DISCOVERY OF δ SCUTI TYPE OSCILLATIONS
IN TWO ALGOL-TYPE BINARIES: DY Aqr and BG Peg

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Algol type binaries with one of the components indicating δ Scuti type pulsations have been found attractive to observe, since both pulsational and eclipsing behaviours in their light and radial velocity curves provide reliable stellar and pulsational parameters. However, it is difficult to measure the pulsations in these systems, because their variations are of such low amplitude. So Algols with δ Scuti components have been studied extensively for only about ten years, although they were known since the 1970s (Tempesti, 1971). Pulsational variability may be expected in Algol type light curves, since their hotter components are mostly located in the δ Scuti region of the instability strip (Soydugan et al., 2006) and sometimes even both components. In recent photometric surveys to detect pulsational variations in Algols several systems with δ Scuti type pulsators were discovered (e.g. Sumter & Beaky, 2007; Turcu et al., 2008; Liakos & Niarchos, 2009). In this work, we report δ Scuti type variability in the primaries of the two Algol type binaries DY Aqr and BG Peg for the first time.
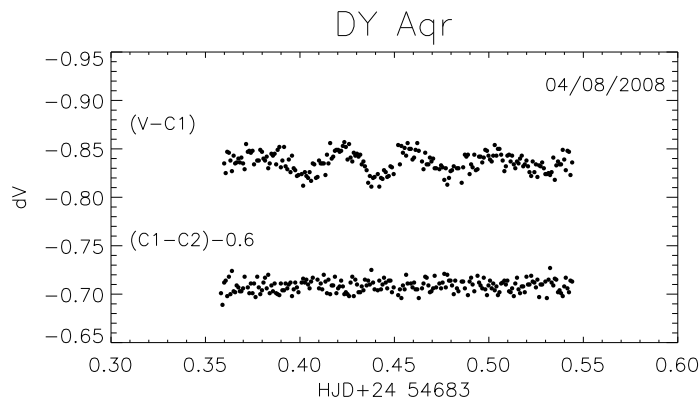

Figure 1. Differential light variation of DY Aqr $(V − C1)$ and also differential magnitudes between comparison and check stars $(C1 − C2)$ in the V filter.

Table 1. Basic information of the variable, comparison, and check stars used
for the CCD photometry

ID	Name	RA (J2000)	DEC (J2000)	V_T^*	$(B-V)_T^*$
Var	DY Aqr	$22^h19^m04\overset{s}{.}3$	$-02°38'30\overset{''}{.}0$	10.51	0.16
C1	GSC 5228-137	$22^h18^m51\overset{s}{.}2$	$-02°47'35\overset{''}{.}6$	11.06	0.50
C2	GSC 5228-188	$22^h18^m27\overset{s}{.}7$	$-02°43'15\overset{''}{.}7$	10.89	1.01
C3	GSC 5228-263	$22^h19^m32\overset{s}{.}4$	$-02°49'08\overset{''}{.}2$	10.09	1.89
Var	BG Peg	$22^h52^m47\overset{s}{.}3$	$+15°39'34\overset{''}{.}0$	11.39	0.32
C1	TYC 1698-1052	$22^h53^m23\overset{s}{.}9$	$+15°33'14\overset{''}{.}0$	10.98	0.19
C2	TYC 1698-1142	$22^h52^m58\overset{s}{.}4$	$+15°32'53\overset{''}{.}1$	12.18	0.52

*: The V_T and $(B-V)_T$ values denote Tycho data.

Photometric observations of DY Aqr and BG Peg were carried out at the Çanakkale Onsekiz Mart University Observatory using the 40 cm Schmidt-Cassegrain telescope equipped with a CCD camera SBIG STL-1001E (1024×1024 pixels, 24 μm pixel size). All observations were made with the Johnson B and V filters. While DY Aqr was observed during 14 nights in July-September 2008, the observing run of BG Peg was covered between September and December 2008. The basic information on the variable, comparison and check stars are given in Table 1. All parameters in this table were taken from Hog et al. (2000). Reduction of the CCD frames was carried out using the MUNIPACK (`http://integral.sci.muni.cz/cmunipack`) software. The comparison and check stars selected for each system did not show any significant light variations between themselves during the observations. The atmospheric extinction coefficients in B and V filters for each observational night were calculated from the observations of the comparison star using common methods (cf. e.g. Budding & Demircan, 2007). Then, all the differential B and V magnitudes (in the sense variable minus comparison) were corrected for atmospheric extinction.

DY Aqr (HD 211705) is an Algol type binary system with orbital period of about 2.1597 d (Kreiner, 2004). The depth of the primary minimum in V is about 0.6 mag in our data. We found no previously published spectroscopic and photometric studies of the system. Pulsational light variability of the primary component of DY Aqr is here noted for the first time and shown in Fig 1. To determine the pulsational period, primary eclipses were excluded from the V data. Period analysis was carried out using the PERIOD04 program (Lenz & Breger, 2005) on data obtained over 11 nights. As a result, it was found that the primary of DY Aqr has a frequency of about 23.39 c/d (1.03 hour period) and a pulsational amplitude of about 0.013 mag. The spectral window and power spectrum for the system can be seen in Fig 2.

