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TWO-COLOR VR CCD PHOTOMETRY OF OLD NOVA V603 AQUILAE

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ABSTRACT

Results of 6 nights of CCD VR photometry of the nova-like variable V603 Aquilae (Nova Aquilae 1918) obtained at the Mallorcian 35-cm telescope in July 2004 are reported. The ephemeris for the superhump maximum is Max.HJD=2453213.60546(96) +0.14813(10)E. The waves with $3^{\rm d}_{\cdot}9$, $1^{\rm d}_{\cdot}4$, $0^{\rm d}_{\cdot}135$ are statistically significant, which may be interpreted as the negative superhump-orbital, the beat periods (negative superhump - positive superhump) and the negative superhump with low amplitude, respectively. Another possible time-scale is $0^{\rm d}_{\cdot}8$, which has no coincidence with the beat periods. Quasi-periodic oscillations with an effective *period* of 18 minutes have been detected, which are close to 15.6 minutes reported by some authors. Their effective semi-amplitudes are $0^m.045$ and $0^m.051$ for V and R, respectively. This corresponds to the 0.12 mag excess in the color index V-R as compared with the mean color, which can be understood as the pulsed emission in the hotter inner parts of the accretion disk, similar to that observed in TT Ari and MV Lyr.

Keywords: variable stars, cataclysmic variables, novae, CCD photometry, V603 Aql.

1. INTRODUCTION

The old nova V603 Aquilae is the object of many investigations from the time of its unusual outburst in 1918 up to the present. The binary nature of the V603 Aql was suggested by Kraft (1964). From $H\gamma$ and $H\delta$ emission lines in 23 spectra, he found the spectroscopic period of $0^{\rm d}_{\cdot}138$.

Rahe et al. (1980) had found the same period ($0^{\rm d}_{\cdot}139 \pm 0^{\rm d}_{\cdot}001$) from 3 subsequent minima in the IUE photometric observations. Arenas et al. (2000) redetermined the orbital period with better accuracy ($P_{orb} = 0^{\rm d}_{\cdot}1385$). From the statistical relationships and own radial velocity measurements, they found that V603 Aql has a very low orbital inclination $i = 13° \pm 2°$ and stellar masses with $M_1 = (1.2 \pm 0.2)M_\odot$ and $M_2 = (0.29 \pm 0.04)M_\odot$ for the primary and secondary star, respectively (Arenas et al. 2000). Haefner & Metz (1985) had found the photometric brightness variations with an amplitude of $0^{\rm m}_{\cdot}2$-$0^{\rm m}_{\cdot}3$ as a hump structure repeating with a period, which is longer ($0^{\rm d}_{\cdot}1449$) than

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the orbital one, and considered this system as an intermediate polar from possible discovery of linear and circular polarization (varying at a period of $2^h48^m = 0.^d1167$ and maybe at the photometric period). They also suggested a photometric period of 15.6 min = $0.^d010833$. Gnedin et al. (1990) suggested a possible 15.6 min modulation of the circular polarization in the Hβ and classified the system as an intermediate polar with a low magnetic field.

Another candidate for the spin period of the white dwarf was proposed by Udalski & Schwarzenberg-Czerny (1989), which is equal to 61.38 minutes. They also reported on a $2.^d5$ period which may correspond to a spin-orbital beat period. Patterson & Richman (1991) had not confirmed any of these 3 periods. However, some of them are reported in other studies, thus one may not exclude a transient quasi-periodic nature of such variations. Therefore a continuation of monitoring is highly needed. Patterson et al. (1993) found the change of the $0.^d14$ period on a time scale of months in the range $0.^d1449$-$0.^d1466$. Patterson et al. (1993, 1997) have identified V603 Aql as a permanent superhump system, based on the fact that the photometric period (P_{sh}) is different from the spectroscopic period (P_{orb}). The system exhibits switches between alternative *positive* and *negative* superhumps at a scale of few years.

In this Paper, we present results of the VR photometric observations of V603 Aql in 2004. The star has been observed within the Inter-Longitude Astronomy project (Andronov et al. 2003) of the international monitoring of variable stars of different types.

2. OBSERVATIONS AND EFFECTIVE RUN CHARACTERISTICS

The observations on which the present study is based were obtained at the Observatori Astronòmic de Mallorca (OAM) by using the 30-cm MEADE UHTC f/10 Schmidt-Cassegrain telescope equipped with a Peltier cooled SBIG STL-1001E CCD camera (KODAK KAF-1001E chip), totally 1024×1024 $24\,\mu$m×$24\,\mu$m pixels. The filters correspond closely to the standard V and R photometric system. V603 Aql was observed on 6 nights (JD 2453211-18). Altogether 3360 CCD observations were obtained. The Finding chart and the brightness of the stars in the field of V603 Aql are presented in Figure 1 and Table 1, repectively The integration time was 30s. To determine instrumental magnitudes of the stars, the CCD frames were processed using the program written by Goranskij (2005). For the final determination of magnitudes, the MCV (Multi-Column View) software by Andronov & Baklanov (2005) have been used, which realizes the method of the multiple comparison stars (see Kim et al. 2004). The *main* comparison star which was used to convert magnitude differences into the stellar magnitudes, was $C6$ with $V = 9.^m89$, $R = 9.^m55$ (Andronov et al. 1993). Unfortunately, it should be noted that at their chart, the designation of this star is apparently closer to another one $C1$. But, in this paper we use the correct identification.

