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CCD PHOTOMETRY OF THE FIELD OF EX CANCRI

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During a test course of our CCD photometer, the Johnson V photometry of the field of EX Cancri in the old open cluster M67 was obtained. This note presents the preliminary results for four of the observed variables: EX Cnc, ES Cnc, EV Cnc and AH Cnc. EX Cnc is a δ Sct star and is now found to be a multiperiodic pulsator; ES Cnc is an EA binary, i.e. an Algol-type eclipsing system; EV Cnc and AH Cnc are two EW/KW binaries, i.e. they are contact systems of the W Ursae Majoris-type eclipsing variables, with ellipsoidal components of F0-K spectral type.

The observations were carried out with a red-sensitive Thomson TH7882 576×384 CCD photometer (Wei et al. 1990; Zhou et al. 2001) on the 85-cm Cassegrain telescope at the Xinglong Station of the Beijing Astronomical Observatory of China in 2000. The CCD has an imaging size of 13.25×8.83 mm^2 corresponding to a sky field of $12\farcm3 \times 8\farcm4$ ($1\farcs2$/pixel, a pixel size is 23 μm^2). Among the stars observed in the field of EX Cnc, followings were selected as reference:

C1 = GSC 00814_01205 ($\alpha = 08^{\rm h}51^{\rm m}27\fs02$, $\delta = 11°51'52\farcs5$, 2000.0, 10.8 V),
C2 = GSC 00814_01425 ($\alpha = 08^{\rm h}51^{\rm m}31\fs94$, $\delta = 11°51'16\farcs6$, 2000.0, 10.4 V),
C3 = GSC 00814_01311 ($\alpha = 08^{\rm h}51^{\rm m}32\fs16$, $\delta = 11°50'03\farcs5$, 2000.0, 12.5 V),
C4 = GSC 00814_01147 ($\alpha = 08^{\rm h}51^{\rm m}29\fs01$, $\delta = 11°50'33\farcs0$, 2000.0, 9.9 V),
C5 = GSC 00814_01981 ($\alpha = 08^{\rm h}51^{\rm m}39\fs24$, $\delta = 11°50'03\farcs6$, 2000.0, 12.2 V).

The atmospheric extinction was not taken into account in view of the close spacing of the observed stars. However, it can be largely eliminated by subtracting a linear-fitted line from the differential light curves if they are significantly affected by the changing air mass during a night. The differential colour effects between the variables and the reference stars were not significant. The differential magnitudes for these four variables are established as (EX Cnc − C4 or C1), (ES Cnc − C2), (EV Cnc − C3) and (AH Cnc − C5). The magnitude differences between the comparison stars generally show a typical standard deviation of $0\fm010$. For the nights of photometric quality a better value of about $0\fm006$ was obtained. All the above comparison stars were detected to be non-variables at the accuracy of observation. Exposure times were 30 s and all data were sampled into 60-s bins.

A preliminary Fourier analysis based on the data of EX Cnc collected on six nights (9, 10, 26, 27, 28 and 29 February 2000) demonstrates that the light variations of EX Cnc can be roughly fitted with three pulsation frequencies $f_1 = 17.9978$, $f_2 = 19.5674$ and $f_3 = 20.6559$ cycle d^{-1} having semi-amplitudes of $0\fm0047$, $0\fm0058$ and $0\fm0039$, respectively.

