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# A NEW LARGE-AMPLITUDE SLOWLY PULSATING SDB STAR

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**Abstract.** We report the discovery of a new large-amplitude slowly pulsating sdB star, EC 21324–1346. Although we have only a small amount of data, it is clear that the star exhibits more than one mode of variation; the present data can be adequately represented with three or four frequencies in the range 170–330 $\mu$Hz (about 0.8 to 1.6 hours). The amplitude of the dominant frequency is about 0.004 mag – large for a slowly pulsating sdB star.

**Key words:** stars: oscillations – stars: horizontal-branch – stars: individual (EC 21324–1346)

## 1. INTRODUCTION

The slowly pulsating sdB stars were discovered as part of a campaign by E. Green and her collaborators (Green et al. 2003) to find and monitor sdB stars in binary systems. As with the rapidly pulsating sdB stars, the slow pulsators have amplitudes $< 0.01$ mag – often much less – but longer periods, typically 1–2 hours. The slow pulsators also appear to be multi-periodic and, like the rapid pulsators, the nomenclature for the slow pulsators is undecided – they have been referred to as "Betsy" stars, after the discoverer, but "PG 1716 stars" (after the prototype, PG 1716+426) is more appropriate.

In the Edinburgh-Cape (EC) survey (Stobie et al. 1997; Kilkenny et al. 1997) many new sdB stars have been found. Following the discovery of the fast pulsators (Kilkenny et al. 1997) these are being checked for variability, but generally only for short intervals of $\sim 2$ hours, so that low-amplitude slow pulsators might have been missed. The star reported here, EC 21324–1346, was of such a large amplitude, that even we could not miss the variability, even in a relatively short run.

EC 21324–1346 is located at $\alpha = 21^{\rm h}\ 35^{\rm m}\ 13^{\rm s}$, $\delta = -13^\circ\ 33'\ 23''$ (2000.0). A preliminary spectral type from the EC survey is "sdB", but no survey $UBV$ photometry has yet been obtained. The photographic magnitude from the plate measurement indicates $B \sim 13$ mag.

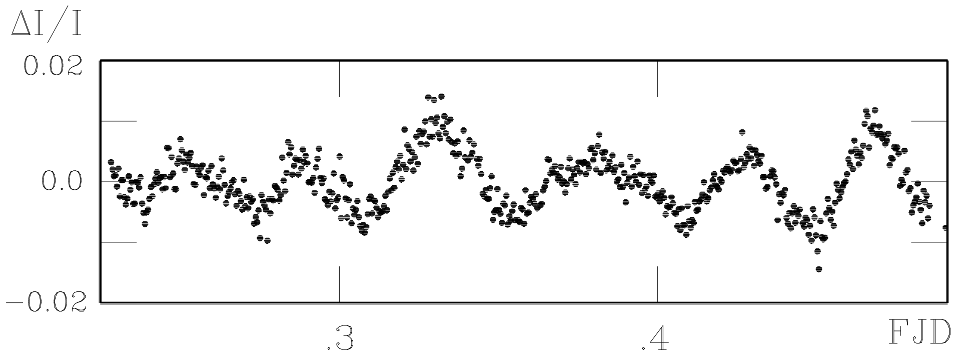


**Fig. 1.** Relative intensity light curve for EC 21324–1346 on JD 2453259 (40 s integrations; no filter). The abscissa is Fractional (heliocentric) Julian Date.

## 2. OBSERVATIONS

Observations were made with the University of Cape Town's frame-transfer CCD on the 1.9 m and 1.0 m telescopes at the Sutherland site of the SAAO. Details are listed in Table 1 and the longest run is shown in Figure 1.

**Table 1.** UCT CCD observation log for EC 21324–1346

| Date (2003) | JD | Tel (m) | Filter | Run (hr) | Integr. (s) |
|---|---|---|---|---|---|
| Jul 15/16 | 2453202 | 1.9 | BG39 | 2.0 | 10 |
| Sep 07/08 | 3258 | 1.0 | – | 4.1 | 30 |
| Sep 09/10 | 3259 | 1.0 | – | 6.3 | 40 |

**Table 2.** Four frequencies extracted from Fig. 2 data (best fit to two nights).

| Frequency (Hz) | Ampl.(mag) | Period (s) | Period (hr) |
|---|---|---|---|
| 0.000253 | 0.0037 | 3950 | 1.10 |
| 0.000332 | 0.0022 | 3010 | 0.84 |
| 0.000175 | 0.0022 | 5710 | 1.59 |
| 0.000226 | 0.0016 | 4420 | 1.23 |

## 3. ANALYSIS

The usual Fourier analysis has been carried out. The night JD 2453259 is the longest run, and we found at least four frequencies clearly above the noise level (see Figure 2). Of course, with such a short data set – covering very few cycles – it is optimistic to think we can extract four frequencies. But inspection of Figure 1 indicates that the variations are clearly not mono-periodic and even that probably more than two frequencies are present.

