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DISCOVERY OF A SHORT-PERIODIC PULSATING COMPONENT IN THE ALGOL-TYPE ECLIPSING BINARY SYSTEM V346 Cyg

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Name of the object:
V346 Cyg

Observatory and telescope:
Mt. Lemmon Optical Astronomy Observatory in USA, 1.0m telescope[1]

Detector:	2K CCD camera

Filter(s):	Johnson B

Date(s) of the observation(s):
November 19, 20, 25, 26, 27, and 28, 2004

Comparison star(s):	2MASS 20193193+3620254

Check star(s):	2MASS 20191838+3621416

Transformed to a standard system:	No

Availability of the data:
Upon request

Method of data reduction:
Standard CCD-frame reduction using the IRAF/DAOPHOT[2] package

[1] Korea Astronomy & Space science Institute (*KASI*) had installed the telescope and has been operating it by remote control from Korea via a network connection.

[2] IRAF is distributed by the National Optical Astronomy Observatories, which are operated by the Association of Universities for Research in Astronomy, Inc., under cooperative agreement with the National Science Foundation.

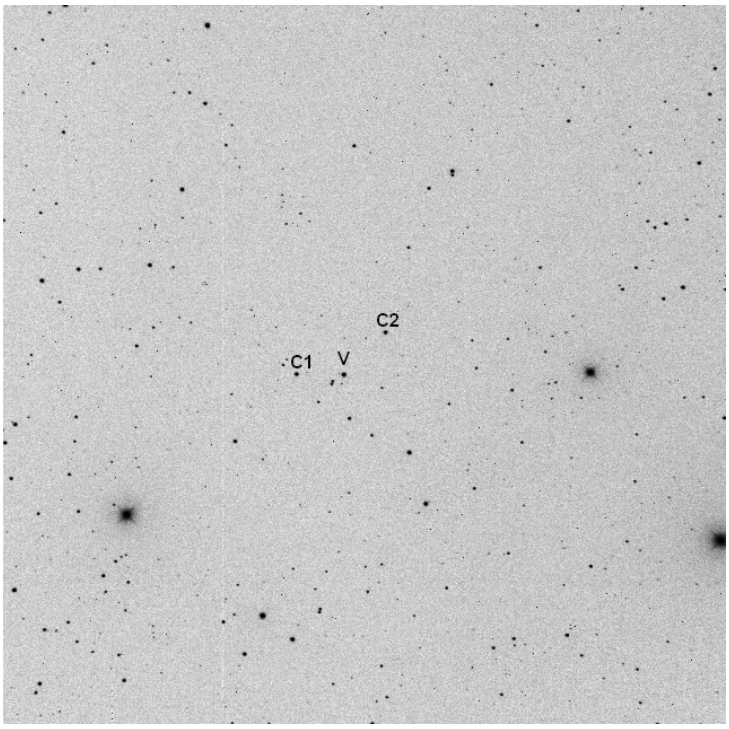

Figure 1. A B-band CCD image ($22\farcm2 \times 22\farcm2$) of the eclipsing binary V346 Cyg (V). North is up and east is to the left. Two stars of 2MASS 20193193+3620254 ($B = 12\overset{\mathrm{m}}{.}354$, $V = 12\overset{\mathrm{m}}{.}128$; Kharchenko 2001) and 2MASS 20191838+3621416 ($B = 12\overset{\mathrm{m}}{.}357$, $V = 11\overset{\mathrm{m}}{.}602$; Kharchenko 2001) were chosen as the comparison (C1) and check (C2) stars, respectively.

