COMMISSIONS 27 AND 42 OF THE IAU
INFORMATION BULLETIN ON VARIABLE STARS

Number 6040

Konkoly Observatory
Budapest
24 November 2012

HU ISSN 0374 – 0676

A NEW VARIABLE STAR: GSC 02936-00267

ZHANG, Y.P.[1]; YAN, K.Z.[1]; FU, J.N.[1]; BAI, Y.[1]; ZHANG, C.[2]; ZHA, Q.[1]

[1] Department of Astronomy, Beijing Normal University, Beijing 100875, China. e-mail: zhangyp@bnu.edu.cn

[2] National Astronomical Observatories, Chinese Academy of Sciences, Beijing 100012, China

During the observations of the eclipsing binary GSC 2936-0478 (Yang et al. 2005) with the 85-cm telescope at Xinglong Station of National Astronomical Observatories of China on January 15, 2008, a new variable star was discovered in the field of view. The new variable star was identified to be GSC 02936-00267 according to the GSC 1 catalog (Morrison et al. 2001), which was named as GSC N8QG000518 in GSC 2.3 (Lasker et al. 2008) and 06361162+4200575 in 2MASS Point Source Catalog. The coordinates of the star is R.A. = $06^{\rm h}36^{\rm m}11\overset{\rm s}{.}61$, DEC=$+42°00'58\overset{''}{.}7$ (epoch=J2000), $V = 13\overset{\rm m}{.}58$.

Time-series photometric observations were made for the field of GSC 02936-00267 with the 85-cm reflecting telescope at Xinglong station. A PI 1024×1024 BFT CCD camera was mounted at the primary focus of the telescope (Zhou et al. 2009). Each pixel of the CCD camera scales $0.96''$ on the sky, leading to a field of view of $16.5' \times 16.5'$. The CCD camera was equipped with a set of standard Johnson-Cousins-Bessell $UBVRI$ filters. Observation dates, available frames and exposure time in the different filters are listed in Table 1.

Table 1. Observation dates, available frames and exposure time in the different filters

Observation date	Filter /available frames	Filter /exposure time
Jan. 15, 2008	$B/225$, $V/225$	$B/80$ s, $V/45$ s
Dec. 08, 2010	$R/112$, $V/112$	$V/80$ s, $R/60$ s
Dec. 11, 2010	$R/155$, $V/148$	$V/80$ s, $R/60$ s
Dec. 13, 2010	$R/66$, $V/71$	$V/80$ s, $R/60$ s
Jan. 21, 2011	$R/140$, $V/140$	$V/90$ s, $R/50$ s
Jan. 22, 2011	$R/136$, $V/138$	$V/90$ s, $R/50$ s
Jan. 26, 2011	$R/158$, $V/158$	$V/90$ s, $R/50$ s

Four reference stars and one check star, as shown in Figure 1, were chosen to obtain differential photometry for the target star. Names, coordinates and magnitudes of these stars are listed in Table 2.

We used the software package IRAF[1] for data reduction and aperture photometry. The same apertures were used for the 6 stars and light curves of $m_{Chk}-(m_{Ref1}+m_{Ref2}+m_{Ref3}+m_{Ref4})/4$ and $m_{Obj}-(m_{Ref1}+m_{Ref2}+m_{Ref3}+m_{Ref4})/4$ were calculated, where m denotes

[1]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.

magnitude. By choosing the light curves of $m_{Chk} - (m_{Ref1} + m_{Ref2} + m_{Ref3} + m_{Ref4})/4$ which have the smallest value of dispersion, we could determine the best aperture for photometry and obtain light curves of the target star and the check star relative to the reference stars. Light curves of the target star in V are shown in Figure 2.

Table 2. Names, coordinates and magnitudes of the reference stars and check star

Number	Name	$\alpha_{2000.0}$ hh:mm:ss	$\delta_{2000.0}$ ° ′ ″	Magnitude (V)
Ref1	GSC 02936-00201	06 36 05.62	+41 59 59.1	13.86
Ref2	GSC 02936-00284	06 35 45.11	+42 01 26.4	13.56
Ref3	GSC 02936-00466	06 35 21.54	+42 04 09.8	12.85
Ref4	GSC 02936-00460	06 36 23.30	+42 04 00.1	12.67
Chk1	GSC 02936-00417	06 35 56.05	+42 05 41.9	13.24

