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PHOTOMETRIC OBSERVATIONS OF V603 AQUILAE

Recent photometric observations of the old nova V603 Aql (1918) revealed periodic light variations which can be interpreted as eclipses of the accretion disk around the white dwarf component. The discovery was made by using the Fine Error Sensor (FES) instrument aboard the IUE satellite, during a longer run of UV-observations (Rahe et al. 1980, Drechsel et al. 1981). Further observations reported by Slovak (1980) were confirming the occurrence of eclipses. The period has been found to be close to Kraft's spectroscopic period ($0\overset{d}{.}13854=3^h19\overset{m}{.}5$); Rahe et al. proposed $0\overset{d}{.}1377=3^h18\overset{m}{.}3$ for the improved orbital period.

Cook, in a recent paper (1981), while accepting the occurrence of periodic "dips" in the light curve, argued against the assumption of an eclipse of the accretion disk and proposed two alternative models. New observations of V603 Aql are in obvious demand.

At the suggestion of Dr. Jürgen Rahe, two sets of photoelectric observations of V603 Aql have been obtained in an attempt to determine the eclipsing period more accurately: at Kitt Peak National Observatory* in September 1980 (no. 3 16 in. tel., 4 nights) and at Cerro Tololo Interamerican Observatory* in March 1981 (no. 1 16 in. tel., 5 nights). In both observing seasons the orbital period was completely covered; in particular, on Sep. 30, 1980, a 183 minute run represented 92 percent of the period. A conventional UBV photometer was used; during the first two runs in 1980 only V was measured, in all other nights B and V.

A conventional single channel photometer is, of course, not the ideal instrument for the photometry of a cataclysmic binary. There is, however, nothing wrong with its use for the study of a feature in the light curve which can last 30-40 minutes and reach an amplitude of 0.35 magn. Both variable and comparison stars were measured in 50 sec. counts; the observations of the variable totalled 210 (at Kitt Peak) and 140 (at

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Cerro Tololo). Comparison star was BD+0°4023, as in the IUE photometry; it is much brighter and redder (K2) than the variable but its closeness made at least the corrections for differential extinction almost negligibly small even for large zenith distances. The short term constancy of the comparison star was clearly indicated by the exemplary, straight Bouguer lines of the extinction diagrams, see Fig. 1. (Most observations have been taken at considerable zenith distances.)

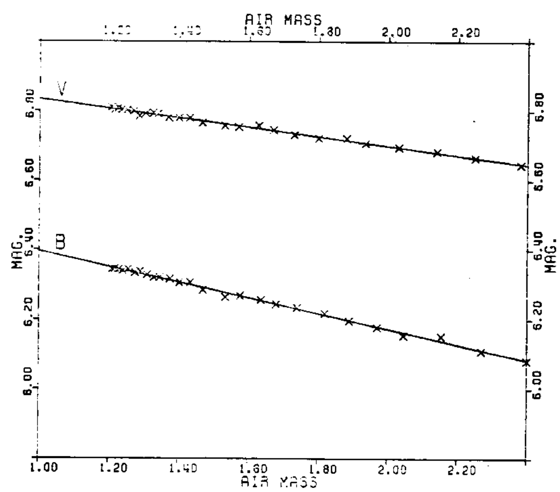


Fig. 1. Observations of BD+0°4023, Sep. 30, 1980. (Zero point of the magnitude scale arbitrary.)

The present list of the minimum epochs reads as follows:

JD 2444	401.399	IUA observers
	415.9235	Slovak
	416.8178	Slovak
	499.625:	this paper, Kitt Peak (Herczeg, Cobble)
	503.692	
	504.74:	
	513.72:	
2444	681.866	this paper, Cerro Tololo (Herczeg)

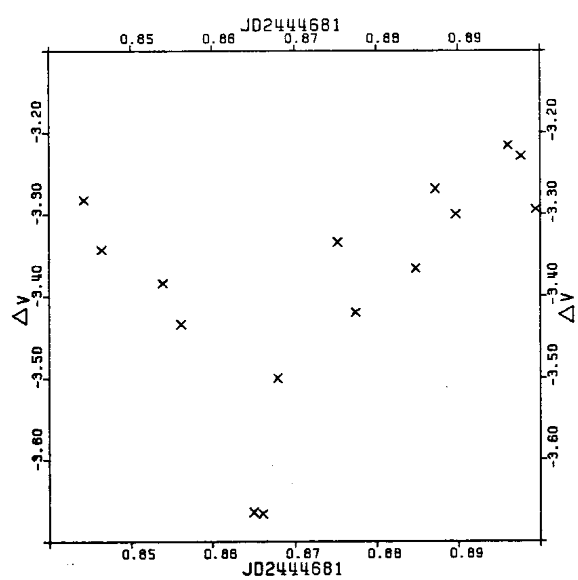
Given the minimum epochs, the derivation of a period (assumed to be constant) is a simple, almost trivial procedure which does not necessitate any details told. In this case, however, we have the added difficulty of a very strongly distorted light curve and frequent irregular variations up to 0.3 magn. (Panek 1979, see also the alarming Fig. 2c in Bruch 1980).*

*We estimate that in our measurements any scatter of the variable's brightness above ± 0.02 magn. is certainly due to intrinsic variations and not of instrumental origin.