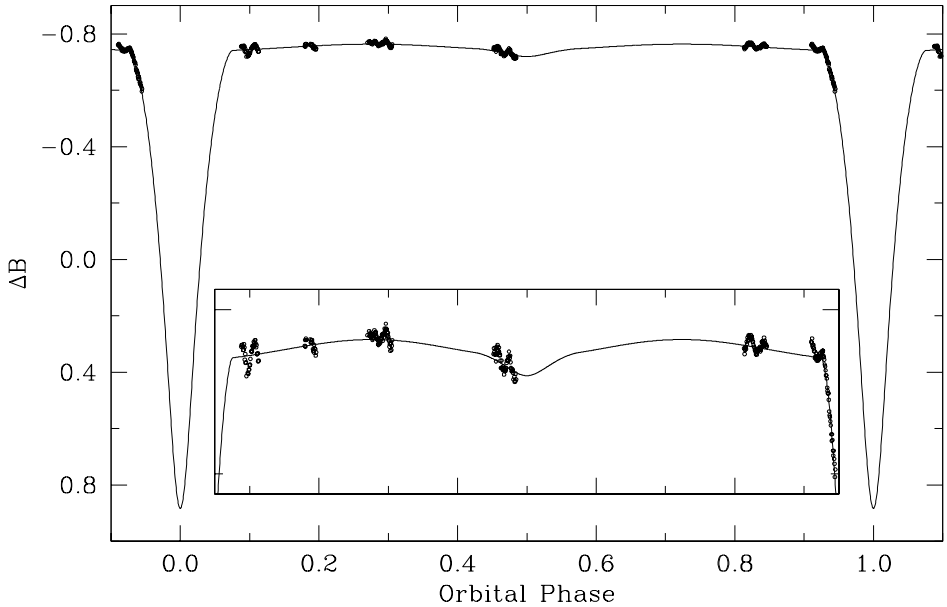

Figure 2. Phase diagram of V346 Cyg in B-passband. The line is a synthetic eclipsing light curve which derived from the 1998-version of Wilson & Devinney (1971) code, taking into consideration of the primary minimum depth of about $1\overset{\mathrm{m}}{.}7$ (Samus et al. 2004) and light curve solution by Surkova & Svechnikov (2004). An enlarged graph for outside the primary eclipse is shown in the inner panel.

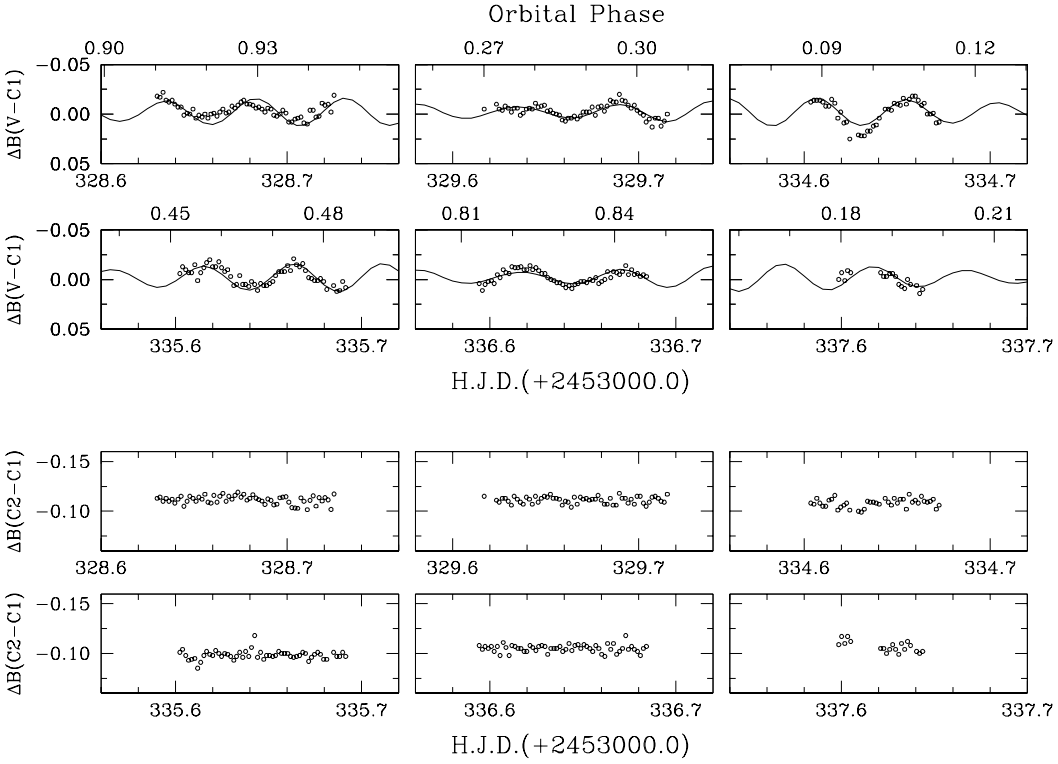

Figure 3. (Upper) Light variations of the residuals after subtracting the synthetic eclipsing light curve from the data. The lines are sinusoidal curves obtained from the multiple frequency analysis. (Lower) Differential magnitudes of the check star, ΔB(C2−C1), are displayed for comparison.

