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**CONFIRMING THE DELTA SCUTI NATURE OF GSC 02696-02622**

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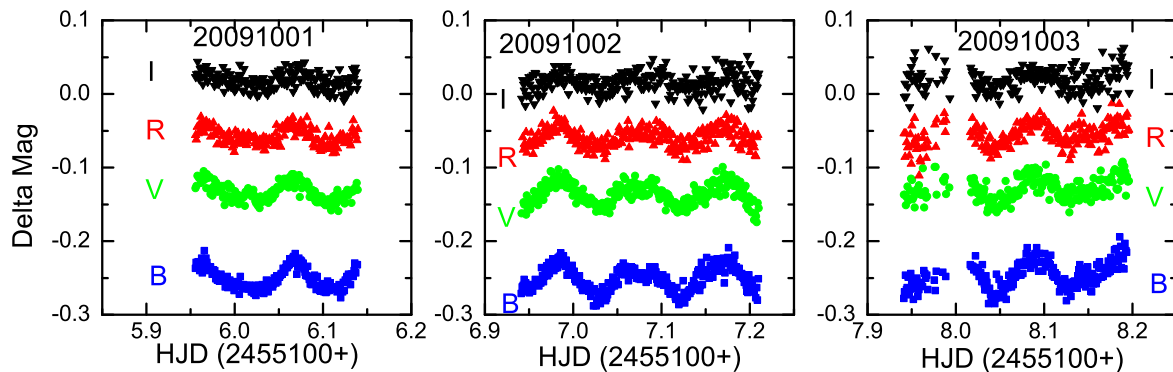
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GSC 02696-02622 ( $\alpha_{2000}=20^{\text{h}}58^{\text{m}}02^{\text{s}}.6$ ,  $\delta_{2000}=+35^{\circ}09'19''.4$ ; 2MASS J20580154+3509196) is a bright star ( $B = 10^{\text{m}}.77$ ,  $V = 10^{\text{m}}.39$ ; Høg et al. 2000). GSC 02696-02622 has been chosen several times as a comparison star by Yu (1923) and Dapergolas et al. (1988). Since 1991, this star has been suspected to be a variable star (Heckert & Zeilik 1991). In 2008, the observations of Hambalek (2008) showed very small variations ( $\Delta B \cong 0.07$  mag,  $\Delta V \cong 0.05$  mag,  $\Delta R \cong \Delta I \cong 0.04$  mag). Recently, Nanouris & Antonopoulou (2010) found the star to be variable by 0.04 mag and 0.08 mag in  $B$  and  $V$  filters, respectively. In this paper, we present our new higher time-resolution light curves and SuperWASP data of GSC 02696-02622, and discuss its properties.

Our new photometric observations were carried out on three consecutive nights (Oct. 1, 2 and 3, 2009) with the 85-cm telescope of Xinglong station of the National Astronomical Observatories of China (NAOC). The photometer was equipped with a  $1024 \times 1024$  pixel CCD and the standard Johnson-Cousins-Bessell  $BVRI$  filters (Zhou et al. 2009). Each pixel of the CCD camera covers about  $0.96''$  on the sky, leading to a field of view of  $16.5' \times 16.5'$ . Exposure times were 7, 4, 3 and 2 s in  $B$ ,  $V$ ,  $R$ , and  $I$  bands, respectively. All observed CCD images were reduced by means of the IRAF\* package in the standard fashion. The star GSC 02696-02207 and the star ( $\alpha_{2000}=20^{\text{h}}57^{\text{m}}50^{\text{s}}.5$ ;  $\delta_{2000}=+35^{\circ}15'11''.4$ ) served as comparison and check stars, respectively. Figure 1 shows the light curves of GSC 02696-02622. The errors of individual points are about 0.007 mag in all bands. The photometric observations are made available online at the IBVS website (*6053-t2.txt*), as Heliocentric Julian Date (HJD) and the delta magnitude (Variable minus Comparison star) in  $BVRI$  bands.

Our light curves show that GSC 02696-02622 is obviously an oscillating variable. To search for periodicity of the light variation, a Fourier analysis was performed by using the software package Period04 (Lenz & Breger 2005). The  $BVRI$  amplitude spectra of GSC 02696-02622 for our data are given in Figure 2, and the spectral window of GSC 02696-02622 in  $B$  band is plotted in Figure 3. At the same time, we also collected published data (<http://www.wasp.le.ac.uk/public/lc/index.php>) of GSC 02696-02622 (see Figure 4, *6053-t3.txt*) from the SuperWASP photometric survey (Polacco et al. 2006). The amplitude spectra and spectral window of the SuperWASP

