PHOTOMETRIC OBSERVATIONS AND PERIODS CHANGES FOR THREE RR LYRAE TYPE STARS: DM CYG, V341 AQL and AV PEG

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ABSTRACT. During observational period 2006-2007 the CCD photometric observation with V system for three RR Lyr type stars: DM Cyg, V341 Aql and AV Peg have been carried out. It was the light curves obtained and the maxima moments were determined. For the purpose of periods changes variation the graphics of O - C was plotted for long term intervals of time, containing several dozen of years, having applied the early published moments of light variations maxima. From these data the new elements for determine of light variations maxima was calculated.

Key words: RR Lyrae – stars: individual (DM Cyg, AV Peg, V341 Aql).

1. Introduction

This photometric study for three RR Lyr stars was undertaken to continue the numerous investigation of RR Lyr stars, which in Astronomical Observatory of Odessa National University were made.

The photometric observation of stars were carried out using the 48 cm reflector AZT-3 with the f/4.5 Newtonian focus and CCD photometer with V filter of UBV system. The CCD photometer was created using CCD chip Sony ICX429ALL, hermetic housing and thermoelectric (Peltier) cooler, which provide a temperature difference between the crystal and the environment of about -30^oC – -40^oC. The exposure time for variable and comparison stars for the most part were choosed for more brightest comparison stars to except a saturation of frame and consist 10 - 15 sec. Evening and morning twilight flat-field frames were obtained for each night to flatten the raw CCD frames. For CCD differential photometry a program was used that performed CCD control, image processing, and aperture photometry. The procedures for the aperture photometry are composed of the dark-level and flat-field corrections and determination of the instrumental magnitude and precision. The mean measurement error was about 0.01 - 0.02 mag.

2. DM CYG

DM Cyg is known as RR Lyr-star type (RRAB) with amplitude $10.^m93 - 11.^m99$ (V), has spectrum A9-F6 and period $0.^d41986$, Kholopov et al. (1985).

The variability was found by L.P.Tserasskaya (1928). The star thoroughly was investigated by D.Ya.Martynov, which determined the primery elements of period. V.P.Tsessevich referred this star to type the stars with suddenly variations of period.

From 500 CCD images of variable DM Cyg were determined the magnitudes comparatively of comparison stars Tycho 2707-01803-1. The phase curves were computed from elements:
Max HJD=2442582.406 + 0.4198600 * E, Kholopov et al. (1985). The light curves of DM Cyg are shown on fig. 1. Dots are data JD2453993, triangles are JD2453995, squares are JD2453985, asterisks are 2454391. The moments of light maxima are shown in table 1. The different amplitudes of light variation on figure is a result of the Blazhko effect.

It is interesting to observe a secular variation of period. To construct the updated O-C diagram, all available data from literature have been collected: (Tsesevich, 1966; Lysova et al., 1980; Braune et al., 1967; Batyrev, 1962; Born et al., 1955; Fitch et al., 1966; Agerer, 2003; Hubscher et al., 2005; Le Borgne et al., 2005). The resulting diagram is plotted in Fig. 2. A least-squares linear fit of O-C diagram have been obtained by new formula for light elements:
Max HJD=2425887.5376 + 0.4198596 x E
A greater accuracy gives parabolic formula:
Max HJD=2425887.561 + 0.4198569 * E+
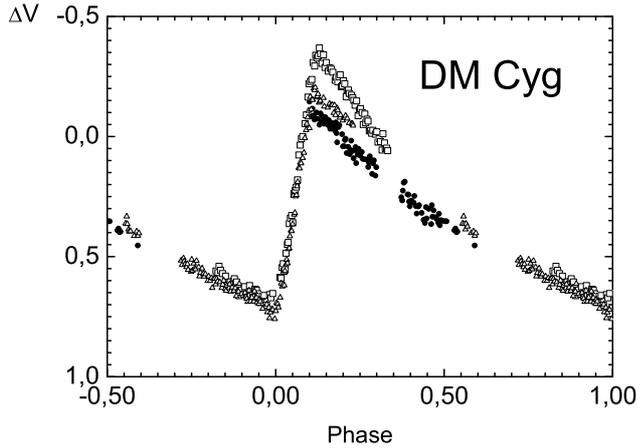$+(4.5*10^{-11})*E^2$.