In the SIMBAD (2005) international database, our comparison star $C6$ is BD+0°4022 with $V = 9.^m92$, $B = 10.^m33$. The value $V = 9.^m98$ (Patterson et al. 1993) is slightly larger than that from SIMBAD (2005) and Andronov et al. (1993). For another star $C4$, one may find in SIMBAD $V = 12.^m430$, $B = 13.^m252$ with a reference to Henden & Honeycutt (1995). We have checked the original paper, as well as the database by Henden (2004), but have not found the comparison stars for V603 Aql. However, taking these values and the statistical dependence $(V - R)_H = -0.^m013(23) + 0.608(20)(B - V)_H$ for the comparison stars near V1315 Aql (Kim et al. 2005), we have estimated the value of $(V - R)_H = 0.^m523$, apparently the same (within rounding errors) as that for our instrumental system. As our data are in a reasonable agreement with other independent estimates, we continue to use the magnitude zero–point for the star $C5$ in Table 1.

The list of observations is presented in Table 2. Six nights of observations from July 24 to July 31, 2004 have been obtained with a total duration of 30.6 hours (92.8 spin periods). Five subsequent

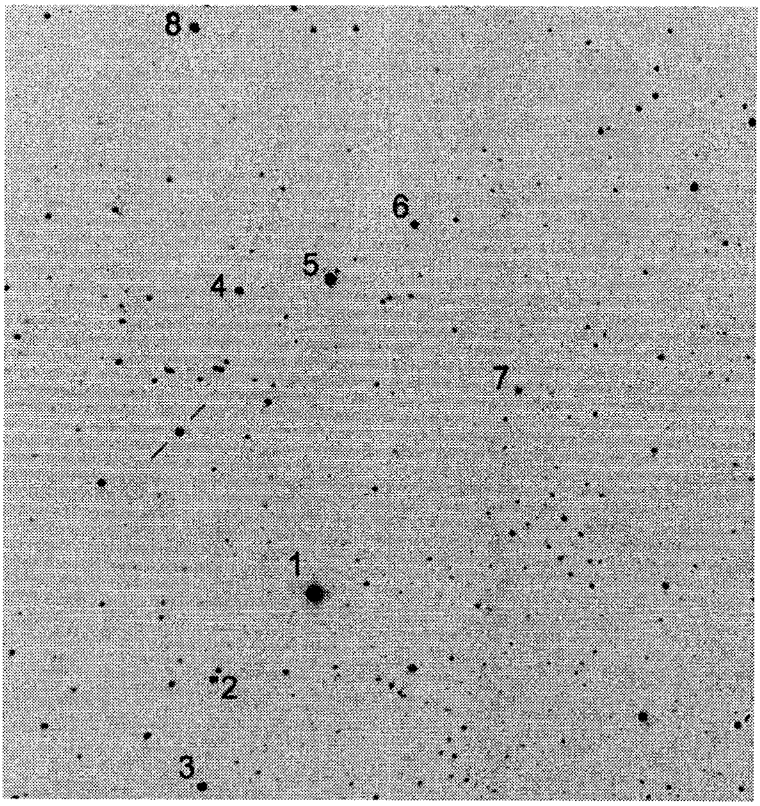

Figure 1. Finding chart for V603 Aql. The size of the field is 20', North is up and East is left.

Table 1. Brightness of the stars in the field of V603 Aql according to the GSC (accuracy of $0.^{m}4$) and this work.

N	Name	V_{GSC}	V	R	W
C1	GSC 0448 0359	8.5	8.395±0.002	7.784±0.003	0.611±0.003
C2	GSC 0448 0794	13.3	13.448±0.003	12.122±0.002	1.326±0.004
C3	GSC 0448 0531	12.3	12.023±0.001	11.517±0.001	0.506±0.002
C4	GSC 0448 0587	12.6	12.360±0.001	11.837±0.001	0.523±0.002
C5	GSC 0448 0731	9.91	9.890±0.002	9.550±0.001	0.340±0.002
C6	GSC 0448 0569	12.5	12.264±0.001	11.668±0.001	0.597±0.002
C7	GSC 0448 0676	12.8	12.618±0.002	12.114±0.001	0.503±0.002
C8	GSC 0448 0307	12.1	11.666±0.001	10.906±0.001	0.760±0.002
V	V603 Aql		12.046±0.004	11.786±0.004	0.261±0.005

nights were obtained with alternatively changing VR filters, and one night without filter (white light, hereafter mentioned as the photometric system "*W*"). For all runs, the integration time was 30 sec, so the complete time resolution of 45 sec corresponds to the limiting Nyquist frequency, 1920 cycles/day (c/d). For either V or R runs with alternating filters, it is twice smaller, i.e. 960 c/d. As the runs in V and R are mostly overlapping, the formal total duration in V, R and W is 106 hours (30

Table 2. A list of observations: designation of the run (integer part of HJD-2453000 and the filter) HJD of the begin and end of the run, number of data points n, sample mean $\bar{m}$ and r.m.s. deviation σ of data points from the sample mean, minimal m_{min} and m_{max} maximal magnitude, peak-to-peak amplitude Δm and duration of the run D in hours.