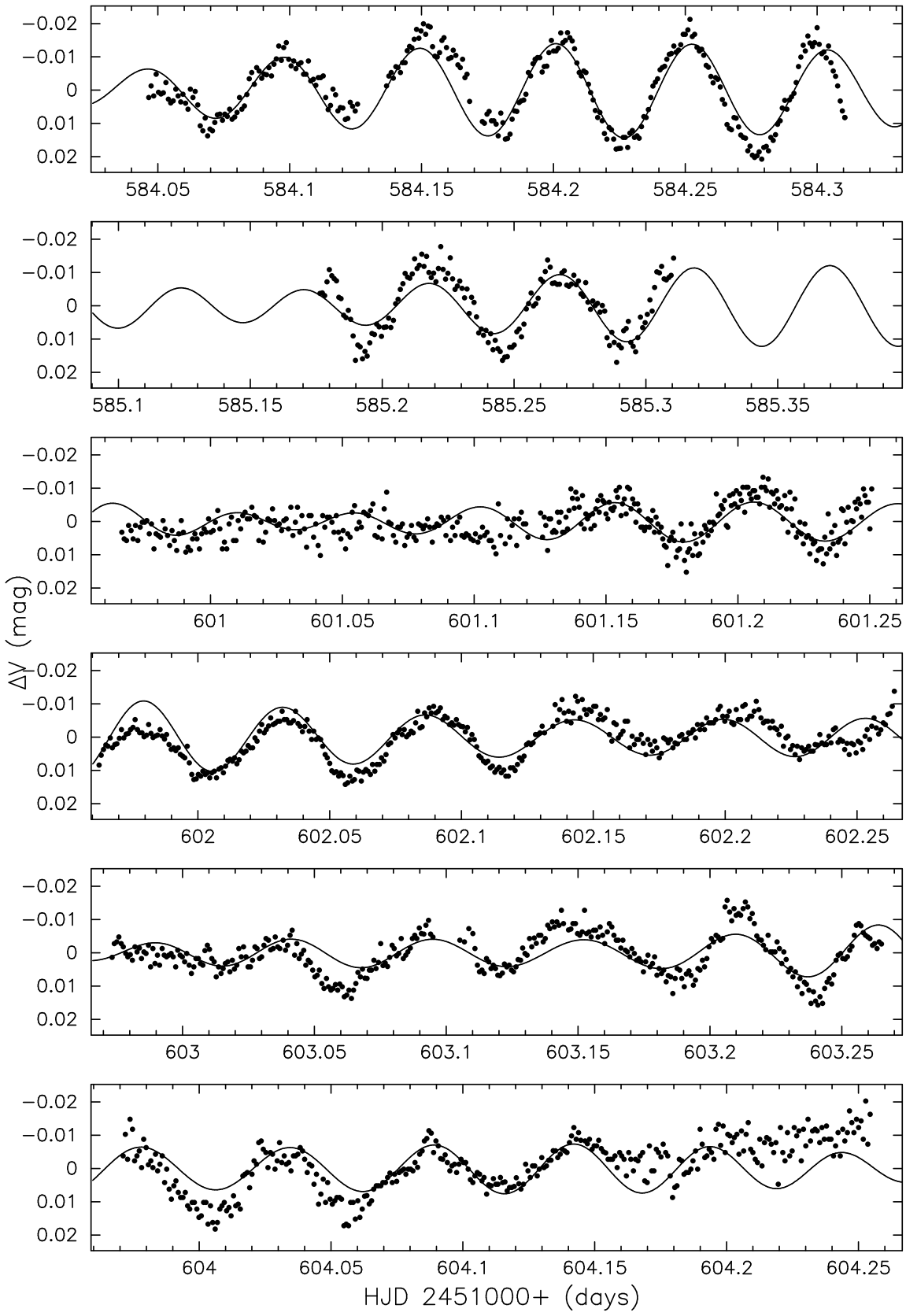

Figure 1. CCD differential light curves of EX Cnc from 9, 10, 26, 27, 28 and 29 Feb. 2000

