

## A STUDY OF UU AQUILAE

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Abstract

AAVSO data from October 1938 to January 1980 on the U Gem type variable UU Aquilae show that it varies with a mean period of 54.9 days and exhibits two types of outbursts, narrow and wide. The narrow maxima tend to be fainter.

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Introduction

UU Aquilae, located at  $\alpha = 19^{\text{h}}51^{\text{m}}52^{\text{s}}$   $\delta = 09^{\circ}35'.2$  (1900), was discovered by Miss M. Fleming on Harvard photographic plates in 1907. The General Catalog of Variable Stars (GCVS) lists its period to be 56 days, its brightness from photographic magnitude  $11^{\text{m}}.0$  to  $16^{\text{m}}.8$ , and its spectral classification to be G. The star is a cataclysmic variable of U Geminorum type. Its duplicity has not yet been established.

Observations

The AAVSO data from April 1938 to January 1980 (J.D. 2428990 - 2444240) indicate that this star varies between visual magnitudes 11.0 and 16.5. At minimum the average magnitude is 15.5, with significant fluctuations between  $15^{\text{m}}.0$  and  $16^{\text{m}}.5$ . On J.D. 2437104, a "mini-maximum" was observed by T. Cragg and J. Roller, when the star brightened to only  $14^{\text{m}}.1$ . Two days later it was observed at  $14^{\text{m}}.5$  by J. Roller and it continued to decline to minimum.

We studied the outbursts of UU Aquilae for the times stated above. To make the study more complete, outbursts recorded by the members of the Variable Star Sections of the Royal Astronomical Society of New Zealand (Bateston 1979) and the British Astronomical Association (Isles 1976) have been checked, and those outbursts missed by members of AAVSO have been included.

During the 15,250 day interval 129 outbursts have been recorded. Of these, 73 appear to be consecutive, with certainty, and these have been used in the determination of the cycle. The mean interval between outbursts is 54.9 days with a standard deviation of 9.5 days. The shortest interval between consecutive outbursts is 37 days, and the longest is 75 days. Figure 1 is a histogram of the frequency of intervals between consecutive outbursts.

The outbursts of UU Aquilae are of two types: narrow and wide. The mean magnitude of narrow outbursts is  $11^{\text{m}}.8$  with a standard deviation of  $0^{\text{m}}.3$ . During this type of outburst the star is brighter than  $13^{\text{m}}.0$  for about 4 days. The wide outbursts are brighter, with a mean magnitude of  $11^{\text{m}}.4$  and standard deviation of  $0^{\text{m}}.3$ . The star is brighter than  $13^{\text{m}}.0$  for about 8 days during this type of outburst. Figures 2a and 2b are composite tracings of well-observed wide and narrow outbursts, respectively. During both types of outbursts the rise to maximum is steep, occurring in less than one day.

Table I lists for each outburst the observed Julian date and magnitude at maximum, the type {narrow (n) <4 days> wide (w)} whenever classification is possible, and the weight on a scale of 1 to 5, with 5 representing best coverage.

In an effort to determine if there is a relationship between the interval preceding or following an outburst and brightness at maximum, the logarithm of the interval following an outburst versus the maximum magnitude is graphed in Figure 3. The logarithm of the interval preceding an outburst versus maximum magnitude is graphed in Figure 4. No convincing relationship has been found.

#### Recommendations

1. More attention should be paid to this star by observers with moderate to large telescopes.
2. Early evening and twilight observations are particularly useful for more complete coverage.
3. If the star is observed brighter than  $14^m.0$ , several observations throughout the night should be made to record the rise to or the decline from maximum.

#### Acknowledgements

We are grateful to the dedicated observers of AAVSO who have been observing this star. Their data made this study possible. We thank Mrs. Katherine Hazen for her assistance in the compilation and analysis of the data.

#### REFERENCES

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- Isles, J. 1976, Journ. Brit. Astron. Assoc. 86, 413.
- Kukarkin B. V. et al. 1969, General Catalog of Variable Stars, Moscow.