Run	$t_s - 2453000$	$t_e - 2453000$	n	$\bar{m}$	σ	m_{min}	m_{max}	Δm	D
211 V	53211.3439	53211.5433	202	12.031	0.085	11.811	12.251	0.441	4.8
211 R	53211.3443	53211.5428	200	11.756	0.081	11.483	11.962	0.479	4.8
211 V-R	53211.3443	53211.5433	401	0.275	0.050	0.077	0.412	0.335	4.8
212 V	53212.3472	53212.6500	321	12.144	0.133	11.771	12.503	0.733	7.3
212 R	53212.3477	53212.6570	327	11.876	0.142	11.473	12.243	0.770	7.4
212 V-R	53212.3472	53212.6570	647	0.265	0.059	-0.124	0.464	0.587	7.4
213 V	53213.3390	53213.6488	314	12.011	0.109	11.722	12.309	0.587	7.5
213 R	53213.3394	53213.6465	305	11.760	0.105	11.478	12.093	0.615	7.4
213 V-R	53213.3390	53213.6488	619	0.250	0.059	0.011	0.526	0.515	7.4
214 V	53214.3381	53214.5803	236	11.942	0.131	11.550	12.312	0.762	5.8
214 R	53214.3386	53214.6039	249	11.691	0.122	11.333	12.066	0.733	6.4
214 V-R	53214.3381	53214.6039	485	0.262	0.086	-0.091	0.710	0.801	6.4
215 V	53215.3337	53215.6386	309	12.068	0.127	11.751	12.424	0.674	7.3
215 R	53215.3342	53215.6298	301	11.808	0.126	11.487	12.159	0.672	7.1
215 V-R	53215.3337	53215.6298	606	0.260	0.064	-0.106	0.531	0.637	7.1
218 W	53218.3661	53218.6334	465	2.325	0.237	1.765	3.182	1.417	6.4

superhump periods). The real duration is 40 hours (11 superhump periods).

As a characteristic of observed variability (consisting of the intrinsic variability of the system and of the observational noise), we have used two parameters - the r.m.s. deviation σ of data points from the sample mean and the peak-to-peak amplitude Δm (see Kim et al. 2005). To obtain values of the color index $V - R$, we have made two artificial data sets. Each of them contains the original data and that interpolated for the times of observations in another color. If the interpolation was not possible because of the absence of nearby data, such a point has been removed from the V-R run of the pseudo-simultaneous observations.

3. MULTI-COMPONENT BRIGHTNESS AND COLOR VARIATIONS

The light curves for individual runs are shown in Figure 2. They are shown as a function of the phase of the superhump maximum according to our ephemeris (Eq. 1). However, the points are not repeated at each phase, extending the phase interval form [0,1] to necessary limits. So we can see the real temporal behaviour, which is not repeated from cycle-to-cycle.

A night-to-night variability of the mean brightness $\bar{m}$ in both colors is clear. It has been originally suggested by Udalski & Schwarzenberg-Czerny (1989) to be periodic ($2\overset{d}{.}5$). Suleimanov et al. (2003, 2004) reported the changes of this value from $3\overset{d}{.}0$ (in 2002) to $3\overset{d}{.}3$ (in 2001). No periodicity at these time scales was present in 7 subsequent nights of CCD (R) observations obtained in 1999 (Baklanov et al. 2003). Instead, the highest peak at the periodogram occured at $0\overset{d}{.}34429$. As there is a 15-20 year-scale variability of the mean brightness with a peak-to-peak amplitude of $0\overset{m}{.}2$ (Richman et al. 1994), it could be suggested that the accretion rate variations leads to the instability of the superhump period (cf. Patterson et al. 1997).

The periodograms were computed for each run using the Four-1 software (Andronov 1994), which realizes a 3-parameter sine fit for each trial period. They are shown in Figure 3. Neglecting the features, which correspond to periods longer than a run (i.e. $f < 4$ c/d), one may see peaks close to the positive superhump period, except the most noisy run 218W. There are no prominent peaks at