As it appears, the time interval of the IUE observations has been marked by an almost exceptionally quiet photometric behaviour of the system and thus the occurrence of eclipses (dips) is beyond doubt. Yet the observations of Slovak's already present a problem. These two minima are incompatible with any period close to Kraft's: they are separated by 6.46x0.1385 days, or, 6.49x0.1377 days. Since in these systems secondary minima are hardly expected, we have to conclude that one of these eclipses was probably spurious, merely a strong fluctuation of the brightness. Combining each of the epochs with the IUE minimum, we can derive three possible values of the period: $0^{d}.1377$, $0^{d}.1383$, $0^{d}.1389$. Kraft's spectroscopic observations are more than 47,000 epochs away and cannot help us to decide about the fourth digit of the period. Neither present us the new observations, regrettably, with completely unambiguous information.

We assume that the minimum observed on JD2444681 at Cerro Tololo, shown in Fig. 2, was "real". The minima obtained at Kitt Peak, however, present a less obvious case.

Fig. 2. V observations, March 17/18, 1981.



1. Let us further assume that the sharp, narrow dip observed on JD2444503 at Kitt Peak, shown in Fig. 3, was an eclipse. If this is so then the three epochs of minimum in the table marked by colons (:) do not correspond to real eclipses (the phases are not compatible with the minimum on

JD2444503). Compared with the first minimum epoch, obtained by IUE observers, these two epochs (Kitt Peak and Cerro Tololo) determine the period to about $1x10^{-5}$ day. The period assumed to be constant, we get five values near $0^d.1380$, compatible with the three epochs: 0.13748, 0.13769, 0.13823, 0.13844 and 0.13898 days. Comparison with Slovak's possible minimum epochs would make $0^d.1377$ the most probable value. One has to add, however, that using this value, Cerro Tololo observations on March 14/15, 1981, should have started at phase 0.04, those on March 16/17 ended at phase 0.99. There is no minimum discernible in the records of March 14/15 while a possible decline is visible at the end of the March 16/17 series, finished already in the astronomical twilight.

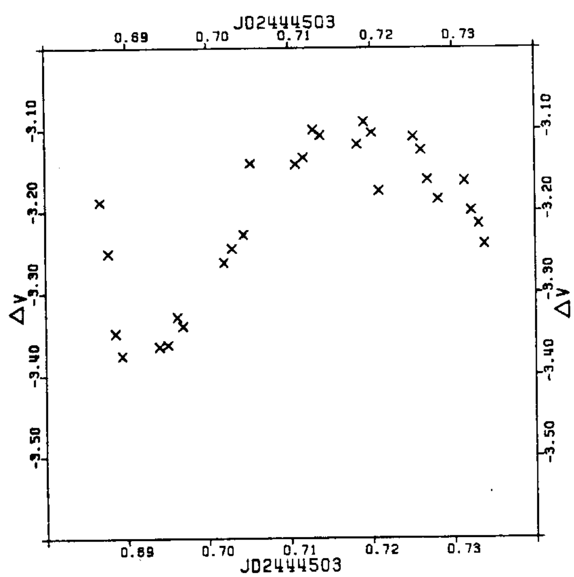


Fig. 3. V observations, Sept. 20, 1980.

2. If we assume, on the other hand, that the dip on JD2444503 was a mere fluctuation, the minimum epoch spurious, then the three less accurate Kitt Peak minima (extrapolations from a rising or descending branch) suggest a period between $0^d.1381$ and $0^d.1383$, see the composite "eclipse" from two series in Fig. 4. Accepting the normal epoch JD2444513.720 for a moment, comparison with the well established epochs indicate $0^d.13816$ as the best value for the period, with the further possibilities of $0^d.13822$ and $0^d.13828$.

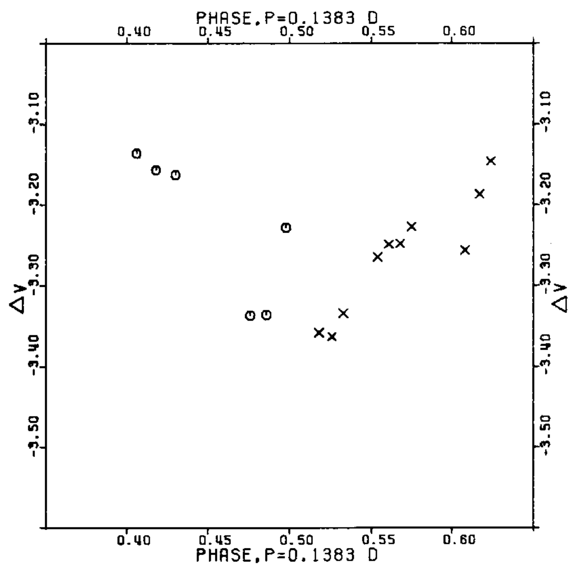


Fig. 4. Composite "minimum", Sep. 16 and Sep. 21, 1980. P = $0^{d}.1383$

We have discussed the meager results of this attempt to derive the eclipsing period of V603 Aql in far more detail than usual in the present literature. Our aim was to emphasize here the very considerable observational difficulties stemming from the strong photometric disturbances the system exhibits.

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ADDENDUM

January 28, 1982

Two recent papers contain significant information about the system V603 Aql.

M. H. Slovak (Ap J 248, 1059, 1981) discussed his photometry in more detail and suggested that the eclipses discovered earlier using the IUE satellite may correspond to transient features in the accretion disk. R. Haefner carried out the hitherto most extensive photometry of the variable (IBVS 2045). His measurements suggest a periodic hump rather than an eclipse in the light curve, but the period he found, 0.14485 days, differs significantly from the spectroscopic value.

Photometric complications indicated in these papers may explain the difficulties we encountered in finding the orbital period of V603 Aql.