TABLE 1  
OUTBURSTS OF UU AQUILAE

<u>Max. JD</u> <u>2400000+</u>	<u>Maximum</u> <u>Magnitude</u>	<u>Type</u>	<u>Weight</u>	<u>Max. JD</u> <u>2400000+</u>	<u>Maximum</u> <u>Magnitude</u>	<u>Type</u>	<u>Weight</u>
29195	11.9	N	4	7030	11.5	?	2
9246	11.9	?	3	7200	11.3	W	5
9343	12.2	?	3	7440	12.2	?	2
9404	12.5	N	4	7571	11.3	W	5
30605	11.9	W?	5	7642	13.1	?	1
0900	11.3	W	5	7763	12.0	?	2
1075	12.2	?	2	7828	12.6	?	2
1276	12.4	?	1	7879	11.5	W	5
1330	11.0	W?	4	7928	11.5	N	5
1600	12.3	?	1	7981	12.0	?	1
1661	11.6	W?	4	8018	12.0	?	1
1756	11.9	N	3	8202	11.6	W	4
1813	11.3	W?	2	8302	12.0	N	2
2038	11.0	?	1	8504	11.8	N	2
2090	12.6	W?	2	8624	11.7	W	4
2145	12.8	?	1	*8666	13.0	?	2
2391	12.0	?	1	8944	12.5	N	3
2500	11.3	W?	3	9000	13.2	?	1
2766	12.2	W?	2	9046	11.4	W	5
2824	11.3	N	2	9302	11.5	?	1
2874	11.2	W	2	9401	11.2	W	5
3124	11.4	W	4	9590	11.3	?	1
3197	12.4	?	1	9626	11.8	N	3
3243	11.5	?	1	9683	12.1	N?	3
3429	11.3	?	2	9757	11.6	W?	4
3478	12.1	N?	5	9800	12.0	?	2
3544	11.3	N	3	*40006	11.5	W	3
3599	11.9	?	2	0080	11.0	W	5
3799	12.6	?	1	0180	11.0	W	2
3841	13.4	?	1	0367	12.1	N?	1
3888	11.6	W	5	0486	11.3 (1)	W	4
3925	13.7	?	1	*0550	11.7	?	1
3990	11.6	?	1	0707	11.3	?	1
4223	11.2	W	5	0791	12.0	W?	3
4275	11.9	N	5	0866	12.1	N?	3
4336	11.8	?	3	0929	11.0	?	2
4554	11.5	?	1	1073	11.4	W?	3
4602	12.0	N	5	1154	12.0	N	3
4663	11.2	N	4	1194	11.1 (2)	W	4
4900	11.3	?	2	1239	11.8 (3)	N	4
4989	11.3	W	5	1449	11.3	?	1
5200	11.9	?	1	1497	12.0	?	2
5299	11.4	N	4	**1564	11.2 (4)	W	3
5360	11.8	N	4	1622	11.6 (5)	?	1
5427	11.1	W	4	**1663	11.8	?	1
5669	11.9	N	2	1811	12.1	N	3
5723	11.0	W	5	1867	11.5	W	5
5808	11.9	?	1	1935	11.7	N	3
6071	12.0	N	5	**2002	11.1 (6)	W	5
6124	11.4	W	3	2163	12.8	?	1
6410	11.8	W	5	2244	11.3	W	5
6453	12.1	N	3	**2291	12.2	?	1
6506	11.6	W	5	2337	11.3	W	5
6752	12.4	N	3	**2393	12.0	N?	1
6804	11.4	W	5	2572	11.7	W	5

TABLE 1 - CONTINUED  
OUTBURSTS OF UU AQUILAE

Max. JD 2400000+	Maximum Magnitude	Type	Weight	Max. JD 2400000+	Maximum Magnitude	Type	Weight
42628	11.4	N?	4	43418	11.2	W?	5
2677	11.7	N	4	**3469	13.3	?	1
2733	11.5	N	4	**3606	12.4	?	1
2922	11.2	?	3	3660	11.2	W?	3
2973	12.0	?	3	3717	11.8	?	5
3028	11.6	W	4	3769	11.6	?	3
3081	11.8	N?	4	3831	13.2	?	1
3324	11.9	?	2	4012	11.8	?	2
3372	11.3	N?	4	4084	11.3	?	5
				4152	11.1	W	5

\*Outburst observed only by BAA (Isles 1976)

\*\*Outburst observed only by VSS, RASNZ (Bateson 1979)

Notes:

- (1) Outbursts reported by BAA on 2440488, and by RASNZ on 2440493 are of the same wide maximum.  
 (2) The decline observed by RASNZ.  
 (3) The decline observed by RASNZ.  
 (4) The decline observed by AAVSO.  
 (5) The decline observed by RASNZ.  
 (6) The decline observed by AAVSO.

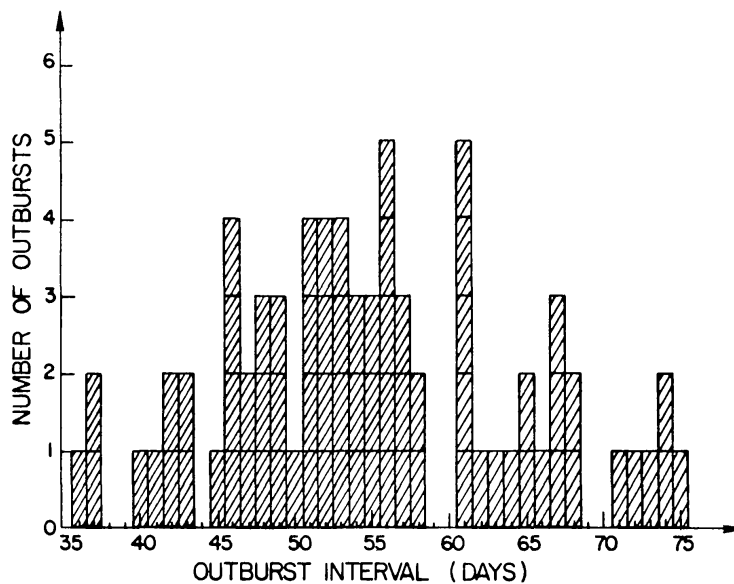


Figure 1. Histogram of the frequency of intervals between consecutive outbursts of UU Aquilae.