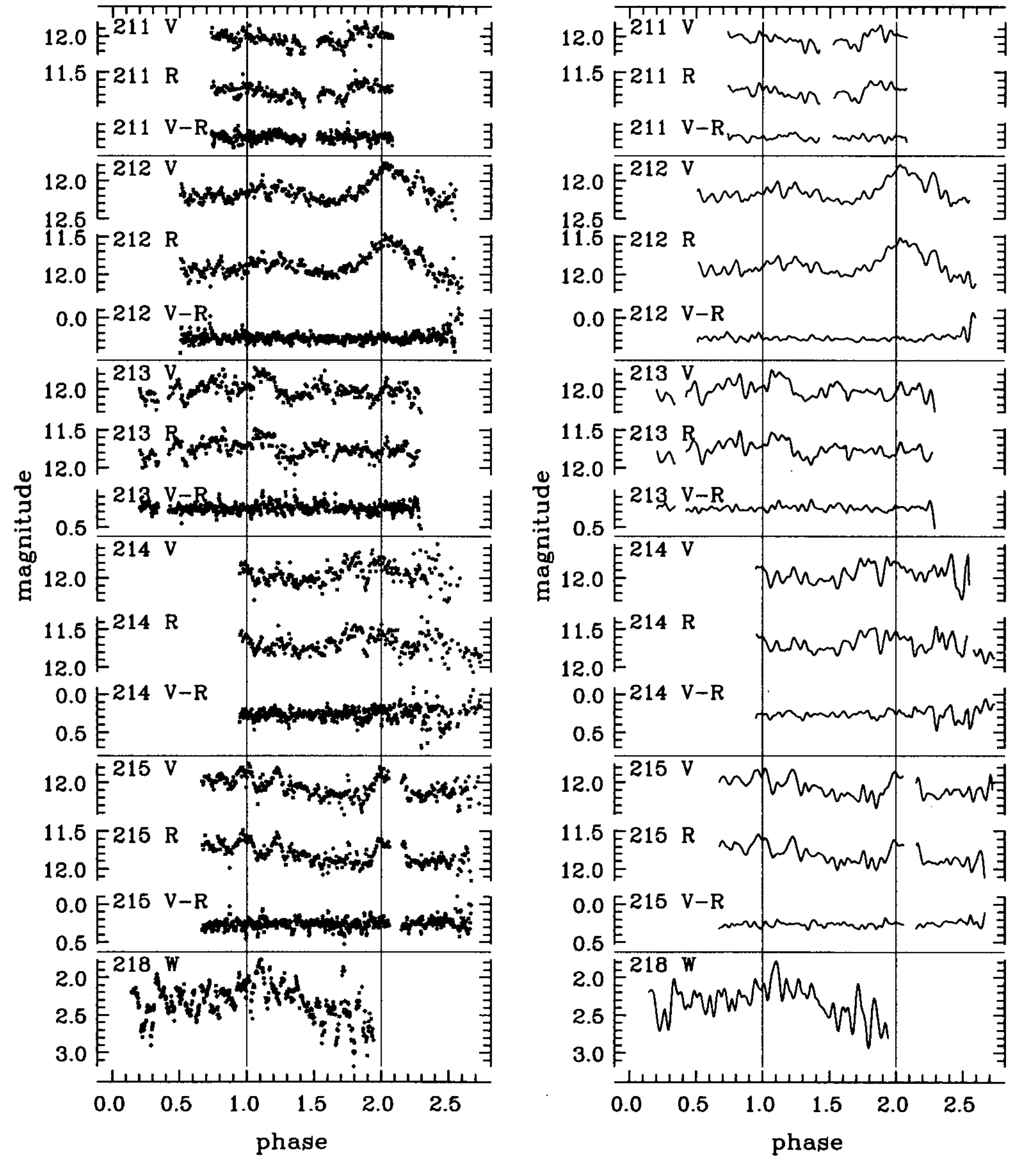

Figure 2. Light and color curves of V603 Aql for individual runs. *Left:* original data, *Right: runningparabola* fits with adopted filter half-width $\Delta t = 0.^{d}006$. Vertical lines mark position of maxima according to ephemeris (Eq. 1).