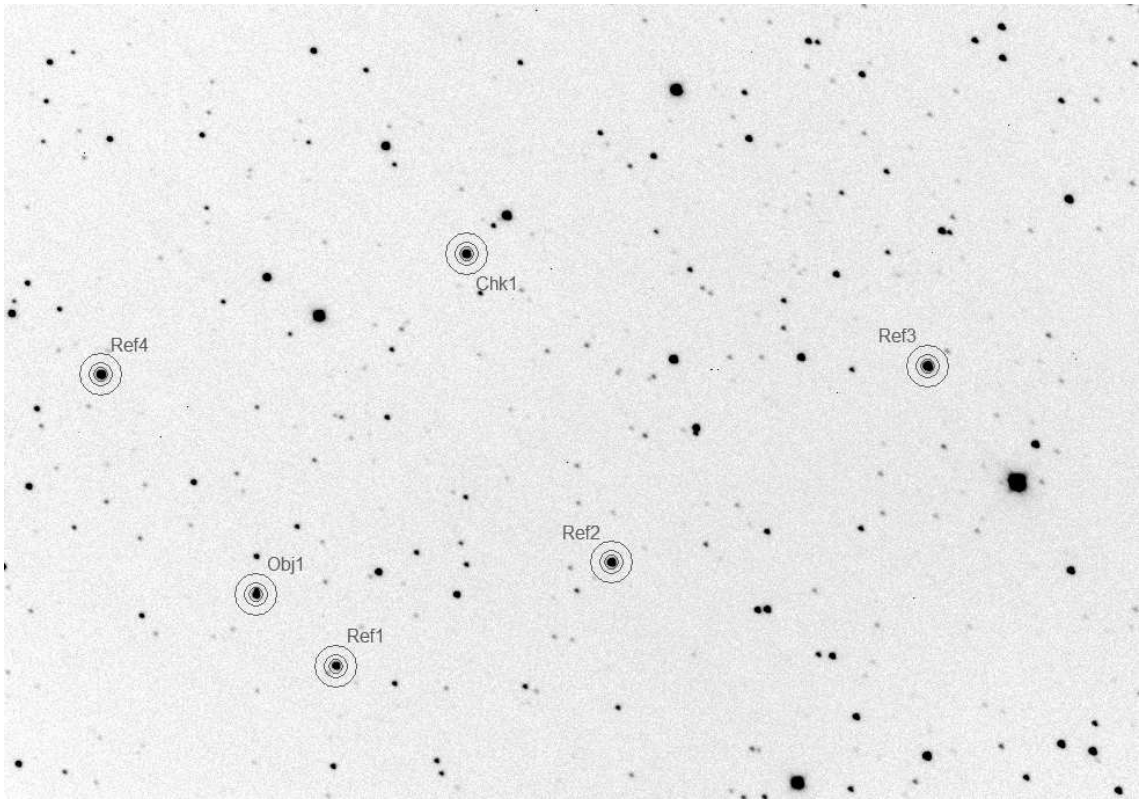

Figure 1. Observed field of GSC 02936-00267 (Obj). The reference stars (Ref) and check star (Chk) are also marked. The size of the FOV is $16.5' \times 12'$.

On 20 November 2011, the OMR low-dispersion spectrograph mounted on the 2.16-m telescope at Xinglong station was used to take a spectrum of GSC 02936-00267. The slit width was $2''.2$. The reciprocal linear dispersion of the grating is 200 Å/mm or 9.36 Å/pixel. The spectral range is 400 nm — 800 nm. The central wavelength is 600 nm. The spectrum is shown in Figure 3.

From the spectrum of the star GSC 02936-00267, we identified the spectral lines of $H_\alpha, H_\beta, H_\gamma, H_\delta$ and the spectral line of sodium at 589 nm. According to the reference of