Figure 1: Light curves of DM Cyg. Dots are JD2453993, triangles are JD2453995, squares are JD2453985, asterisks are JD2454391
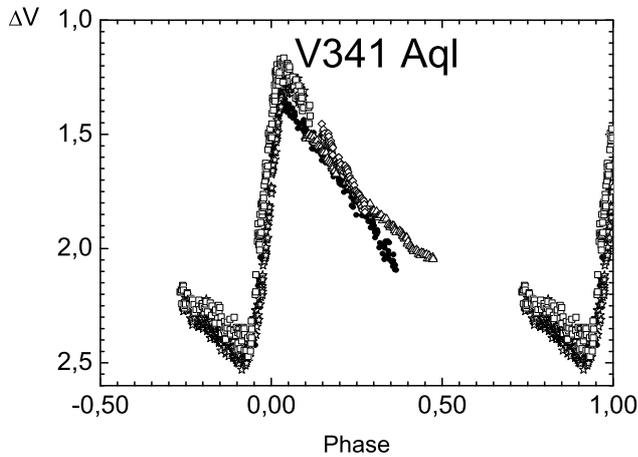

Figure 2: Light curves of V341 Aql. Dots are data JD2453965, triangles are JD2453935, squares are JD2453966, asterisks are 2454362, rhombs are JD2453961
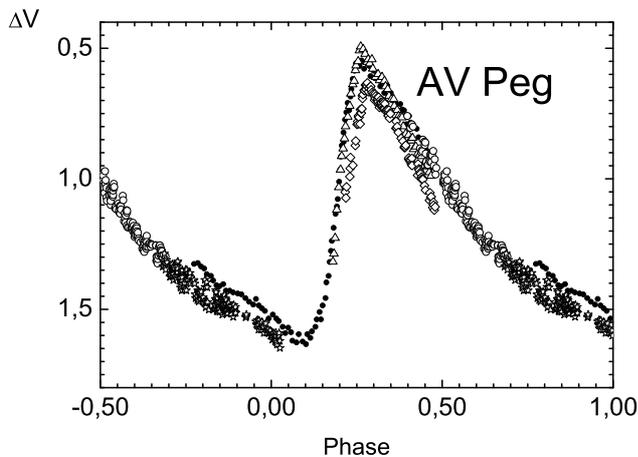

Figure 3: Light curves of AV Peg. Dots are data JD2454028, triangles are JD2454036, open circles are JD2454376, asterisks are JD54378, rhombs are JD2454377

3. V341 Aql

V341 Aql is known as RR Lyr-star type (RRAB) with amplitude $10.^m13 - 11.^m39$ (V), has spectrum A6-F5 and period $0^d.57802054$, (Kholopov et al., 1985).

The variability was found by K.Hoffmeister (1934). The star was investigated by S.M.Selivanov, which determined the primary elements of period. V.P.Tsessevich referred this star to type the stars with light variations proportionally of time.

From 970 CCD images of variable V341 Aql were determined the magnitudes comparatively of comparison stars Tycho 0510-01216-1. The phase curves were computed from elements:
Max HJD=2441196.251 + 0.57802054 * E, Kholopov et al. (1985). The light curves of V341 Aql are shown on fig. 3. Dots are data JD2453965, triangles are JD2453935, squares are JD2453966, asterisks are JD2454362, rhombs are JD2454361. The moments of light maxima are shown in table 1.

Table 1: The moments of light maxima from CCD observations 2006-2007

DM Cyg	2453993.413
	2453995.460
	2453985.380
	2454391.446
V341 Aql	2453965.322
	2453966.480
	2454362.428
AV Peg	2454028.382
	2454036.193
	2454377.386

To construct the updated O-C diagram, all available data from literature have been collected: (Tsessevich, 1966; Stepien, 1972; Fitch et al., 1966; Pojmanski, 2002; Agerer, 2003; Hubscher et al., 2005).

The resulting diagram is plotted in Fig. 4. A least-squares linear fit of O-C diagram have been obtained by new formula for light elements:
Max HJD=2434244.4168 + 0.57902016 x E
A greater accuracy gives parabolic formula:
Max HJD=2434244.401 + 0.578019 * E+ $+(7.2*10^{-11})*E^2$.