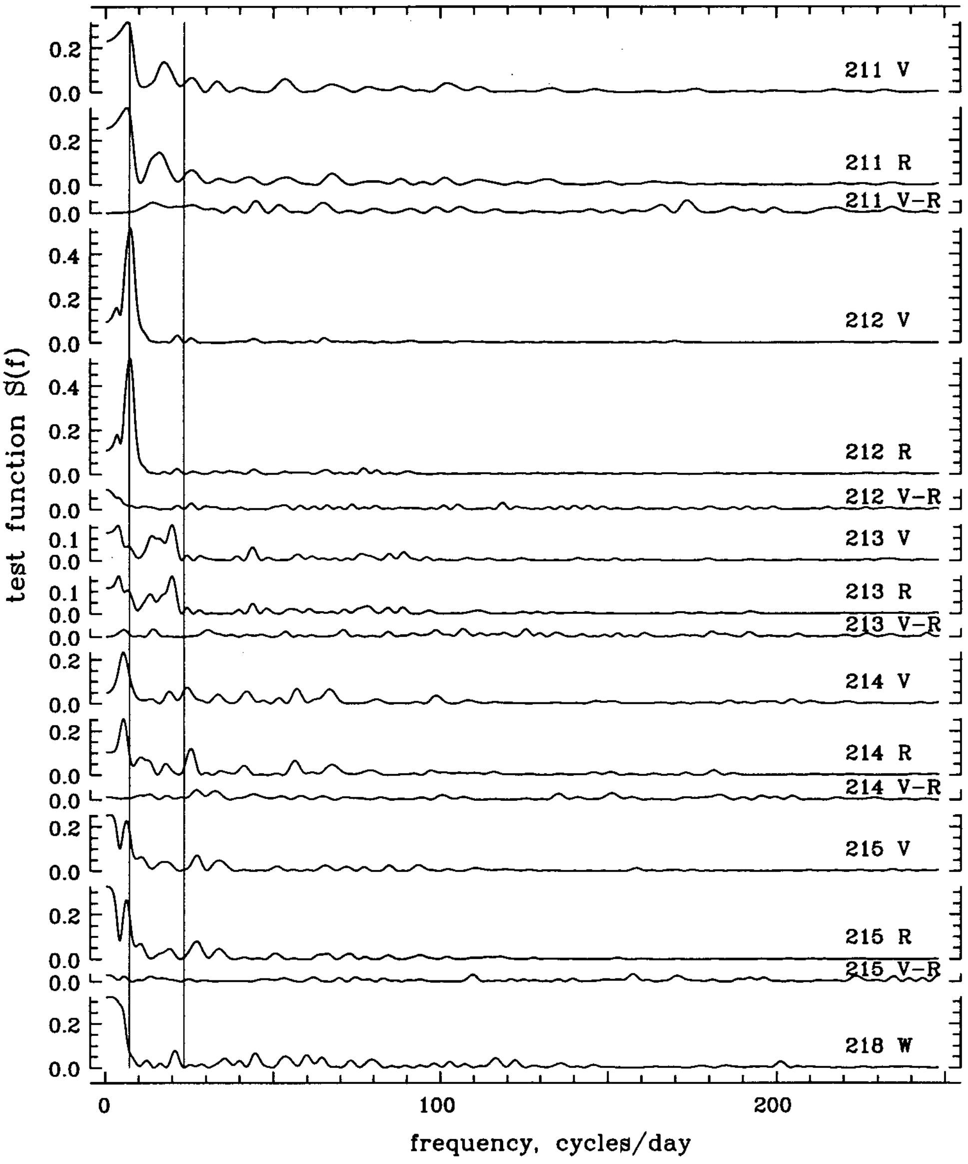

Figure 3. Periodograms for individual runs. Vertical lines correspond to the *positive* superhump period by Patterson et al. (1993) and to the 61.38 minute periodicity suggested by Udalski & Schwarzenberg-Czerny (1989).

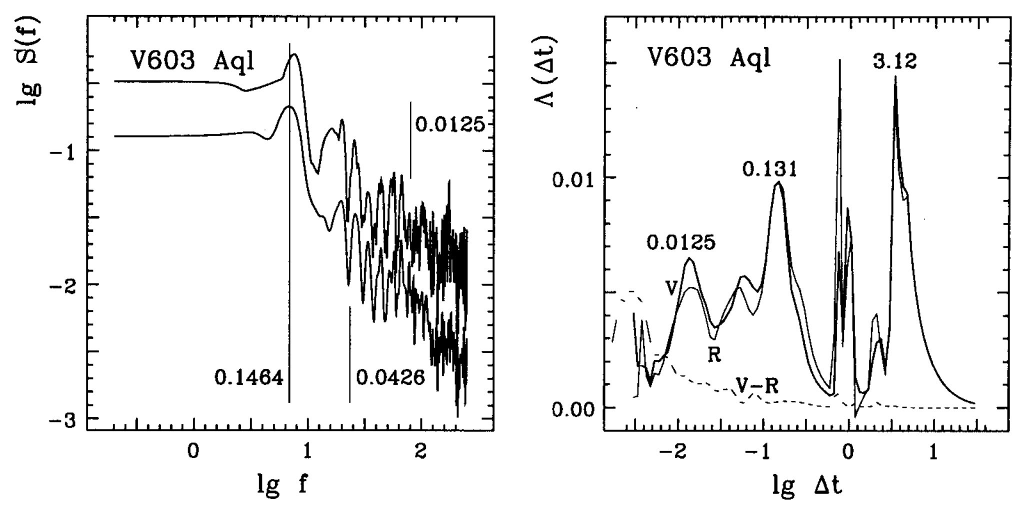

Figure 4. *Left:* The weighted mean (*bottom curve*) periodogram for individual runs in V and R and the dependence of the maximal value of the test function at the fixed period (*upper curve*). The numbers correspond (left to right) to periods by Patterson et al. (1993), Udalski & Schwarzenberg-Czerny (1989) and this work. *Right:* "Λ" – scalegram for complete runs in V, R and V-R. The numbers correspond to the local maxima.

the periodograms for the color index V-R.