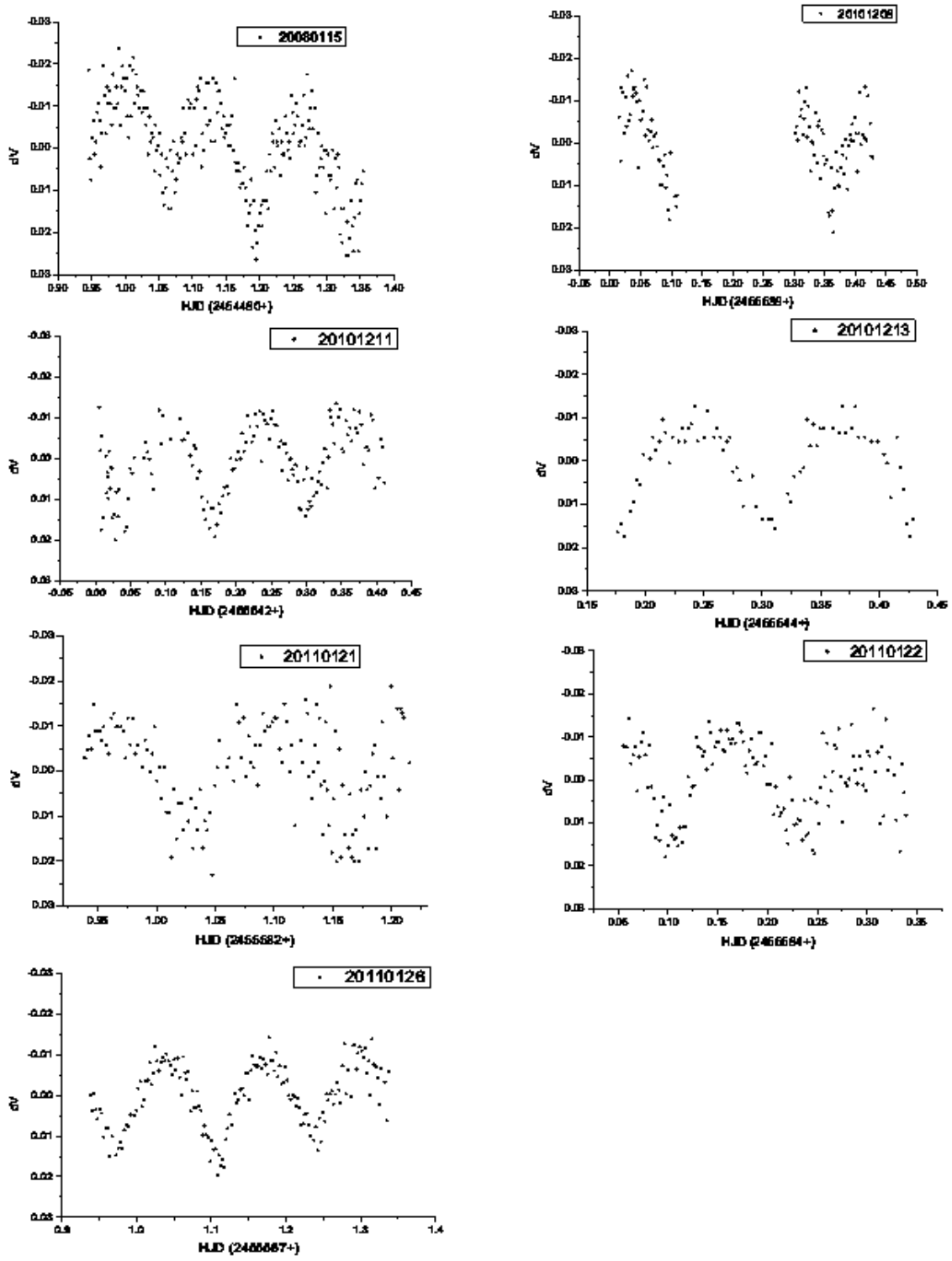

Figure 2. Light curves of GSC 02936-00267 in V

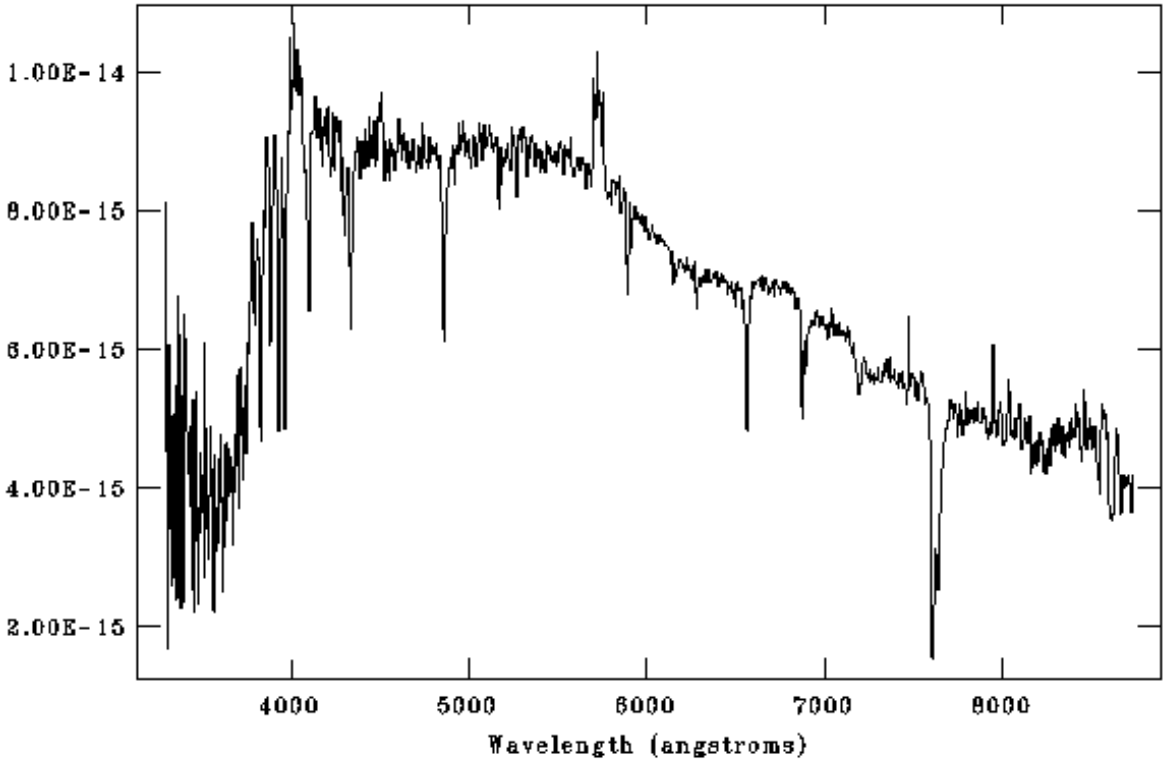

Figure 3. Low-dispersion spectrum of GSC 02936-00267. The y axis is the flux in erg $s^{-1}cm^{-2}Å^{-1}$.

Pickles Atlas (Pickles 1998), we identified the spectral type of GSC 02936-00267 as F2V based on the ratio of depths of the spectral lines of H_α and of sodium at 589 nm. We note that there is a strong emission line with a central wavelength of 572.5 nm and full width at half maxium of around 6.5 nm. Since there was a fainter star very close to GSC 02936-00267 in the slit during the observations, we suspect that the emmission line was created by the fainter star whose spectral type is unknown. This needs to be confirmed with spectroscopic observations for the two stars respectively with larger-aperture telescopes.

The software package Period04 (Lenz & Breger 2005) was used to analyze pulsation periods of GSC 02936-00267. The results ot the analysis are as follows:

Main frequency $(f_1) = 7.488423\ \mathrm{d}^{-1}$

Amplitude of the main frequency $(A) = 0\overset{\mathrm{m}}{.}010 \pm 0.001$ mag

$T_{\mathrm{Max}} = \mathrm{HJD}\ 2454480.99916 + 0\overset{\mathrm{d}}{.}133539(5) \times E$.