The Algol type binary system BG Peg was listed as a candidate Algol having a pulsating component in the Catalogue of Close Binaries in the δ Scuti region of the Cepheid Instability Strip (Soydugan et al., 2006). BG Peg has an orbital period of 1.952443 d (Kreiner, 2004), and we measured the depth of the primary minimum as 0.96 mag. In the Algols catalogue of Budding et al. (2004), the spectral type of BG Peg is given as A2. We couldn't find any previous detailed study for the system in relevant literature. The system was observed during 13 nights in 2008. The pulsational behaviour of the hotter component of BG Peg is indicated in Fig 3. A frequency search was made using the V data from 10 nights. We found the primary component of BG Peg to show a pulsational frequency of about 25.54 c/d (1.34 hour period), with an amplitude of about 0.03 mag. The spectral window and power spectrum of this star is shown in Fig 4.

Candidate oscillating Algol systems selected from the Catalogue of Soydugan et al. (2006) will be searched and any further new discoveries should be announced in due course.
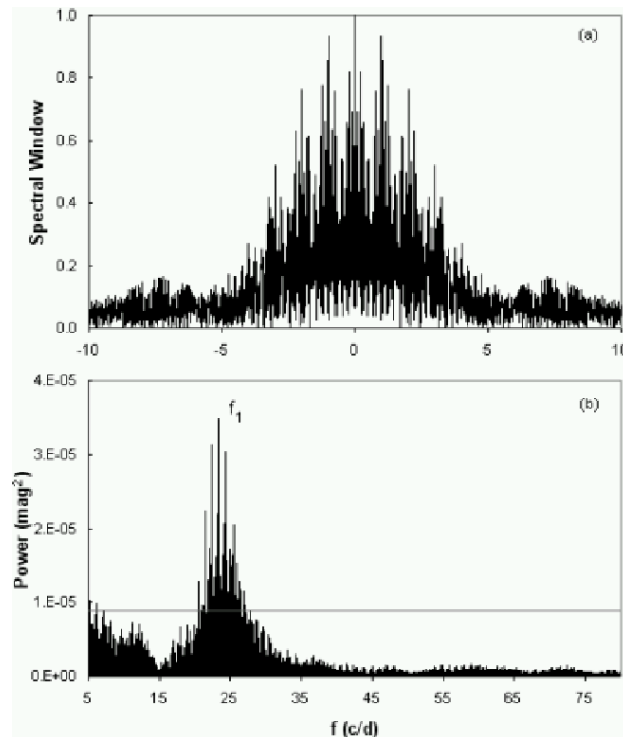

Figure 2. a) The spectral window, (b)Power spectrum and the significance limit (horizontal line) for the data of DY Aqr.
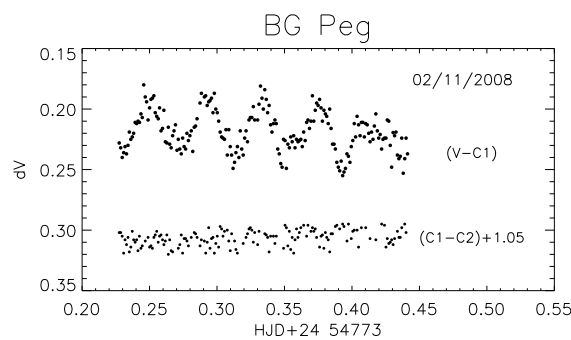

Figure 3. As per Fig.1 but for BG Peg

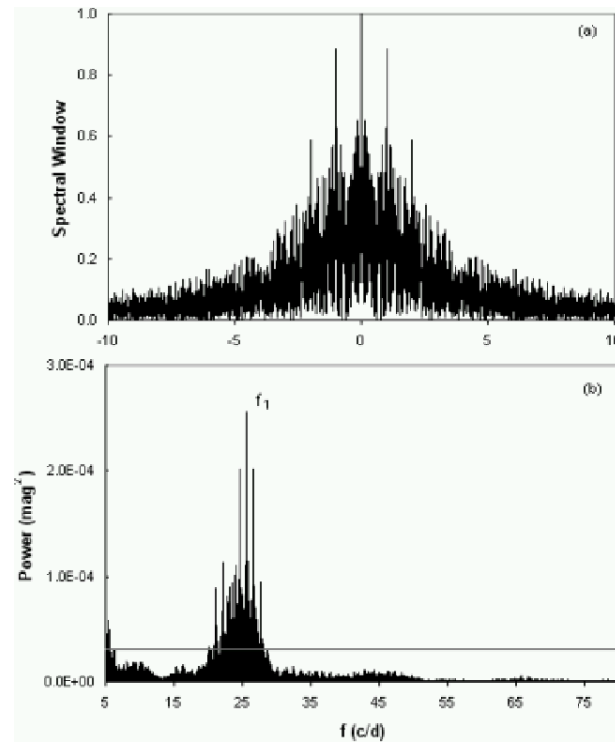**Figure 4.** a) The spectral window, (b)Power spectrum and the significance limit (the horizontal line)
for the data of BG Peg.

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