To confirm the quasi-periodic oscillations, we have computed the weighted mean periodogram for the V, R runs. Results are shown in Figure 4. as well as the *maximum* periodogram, i.e. the dependence of the maximal (among all runs) test function vs. the trial frequency. No repeating peaks are seen at 23.5 c/d (a possible period of 61.38 minutes reported by Udalski & Schwarzenberg-Czerny (1989)), despite there are peaks with variable deviations of few dozens per cent. This resembles another star TT Ari (Tremko et al. 1996, Andronov et al. 1999), where there are quasi-periodic oscillations at preferred time-scales. There are no other repeating peaks at other frequencies, including that close to 15.6 minutes (92.3 c/d). However, there are few peaks at comparable smaller frequencies, so one may suggest quasi-periodic oscillations of low coherency, which need an analysis with worse frequency resolution. For this purpose, we have used the "Λ"–scalegram analysis (Andronov 2003). The corresponding test functions are shown in the right part of Figure 4. The scatter at $\lg \Delta t \approx 0$ is caused by the daily interval between the observations, and may be neglected. However, there are 3 peaks seen both in V and R. The *period* and *semi – amplitude* estimates differ by less than 5 per cent for two colors for all three $0\overset{d}{.}0125$, $0\overset{d}{.}1487$ and $3\overset{d}{.}12$ waves.

It should be noted, that the effective *periods* obtained from the "Λ"–scalegram analysis may be shorter than real ones in a case of non-sinusoidal signal. This is also the case of $0\overset{d}{.}131$ wave, as the real period for our data is slightly longer ($0\overset{d}{.}1487$, see below). However, we may conclude on the presence of 3 photometric waves in the light curve. The periodograms for the complete V and R data runs are shown in Figure 5. Such an analysis is mostly effective for the periodic signals of good coherence length(order of the interval duration). The highest peak occurs at $3\overset{d}{.}8$, the another one is present at the superhump period, which is equal, for our observations, to $0\overset{m}{.}1487$. However, a significant peak of comparable height occurs at $0\overset{d}{.}8$. The $3\overset{d}{.}8$ and $0\overset{d}{.}8$ peaks are not seen at periodograms for individual runs (Figure 3) because the length of these runs is smaller than these values. At high frequencies, there is a part of the periodogram which approximately obeys a power law similar to other cataclysmic variables (cf. Andronov et al. 1999).

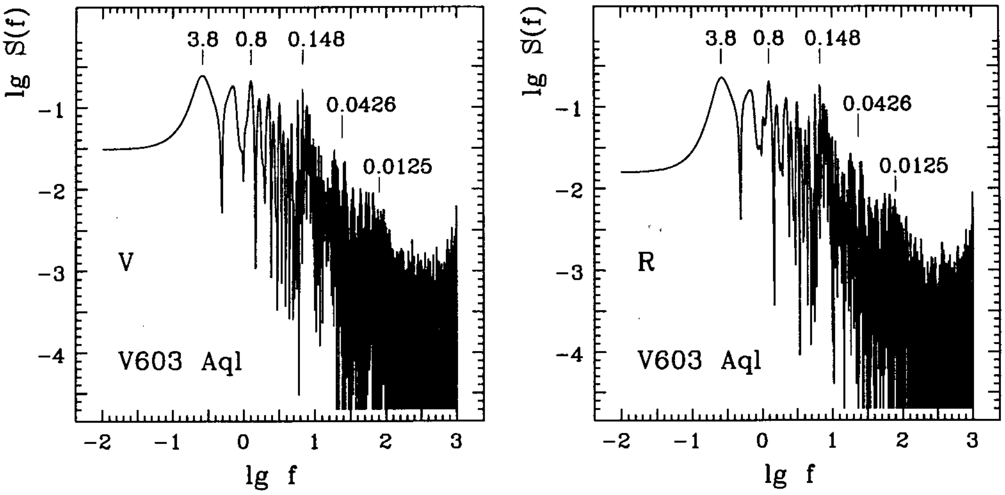

Figure 5. Periodograms for complete runs in V *(left)* and R *(right)*. The numbers correspond to 3 highest peaks and the periods 0.0426 by Udalski & Schwarzenberg-Czerny (1989) and quasi-periodic oscillations 0.0125 from this work.

Such additional *periods* are seen in TT Ari (Tremko et al. 1992) and V2275 Cyg (Ostrova et al. 2003). However, their study is very complicated because the runs are usually shorter than the probable period, and the daily gaps are longer. The best solution to check this new value could be a future campaign of the multi-site observations like WET (Whole Earth Telescope), CBA (Center for Backyard Astrophysics) or ILA (Inter-Longitude Astronomy).

To confirm the existence of this peak, we have applied a 3-simusoidal model. The initial values of the periods were used, which correspond to 3 peaks at the 1-sine periodogram. Then they have been optimized using iterations in the linearized least-squares model. The corresponding parameters of the fit are listed in Table 3. Assuming that the periods in the photometric systems V and R should be the same for the same time interval of alternating filters, we have computed the mean weighted values of the frequencies and thus periods. They are also listed in Table 3 for comparison of results obtained by using different complementary methods. Using these fixed values of three periods, the amplitudes and epochs have been computed. The periods and epochs in V and R are the same within their error estimates. Because of some difference in the amplitudes, the amplitudes for the V-R data set show apparent amplitudes of $0^m.005$, $0^m.019$ and $0^m.017$ for 3 *periods* with corresponding *signal/noise* ratio $r/\sigma_r = 2.0$, 4.2 and 3.8, respectively. There are no statistically significant color variations with the superhump phase. For other waves, the values of r/σ_r are much smaller than that for V and R, and one may not exclude their origin from statistical fluctuations.