According to the pulsation frequency and the spectrum of GSC 02936-00267, we classify it as a δ Scuti type variable.

Since there is a faint neighboring star ($V = 13\overset{\mathrm{m}}{.}58$) very close to GSC 02936-00267, and because the amplitude of pulsation is small ($A \sim 0\overset{\mathrm{m}}{.}01$), more time-series photometric data and spectroscopic observations are needed to confirm the spectral type classification and check the pulsation period.

Acknowledgments: We acknowledge the support from National Natural Science Foundation of China (NSFC), through the Grants 10778601 and U1231202. The research is partially supported by National Basic Research Program of China (973 Program 2013CB834900) and the fundamental Research Funds for the Central Universities.

References:

Lasker, B.M., Lattanzi, M.G., McLean, B.J. et al. 2008, *AJ*, **136**, 735
Lenz, P., and Breger, M. 2005, *Commun. Asteroseismol.*, **146**, 53
Morrison, J.E., Roeser, S., McLean B., Bucciarelli, B., Lasker, B. 2001, *AJ*, **121**, 1752
Pickles, A.J. 1998, *PASP*, **110**, 863
Yang, Y.G., Qian, S.B., Gonzalez-Rojas, D.J. and Yuan, J.Z. 2005, *ApSS*, **300**, 337
Zhou, A.Y., Jiang, X.J., Zhang, Y.P., Wei, J.Y. 2009, *Res. Astron. Astrophys.*, **9**, 349