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MORE NEW SDB PULSATORS DISCOVERED WITH THE NORDIC OPTICAL TELESCOPE †

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Abstract. We report briefly the results from a continuation of the NOT search program for pulsating sdB stars. During this period we have observed 45 candidates and found three new short period pulsating sdB stars. Two of the new pulsators were selected based on spectroscopy from the Sloan Digital Sky Survey, while the third is a PG object. All the stars have periods in the range 120–140 s, typical for short period subdwarf B pulsators, and the detected pulsation amplitudes are all relatively low, between 0.3 and 0.7 %.

Key words: stars: hot subdwarfs – stars: oscillations – stars: individual (PG 1419+081, SDSS J 1445+0002, SDSS J 1642+4252)

1. INTRODUCTION

A search program for new sdB pulsators was conducted with the Nordic Optical Telescope (NOT) in the years 1999–2001. In total ten pulsators were found among candidates selected from the HS, HE and PG surveys. Additionally, one pulsator was found in a small SDSS sample observed in 2002 October (Solheim et al. 2004). Here we report the results of a continuation of the NOT search program in 2004 and 2005. Candidates were selected from sdB stars with $T_{\rm eff}$ between 27 000 and 37 000 K, with preliminary $T_{\rm eff}$ determined from SDSS spectra or taken from literature sources.

2. OBSERVATIONS

The program was granted observing time 2004 June 4–9 and 2005 February 15–20. The first run had mostly clear weather, but the second was totally lost due to heavy snow at the observatory. In the 2004 run 45 candidates were observed and three new pulsators were detected. They are PG 1419+081 and two new sdB

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†Based on observations made with the Nordic Optical Telescope, operated on the island of La Palma jointly by Denmark, Finland, Iceland, Norway and Sweden, in the Spanish Observatorio del Roque de los Muchachos of the Instituto de Astrofisica de Canarias. The data presented here have been taken using ALFOSC, which is owned by the Instituto de Astrofisica de Andalucia (IAA) and operated at the Nordic Optical Telescope under agreement between IAA and the NBIfAFG of the Astronomical Observatory of Copenhagen.

Table 1. Time series photometry. The length of each run is the number of cycles N times the cycle time.

Object	Date (2004)	Observers	Start (UT)	N	Cycle (s)
PG 1419+081	June 8	J.E.S., R.Ø.	21:56	128	30
SDSS J 144514.93+000249.0	June 6	J.E.S., R.Ø.	00:27	137	30
	June 7	J.E.S., R.Ø.	23:57	121	30
SDSS J 164214.21+425234.0	June 6	J.E.S., R.Ø.	02:22	220	20
	June 9	J.E.S.	01:48	181	20

Table 2. Detected periods and amplitudes for the three new pulsators. The last column gives the one-sigma noise level found in the amplitude spectrum when avoiding the region between 7 and 9 mHz.

Object	Date (2004)	P_1	P_2 (s)	P_3	A_1	A_2 (mma)	A_3	σ (mma)
PG 1419+081	June 8	144	136		7.3	2.3		0.7
J 1445+0002	June 6	119	124	142	7.7	6.2	4.8	0.9
	June 7	118	126	142	5.7	4.5	4.4	0.8
J 1642+4252	June 6	138	130		3.3	1.9		0.4
	June 9	138			3.4			0.5

stars from the SDSS survey, which we refer to as J 1445+0002 and J 1642+4252. The log of observations for these three stars is given in Table 1, together with the full designations for the two SDSS stars.

PG 1419+081 ($V = 15.1$) was classified as a subdwarf (sd) in the PG catalogue (Green et al. 1986) and as an sdB in the BPS catalogue (BPS CS 22883-25; Beers et al. 1992). The $\log(T_{\rm eff}) = 4.53$ given in the BPS catalogue was based on UBV photometric observations only and has a large associated error (10 %). No new spectroscopy has been obtained yet, but it is worth noting that 2MASS photometry indicates IR excess (J–$H = +0.28$), compatible with an F–G class main-sequence companion.

The SDSS stars have magnitudes $g' = 17.34$ for J 1445+0002 and $g' = 15.68$ for J 1642+4552. Both show IR excess from 2MASS photometry (J–$H = +0.15$ and +0.19, respectively), and their spectra also show signs of contamination from a cool companion (Ca II, Mg I and Na D lines). Model fits to the SDSS spectroscopy of these stars give effective temperatures of 37 650 and 33 900 K, respectively, but these fits are quite uncertain due to the contamination from the main-sequence companion. J 1445+0002 displays the He II 4686 Å line making it an sdOB star, which is consistent with the relatively high temperature, but we note that such a high temperature has not been seen in any other pulsating sdOB star yet, so it is probably an artifact introduced by the contamination, and we estimate that the true temperature could be lower by as much as 10 %.

The time-series observations were all done with ALFOSC in the windowed readout mode as described in Solheim et al. (2004). The observing log for the new pulsating objects is shown in Table 1.