The possible $15.6minute$ variability is not seen at the periodograms, showing it′s transient or quasi-periodic nature. From the Λ−scalegram analysis, the effective values of the period are equal to $0^{\rm d}.0122$ and $0^{\rm m}.0127$ for V and R, respectively, so we may use a mean value of $0^{\rm d}.0125$=18 min. This value is slightly larger than 15.6 min suggested by Haefner & Metz (1985), but possibly may correspond to these oscillations, taking into account the absence of the strict periodicity.

To determine the statistically optimal value of the filter half-width Δt, Andronov (1997) recommends to use the criterion of maximization of the *signal/noise* (SN) ratio. For our multi-component signal, there are two maxima corresponding to $3^{\rm d}.8$ and $0^{\rm d}.1487$ variability. For much smaller $0^{\rm d}.0125$ *period*, there is no local maximum. So we have used another recommendation of

Table 3. The characteristics of one and three-sinusoidal fits to the V and R runs: period P, frequency f, initial epoch for maximum brightness (minimal stellar magnitude) T_0, semi-amplitude r. The numbers of the second line mark the number of the wave assumed to be periodic during our observations. The number of parameters m determined using the least squares method correspond to one-wave ($m = 3$) periodogram analysis, 3-wave linearized least squares fit with corrected period ($m = 10$), and to 3-wave fit with fixed (weighted mean from characteristics for V and R) adopted values of the periods ($m = 7$). The case 7a corresponds to a pair of additional periods 3.8 and 0.8, whereas 7b - to a pair P_n, P_{ns}.

Parameter	V			R			
	1	2	3	1	2	3	m
P, d	0.14810	3.849	0.799	0.14804	3.738	0.794	3
-'-	0.14815(15)	3.985(78)	0.837(10)	0.14812(14)	3.996(96)	0.863(11)	10
-'-	0.14813(10)	3.989(61)	0.8493(77)				7a
f, c/d	6.7506(48)	0.2507(38)	1.177(11)				-'-
$T_0 - 2453210$	3.60546(96)	4.527(21)	3.446(7)				-'-
r,mmag	67(4)	105(6)	55(8)	72(4)	114(6)	76(8)	-'-
r/σ_r	16.3	16.5	7.0	17.8	17.9	10.0	-'-
P	0.14745(16)	0.13497(22)	1.3815(90)	0.14751(15)	0.13503(22)	1.3927(105)	7b
f, c/d	6.7817(73)	7.4090(122)	0.7239(47)	6.7792(67)	7.40598(121)	0.7181(54)	-'-
$T_0 - 2453210$	3.60467(136)	3.5274(21)	3.1954(97)	3.60427(125)	3.5287(21)	3.1765(113)	-'-
r,mmag	72(4)	43(5)	93(5)	77(4)	43(4)	80(4)	-'-
r/σ_r	16.4	9.7	20.5	17.6	9.8	18.3	-'-

Andronov (1997) for the fast determination of Δt as approximately half of the investigated *period*. Finally we have adopted a value of $\Delta t = 0.^{d}006$. The corresponding values of SN are 4.7 and 5.2 for V and R, respectively.

The values of effective amplitudes are $0^{m}.045$ and $0^{m}.051$ and are smaller than that for 3 photometric waves discussed above. Their ratio corresponds to a color excess of $\Delta(V - R) = -2.5\lg(r_V/r_R) = -0.^{m}12$ in respect to a mean flux. Such a negative value argues for a higher temperature of the emission region, which is responsible for oscillations, and may be located in the hotter inner parts of the accretion disk. This is similar to TT Ari (Tremko et al. 1996, Andronov et al. 1999) and MV Lyr (Andronov & Antoniuk 2005).

The smoothing curves obtained using the method of the running parabolae are shown in Figure 2 together with that for the 3-sinusoidal fit (for the case $7a$ in Table 3). They show quasi-periodic oscillations as well as other components of variability at longer time scales. The ephemeris for the superhump maximum is

$$\text{Max. } HJD = 2453213.60546(96) + 0.14813(10) \cdot E. \tag{1}$$

4. SUPERHUMP PERIOD

Patterson et al. (1997) had detected *negative* superhumps with a period of $0.^{m}1338$-$0.^{d}1345$, which are 3 per cent shorter than the orbital period. Negative superhumps may be explained by a nodal precession of the wobbing accretion disk with an inclination instability (cf. Patterson et al. 1997, Hellier 2001), whereas the positive superhumps may be resulted by an apsidal precession of an accretion disk (cf. Whitehurst 1988, Warner 1995).