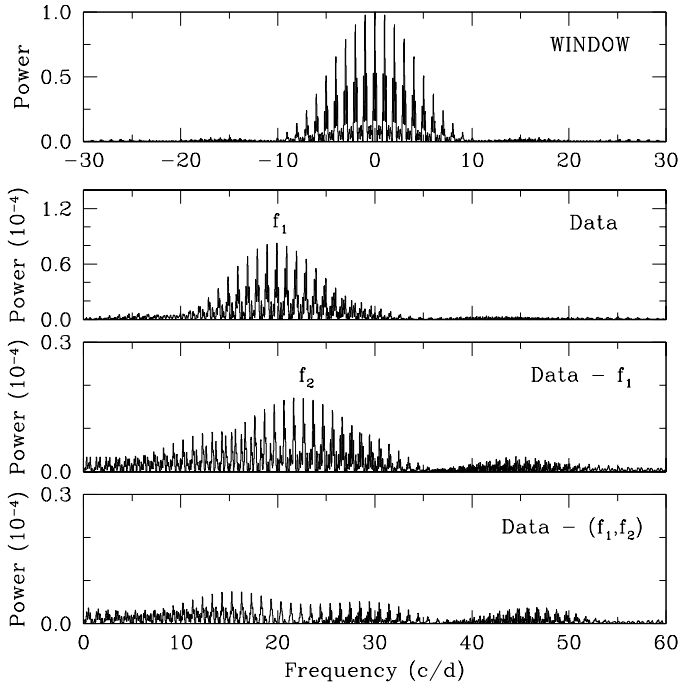

Figure 4. Power spectra of the residuals, except for the data around the primary minimum. The window spectrum is displayed in the top panel. We can detect two frequencies of f_1 = 19.912 c/d and f_2 = 22.636 c/d from the successive pre-whitening procedure (Kim & Lee 1996).

Remarks:

As a part of our photometric survey project to search for A-type pulsating components in eclipsing binary systems (Kim et al. 2003), we monitored the Algol-type semi-detached eclipsing binary V346 Cyg. The observations were performed for six nights in November 2004, about 2 hours per night, with a 2K CCD camera. Exposure time was typically 100 seconds in B-passband. Simple aperture photometry was applied to get instrumental magnitudes with an aperture radius of 8 pixels ($=5''.12$); seeing size was about $2''.5$ during the observing runs.

Phase diagram of V346 Cyg is shown in Figure 2, where orbital phases were calculated with the orbital period of 2.743305 day and the primary minimum epoch of $H.J.D.2452500.398$ (Kreiner 2004). We obtained residuals after subtracting a synthetic eclipsing light curve from the data. Amplitudes of their variations change from cycle to cycle (Figure 3), implying that the variable star has multiple periods. Power spectra of the residuals were obtained from the multiple frequency analysis (Kim & Lee 1996), displayed in Figure 4. We could detect two frequencies of $f_1 =$ 19.912 c/d (cycles per day) and $f_2 = 22.636$ c/d from the successive pre-whitening procedure.

In conclusion, our observations show that the primary component of V346 Cyg has δ Scuti-type pulsational characteristics such as periods of about 1.2 hours, peak-to-peak amplitudes of about $0^m.03$ in B-passband, multi-periodicity, and spectral type of A5 (from the CDS). Considering these pulsational characteristics and the semi-detached binary configuration (Budding et al. 2004; Samus et al. 2004), we suggest that V346 Cyg is a new member of the oscillating EA (oEA) stars, a group of mass-accreting pulsating components in Algol-type semi-detached eclipsing binary systems (Mkrtichian et al. 2004); the oEA stars have different evolutionary stage from classical δ Scuti-type pulsators. Then the number of the oEA stars has increased seventeen (Mkrtichian et al. 2005; Kim et al. 2005).

Acknowledgements:

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