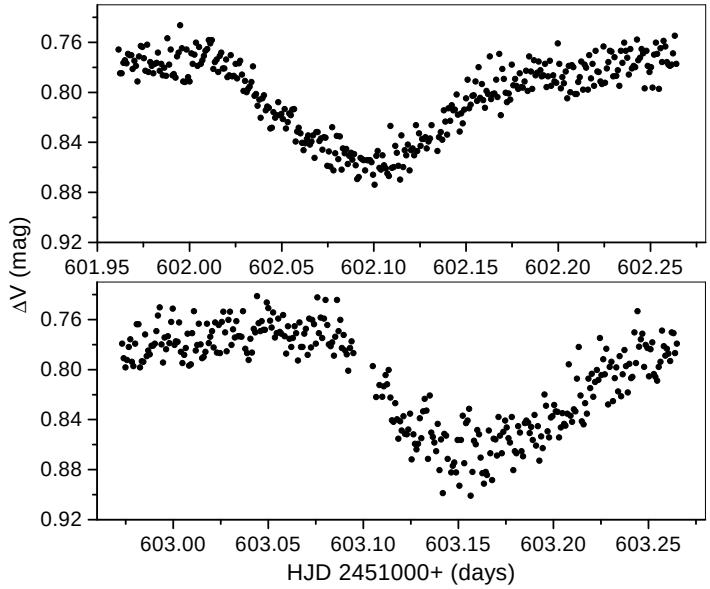

Figure 2. CCD differential light curves of ES Cnc from 27 and 28 Feb. 2000

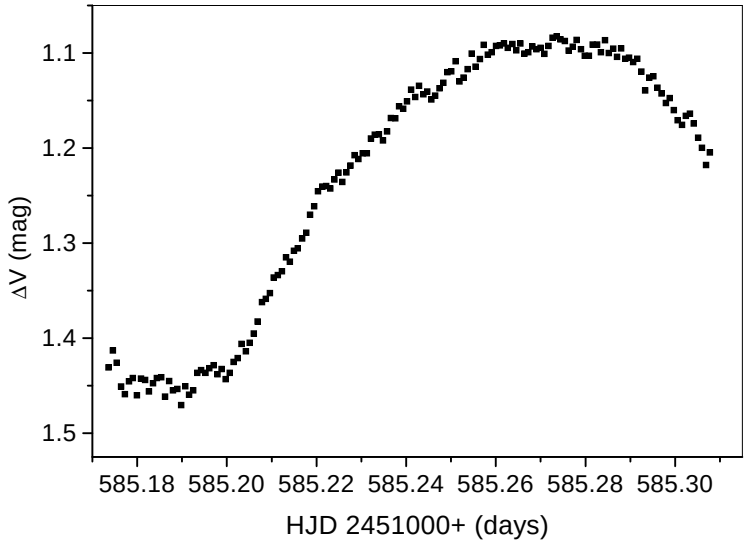

Figure 3. CCD differential light curves of AH Cnc from 10 Feb. 2000

The fitting yields the residuals with a standard deviation of $\sigma = 0\overset{m}{.}0049$, conforming to the observational accuracy. The results suggest EX Cnc is a multi-mode pulsator. Figure 1 depicts the observed (dots) and fitted (lines) light curves of EX Cnc from the six nights. When looking at the third panel and the last two panels of Figure 1, however, we note the poor fit occurred for the leading part of 26 February, the ending part of the night 29 February and the most data from 28 February. The reason for the former two cases might be resulted from bad seeing. For the latter case, it seems that additional frequencies are still not uncovered.

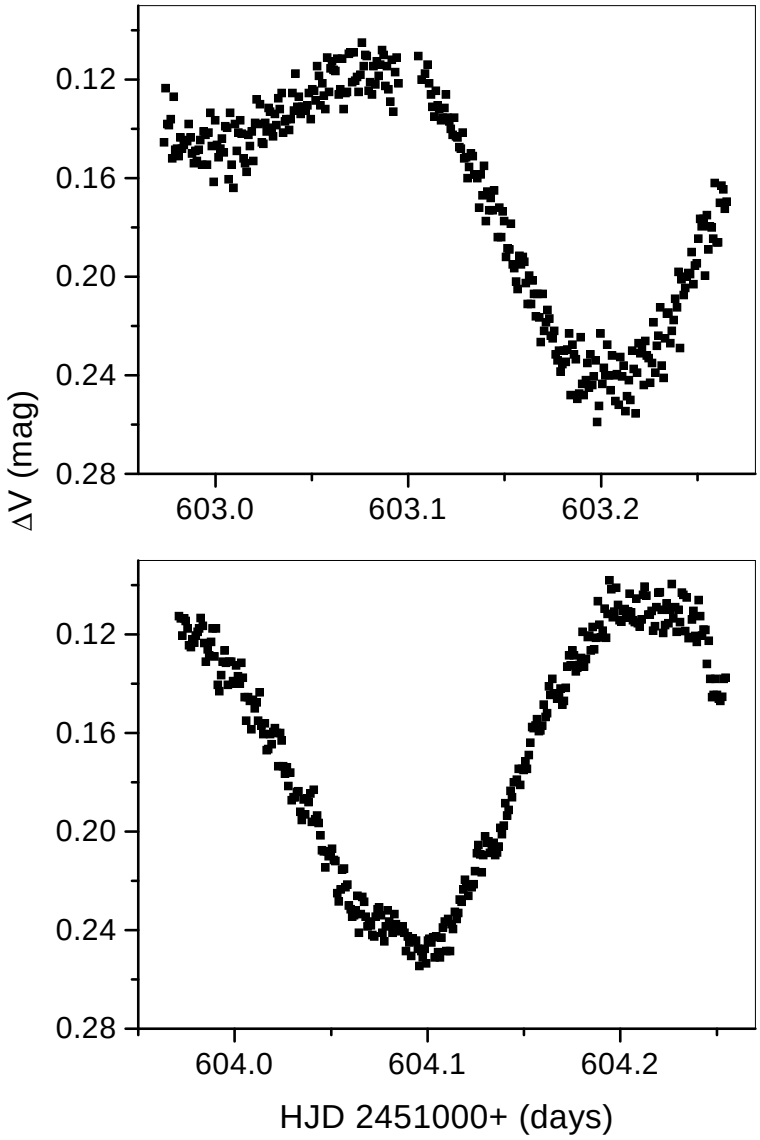

Figure 4. CCD differential light curves of EV Cnc from 28 and 29 Feb. 2000

During the test course, except the centered target EX Cnc, other observed stars in the field were arbitrarily selected from night to night because of the task of instrument test and variables survey. Therefore the three other binaries were not continuously observed with EX Cnc over all the six nights. Figures 2–4 present the light curves we obtained during this course. Detailed information for the binaries needs further observations and studies. The time-series data are available upon request from the author.

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