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# Multi-season photometry of the newly-discovered roAp star HD75445

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**Abstract.** HD75445 was recently announced by Kochukhov *et al.* (2009) to be a low-amplitude roAp star, based on spectroscopic measurements. We present putative pulsation frequencies of HD75445 determined from 22 hours of Johnson B photometry obtained in 2008, 2009 and 2010. We present the first photometric periodicities detected in this star. We make a marginal detection of one of Kochukhov *et al.* (2009)'s spectroscopic periods, along with a range of confidently detected periodicities covering the low-frequency end of the roAp instability spectrum and the high-frequency end of the Delta Scuti instability spectrum.

**Keywords.** stars: variables: roAp, delta Scuti, stars: HD75445

## 1. Introduction

Kochukhov *et al.* (2009) reported HD75445 as a low-amplitude roAp star, based on high-resolution spectroscopy including Nd II and Nd III lines. They reported periods of 9.20, 9.01 and 8.37 minutes respectively, all present at extremely low amplitudes. They also determined an effective temperature of 7700 K for HD75445, while Kochukhov & Bagnulo (2006) determined log $(L/L_{sun}) = 1.17$ and $(M/M_{sun}) = 1.81$ for HD75445. These numbers imply that HD75445 just falls within the hotter half of detected roAp stars (see, for example, Théado *et al.* (2009)) and is expected to display pulsation frequencies at the higher end of the range of pulsation frequencies seen in roAp stars (see, for example, Dupret *et al.* (2008)). We detect only one high-frequency roAp mode (and this is only a marginal detection), accompanied by a set of much stronger lower-frequency modes extending all the way into the Delta Scuti domain.

## 2. Observations and Analysis

We used PMT photometry to observe HD75445 in the Johnson B filter for between 90 minutes and 320 minutes on each of 4 nights in February 2010, 3 nights in January 2009 and one night in January 2008, using the 0.5 m telescope at the Sutherland station of the South African Astronomical Observatory. We marginally confirm one of the spectroscopically determined periods reported in Kochukhov *et al.* (2009), at approximately 8.6 minutes. However, we also find strong periodicities ranging from 18 to 23.5 minutes (none between 8.6 and 18 minutes), i.e. populating the lower-frequency end of the currently recognised roAp pulsation spectrum. The subset of these detections that are common to all three observing seasons appear in Table 1. Moreover, we detect strong

**Table 1.** Five periodicities common to all three seasons (2008, 2009 and 2010) of our photometry of HD75445, plus the 8.6 minute period only detected in the 2009 dataset.

| Number | Freq.($\mu$Hz) | Period (min.) | Amp. (mmag) | SNR |
|---|---|---|---|---|
| $f_1$ | 411 | 40.5 | 0.5 | 15 |
| $f_2$ | 438 | 38.0 | 0.8 | 11 |
| $f_3$ | 708 | 23.5 | 0.7 | 11 |
| $f_4$ | 756 | 22.1 | 0.7 | 14 |
| $f_5$ | 922 | 18.1 | 0.4 | 5 |
| $f_6$ | 1950 | 8.6 | 0.4 | 4 |

*Notes:*
[1]The signal-to-noise ratio (SNR) was determined using the Period04 package described by Lenz & Breger (2005). The detection of the 18.1 minute period is a bit questionable in the 2008 data, where a strong peak is found at 15 $\pm$ 1 minutes, rather than 18. The detected Delta Scuti-type perodicities longer than 45 minutes only appear in the 2009 data and are not shown in this table.

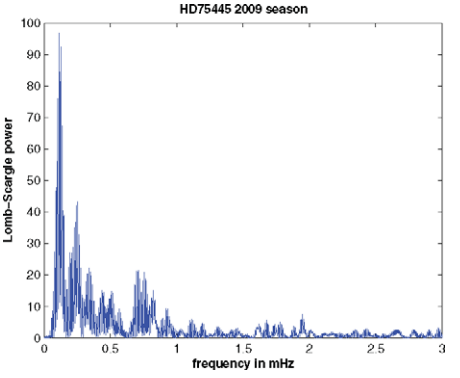


**Figure 1.** Lomb-Scargle periodogram of 2009 data.

signals at the short end of the Delta Scuti instability spectrum (six firmly established periodicities, ranging from 32 to 146 minutes) in the 2009 dataset. Two of these appear in all three observing seasons and are also listed in Table 1. The appearance of roAp and Delta Scuti pulsations in the same star was first reported only very recently (Balona *et al.* (2010)), using satellite data. Our results present the first such detection using ground-based photometry. Figure 1 displays the Lomb-Scargle periodogram for the observations obtained in 2009 (representing 12.4 hours of photometry in total, i.e. more than half the total duration of the multi-season photometry). The strength of the detected Delta Scuti-type signals is clearly seen.

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## References

Balona, L. A., and 11 co-authors 2010, arXiv:1006.4013v1
Dupret, M.-A., Théado, S., & Noels, A. 2008, *J. Phys. Conf. Ser.*, 118, 012052
Kochukhov, O., Bagnulo, S., Lo Curto, G., & Ryabchikova, T. 2009, *A & A*, 493, L45-48
Kochukhov, O. & Bagnulo, S. 2006, *A & A*, 450, 763
Lenz, P. & Breger, M. 2005, *CoAst*, 146, 53
Théado, S., Dupret, M.-A., Noels, A. & Ferguson, J.W. 2009 *A& A*, 493, 159