4. AV Peg

AV Peg is known as RR Lyr-star type (RRAB) with amplitude $9.^m88 - 10.^m92$ (V), has spectrum A7-F6 and period $0^d.3903747$, (Kholopov et al., 1985).

The variability was found by K.Hoffmeister (1931). After two years H.Shapley and E.Use independently

discovered it on Observatory in Harvard. C.Pain-Gaposhkin and S.Gaposhkin found the variability of light from Harvard photo plates.

V.P.Tsessevich referred this star to type the stars with light variations proportionally of time.

From 820 CCD images of variable AV Peg Aql were determined the magnitudes comparatively of comparison stars Tycho 2202-00987-1. The phase curves were computed from elements:
Max HJD=2443790.316 + 0.3903747 * E, Kholopov et al. (1985). The light curves of AV Peg are shown on fig. 5. Dots are data JD2454028, triangles are JD2454036, open circles are JD2454376, asterisks are JD54378, rhombs are JD2454377. The moments of light maxima are shown in table 1.

To construct the updated O-C diagram, all available data from literature have been collected: (Tsessevich, 1966; Lysova, 1980; Firmanyuk, 1976; Ahnert, 1960; Braune et al., 1967; Fitch et al., 1966; Szeidl et al., 1986; Agerer, 2003; Hubscher et al., 2005; Le Borgne et al., 2005).

The resulting diagram is plotted in Fig. 6. A least-squares linear fit of O-C diagram have been obtained by new formula for light elements:
Max HJD=2418950.0788 + 0.3903732 x E
A greater accuracy gives parabolic formula:
Max HJD=2418950.257 + 0.3903646 * E+ +$(9.0*10^{-11})*E^2$.

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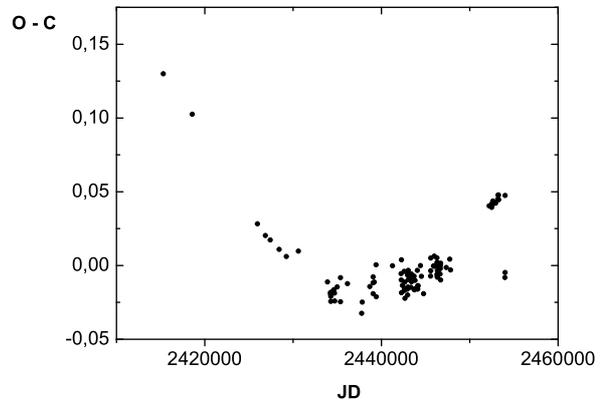
Figure 4: The mean O - C diagram of DM Cyg from 1929 to 2007
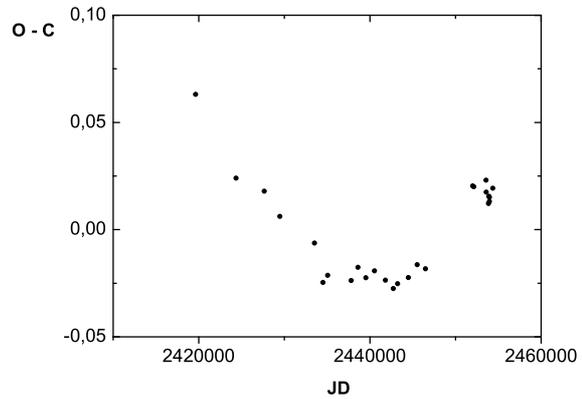

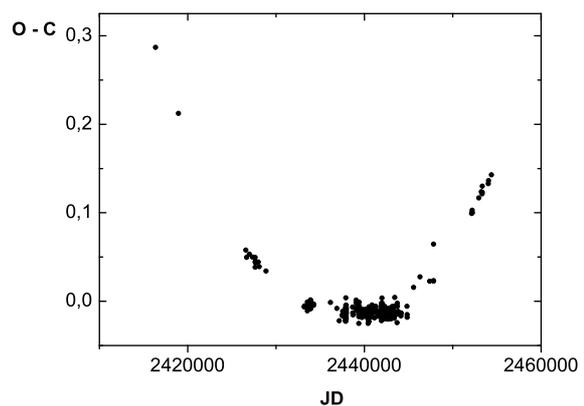Figure 5: The mean O - C diagram of V341 Aql from 1934 to 2007

Figure 6: The mean O - C diagram of AV Peg from 1904 to 2007