Using the statistical relationship between the orbital period P_{orb} and the superhump period P_{sh} in a form $P_{sh} = -0.0057 + 1.112 * P_{orb}$ (Andronov 1990) and the value of the orbital period $P_{orb} = 0.^{d}1385$ (Arenas et al. 2000), one may estimate $P_{sh} = 0.^{d}1483(14)$. This value is in an excellent agreement with the observed one of $0^{\rm d}.14813(10)$. This means that, during our observations, V603 Aql was in a state of positive superhumps. The beat period $P_{so} = P_{sh}P_{orb}/(P_{sh} - P_{orb})$ is expected to be $2^{\rm d}.1$, far from the observed value $3^{\rm d}.9$. Patterson et al. (1997) had found an empirical statistical relation between periods of simultaneously acting positive P_{sh} and negative P_n superhump periods, which may be rewritten in a form $P_n - P_{orb} = -\alpha(P_{sh} - P_{orb})$, where $\alpha = 1.9 \pm 0.4$. Their estimate of the orbital period is $P_{orb} = 0^{\rm d}.13809(12)$ in agreement with that of Arenas et al. (2000).

This relation and two estimates of P_{orb}, allows to calculate a "1σ" corridor for P_n from $0^{\rm d}.1314$ to $0^{\rm d}.1343$. One may note that there is a peak at the periodogram at $0^{\rm d}.13434(10)$ for both V and R (left to the higher one marked as 0.148 in Figure 5). The semi-amplitudes of the variations are $0^m.082$ and $0^m.077$ with $r/\sigma_r = 16.5$ and 15.7, respectively. Thus this peak may be statistically significant, despite its height is less than that of the positive superhump. The value of $0^{\rm d}.13382(5)$ for the 1994 year (Patterson et al. 1997) also well fits within this interval. The corresponding beat period between the negative superhumps and the orbital motion is $P_{no} = P_nP_{orb}/(P_{orb} - P_n)$ and ranges from $2^{\rm d}.8$ to $4^{\rm d}.4$. The observed value $3^{\rm d}.89$ also corresponds to this interval. The explanation of this long period as the beat between the negative superhumps (of smaller amplitude) and the orbital period is unsure, but this is an observed coincidence.

There is a third pair (P_n, P_{sh}), which had been neglected in previous studies. For our data, the range is from $1^{\rm d}.22$ to $1^{\rm d}.48$ with an observed value of $P_{ns} = P_nP_{sh}/(P_{sh} - P_n) = 1^{\rm d}.443$. This period does not correspond to the nearby peak at the period of $0^{\rm d}.8$. However, one may see a distinct peak in Figure 5 between the marks 3.8 and 0.8. The mean period for V and R data is $1^{\rm d}.440(12)$ in an excellent agreement with the predicted value. The corresponding amplitudes are $0^m.090$ and $0^m.081$ ($r/\sigma_r = 18.0$ and 16.4), respectively.

We have tried to obtain a 5-period least squares fit for V and R. Unfortunately, for such large number of parameters, the iterations converge to the values of the period interpreted as P_{so}, which are longer than the duration of observations. Thus we have to reject this solution, despite for the rest periods results for V and R are in a good agreement. Better solution occurs for three periods P_{sh}, P_n, and P_{ns}. The parameters are listed in Table 3 and marked as 7b. The amplitudes are large enough to be statistically significant for all periods. However, the r.m.s. deviation from the fit is by $\sim 3\%$ larger than for the case 7a, which corresponds to 3 periods P_{sh}, P_{so}, anc 0.8. For $n = 1382$ observations, this loss of accuracy is significant. So, from these data, the case 7a should be preferred, despite of the 0.8 period has no explanation yet.

5. CONCLUSIONS

The analysis of two-color VR photometry of V603 Aql obtained in July 2004 in the Observatori Astronòmic de Mallorca, had lead to the following results:

- The superhump period was $0^{\rm d}.14813(10)$, in an excellent agreement with the value expected from the statistical positive superhump - orbital period relation by Andronov (1990), so the system was in a state of the positive superhumps;

- The $daily - scale$ photometric wave had a period of $3^{\rm d}.9$, nearly twice larger than $2^{\rm d}.1$ expected from the superhump-orbital beat model;

- In the present data, one may suggest a wave with a $0^{\rm d}.85$ period with some similarity to the nova-like variable TT Ari and to the ex-Nova V2275 Cyg; the negative superhump and beat waves between the positive and the negative superhumps seem to be statistically significant, but the 5-period solution may not be justified from the present data; For checking its realiability and stability, the multi-site observations are needed to get sufficiently *long* light curves combining data from different longitudes;

- The amplitudes of all detected components of variability are the same in V and R within few per cent, except quasi-periodic oscillations with a time scale of 18 minutes and semi-amplitudes $0^m.051$ and $0^m.045$ for V and R, respectively;
- Because of the multi-component character of variability, it is recommended to make observational campaigns to observe at least (4^h) per night to cover a complete superhump period; 5-8 nights per year are needed to determine parameters of the variability components in the further study of their year-scale variations;

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