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U,B,V LIGHT CURVES AND PERIOD BEHAVIOR FOR THE SOLAR-TYPE ECLIPSING BINARY, V417 AQUILAE

As a part of our continuing study of short period, solar-type binaries, we have obtained well-covered UBV light curves of V417 Aquilae [$\alpha(2000) = 19^h35^m24^s.1$, $\delta(2000) = 5°50'17"$, GSC 4904.531, PPM 168201, BD +05°4202]. V417 Aql was discovered by Hoffmeister (1935). Soloviev (1937) classified it as a W UMa variable, gave 4 times of minimum light, and found it to have a period of $0^d.37$. One set of B, V light curves, formed from normal points, has been published (Faulkner 1983). A later paper (Faulkner 1986) gave the following improved ephemeris:

$$\begin{array}{lll} \text{JD Hel Min.I} = 2445554.7240 & + 0^d.37031142 & \times \text{E} \\ & \pm 1 \qquad\quad & \pm 30 \end{array} \tag{1}$$

Some 70 epochs of minimum light are available in the literature, including four photoelectric timings by Agerer and Hübscher (1995), six by Faulkner (1983, 1986), and many visual/photographic timings by BAV members (see, for instance, Kämper 1984).

Our present observations were obtained from July 19 to 24, 1995 at Lowell Observatory in Flagstaff, Arizona. A thermoelectrically cooled EMI 6256S (S-13 cathode) PMT was used in conjunction with the 0.78-m Lowell reflector. A finder chart is included as Figure 1. The variable is denoted as "V" while the comparison [$\alpha(2000) = 19^h34^m55^s.8$, $\delta(2000) = 5°47'36"$] and check [$\alpha(2000) = 19^h35^m30^s.8$, $\delta(2000) = 5°44'27"$] stars are denoted as "C" and "K", respectively. About 850 observations were taken in each passband.

Seven mean epochs of minimum light were determined from the observations made during two primary and five secondary eclipses using bisection of chords. These minima are given in Table 1 accompanied by their probable errors in parentheses.

Inspection of the O−C residuals of a full linear fit to all the timings revealed two eras of constant, but different, periods connected by what may be a smooth transition (see Figure 2). We calculated a period of $0^d.3703142(2)$ for the first era (before JD 2433000) and the following improved ephemeris for the modern era:

$$\begin{array}{lll} \text{JD Hel Min.I} = 2449546.4979 & + 0^d.3703119 & \times \text{E} \\ & \pm 11 \qquad\quad & \pm 1 \end{array} \tag{2}$$

The data indicates a period change $\sim -0^s.16$, statistically significant at the 12σ level. We find that our identification of primary and secondary eclipses are reversed relative to those in recent publications. This is not surprising since the eclipse depths are nearly equal.

The linear ephemeris for late timings (equation 2) was used to calculate the O−C residuals in Table 1 and the phases of the present observations. More timings of minimum light are needed, both from photographic archives and future observations.

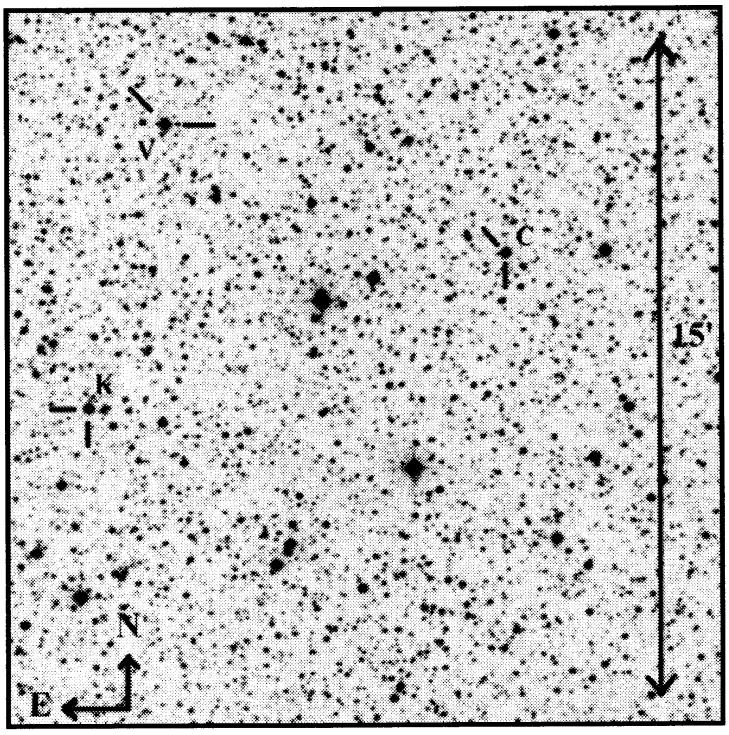

Figure 1. Finding chart (modified from a Digitized Sky Survey image) of V417 Aql (V), the comparison star (C), and the check star(K)