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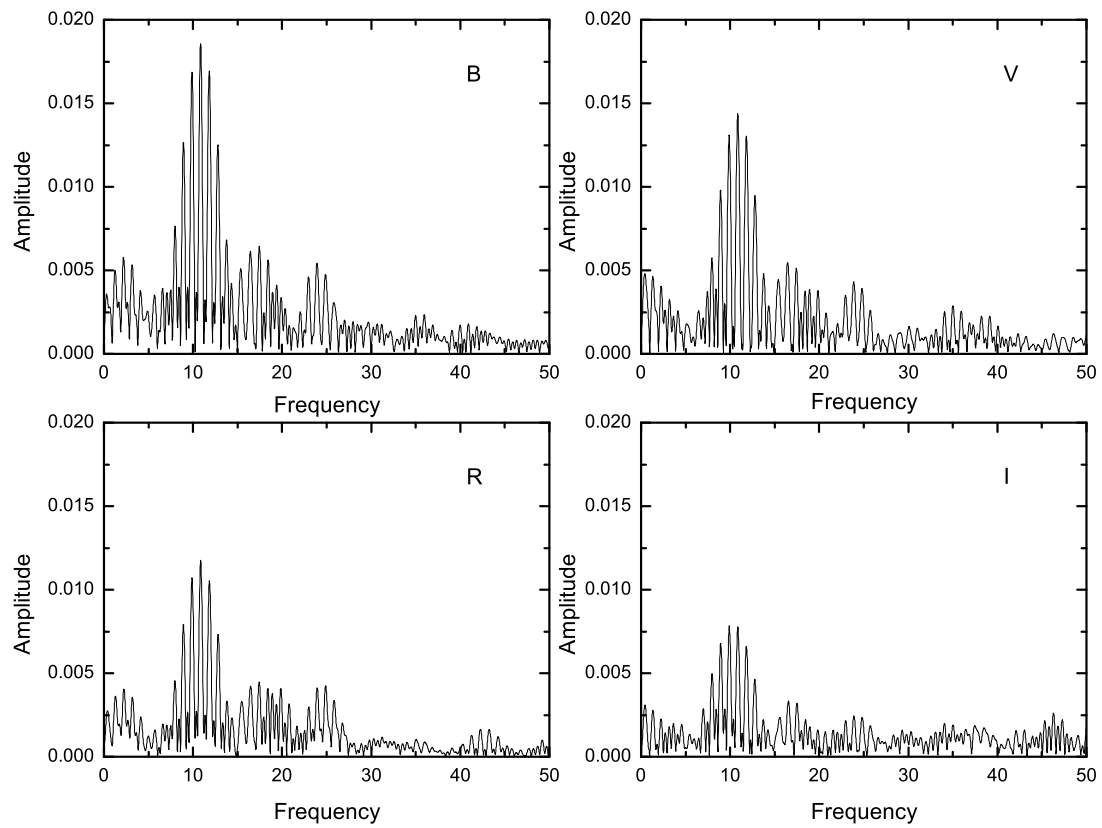


**Figure 1.** New Light curves for GSC 02696-02622 at Xinglong station, NAOC, in Oct. 2009.

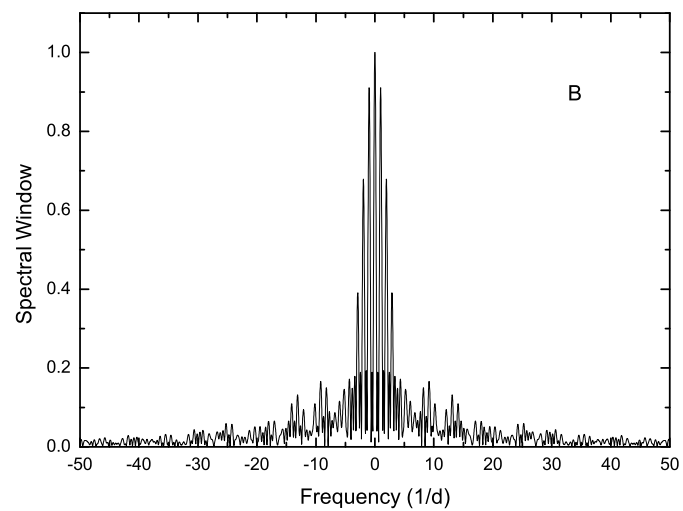
data for GSC 02696-02622 are plotted in Figures 5 and 6, respectively. The results of the frequency analysis for GSC 02696-02622 are given in Table 1. The errors of the amplitudes were determined by using the formal least-squares method, which tend to be smaller than the real errors (Montgomery & O’Donoghue 1999). For our data, maximum amplitudes are 0.0185 mag, 0.0144 mag, 0.0118 mag, and 0.0077 mag in *BVRI* band, respectively. For the SuperWASP data, maximum amplitude is 0.0135 mag in *V* band, which is similar to the result from our data of *V* band. Our obtained amplitudes are smaller than the previous results (Hambalek 2008; Nanouris & Antonopoulou 2010). This is an indication that the amplitude might vary. This phenomenon was also found in other delta Scuti stars, such as BR Cancri (Zhou et al. 2001). The dominant oscillation period of GSC 02696-02622 is about 2.21 hours for *BVR* bands. Other potential frequencies are weak, as can be seen from the frequency spectra (Figures 2 and 5). Because the data in the *I* band show larger scatter, we used the frequency of the other bands to calculate the amplitude value of the *I* band. Our results of oscillation period are similar to the previous results (Hambalek 2008; Nanouris & Antonopoulou 2010). The star’s colour index  $J - H = 0.126$  mag (Cutri et al. 2003) corresponds to effective temperature of  $6638 \pm 92$  K (Collier Cameron et al. 2007), which suggests the spectral type to be about F5. The main period and amplitude are wholly consistent with delta Scuti pulsation. Therefore, we confirmed that it is a  $\delta$  Scuti variable star with an amplitude smaller than 0.02 mag. More time-series photometric data and spectroscopic observations are needed to determine a more accurate spectral type and study the multi-periodic nature of the pulsation.