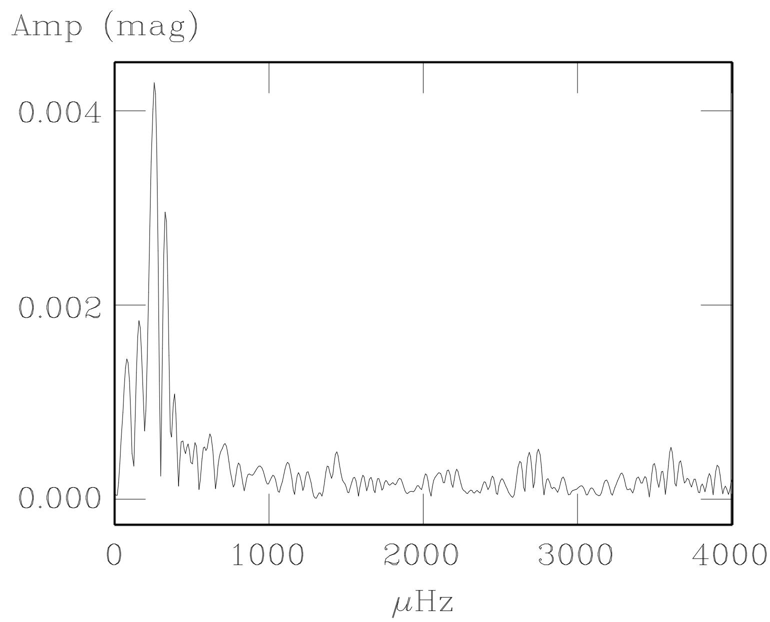


**Fig. 2.** Periodogram from Fig. 1 data for EC 21324–1346.

We have repeated the analysis for the two consecutive nights – JD 2453258 and JD 2453259 – together. We extract the same four frequencies and Figure 3 shows the best four frequency fit to the data for the two nights.

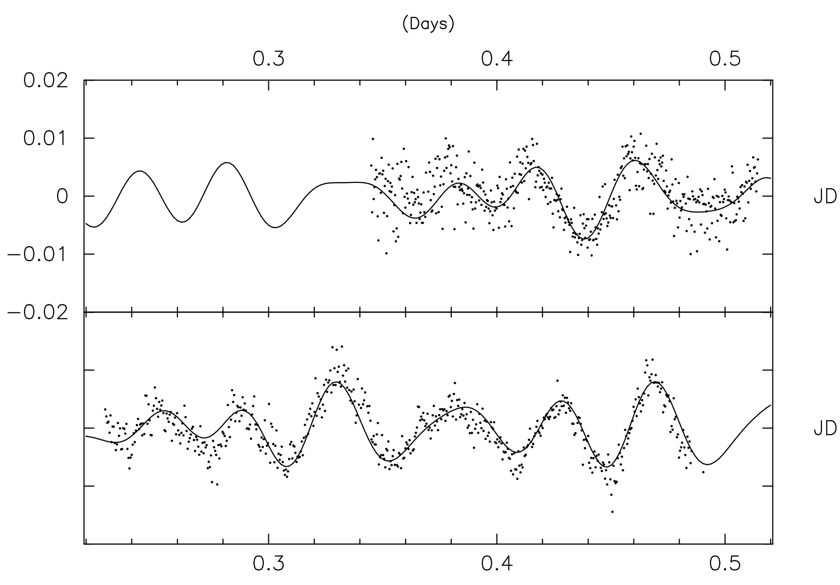


**Fig. 3.** Four-frequency fit to EC 21324–1346 data for JD 2453258 and 3259.

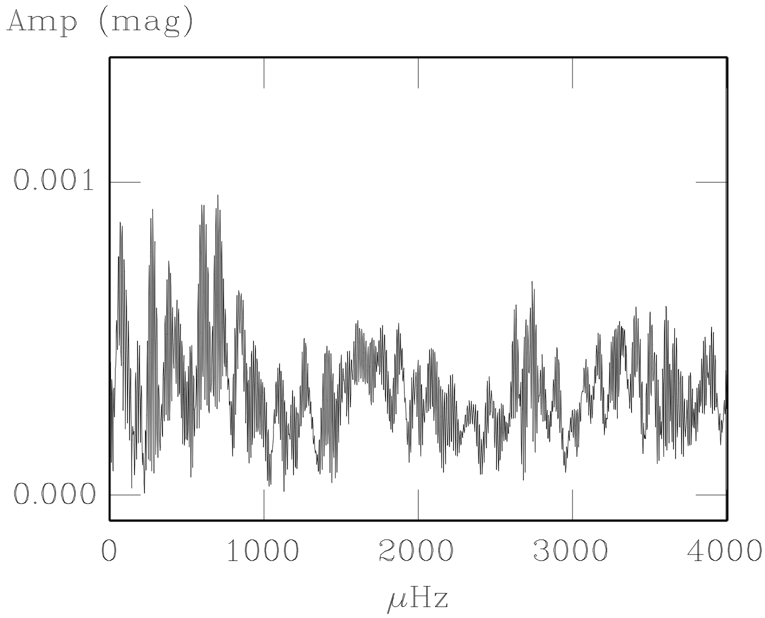


**Fig. 4.** Periodogram for the EC 21324–1346 data for JD 2453258 and 3259 after the removal of the four strongest frequencies.

## 4. CONCLUSIONS

EC 21324–1346 is an sdB star which exhibits multi-periodic variation with periods in the range 0.8 to 1.6 hours (see Table 2). It is clearly a slowly-pulsating star of the type discovered by Green et al. (2003) and has rather a large amplitude for this class of star.

## REFERENCES

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