5 13.2	1.02	14.20	.12:		c		
6 6.8	1.04	14.41	.07		-		
6 47.2	1.09	14.28	.09		-		
7 10.7	1.13	14.44	.22		-		
7 13.4	1.14	13.65	.77	2.35	+ .13	+ .03	
7 22.2	1.16	14.72	.12		-		
7 47.5	1.23	14.04	.24	1.4	+ .47	+ .29	

Event U.T.	Air- mass	U _{peak}	T _{0.5}	T _{0.1}	τ ₁	τ ₂	τ ₃
1967 Oct 07, continued							
8 ^h 10 ^m .0	1.31	9.90	.24	1.2	+ .73	+ .25	-.03
8 17.7	1.35	13.56	2.15		-.59		
8 33.3	1.42	10.68	.48c	1.92	+ .27	-.09	-.16
8 35.4	1.43	13.43	.06		1.31:		
8 41.7	1.46	14.44	.58:		-		
8 57.4	1.57	13.96	1.48:		-.23		

1967 Oct 08, 0^h57^m.8-4^h19^m.4 & 4^h26^m.3-8^h53^m.2 21 events 7^h.808

1 ^h 01 ^m .2	1.88	14.46	.65		-		
1 10.6	1.78	14.17	.11		-		
1 29.9	1.61	13.47	.11		1.05		
1 33.1	1.59	14.14	.21		-		
2 15.7	1.35	14.99	1.79		-		
2 41.2	1.24	13.13	.11	1.63	+ .64	+ .01	
2 43.5	1.24	14.12	.09		-		
4 03.2	1.07	14.50	.23		-		
4 08.5	1.06	12.91	.07	.55	1.25	+ .53	+ .19:
4 39.5	1.04	14.23	.40		c		
4 40.0	1.04	13.14	.07	.54:	+ .89	+ .90:	c
5 50.1	1.03	12.49	.13	1.18	+ .83	+ .07	+ .04
6 01.8	1.04	14.46	.08		-		
6 58.8	1.11	14.57	.16		-		
7 01.5	1.12	12.76	.35c		+ .4:c	c	
7 02.5	1.12	13.01	1.25c		-.09c	-.09	
7 14.5	1.14	15.35	.31:		-		
7 34.9	1.19	12.31	.16	.64	+1.06	+ .42	-.06
8 26.1	1.40	14.21	.07		-		
8 31.5	1.43	14.84	.43:		-		
8 36.2	1.46	13.56	.05		1.00	+ .43	

1967 Oct 09, 0^h59^m.7-3^h49^m.8 & 3^h57^m.8-8^h59^m.7 19 events 7^h.867

1 ^h 33 ^m .7	1.59	13.69	.46	2.9:	.12		
2 08.1	1.38	13.08	.34	9.4:	c		
3 31.3	1.11	13.95	.24		.60		
4 59.4	1.02	12.62	.45	.76	.92	+ .60	+ .32
4 59.6	1.02	12.33					
5 16.3	1.02	11.86	.14	.51	1.07	+ .80	+ .35
5 19.5	1.02	12.97	.79	c	+ .14:	c	
5 20.8	1.02	13.45	.9c	c	c		
6 08.3	1.05	13.73	.51c	3.8:	+ .08c		
6 24.7	1.07	14.43	.31		+ .42		

Event U.T.	Air-mass	U _{peak}	T _{0.5}	T _{0.1}	τ ₁	τ ₂	τ ₃
1967 Oct 09, continued							
6 ^h 31 ^m .2	1.07	14.04	.6:		+ .11		
6 32.8	1.08	13.67	.26		+ .66		
6 54.6	1.11	14.03	.23	.9:	+ .62		
7 10.0	1.15	12.46	.06	.29	1.42	+ .85	+ .08
7 21.9	1.18	9.77	.3c	2.2	+ .33:c	- .31	- .57
7 27.9	1.19	11.75	.13c	.52	+ .89	+ .56	
8 07.7	1.33	14.03	.17		-		
8 08.0	1.34	13.78	.22		+ .41		
8 51.5	1.58	14.69	.28		-		

1967 Oct 10, 0^h32^m.0 - 1^h26^m.1 & 4^h50^m.6 - 8^h55^m.2 14 events 4^h.978

0 ^h 43 ^m .5	1.98	12.66	.34	1.6	+ .22	- .08	
1 10.6	1.75	14.04	.15				
5 01.9	1.02	13.93	5.9	12.5:	- .82:	- .2:	
6 10.3	1.05	13.58	.18	.5:	1.17	1.05:	
6 21.1	1.07	14.50	.24		-		
6 21.4	1.07	14.45	.25		-		
6 32.0	1.08	14.01	.4		+ .50		
6 33.4:	1.08	14.54	2:c		c		
6 49.5	1.11	14.30	.10		-		
6 51.5	1.11	14.36	.05		-		
6 56.8	1.13	13.97	3.0		- .57		
7 01.3	1.14	12.88	.16	c	+ .11	0:	
7 07.9	1.14	14.48	.35		-		
8 41.7	1.24	14.15	.15		-		

1967 Oct 11, 1^h16^m.7 - 4^h04^m.3 & 4^h20^m.1 - 8^h33^m.0 18 events 7^h.008

1 ^h 36 ^m .8	1.51	13.84	.15		-		
2 20.5	1.29	13.58	.13		+1.02		
3 12.2	1.13	13.84	.10		+ .70		
3 21.3	1.12	14.54	.23		-		
3 27.0	1.11	14.28	.05		-		
3 46.9	1.07	12.29	.08	.50	1.10	+ .72	- .06
3 58.4	1.06	12.07	.17	1.3	c	+ .09c	+ .23
4 39.8	1.03	14.41	.09		-		
4 54.5	1.02	14.25	1.5		- .13		
5 42.3	1.04	14.33	.10		-		
6 03.4	1.05	12.52	.05	.15	1.34	1.18	.74
5 58.6	1.05	14.78	.36				
6 16.1	1.07	14.03	.78		- .30		

Event U.T.	Air- mass	U peak	T _{0.5}	T _{0.1}	τ_1	τ_2	τ_3
1967 Oct 11, continued							
6 ^h 20 ^m 9	1.07	14.42	.10		-		
6 30.8	1.09	13.51	1.23	4.4	-.14	-.22	
7 41.0	1.26	14.41	.14		-		
8 14.9	1.41	13.66	.31		+ .71		
8 16.9	1.42	14.62	.25		-		

References

- Bateson, F.M., and Kohler, 1968, Southern Stars 22, 118.
 Kunkel, W.E., 1967, Unpublished Ph.D. Dissertation, University
 of Texas, Austin.
 Oskanian, V.S., 1964, Publ. Obs. Astr. Beograd No. 10
 Petit, M., 1955, J. Obs. 38, 354
 Roques, P.E., 1958, P.A.S.P. 70, 310.