**Table 1.** The pulsation properties of GSC 02696-02622.

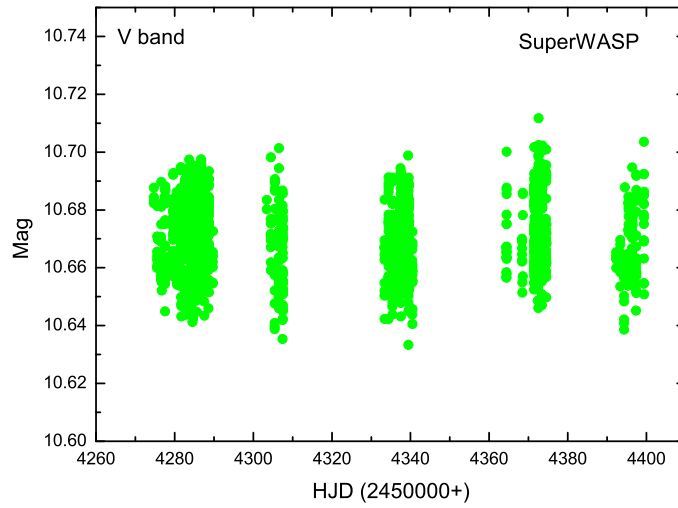
Band	Peak Amplitude	Uncertainty	Frequency	Source
	mag	mag	$d^{-1}$	
<i>B</i>	0.0185	0.0005	10.86	Our observation
<i>V</i>	0.0144	0.0006	10.85	Our observation
<i>R</i>	0.0118	0.0006	10.85	Our observation
<i>I</i>	0.0077	0.0007	10.85	Our observation
<i>V</i>	0.0135	0.0003	10.86	SuperWASP



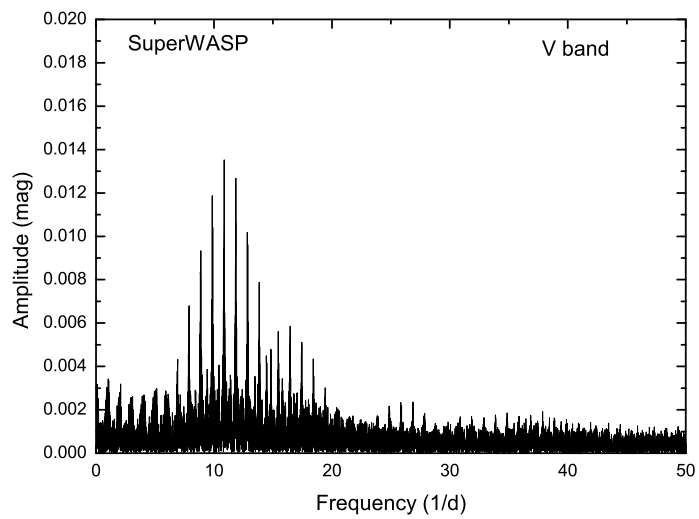
**Figure 2.** Amplitude spectrum of GSC 02696-02622 for our observational data in *BVRI* bands.



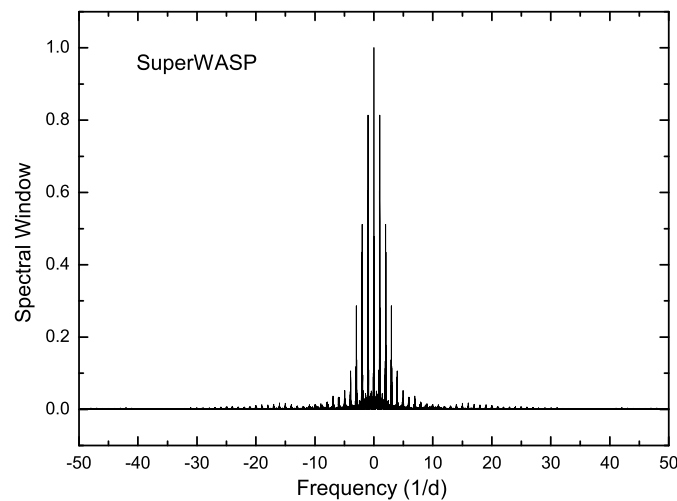
**Figure 3.** Spectral window of GSC 02696-02622 for our observational data in *B* band.



**Figure 4.** Light curve for GSC 02696-02622 from SuperWASP survey.



**Figure 5.** Amplitude spectrum of SuperWASP data for GSC 02696-02622.



**Figure 6.** Spectral window of SuperWASP data for GSC 02696-02622.

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