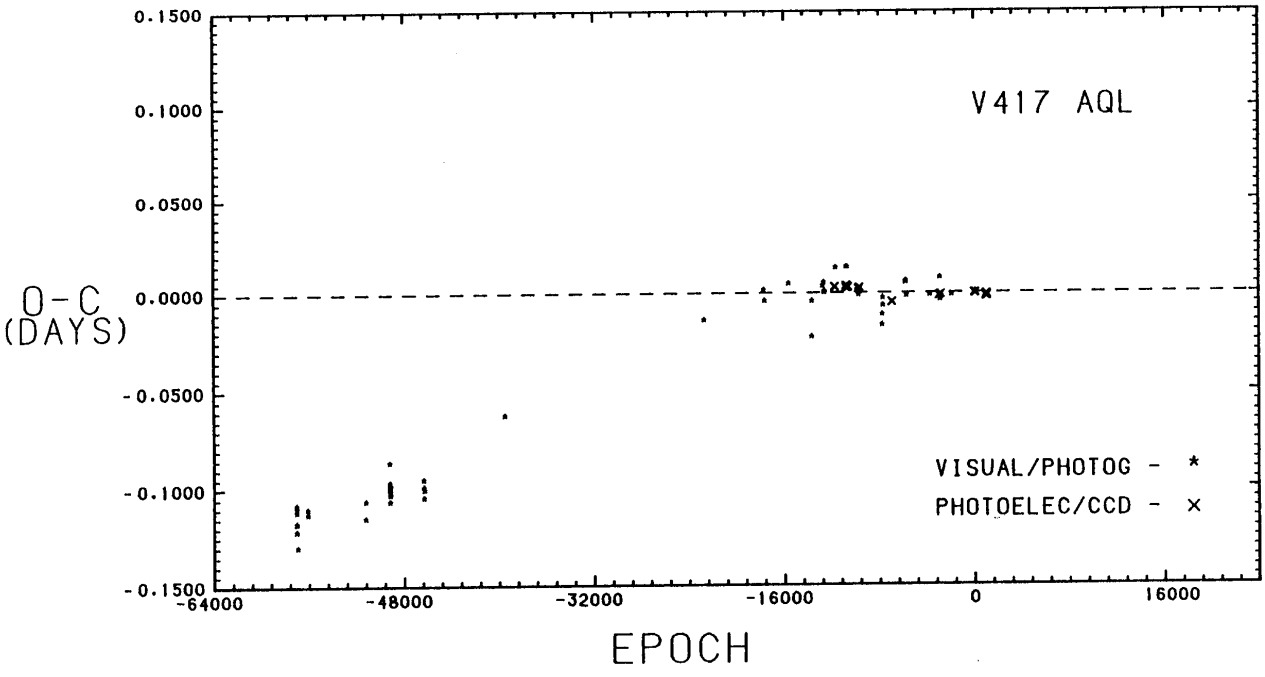

Figure 2. O−C residuals for all available times of minimum light as calculated from equation 2

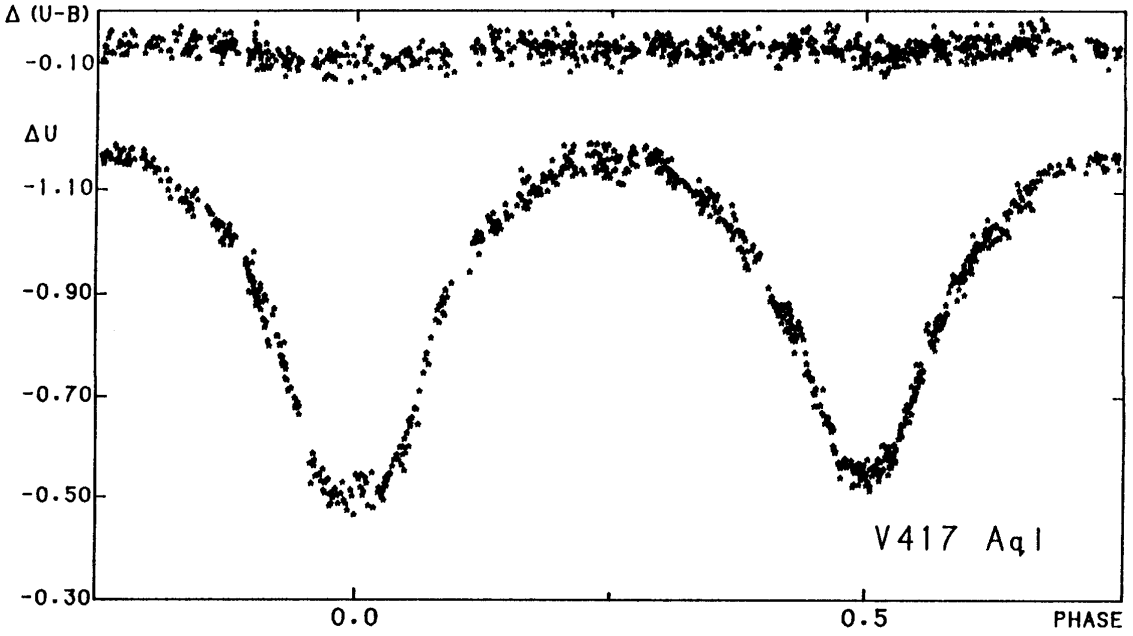

Figure 3. U light curve and U−B color curve for V417 as magnitude differences, variable minus comparison star