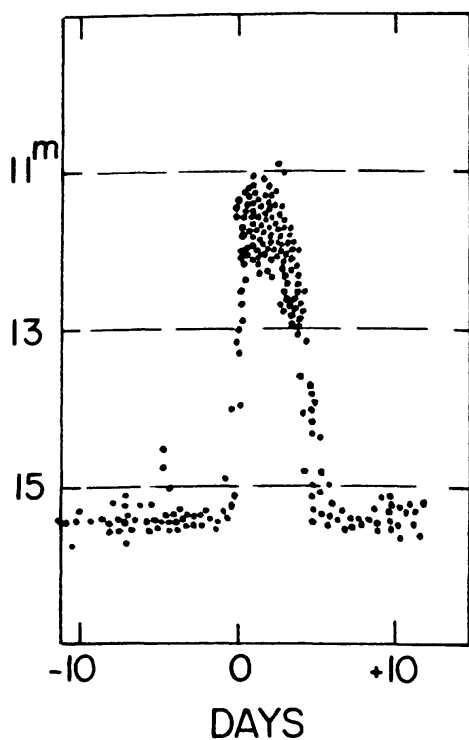


Figure 2a. Composite light curve of the wide outburst of UU Aql.

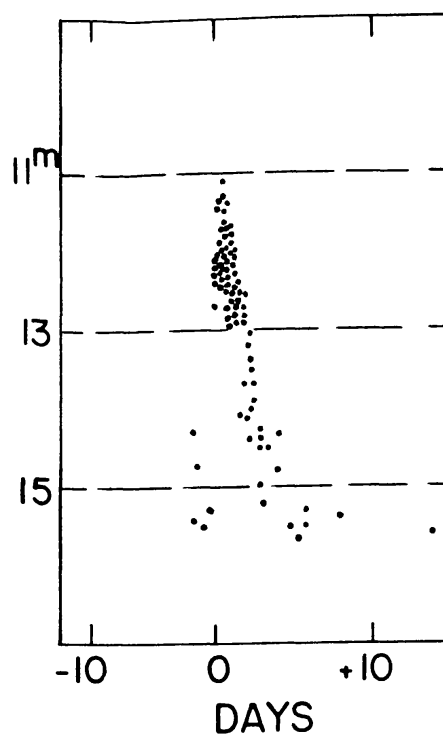


Figure 2b. Composite light curve of the narrow outburst of UU Aql.

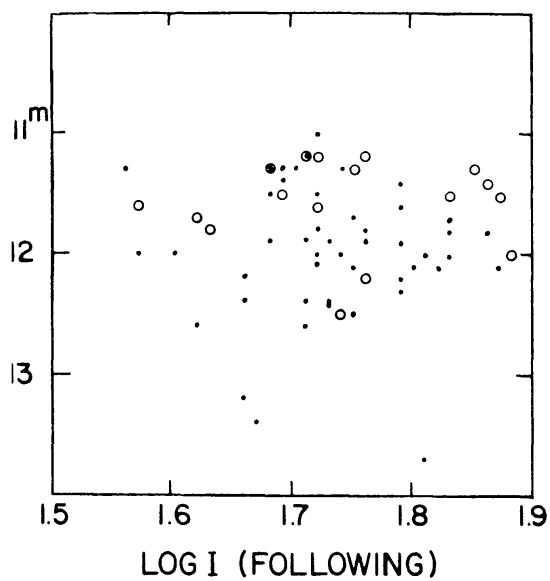


Figure 3. Relationship between brightness at maximum and the interval following consecutive outbursts of UU Aql. Narrow outbursts are indicated by dots, and wide outbursts by open circles.

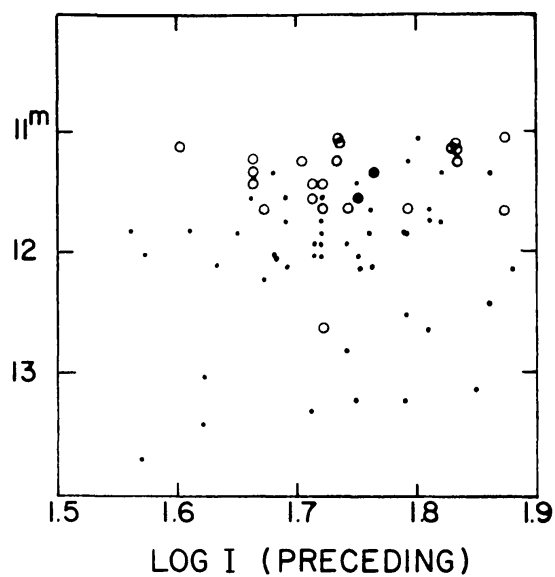


Figure 4. Relationship between brightness at maximum and the interval preceding consecutive outbursts of UU Aql.