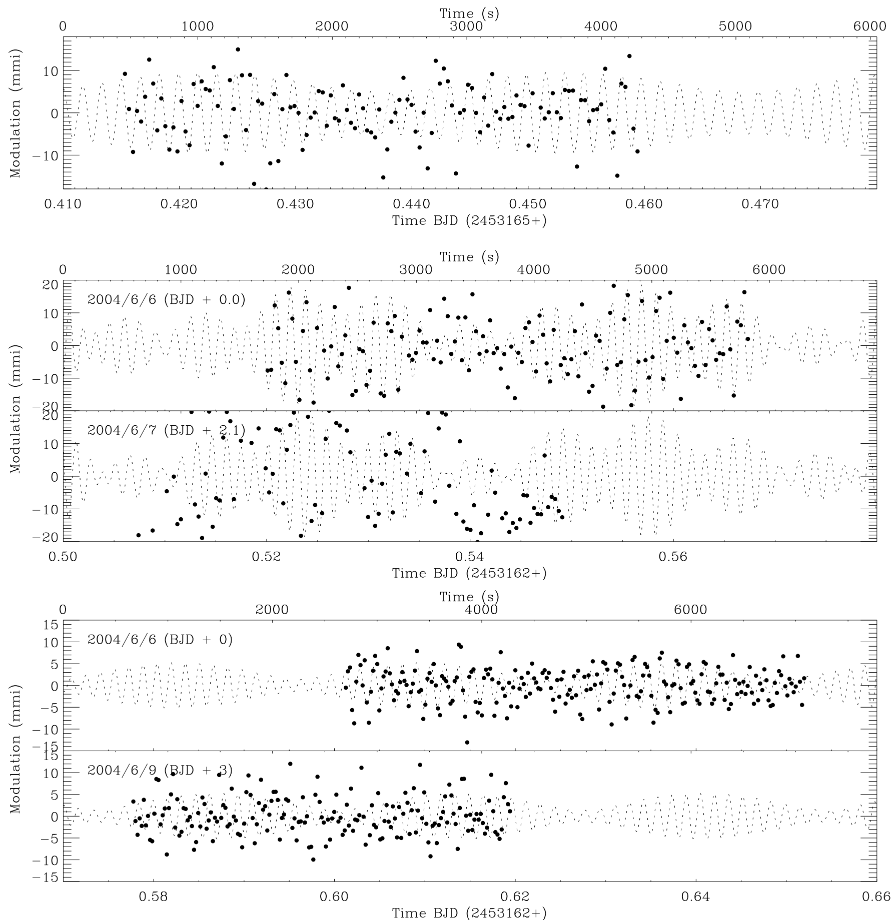

Fig. 1. The observed light-curves of the three new pulsators. Top panel: PG 1419+081; Middle panel: J 1445+0002; Lower panel: J 1642+4552. The dotted lines show the oscillations associated with the detected periods.

3. RESULTS

The three new pulsators show low amplitude pulsations with periods between 118 and 142 s, typical for most other known EC 14026 pulsators. The light-curves are shown in Figure 1, and their Fourier transforms in Figure 2.

For PG 1419+081 we have only one short run which shows one clear peak at 144 s and a second barely above the 3σ detection limit.

The Fourier transforms of the two light-curves of J 1445+002 both show rich amplitude spectra with three clearly detected periods on the first night, all confirmed on the second run 46 hours later.

J 1642+4552 is the lowest amplitude pulsator, with the strongest peak at 138 s and an amplitude of 3.4 mma. The first night we detected also a second peak at 130 s, but this was below the detection limit the second run.

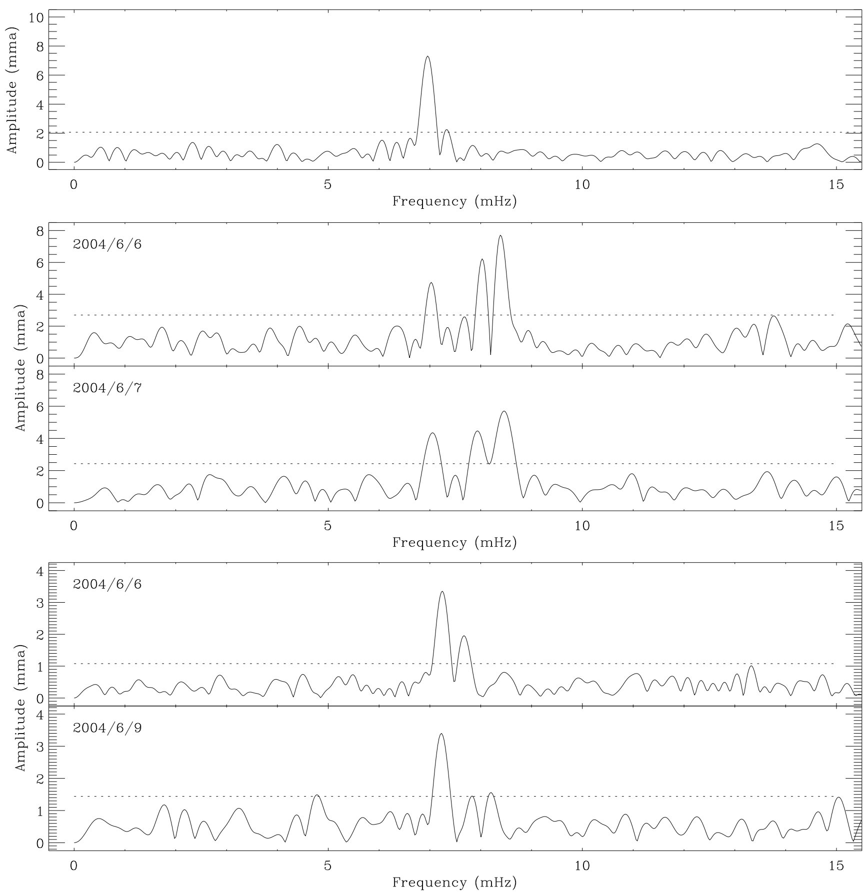

Fig. 2. The Fourier transforms of the light-curves of the three new pulsators. Top panel: PG 1419+081; Middle panel: J 1445+0002; Lower panel: J 1642+4552. The dotted lines indicate three times the noise level as given in Table 2.

4. CONCLUSIONS

We have presented the discovery data for three new short period sdB pulsators. With these three pulsators, the total no of EC 14026 pulsators has now reached 36. All these sdB stars show evidence of having a main-sequence companion, as has been seen with about half of all short period pulsators discovered to date.

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