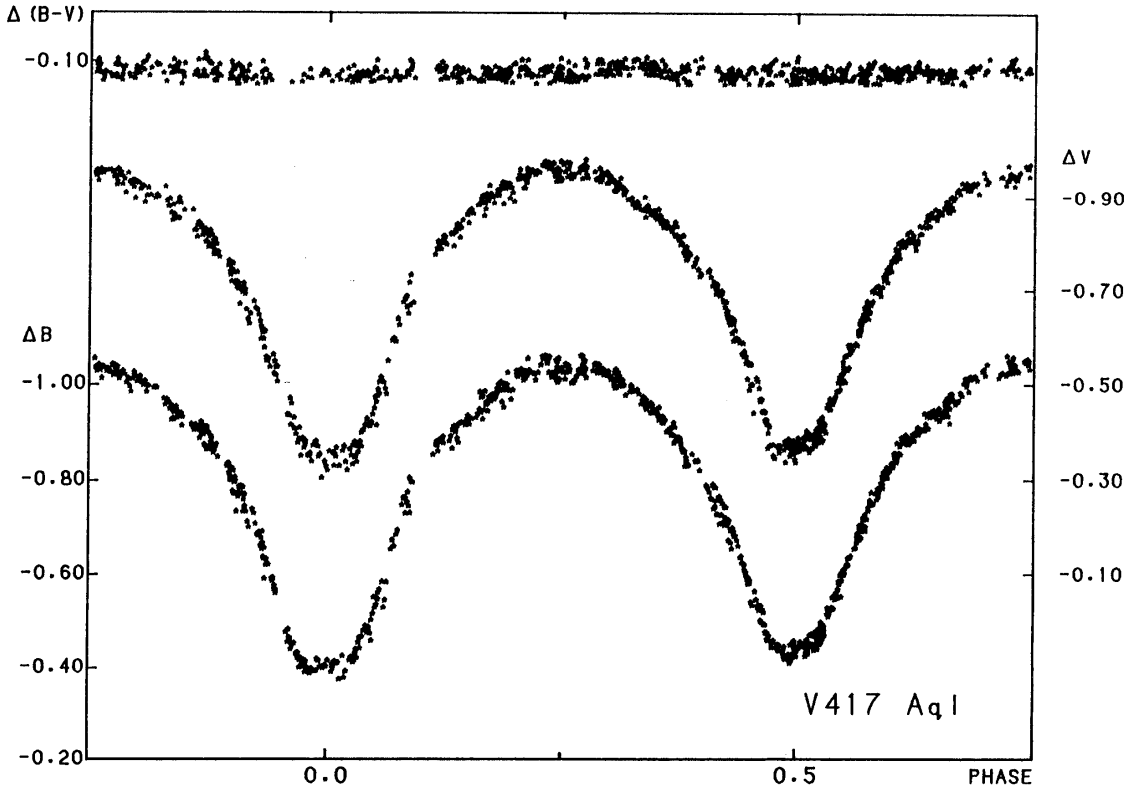

Figure 4. B and V light curves and B−V color curve for V417 Aql as magnitude differences, variable minus comparison star

Table 1. Epochs of Minimum Light, V417 Aquilae

JD Hel. 2449000+	Min	Cycles	(O-C)	Source
546.4979(5)	I	0.0	−0.0003	AH
917.9200(6)	I	1003.0	−0.0010	PO
918.8454(7)	II	1005.5	−0.0014	PO
919.9563(6)	II	1008.5	−0.0014	PO
920.6964(9)	II	1010.5	−0.0020	PO
920.8826(10)	I	1011.0	−0.0009	PO
921.8081(5)	II	1013.5	−0.0012	PO
922.9183(3)	II	1016.5	−0.0019	PO

Sources: AH: Agerer and Hübscher (1995), PO: present observations

The U, B, V light curves and U−B, B−V color curves of V417 Aql, as defined by their individual observations, are shown in Figure 3 and 4 as differential standard magnitude (variable–comparison) versus phase. Our light curve solutions reveal that V417 Aql is a W-type W UMa binary with a mass ratio of 0.37, and a fill-out of 19%. A total eclipse of ∼25 min duration occurs in the primary minimum. Reductions and analyses were largely done by BP as a part of her spring and summer undergraduate research project at Millikin University. RGS and BC acted as her advisors.

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